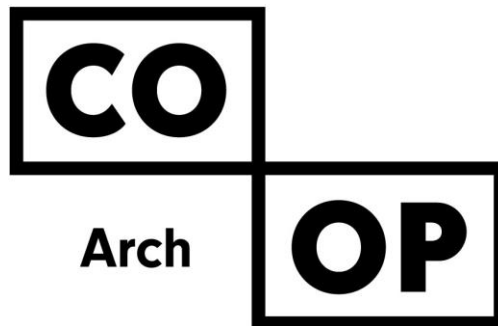


PROJECT MANUAL

**Faulkton School Renovation 1.0
Faulkton School District
Faulkton, South Dakota**

CO-OP PROJECT NO. 2447



FAULKTON SCHOOL RENOVATION 1.0
FAULKTON SCHOOL DISTRICT
FAULKTON, SD

CO-OP Architecture Project No. 2447
February 4, 2025

Project Contacts:

Owner: Faulkton School District
Contact: Lisa Hushka
Title: Business Manager
Faulkton, SD 57438
Ph: 605-598-6266

Architect: CO-OP Architecture
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Civil Engineer: Helms & Associates
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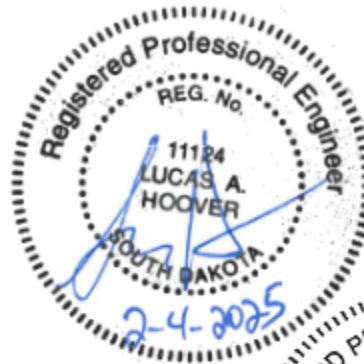
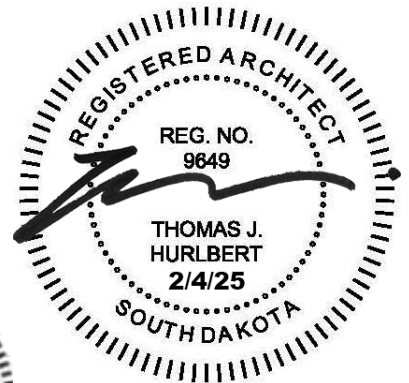


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NOTICE TO BIDDERS

Sealed bids will be received by the Faulkton Area Schools District 24-4 of Faulk County, South Dakota for the proposed construction related to the **Faulkton School Renovation** until **1:00 p.m., local time on Tuesday the 4th day of March, 2025**. The bid letting will be held in the Faulkton Area School's 24-4 board room at the 1114 Court St., Faulkton SD 57438. A pre-bid meeting will be held on site at 1:00 p.m., local time on Tuesday the 18th of February, 2025.

Copies of the Plans and Specifications will be made available electronically (pdf format). Technical questions shall be directed to Brian Skrovig, Sioux Falls, South Dakota at 605-334-9999, or brian@co-oparch.com.

Bidding documents may also be examined at the following locations:

Sioux Falls Builders Exchange, Sioux Falls, SD
Plains Builders Exchange, Sioux Falls, SD
Aberdeen Builders Exchange, Aberdeen, SD
Fargo-Moorhead Builders Exchange, Fargo, ND
Minneapolis Builders Exchange, Minneapolis, MN

Bids shall be submitted to the Faulkton Area Schools District 24-4 in a sealed envelope with the name and address of the bidder clearly identified on the envelope and the words "Bid for Faulkton School Renovation 1.0". All bidders shall take note of the AIA Document A701 "Instructions to Bidders", and the AIA Document A201 "General Conditions of the Contract for Construction". Faxed bids will not be accepted; nor, will fax bid adjustments be accepted.

No bidder may withdraw a bid for 30 days following the bid opening without a written request explaining the cause of the withdrawal and without written consent of the Owner after reviewing the cause.

Each bid shall be accompanied by a certified check, a cashier's check or draft certified or issued by a state or national bank, in the amount of at least five percent (5%) of the total amount of the bid, payable to Faulkton Area Schools District 24-4; or in lieu thereof, bidder may furnish a bid bond in the amount of not less than ten percent (10%) of the amount of the bid, such bond to be issued by a surety authorized to do business in the State of South Dakota and payable to Faulkton Area Schools District 24-4 as a guarantee that such bidder will enter into a contract for the work described in the bid and as specified.

Bidders to take note of project schedule as follows:

Area A – March 17th, 2025 – August 15th, 2025

Area B – April 1st, 2025 – August 15th, 2025

Area C – May 19th, 2025 – August 15th, 2025

The Faulkton Area Schools District 24-4 reserves the right to reject any part of, or all bids, and to waive any informalities or irregularities therein.

By virtue of statutory authority preference will be given to contracts, labor, materials, products, and supplies found or produced with the State of South Dakota in a manner provided by law.

Faulkton Area Schools District 24-4
of Faulk County, South Dakota

By: Lisa Hushka
Title: Business Manager

Published Cost: _____

Published February 5 & February 12, 2025.

BID FORM

PROJECT: Faulkton School Renovation 1.0

TO: Faulkton School District 24-4
1114 Court Street
Faulkton, South Dakota, 57438

Bid of: _____
(hereinafter called "Bidder")

The Bidder, in compliance with your Advertisement for Bids for the Complete Construction (general, mechanical and electrical) work for the proposed building renovations, having examined the drawings and specifications with related documents and the site of the proposed work, and being familiar with all of the conditions surrounding the construction of the proposed project, including the availability of materials and labor, hereby proposes to furnish all labor, materials and supplies, and to construct the project in accordance with the Contract Documents, within the time set forth therein, and at the prices stated below. These prices are to cover all expenses incurred in performing the work required under the Contract Documents of which this Bid is a part. Bidder hereby agrees to commence work under this Contract on or before a date to be specified in written "Notice to Proceed" of the Owner, and to fully complete the project at the dates set forth in the Contract Documents.

BIDDER AGREES TO PERFORM THE COMPLETE CONSTRUCTION for the following sum:

For the following Base Bid:

_____ (\$ _____)

Alternate No. 1: Shop Addition (Add Alternate)

(ADD) _____ (\$ _____)

Alternate No. 2: Fire Sprinkler Area A (Add Alternate)

(ADD) _____ (\$ _____)

Alternate No. 2.1: Fire Sprinkler Area A – Shop Addition (Add Alternate #1) (Add Alternate)

(ADD) _____ (\$ _____)

Alternate No. 3: Window/Façade Improvements at South Façade (Add Alternate)

(ADD) _____ (\$ _____)

Alternate No. 4: HVAC Temperature Controls (Add or Deduct Alternate)

(ADD) _____ (\$ _____)

Alternate No. 5: Music Room Music Storage Casework (Add Alternate)

(ADD) _____ (\$ _____)

Alternate No. 6: Music Room Acoustical PET (Add Alternate)

(ADD) _____ (\$ _____)

Alternate No. 7: Carpet

(ADD) _____ (\$ _____)

Alternate No. 8: Existing Casework Doors

(ADD) _____ (\$ _____)

ADDENDA:

The undersigned acknowledge receipt of addenda as noted and the bid submitted herewith is in accordance with the stipulations set forth herein.

ADDENDUM NO _____ DATED _____
ADDENDUM NO _____ DATED _____
ADDENDUM NO _____ DATED _____
ADDENDUM NO _____ DATED _____

The undersigned agrees that his bid may not be withdrawn for a period of 30 days from the time set for opening of bids and that if notified of acceptance of his Proposal within the stated time, or at any time thereafter before the bid is withdrawn, he will within ten (10) days of such notification, execute and deliver a Contract in the Form of Contract specified.

The Contractor shall commence work under this Contract within ten (10) calendar days after the date of receipt by him of Notice to Proceed, to prosecute said work diligently, and to complete the entire project ready for use at the dates set forth in the Contract Documents. The time stated for completion shall include a time allowance for inspections, completion of items requiring further attention and a final cleanup of premises.

The above bid includes State and Local Sales Tax on materials and all other State and Federal Taxes that would affect the amount of the bid.

In submitting this bid it is understood that the right is reserved by the Architect and Owners to reject any and all bids and to waive all informalities.

BIDDER: _____

BY: _____

TITLE: _____

BUSINESS
ADDRESS: _____

STATE OF
INCORPORATION: _____
(SEAL)

**SECTION 011000
SUMMARY**

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: Faulkton School Renovation
- B. Owner's Name: Faulkton School District 24-4.
- C. Architect's Name: CO-OP Architecture.
- D. The Project consists of the remodel of the Faulkton school..

1.02 CONTRACT DESCRIPTION

- A. The work of each separate prime contract is identified in this section and on Drawings.

1.03 OWNER OCCUPANCY

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

1.04 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Arrange use of site and premises to allow:
 - 1. Owner occupancy.
 - 2. Work by Others.
- C. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- D. Existing building spaces may not be used for storage.
- E. Utility Outages and Shutdown:
 - 1. Limit disruption of utility services to hours the building is unoccupied.
 - 2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
 - 3. Prevent accidental disruption of utility services to other facilities.

END OF SECTION

**SECTION 012000
PRICE AND PAYMENT PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.

1.02 RELATED REQUIREMENTS

- A. Section 017800 - Closeout Submittals: Project record documents.

1.03 SCHEDULE OF VALUES

- A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- B. Forms filled out by hand will not be accepted.
- C. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Forms filled out by hand will not be accepted.
- C. For each item, provide a column for listing each of the following:
 - 1. Item Number.
 - 2. Description of work.
 - 3. Scheduled Values.
 - 4. Previous Applications.
 - 5. Work in Place and Stored Materials under this Application.
 - 6. Authorized Change Orders.
 - 7. Total Completed and Stored to Date of Application.
 - 8. Percentage of Completion.
 - 9. Balance to Finish.
 - 10. Retainage.
- D. Execute certification by signature of authorized officer.
- E. Submit one electronic and three hard-copies of each Application for Payment.

1.05 MODIFICATION PROCEDURES

- A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
- B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
 - 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
 - 2. Promptly execute the change.
- C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 7 days.
- D. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
- E. Substantiation of Costs: Provide full information required for evaluation.
 - 1. On request, provide the following data:
 - a. Quantities of products, labor, and equipment.
 - b. Taxes, insurance, and bonds.
 - c. Overhead and profit.
 - d. Justification for any change in Contract Time.

- e. Credit for deletions from Contract, similarly documented.
- F. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

1.06 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 017000.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

012300 DESCRIPTION OF ALTERNATES

ALTERNATE #1 – Shop Addition (Add Alternate)

As shown and indicated on the contract drawings, all necessary work to construct the shop addition, including but not limited to utilities, site work, excavation, foundations, structure, enclosure, MEP systems, provide and install the operable wall partitions. See contract drawings for details.

ALTERNATE #2 – Fire Sprinkler Area A (Add Alternate)

As shown and indicated on the contract drawings, fire sprinkler contractor to provide & install fire sprinkler system to serve Area A remodel. Remove existing 2” domestic water service and replace with new 6” combination fire sprinkler and domestic water service into existing Mechanical Room A110. See contract drawings for details.

ALTERNATE #2.1 – Fire Sprinkler Area A – Shop Addition (Add Alternate #1) (Add Alternate)

As shown and indicated on the contract drawings, fire sprinkler contractor to provide & install fire sprinkler system to serve Area A shop addition. See contract drawings for details. Alternate #1 & Alternate #2 must be selected to select this alternate.

ALTERNATE #3 – Window/Façade Improvements at South Facade (Add Alternate)

As shown and indicated on the contract documents, demolish and replace storefront system at the south end of the main gym. Includes replaced baseboard heat solution, refer to mechanical drawings. See contract drawings for details.

ALTERNATE #4 – HVAC Temperature Controls – Select (Add or Deduct Alternate)

As shown and indicated on the contract drawings, direct digital HVAC temperature controls system to be by G&R Controls. Base bid shall be direct digital HVAC temperature controls by Johnson Controls Inc. See contract drawings for details.

ALTERNATE #5 – Music Room Music Storage Casework (Add Alternate)

As shown and indicated on the contract drawings, all music storage casework inside music classroom to be provided as an add alternate. If not selected, casework to be owner provided. See contract drawings for details.

ALTERNATE #6 – Music Room Acoustical PET (Add Alternate)

As shown and indicated on the contract drawings, PET felt fins at ceiling tile in Music Room B102. See contract drawings for details.

ALTERNATE #7 – Carpet

As shown and indicated on the contract drawings (finish legend), remove and replace CPT-1 with CPT-1 ALT. See contract drawings for details.

ALTERNATE #8 – Existing Casework Doors

As shown and indicated on the contract drawings, add door fronts to existing casework in special education classroom. See drawings on A402.C. See contract drawings for details.

CONSTRUCTION DOCUMENT CONTRACT CLARIFICATIONS

- Duct Cleaning on existing ductwork, Owner can do outside of contract but could be an alternate if desired.
- Existing waste piping camera work, see floor cutting plan, with this floor demolition work we are thinking it is not necessary to camera.
- Temperature control scope – if Alternate #4 is part of the project, only the areas affected by construction will be included. If there is a desire from the Owner to switch to G&R Controls, having G&R take over the remainder of the building will be outside the scope of this project.
- Air conditioning in the shop addition – it's our understanding this space will likely mostly be used for project storage, and future use beyond that is unknown at this time. We have sized the HVAC system for the shop remodels to only handle the air conditioning needs of those spaces. Any air conditioning desired for the addition would be at a later date. The shop will still have heating and general ventilation as required.
- Security scope – all camera work, including rough ins, camera wiring, devices, and installation will be by Owner.
- Audio upgrades to use Audio Enhancement to tie into existing building system – material and labor to be included in project scope. Will include all rough ins, pathways, data cabling, termination, and testing for all audio enhancement systems and door access systems (All inclusive, no work/equipment by Owner)
- Fire Alarm – electrical contractor will include all rough ins, pathways, cabling, termination and testing for all fire alarm systems (all inclusive, no work/equipment by Owner)
- Door Access System material and labor to be included in project bid by *Integrated Technology & Security (ITS)*. ITS is used as provider for wiring and equipment to be included in the project by the EC. (All inclusive, no work/equipment by Owner)
- Data cabling - material and labor to be included in project bid including but not limited to jacks, wiring, data racks, patch panels, and testing to be included in project by the EC. Any switches, routers, and fiberoptic patch panels are not in project scope and are to be owner provided.
- Casework and Equipment
 - Shop classroom A111 casework to be salvaged from existing community center. See contract drawings or details.
 - Shop tool storage solutions, worktables, table saw, two miter saws, and band saw in wood shop A113 to be owner provided and installed. See contract drawings for details.
 - Welding stations, welders, cutting station, band saw, drill press, welding simulator, laser cutting table, and CNC table in metal shop A114 to be owner provided and installed. See contract drawings for details.
 - Music room Wenger sliders in storage room B108 to be owner provided and installed. See contract drawings for details.
 - Appliances in shop classroom A111 and Mechanical room A110 are owner provided and relocated from existing community center.
- Whiteboards and tackboards
 - To be priced in base bid of project scope. See contract drawings for details
- Smartboard
 - Equipment to be owner provided and installed. See contract drawings for details.
- Wrestling Wall Mats
 - To be owner provided and installed. See contract drawings for details.

**SECTION 012500
SUBSTITUTION PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

- A. Section 002113 - Instructions to Bidders: Restrictions on timing of substitution requests.
- B. Section 004325 - Substitution Request Form - During Procurement: Required form for substitution requests made prior to award of contract (During procurement).
- C. Section 013000 - Administrative Requirements: Submittal procedures, coordination.

1.03 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
 - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
 - a. Unavailability.
 - b. Regulatory changes.
 - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
 - a. Substitution requests offering advantages solely to the Contractor will not be considered.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
 - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
- C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 - 1. Forms indicated in the Project Manual are adequate for this purpose, and must be used.
- D. Limit each request to a single proposed substitution item.
 - 1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

- A. Submittal Time Restrictions:
 - 1. Architect will consider requests for substitutions only if submitted at least 5 days prior to the date for receipt of bids.
- B. Submittal Form (before award of contract):
 - 1. Submit substitution requests by completing the form attached to this section. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.03 RESOLUTION

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request via Addenda.

3.04 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

3.05 ATTACHMENTS

- A. A facsimile of the Substitution Request Form that may be used on the Project is included after this section.

END OF SECTION

**PRIOR APPROVAL / SUBSTITUTION
REQUEST FORM**

Date: _____

Company Submitting Request: _____
(Name and Address)

Contact Name: _____ Phone: _____ Fax: _____

E-Mail: _____

PROJECT NAME: _____

SPECIFIED ITEM: _____
(Section) (Page) (Description)

The undersigned requests consideration of the following product substitution:

PROPOSED SUBSTITUTION: _____
Provide Product Name / Model /Manufacturer

1. Attached data includes: _____ Product Description _____ Performance and Test Data
_____ Drawings _____ Specifications _____
Photographs

2. _____ Yes / No changes will be required to the Contract Documents for the proper installation of proposed product substitution. If yes, then attach data that includes description of changes.

The undersigned states that the following paragraphs, unless modified by attachments, are correct:

1. The proposed substitution does not affect dimensions shown on the drawings.
2. No changes to the building design, engineering design, or detailing are required by the proposed substitution.
3. The proposed substitution will have no adverse effect on other trades, the construction schedule, or **specified warranty requirements.**
4. No maintenance is required by the proposed substitution other than that required for originally specified product.
5. Other Information

The undersigned further states that they have read the corresponding specification section in the project manual and confirms that the function, appearance and quality of the proposed substitution are equivalent or superior to the originally specified product._initial.

Signature: _____ Printed Name: _____

Fax Number: _____

For Architect's Use:

_____ Accepted	_____ Accepted As Noted	_____ Incomplete Information
_____ Not Accepted This	_____ Received Too Late	_____ No Substitutions Accepted For Product

Reviewed By / Date: _____

Processed by Addendum No. _____

Comments: _____

**SECTION 013000
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electronic document submittal service.
- B. Preconstruction meeting.
- C. Progress meetings.
- D. Submittals for review, information, and project closeout.
- E. Number of copies of submittals.
- F. Submittal procedures.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 - 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 - 2. It is Contractor's responsibility to submit documents in allowable format.
 - 3. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
 - 4. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
- B. Submittal Service: The selected service is:
 - 1. Submittal Exchange (tel: 1-800-714-0024): www.submittalexchange.com/#sle.
 - 2. EADOC LLC (tel: 1-877-305-3844): www.eadocsoftware.com/#sle.
 - 3. Newforma ConstructEx: www.newforma.com/our-solutions/constructex/#sle.

3.02 PRECONSTRUCTION MEETING

- A. Architect will schedule a meeting after Notice of Award.
- B. Attendance Required:
 - 1. Owner.
 - 2. Architect.
 - 3. Contractor.
- C. Agenda:
 - 1. Execution of Owner-Contractor Agreement.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Distribution of Contract Documents.
 - 4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 - 5. Designation of personnel representing the parties to Contract and Architect.
 - 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 - 7. Scheduling.

- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

- A. Architect will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- B. Attendance Required:
 - 1. Contractor.
 - 2. Owner.
 - 3. Architect.
 - 4. Contractor's superintendent.
 - 5. Major subcontractors.
- C. Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems that impede, or will impede, planned progress.
 - 5. Review of submittals schedule and status of submittals.
 - 6. Maintenance of progress schedule.
 - 7. Corrective measures to regain projected schedules.
 - 8. Planned progress during succeeding work period.
 - 9. Maintenance of quality and work standards.
 - 10. Effect of proposed changes on progress schedule and coordination.
 - 11. Other business relating to work.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE - SEE SECTION 013216 - SEE SECTION 013216

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.

3.05 SUBMITTALS FOR REVIEW

- A. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- B. Samples will be reviewed for aesthetic, color, or finish selection.
- C. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 017800 - Closeout Submittals.

3.06 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 - 1. Design data.
 - 2. Certificates.
 - 3. Test reports.
 - 4. Inspection reports.
 - 5. Manufacturer's instructions.
 - 6. Manufacturer's field reports.
 - 7. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

3.07 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

3.08 SUBMITTAL PROCEDURES

- A. General Requirements:
 - 1. Transmit using approved form.

- a. Use form generated by Electronic Document Submittal Service software.
 2. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
 3. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
 4. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 5. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
 6. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 7. Provide space for Contractor and Architect review stamps.
 8. When revised for resubmission, identify all changes made since previous submission.
 9. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
 10. Submittals not requested will not be recognized or processed.
- B. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
 2. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

END OF SECTION

**SECTION 013216
CONSTRUCTION PROGRESS SCHEDULE**

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 10 days after joint review, submit complete schedule.
- D. Submit updated schedule with each Application for Payment.

1.03 SCHEDULE FORMAT

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

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

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

3.02 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- D. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.
- E. Indicate delivery dates for owner-furnished products.
- F. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

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

3.04 REVIEW AND EVALUATION OF SCHEDULE

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

3.05 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.

3.06 DISTRIBUTION OF SCHEDULE

- A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION

SECTION 01 32 23 SURVEY AND LAYOUT DATA

PART 1 GENERAL

1.01 GENERAL

- A. The requirements and provisions for engineering and layout of survey and layout data are as specified in the General Conditions and as supplemented herein.
- B. Topography and profiles showing existing ground elevations and culture were obtained by topographic survey.
- C. The Contractor shall hire the Engineer/Surveyor to furnish construction staking to prosecute the Work as described below. The Contractor shall make timely demands of the Engineer/Surveyor for such staking. The Contractor shall provide advance written notice of not less than three working days for setting stakes.
 1. Benchmarks for elevation will be provided in close proximity to site.
 2. Stakes showing sanitary sewer grade lines will be provided, at an offset as agreed to by the Contractor, at intervals of not less than 50 feet. Water lines will be staked for alignment at 100 ft stations. All stakes will be set an offset as agreed by the Contractor.
 3. Concrete sidewalk and concrete pavement shall be staked at 25 foot intervals and at all changes in grade or line and will include radius stakes.
 4. The subgrade and base course for the parking lots and other areas shall be blue topped at an interval as agreed upon between the Engineer and the Contractor.
 5. The contractor shall be responsible for transferring from benchmarks, grade and line stakes all distances and elevations necessary for the execution of the work.
 6. The Contractor may request additional staking at the Pre-Construction Conference. Should the Contractor request the setting of stakes in excess of those described above, after the Pre-Construction Conference, the Contractor shall be responsible for the extra cost, which will be prorated on the basis of the total number of stakes set.
 7. **Electronic files can be made available for use with a Contractor's GPS system. Contractor will be responsible for the extra cost which Helms and Associates puts into preparing these files for their use and for any additional control points set by Helms and Associates personnel.**

- D. The Contractor shall preserve all construction stakes, reference points, and other survey points. In case of their loss or destruction, the Contractor shall be liable for and charged with the cost of their replacement and of any expense resulting from their loss or disturbance. Such surveys shall constitute instruction from the Engineer, and the Contractor shall not proceed with the Work until construction stakes have been provided.
- E. Should the Owner's representative be required to reset construction stakes, the cost for such resetting will be at the then current per diem rates. The charges for such Work will be deducted from the progress payments for the Contractor for the month in which the surveying Work is done by the Owner and thereon paid to the Owner's representative.

* * * END OF SECTION * * *

**SECTION 014000
QUALITY REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. Testing and inspection agencies and services.
- C. Control of installation.
- D. Defect Assessment.

1.02 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Compliance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.

1.03 TESTING AND INSPECTION AGENCIES AND SERVICES

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

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

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

3.02 TESTING AND INSPECTION

- A. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.

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

3.03 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION

SECTION 01 45 23
QUALITY CONTROL – TESTING AND INSPECTING SERVICES

PART 1- GENERAL

1.1 WORK INCLUDED

- A. Extent of work of this section includes all labor, materials, equipment and services necessary for the testing of specific contractor installed materials in the Construction Documents.
- B. As the Testing Laboratory is not a Contractor; the normal services and agreements in the general conditions and bidding procedures do not apply. This section, governs the procedures.
 - 1. Testing Laboratory performance is governed by the laws of the **State of South Dakota**.
- C. Selection, payment and use of Testing Laboratory Services
 - 1. By providing a cost for the services described below directly to the owner, on the date of other bids, the Testing Laboratory shall be retained and paid for by the Owner, except as noted. The Testing Laboratory shall act in all matters relating to testing.
 - a. Contractors will not control the means or the methods of testing or inspections. Contractors must however provide scheduling information to the Testing Laboratory.
 - b. Testing agency will contact the Architect and Engineer for instructions on scope of the work, if necessary.
- D. It shall be the responsibility of the Testing Laboratory to familiarize themselves with all sections of the Contract Documents and the project schedule.
- E. All testing required of this project shall be performed by a single testing laboratory.
- F. The testing requirements shall remain in force for the full duration of the construction contract, including all delays or time extensions.
- G. Provide to the Contractor, contact information, list of items to be inspected and other information to assist the Contractor in scheduling his work, while allowing for inspections and tests of this section.
- H. Related Contract Documents.
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and remaining Division 00 and 01 Specification Sections as they apply to this section.

1.2 TESTING LABORATORY REQUIREMENTS OF COST AND ABILITY

- A. All testing laboratories desiring to provide their services for this project must submit for approval to the Owner, at the time and date of bid, for review by the Architect the following:
 - 1. Documentation that the Testing Laboratory meets requirements of the American Council of Independent Laboratories (ACIL).
 - 2. Provide documentation that the Testing Laboratory has an in-house quality assurance program.
 - 3. Proof that the Testing Laboratory is owned and directly managed by a Professional Engineer, licensed in the State where testing and inspections occur.
 - a. Principals of the Testing Laboratory and their project managers must be registered professional engineers with a minimum of five years experience in the types of testing required under this contract. Each person in charge of laboratory testing, field-testing and inspection must have not less than one's years experience in the duties performed under this contract and shall perform their duties only under the direct supervision of a registered professional engineer.

4. Total price of services for the project, as a bid, based on the scope of the work shown in this section and the laws of the state of South Dakota as they relate to professional engineering services.
 - a. Use Bid form provided in Project Manual.
 - b. This bid if made into a contract is not subject to retainage.
 - c. This bid is a lump sum made on the basis of a computation of unit prices for testing and observation services. At the end of this section a quantity of units in terms of hours and or specific activities is given. The bid provided shall be based on that information.

** The Quantity of tests required is part of the submittal by the Testing Laboratory to the Owner. (See end of Part 3)*
 - d. Provide a unit price for each hour or quantity asked for. These unit prices shall become the basis, if required, to provide additional testing services.

1.3 REFERENCES

- A. ANSI/ASTM E329 - Standard Practice for Use in the Evaluation of Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
- B. ASTM E543 - Practice for Determining the Qualifications of Agencies Performing Nondestructive Testing.
- C. ASTM E548 - Standard Guide for General Criteria Used for Evaluating Laboratory Competence.
- D. ASTM A802 – Standard Practice for examination of steel castings, surface acceptance and visual examination.
- E. ASTM E174 Standard Practice for Radiographic Examination.
- F. ASTM C1077 – Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
- G. ASTM C1093 - Practice for the Accreditation of Testing Agencies for Unit Masonry.
- H. ANSI/ASTM D3740 - Standard Recommended Practice for Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- I. ASTM D4561 – Practice for quality control systems for an inspection and testing agency for bituminous paving materials.
- J. ASTM E699 – Practice for criteria for evaluation of agencies involved in testing, quality assurance, and evaluating building components in accordance with test methods promulgated by ASTM committee E6.
- L. ICBO Model Program for Special Inspection (excerpts).
- N. CASE-Council of American Structural Engineers.
- O. AIA Document A201 - General Conditions - 1997 Edition

1.4 RELATED SECTIONS

- A. Project specifications and plans for all items to be inspected.
- B. Schedule as shown in Division 01 in Project Specifications.
- C. Submittals section in Division 01 as shown in Project Specifications.
- D. Contract closeout section in Division 01 as shown in Project Specifications.
- E. Project meeting Section in Division 01 as written in Project Specifications.

1.5 REPORTS OF TESTING

- A. Written Reports: Submit all test reports to Owner, Architect and Engineer, within 72 hours after each test is completed. Contractor shall also be given a copy.
- B. Verbal Phone Reports: Testing Laboratory is to give immediate verbal notification, to the Owner, the Architect, and to Heyer Engineering, immediately of any irregularity, failure, or non-compliance of tested items to ensure all necessary retesting and/or replacement of materials with the least possible delay in progress of the work.

- C. Test Standards: Testing Laboratory shall furnish the Architect and Engineer upon request, one (1) copy of each standard (ASTM, AASHTO and AWS) referred to or which is pertinent to these specifications.
- D. All reports, written and verbal, must state clearly whether work inspected or tested is/is not in compliance with Contract Documents.

1.6 PAYMENT OF TESTING SERVICES

A. Initial services:

- 1. The Owner, will pay for all initial-testing services requested by and anticipated by this specification. Costs for all such testing services shall be included in a proposal submitted directly to the Owner through the Architect. See information in this section.
 - a. See form at end of this specification section 3 for the required testing units. These units in either hours or events will form the basis of the cost of testing laboratory services.
- 2. Owner will through the Architect issue a change order if additional services are required. These additional services must be agreed to in writing by the owner, the testing laboratory and the architect. Additional services will be based on unit prices submitted by the testing laboratory and listed at the end of this specification section.

B. Additional or re-testing:

- 1. When initial tests indicate non-compliance with the Contract Documents, all subsequent re-testing occasioned by the non-compliance shall be performed by the same Testing Laboratory and the costs thereof will be borne entirely by the **Contractor**. If needed the Owner, through the Architect, will deduct the amount of the re-testing from the Contractors pay request.

C. Contractor required specimens and tests not in this Specification Section.

- 1. Products and materials, such as concrete, masonry, mortar or proposed engineered fill, requiring a test report or a design done by a Professional Registered Engineer prior to use; shall be performed by the Contractor and are not a part of the cost of this section for the Testing Laboratory Services.
- 2. Mechanical balancing, adjusting, or startup of systems or motor startup by either Mechanical, Electrical, or Plumbing Contractors is not a part of this work.

1.7 NON COMPLIANCE WORK STOPPAGE

- A. The Testing Laboratory shall act as the Owner's agent in testing and inspections on items in this section to determine compliance with plans and specifications.
- B. The Testing Laboratory **shall further advise the Owner, the Architect and the Structural Engineer if the non-compliance should result in the Owner** stopping that type of work from being performed until corrective action or replacement is completed. Based on the following criteria:
 - 1. If additional work would be added to existing non-complying work, adding additional expense to the Contractor to remove.
 - 2. It is clear by the quality and status of the non-complying work that the Contractor will continue to produce substandard work.
 - 3. It is clear that the Contractor does not understand how the work is to be produced in a manner consistent with the Contract Documents.
 - 4. A required inspection by a governmental official cannot be done unless further work is stopped, or work needed to be inspected is in danger of being covered.
 - 5. Public or worker safety in the sole opinion, of the Testing Agency, would be compromised if the work continues.

1.8 LIMITS ON AUTHORITY

- A. Employment of the Testing Laboratory in no way relieves the Contractor of his obligation to perform work in accordance with requirements of Contract Documents.

- B. Inspection firm may not release, revoke, alter, or enlarge any requirements of the Contract Documents.
- C. Inspection firm may not approve or accept any portion of the work.
- D. Inspection firm may not assume any duties of the Contractor.
- E. As stated in Section 1.6 above, Owner, not Testing Laboratory, has authority to stop work.
- F. Mechanical balancing, adjusting or startup of systems or motor startup by either Mechanical, Electrical or Plumbing Contractors is not a part of this work.

1.9 CONTRACTOR SCHEDULING AND NOTIFICATION RESPONSIBILITY

A. Even though Contractor is not paying for the work of this section. He must perform the notification and scheduling of all Testing. Therefore Contractor shall:

- 1. Provide notification to the Testing Laboratory based on schedule of all work to be inspected. Inspections missed due to the Contractor not notifying Testing Laboratory shall require contractor dismantling and un-covering of in place work.
 - a. If this is not done, the Owner, will stop all construction at the contractor's expense until he receives the proper documentation that the tests were performed. Once the engineer has approved the criteria and testing results, the work may proceed.
- 2. The Testing Laboratory shall attend the pre-construction meeting and all other meetings during work that is to be inspected to familiarize themselves with the project, the contractors and the project schedule.
 - a. **The Contractor is responsible for the project schedule and for scheduling of all testing.**
- 3. When changes of construction schedule are necessary during construction, the Contractor shall make contact with the Testing Laboratory to determine such schedule changes.
 - a. The Testing Laboratory will not be held accountable for lack of inspection when a Contractor purposely covers portions of the work to be inspected.
- 4. Provide incidental labor and materials to provide access to work to be inspected. Such as having ladders, available scaffolding and other components readied and in the same safe condition as that available for they're own workmen.
- 5. Inspection or testing performed exclusively for a Contractor's convenience shall be the sole responsibility of the Contractor. This includes strength tests for OSHA or AWAIR.

1.10 TAKING SPECIMENS

- A. All specimens and samples for testing will be taken only by the Testing Laboratory; all sampling equipment and personnel will be provided by the Testing Laboratory; and all deliveries of specimens and samples to the Testing Laboratory will be performed only by the Testing Laboratory.
 - 1. The only exception for taking of specimens is that the Masonry Contractor may take his own mortar test cylinders. However they must be transported by the Testing Laboratory.
- B. Contractors shall provide representatives of the Testing Laboratory access to the work at all times in order that the Laboratory may properly perform its functions.

1.11 CODE COMPLIANCE TESTING

- A. Inspections and test required by codes or ordinances, or by a plan approval authority, not listed in Part 3 Execution, shall be the responsibility of and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.
 - 1. Contractor, not Testing Laboratory, is responsible for design of certain materials to be used in the field such as concrete and mortar mix designs and design of precast, wood and light gauge engineered assemblies and systems.

1.12 SPECIAL INSPECTIONS

- A. All requirements under the Special Inspections portion of the International Building Code are separate items not listed under this section. They however are required by the Owner of the Contractor.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 VIBRATION CONTROL (Not Used)

3.2 EXCAVATION & BACKFILLING (Includes Special Inspection per CASE and IBC 2018)

- A. The Testing Laboratory shall be on site to observe and monitor the mass site excavation and backfilling of the building structure area.
 - 1. Verify that all unsuitable organic materials, black and soft soils have been removed.
 - 2. Test the mass backfill and verify correct depth of material backfill lifts.
 - 3. After mass backfill is complete, monitor and verify the correction of secondary settlement and inform the Architect/Structural Engineer and General Contractor the readiness for footing excavation to begin.
- B. Inspect each footing and slab subgrade to determine if subgrade materials are acceptable. Perform hand auger borings and soil classifications. Make density tests to determine if the actual soil bearing values capacity complies with specified value.
- C. Test all engineered fill materials as to density and optimum moisture content. Per ASTM D698.
 - 1. Visit the site of the borrow pit or site and determine that anticipated values of sample are consistent with all materials to be used from the pit or site.
 - 2. Use values determined from tests to calibrate site compaction and soil density work.
- D. For footings or foundation walls. Take soil density and moisture tests at the site in all engineered fill areas. Test 4 corners of each 2000 s. f. or 2 locations in every 100 lineal foot of fill and backfill. This shall be done per every one foot of lift, of fill or backfill. Per Nuclear Density Method B in ASTM D2922 overall Basis.
- G. Slab on grade work includes the use of vapor barrier and a 6" granular cushion. Examine both prior to placement of reinforcing steel to determine that:
 - 1. All mechanical, electrical, underfloor drainage and or other below surface work are complete prior to installation of vapor barrier and or granular cushion. Do not allow placement until underground work is complete.
 - 2. All vapor barrier seams are overlapped a min. of 12 inches. Sides of vapor barrier are raised up 12" over the top level of slab and are attached to walls and that all seams are taped.
 - 3. The 6" granular fill is placed above the vapor barrier and the vapor barrier is not broken during placement.

3.3 GRADING FOR PARKING LOTS, DRIVEWAYS, APPROACHES

- A. Testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- B. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved Concrete or Asphalt Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area, but in no case fewer than three tests.
 - 2. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.4 ASPHALTIC CONCRETE

- A. Verify at batch plant that asphaltic formulation meets project specifications.
- B. Test aggregate base course for proper compaction and observe proof rolling for pumping.
 - 1. Aggregate base course must be compacted to not less than 100% Standard Proctor maximum dry density ASTM D698.
 - 2. Areas that are pumping must be cut out, relaid, recompact and proof rolled.
- A. Verify correct number of asphalt lifts are being laid.
- B. Take bituminous course tests at every 5000 sq. feet for bitumen content, gradation of aggregate, field density, air void content and thickness. **(All tests must be taken after laydown but prior to rolling or compaction.)**
 - 1. Test each course.
 - 2. Density must be 95% of Marshall density.
 - 3. Asphalt content by weight shall be 6.0 to 8.0% of the total mixture.
 - 4. Air void Content shall be 3-5% maximum as per ASTM 2041.
- C. Using surveying equipment and or lasers verify drainage of all paved areas after compaction and rolling. Drainage in all paved areas to be a minimum of ¼" per foot.
 - 1. Test at random 10'-0" areas so that surface is smooth to ¼" +/- in 10'-0" area.
All bird baths must be redone.

3.5 FORMWORK (Includes Special Inspection per CASE and IBC 2018)

- A. Verify formwork for all concrete will result in member size, location, and configuration as described on the contract documents, as it affects the structural integrity of the concrete elements to be placed.
 - 1. Measure distance between forms and reinforcing to determine proper coverage of reinforcing.
 - 2. Check for form oil or lubricants on reinforcing.
 - 3. Verify that formwork is properly tied and supported.

3.6 REINFORCING STEEL (Includes Special Inspection per CASE and IBC 2018)

- A. All steel bars must be positively identified as to heat number and mill analysis. Reports to be provided by the supplier. All reinforcing steel shall have a number assigned to it corresponding to the placement mark on the submittal.
 - 1. All steel bars that cannot be identified by heat number and mill analysis shall have one tensile and one bend test made for each 2-1/2 tons or fraction thereof, of each size and kind of reinforcing steel.
Testing procedure shall conform to ASTM A615.
- B. No reinforcing steel shall be placed without an approved shop drawing.
- C. The testing laboratory shall verify size and location of all bars prior to concrete placement.
 - 1. Verify that chairs or similar product have been provided and are in place for all slab reinforcement.
- D. A written report shall be submitted to the Engineer stating the results of the verification and any modifications required by the General Contractor to meet the plans and or specifications.

3.7 CONCRETE (Includes Special Inspection per CASE and IBC 2018)

- A. Portions of the following such as Engineered mix design are furnished by the installing Contractor; Testing of Concrete in the field is performed by the Testing Agency under the Owner.
- B. **After Contractors Mix design work is complete, field testing shall occur as follows:**
 - a. Contractor or Testing Lab shall perform slump tests and take strength test cylinders (minimum of 5) at the point of application, or after it has been pumped, during first day's work. If a plasticizer is being used, test before and after addition of plasticizer and so note on the test report. Non

compliant tests shall mean non-use of that trucks' product. All other days work shall be tested on every other truck after it has passed through the pumper.

- b. Air entrainment tests shall be taken in the same manner as the concrete slump tests **but shall be taken by the Testing Laboratory.**
2. If slump or air content falls outside specified limits another test shall be made immediately from another portion of same batch. If this test likewise fails, the concrete of that load shall be discarded and the truck carrying it shall not be allowed to unload at the site for 1 hour. Truck identification number shall be recorded if this procedure is necessary
3. Notify batch plant of mix irregularities and request materials and proportioning check
4. Use and reporting of Field Samples:
 - a. Testing Lab shall perform laboratory strength tests on actual concrete work. Provide a single cylinder 7 day test and a final 28 day test with an average of 3 test cylinders, Keep one additional cylinder as a field hold to be tested in cold weather or as needed. A total of 5 (five)-test cylinders are required. Contractor may keep additional cylinders for use in determining form removal timing and to verify OSHA strength requirements for steel columns. Take daily tests on every 50 yards of each type of concrete used.
 - b. Furnish certified compression test reports to Owner, Engineer, Architect and Concrete Contractor. On test report indicate following information:
 - Cylinder identification number and date cast.
 - Portion of structure and location of structure where tested
 - Type of concrete, slump and percent air.
 - Compressive strength of concrete in PSI.
 - Weather conditions during placing.
 - Temperature of concrete.
 - Maximum and minimum ambient temperature during placing.
 - Ambient temperature when concrete sample in test cylinder was taken.
 - Date delivered to laboratory and date tested.
 - Certification by the plant that the specified mix design and all required admixtures are included.
11. Verify thickness of concrete walls, slabs, raised slabs and other concrete work.
12. Verify that concrete meets FF and FL level and flatness standards listed in Section 03300 or 03300 Part 3 Execution The system is designed to measure 4 20' x 20' test sections randomly chosen on the slab on grade and the raised deck floor not including stoops. The Sections should not adjoin each other unless the floor is less than 80'x 80' in size.
13. Verify that hot weather and or cold weather concrete installation requirements are being followed by the Contractor. If sufficient protections and methods are not being followed for the production, installation, protection and curing of concrete in cold weather or hot weather conditions, the pour must stop and only continue once conditions are remedied. See ACI 305R, ACI 306R.

3.8 STRUCTURAL STEEL BEAMS, COLUMNS, JOISTS AND GIRDERS(Includes Special Inspection per CASE and IBC 2018)

- A. Verify that anchor bolts and their setting pattern is at correct elevation, allows for 1-1/2" grout under the base plate and that pattern matches Contract Drawings and reviewed shop drawings.
- B. Welding:
 1. Field-welded connections shall be inspected visually.

- a. Fillet Welds - 50% of all connections, closely visually inspected as per AWS D1.1.
 - b. Partial Penetration - 50% of all connections, closely visually inspected as per AWS D1.1.
 - c. Full Penetration - 50 % of all connections, closely visually inspected as per AWS D1.1.
- 2. X ray testing of welded connections shall be required only if visual inspection determines that numerous (over 20%) flaws exist in the welding fillets and further visual inspection cannot be made to determine adequate welded connections.
- C. Bolted Connections: Per AISC, All bolted connections shall be bolted with ASTM A325, Type 1, 3/4" min. diameter bolts. All shear bolts at initial erection shall be snug fit tightened with a wrench.
 - 1. After final erection tightening and correction of plumb and square of steel; all shear bolt connections shall have the additional requirement of paint stick match marking. Paint shall mark the connection surface, the bolt, and the nut. A final 1/4" turn past snug fit with a wrench shall be required. Then the threads shall be welded or damaged
 - 2. Quantity of Bearing Connections inspected is: 20% of total number of connections. Each bolt in tested connection shall be tested for snug fit.
 - a. Retighten 100% of bolts in tested connection if any bolts within tested connections are not adequately tightened.
 - b. Retighten 100% of ALL bearing style connections if more than 10% of the tested connections contain bolts not adequately tightened.
 - c. Retest system as defined above, if system has to be re-erected.
 - 3. Steel members shall be inspected to plumb, square and level. The standards shall vary but in general shall be no more than 1/2" per 16'-0" individual member.

3.9 STEEL DECKING (Includes Special Inspection per CASE and IBC 2018)

- A. The decking shall be marked as to thickness and type
 - 1. Decking must be supplied free of oil or lubricating fluids.
 - 2. If decking is to be painted, it must be primed and free from rust or excess abrasion.
 - 3. If decking is to be galvanized, the galvanizing must be free from abraded areas and the galvanizing shall be well bonded to all surfaces.
- B. Certification of the welder shall be made for the type and thickness of decking to be installed.
- C. Prior to work commencing, the welder shall assemble and weld at least two samples of deck material to a base steel section simulating the framing with one weld each sample. Twist the deck sample with respect to the base until failure occurs. If the decking tests or if the welds on shearing in torsion show the proper fusion area, the welds are satisfactory.
- D. Inspection of all welds and placement of decking shall occur before any covering materials are applied. 50% of all welds shall be inspected.
 - 1. Any areas that show burn-through shall be removed and replaced.
 - 2. Adequate bearing on base steel sections shall be verified.
 - 3. All openings larger than 6" shall have steel channel backup and bracing.

3.10 MASONRY (Includes Special Inspection per CASE and IBC 2018)

- A. Quality Assurance
 - 1. Concrete Masonry Unit: For each type of concrete masonry unit indicated, verify compliance with ASTM C 90 and the strength required by design. Verification may be by reviewing certification from unit producer showing compliance.

2. Review field welder qualifications by certification or verify by retesting. Obtain welder certificates.
- B. Field Testing
1. Masonry Strength Testing
 - a. Verification Testing Frequency: Verification of masonry strength (f_m) will be performed at the beginning of masonry construction and during construction for each 5,000 square feet of wall area or portion thereof.
 - b. Mortar
 - i. As construction begins, verify the proportions of the site-prepared mortar mix comply with the requirements of ASTM C 270 for the type specified.
 - ii. Verify the proportions of materials in premixed or preblended mortar comply with the requirements of ASTM C 270 for the type specified as delivered to the site.
 - c. Grout
 - i. Prior to grouting, verify the proportions of site-prepared grout mix comply with the requirements of ASTM C 476 for each type of grout used.
 - ii. Verify the proportions of materials in premixed or preblended grout comply with the requirements of ASTM C 476 as delivered to the site.
 - iii. For grout pre-mixed at a batch plant or otherwise not prepared on site, grout shall be sampled and tested in accordance with ASTM C 1019. Prepare one set of grout samples for testing at seven days and two sets for testing at 28 days.
 - d. For each type of wall construction indicated for testing, test representative masonry prisms by methods of sampling and testing of ASTM C 1314, and as follows:
 - i. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.
 - ii. For concrete masonry prisms adhere to requirements as specified under preconstruction testing. Build prisms on job using same materials and methods as for wall construction. Store prisms in air at temperature not less than 65°F in a facility supplied by the contractor where they will be undisturbed for seven (7) days. After seven (7) days, transport to laboratory in a manner which will not disturb mortar bond.
 - iii. Cap each prism with suitable material to provide bearing surfaces on each end.
 - iv. The preparation of prisms shall be observed by the testing agency that will test the prisms.
 - e. Report test results in writing and in form specified under each test method, to Architect and Contractor, on same day tests are made.
 - f. Retests: Where prism tests indicate non-compliance with specified requirements, additional testing shall be performed at the frequency of two additional tests for each unsatisfactory test. The cost of such additional testing shall be the responsibility of the Contractor. Where retesting fails to indicate conformance with specified requirements, any masonry construction represented by unsatisfactory tests shall be removed and replaced with acceptable masonry construction.
 - g. Testing of Non-Shrink Grout for Base Plates and Bearing Plates
 - i. Compressive Strength Tests: Compressive strength of grout shall be determined by testing grout cubes according to the requirements of ASTM C 109 - Modified. Test one set of three cubes at one day, and one set of three cubes at 28 days.
 - ii. Frequency of Testing: One set of cubes (6 cubes) shall be made for every ten base plates and bearing plates or fraction thereof but not less than one set for each day's operation. One set of cubes shall be made for each day's operation of grouting wall panels.

C. Field Inspection

1. Mortar Joints: As construction begins, verify that mortar joints are being prepared in accordance with these specifications and ACI 530.1/ASCE 6/TMS 602.
2. Reinforcement and Connectors: Prior to grouting, verify the size, grade, type and placement of reinforcement and connectors is in compliance with specified requirements.
3. Grouting: Prior to any grouting procedure, the grout space shall be inspected to verify that it is clean and that cleanouts, if required, are in place and conform to requirements. Verify through continuous inspection that the placement of grout is in compliance with the requirements of the contract specifications and ACI 530.1/ASCE 6/TMS 602.
4. Anchors: Continuously inspect the installation of anchors including anchors of masonry to other structural members, frames, or construction verifying their type, size, location, and installation.
5. Anchors: Periodically verify the type, size and location of anchors including anchors of masonry to other structural members, frames, or construction is in compliance with specified requirements.
6. Anchors: Verify maximum anchor tightening torque for all post-installed anchors.
7. Welding of Reinforcing Bars: Observe the welding of reinforcing bars.
8. Installed items: Verify that installed flashing, weep holes, construction joints, control joints and wall vents are installed in accordance with specifications.

3.12 FINAL REPORTING

- A. At the conclusion of the work, required to be inspected by the Testing Laboratory, a written report in binder form with an index shall be submitted as a permanent record to the Owner through the Structural Engineer of all tests, logs, comments and written reports.

END OF SECTION

SECTION 015000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 TEMPORARY UTILITIES - SEE SECTION 015100

- A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.

1.03 TELECOMMUNICATIONS SERVICES

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

1.04 TEMPORARY SANITARY FACILITIES

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

1.05 BARRIERS

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

1.06 SECURITY

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

1.07 VEHICULAR ACCESS AND PARKING - SEE SECTION 015500

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

1.08 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.09 FIELD OFFICES

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Locate offices a minimum distance of 30 feet (10 m) from existing and new structures.

1.10 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet (600 mm). Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 016000
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 SUBMITTALS

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

PART 2 PRODUCTS

2.01 PRODUCT OPTIONS

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

2.02 MAINTENANCE MATERIALS

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

PART 3 EXECUTION

3.01 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.02 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 017419.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- G. Comply with manufacturer's warranty conditions, if any.
- H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- I. Prevent contact with material that may cause corrosion, discoloration, or staining.
- J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

**SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Pre-installation meetings.
- C. Cutting and patching.
- D. Cleaning and protection.
- E. Starting of systems and equipment.
- F. Demonstration and instruction of Owner personnel.
- G. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

1.02 PROJECT CONDITIONS

- A. Use of explosives is not permitted.
- B. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.03 COORDINATION

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

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

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

3.03 PREINSTALLATION MEETINGS

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

3.04 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 1. Verify that construction and utility arrangements are as indicated.
 2. Report discrepancies to Architect before disturbing existing installation.
 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Remove existing work as indicated and as required to accomplish new work.
 1. Remove items indicated on drawings.
 2. Relocate items indicated on drawings.
 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

- C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and _____): Remove, relocate, and extend existing systems to accommodate new construction.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 - 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
 - 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 - b. Provide temporary connections as required to maintain existing systems in service.
 - 4. Verify that abandoned services serve only abandoned facilities.
 - 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- D. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
- E. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
- F. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- G. Refinish existing surfaces as indicated:
 - 1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
 - 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- H. Clean existing systems and equipment.
- I. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- J. Do not begin new construction in alterations areas before demolition is complete.
- K. Comply with all other applicable requirements of this section.

3.06 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-complying work.

- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 078400, to full thickness of the penetrated element.
- J. Patching:
 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 2. Match color, texture, and appearance.
 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.07 PROGRESS CLEANING

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

3.08 PROTECTION OF INSTALLED WORK

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

3.09 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.

- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 DEMONSTRATION AND INSTRUCTION

- A. See Section 017900 - Demonstration and Training.

3.11 ADJUSTING

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

3.12 FINAL CLEANING

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

3.13 CLOSEOUT PROCEDURES

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

END OF SECTION

SECTION 01 73 29 CUTTING AND PATCHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general requirements of the Contract including General and Supplementary Conditions and as supplemented herein shall apply to the Work covered by this Section.

1.02 SCOPE AND DESCRIPTION

- A. This section describes the necessary coordination, materials and labor associated with cutting and patching of completed Work or connection of specified Work to existing facilities.

1.03 SUBMITTALS

- A. Prior to cutting which may affect the structural integrity of any structure, facility or portion of the project, or Work of another Contractor, or completed Work or existing facilities, the Contractor shall submit written notice to the Engineer requesting consent to proceed with the cutting. The notice shall designate the location, date and time the Work will be exposed for observation, and cutting will be initiated and completed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All materials for cutting and patching shall comply with the Specifications for the type of Work to be done.

PART 3 EXECUTION

3.01 GENERAL

- A. Cutting (including excavating), fitting or patching of Work shall be executed as required to:
 - 1. Uncover Work to provide for installation of ill-timed Work.
 - 2. Remove and replace defective Work
 - 3. Install and properly fit specified Work in existing construction, facilities, or structures.
 - 4. Remove and replace Work not conforming to requirements of Contract-Legal Documents, Specifications, or Drawings.
 - 5. Remove samples of installed Work as specified for testing.
- B. The Work of another Contractor, Work already completed, or existing facilities shall not be cut without the consent of the Engineer.

3.02 INSPECTION

- A. Representatives of the Contractor, Owner, and Engineer shall, before starting Work on that portion of the project, inspect and record the existing conditions of Work, including elements subject to movement or damage during:
 - 1. Cutting and patching
 - 2. Excavating and backfilling

- B. After uncovering the Work, the Contractor and Engineer shall inspect Work and note all

conditions affecting installation of new products.

3.03 PREPARATION

- A. The Contractor shall be responsible for providing shoring, backing and support as required to maintain structural integrity of the Work, protect other work, and provide protection from the elements.

3.04 PERFORMANCE

- A. The fitting and adjustment of products and material shall be executed to provide a finished installation that will comply with specified tolerances and finishes.
- B. All cutting and demolition shall be executed by methods that will prevent damage to other Work, and will provide the proper surfaces to receive installation of repairs and new Work.

PART 4 MEASUREMENT AND PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Cutting and patching is considered incidental Work with no separate measurement to be made.

4.02 BASIS OF PAYMENT

- A. The cost of cutting and patching to complete Work as specified and shown on the Drawings shall not be measured and paid directly but shall be considered incidental to the project as bid.

* * * END OF SECTION * * *

**SECTION 017800
CLOSEOUT SUBMITTALS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project record documents.
- B. Operation and maintenance data.
- C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Individual Product Sections: Specific requirements for operation and maintenance data.
- C. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

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

PART 3 EXECUTION

2.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Changes made by Addenda and modifications.
- F. Record Drawings: Legibly mark each item to record actual construction including:
 - 1. Field changes of dimension and detail.
 - 2. Details not on original Contract drawings.

2.02 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

2.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

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

2.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

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

2.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in

each volume, with the current volume clearly identified.

- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- J. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.
 - b. Operation and maintenance data.
 - c. Field quality control data.
 - d. Photocopies of warranties and bonds.
 - 4. Design Data: To allow for addition of design data furnished by Architect or others, provide a tab labeled "Design Data" and provide a binder large enough to allow for insertion of at least 20 pages of typed text.

2.06 WARRANTIES AND BONDS

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

END OF SECTION

**SECTION 017900
DEMONSTRATION AND TRAINING**

PART 1 GENERAL

1.01 SUMMARY

- A. Demonstration of products and systems where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
 - 1. All software-operated systems.
 - 2. HVAC systems and equipment.
 - 3. Plumbing equipment.
 - 4. Electrical systems and equipment.
 - 5. Items specified in individual product Sections.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
 - 1. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

- A. Section 017800 - Closeout Submittals: Operation and maintenance manuals.
- B. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit to Architect for transmittal to Owner.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
 - 1. Include applicable portion of O&M manuals.
 - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
 - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.

1.04 QUALITY ASSURANCE

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

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

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

3.02 TRAINING - GENERAL

- A. Conduct training on-site unless otherwise indicated.
- B. Owner will provide classroom and seating at no cost to Contractor.
- C. Provide training in minimum two hour segments.
- D. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- E. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
 - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 - 3. Typical uses of the O&M manuals.
- F. Product- and System-Specific Training:
 - 1. Review the applicable O&M manuals.
 - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
 - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
 - 6. Discuss common troubleshooting problems and solutions.
 - 7. Discuss any peculiarities of equipment installation or operation.
 - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
 - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
 - 10. Review spare parts and tools required to be furnished by Contractor.
 - 11. Review spare parts suppliers and sources and procurement procedures.
- G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

SECTION 02 01 00 MAINTENANCE OF EXISTING CONDITIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Supplementary Conditions shall apply to the Work covered in this Section.

1.02 SCOPE

- A. This Section describes, but is not limited to, the relationship of the Project to existing underground utilities and the Work associated with the location, adjustment, and repair of underground utilities.
- B. The information and data relative to existing underground utilities are provided to assist the Contractor with the preparation of his bid. This information should not be used by the Contractor for reference during construction of the Work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL

- A. Existing underground utilities, as shown on the drawings, are located in accordance with available data, but locations may vary and cannot be guaranteed. The exact locations shall be determined by each Contractor as the Work proceeds. Excavation work shall be done carefully so as to avoid damaging the existing utilities and Work.
- B. Each Contractor shall provide for protection, temporary removal and replacement or relocation of obstructions as required for the performance of this Work required in these contract documents.
- C. Other obstructions not shown on the plans and requiring relocation shall be exposed by the Contractor without injury; or if injured, shall be repaired by Contractor at his expense. Removal of such obstruction or its relocation shall be made by the Contractor according to the provisions of the General Conditions.

3.02 UTILITY CONTACT

- A. Prior to Work in a specific area affecting underground utilities, the following individuals shall be notified as appropriate:
- B. All above utilities, excepting water, may be located utilizing the South Dakota One Call Notification Center:

(Locate Phone Number) 1-800-781-7474

(Admin. Phone Number) 1-800-422-1242

- C. The failure of any utility to be present for any reason, at the Pre-Construction Conference, if held, shall not relieve the Contractor of any responsibility described herein.

3.03 UTILITY REPAIR:

- A. When an underground utility is exposed or damaged, the Contractor shall comply with the repair requirements of the affected utility.
- B. When an underground utility is exposed, the Contractor shall compact the backfill beneath the exposed utility before completion of the backfill operation.

3.04 SANITARY/STORM SEWER AND WATER MAIN SEPARATION:

- A. Horizontal Separation - Sewers shall be laid at least 10 feet (3.0 m) horizontally from any existing or proposed watermain. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 foot (3.0 m) separation, the Department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the sewer closer to a watermain, provided that the watermain is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so the bottom of the watermain is at least 18 inches above the top of the sewer.
- B. If it is impossible to obtain proper horizontal separation as described above, both the watermain and sewer shall be constructed of slip-on or mechanical joint pipe complying with public water supply design standards of the Department and be pressure tested in accordance with AWWA standards to assure water tightness before backfilling.

3.05 Vertical Separation

- A. Sewers Crossing Under Watermains - The sewer shall be laid to provide a minimum of 18 inches from the top of the sewer to the bottom of the watermain. The crossing shall be arranged so the sewer joints will be equidistant and as far as possible from the watermain.
- B. Sewers Crossing Over Watermains - Either the watermain or the sewermain must be encased in a watertight carrier pipe that extends 10 feet (3.0 m) on both sides of the crossing, measured perpendicular to the watermain. The carrier pipe shall be PVC, ABS, or HDPE, and the ends sealed with a rubber gasket or boot.
- C. Special Conditions - When it is impossible to obtain the proper horizontal and vertical separation as stipulated above, one of the following methods shall be specified:
- D. Water Pipe - The sewer shall be designed and constructed equal to water pipe and shall be pressure tested in accordance with AWWA standards prior to backfilling to assure water tightness; or;
- E. Carrier Pipe - Either the watermain or the sewermain may be encased in a watertight carrier pipe that extends 10 feet (3.0 m) on both sides of the crossing, measured perpendicular to the watermain. The carrier pipe shall be PVC, ABS, or HDPE, and the ends sealed with a rubber gasket or boot.

3.06 Storm Sewer Requirements:

- A. A reinforced concrete pipe (RCP) storm sewer may cross below a watermain with a separation of less than 18 inches or at any height above a watermain provided the joints on

the RCP within 10 feet of either side of the watermain are assembled with:

- B. Preformed butyl rubber sealant meeting federal specification #SS-S-210A and AASHTO M 198, and each of these joints are encased with a minimum 2-foot wide by 6-inch thick concrete collar centered over the joint and reinforced with the equivalent steel area as that in the RCP. Encasement of the watermain will not be required when the RCP joints are collared within the 20-foot section.
- C. An O-ring that conforms to ASTM C 443 specifications. O-rings are manufactured for concrete pipe with diameters up to 18 inches.
- D. A strip of impermeable material held in place with stainless steel bands and tested to 5 psi prior to the storm sewer being put into use.
- E. There shall be at least a 10-foot horizontal separation between watermains and sanitary sewer forcemains. There shall be an 18-inch vertical separation at crossings as required in paragraphs B and C.

PART 4 MEASUREMENT AND PAYMENT

4.01 METHOD OF MEASUREMENT

- A. The cost to repair any underground utilities or other obstructions damaged by the Contractor's activities shall be considered incidental Work with no separate measurement made.

4.02 BASIS OF PAYMENT

- A. The cost to repair any underground utilities or other obstructions damaged by the Contractor's activities shall be considered incidental Work with no separate and payment to be made.

* * * END OF SECTION * * *

SECTION 024100 DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of built site elements.
- B. Selective demolition of building elements for alteration purposes.

1.02 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.
 - 1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 3 EXECUTION

2.01 DEMOLITION

- A. Reference sheets D100, D100.A, D100.B, D100.C, D102 for extents of demolition. Also reference Civil, Mechanical and Electrical drawings for further demolition.

2.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public. The following items are the sole responsibility of the Contractor, provide engineering services where required.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Comply with applicable OSHA requirements.
 - 4. Use of explosives is not permitted.
 - 5. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 6. Provide, erect, and maintain temporary barriers and security devices.
 - 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 8. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
 - 9. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
 - 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Protect existing structures and other elements to remain in place and not removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.

2.03 EXISTING UTILITIES

- A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.

- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

2.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
 - 1. Verify construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Remove existing work as indicated and required to accomplish new work.
 - 1. Remove items indicated on drawings.
- C. Services including, but not limited to, HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications: Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Verify that abandoned services serve only abandoned facilities before removal.
 - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.
- D. Protect existing work to remain.
 - 1. Prevent movement of structure. Provide shoring and bracing as required.
 - 2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch to match new work.

2.05 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

**SECTION 030516
UNDERSLAB VAPOR BARRIER**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sheet vapor barrier under concrete slabs on grade.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.03 REFERENCE STANDARDS

- A. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.
- B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products.
- C. Test Data: Submit report of tests showing compliance with specified requirements.
- D. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Underslab Vapor Barrier:
 - 1. Water Vapor Permeance: Not more than 0.010 perms (0.6 ng/(s m² Pa)), maximum.
 - 2. Thickness: 15 mils (0.4 mm).
- B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

3.02 INSTALLATION

- A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
- B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.
- C. Lap joints minimum 6 inches (150 mm).
- D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
- E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
- F. Repair damaged vapor retarder before covering with other materials.

END OF SECTION

**SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Forms for all cast in place concrete
- B. Form accessories.
- C. Stripping forms.
- D. Waterstops
- E. Formdeck for stoops
- F. Opening in forms for other effected work.
- G. Shoring and reshoring as required. See structural notes page and details.

1.2 RELATED CONTRACT DOCUMENTS

- A. Documents affecting work of this Section include, drawings and general provisions of Contract, all General and Supplementary Conditions and all other Division 0 and 1 Specification Section.

1.3 WORK INSTALLED BUT FURNISHED UNDER SECTIONS

- A. Section 05 12 00 - Structural Steel: Steel fabrications attached to form work.

1.4 RELATED WORK

- A. Section 03 20 00 - Concrete Reinforcement.
- B. Section 03 30 00 –Cast-In-Place Concrete.
- C. Section 05 12 00– Structural Steel

1.5 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 315 - Details and Detailing of Concrete Reinforcement.
- C. ACI 318 – Building Code Requirements for Structural Concrete.
- D. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures
- E. ACI 347 - Recommended Practice for Concrete Formwork.
- F. PS 1 - Construction and Industrial Plywood.
- G. ACI 117-Standard Specifications for Tolerances.

1.6 QUALITY ASSURANCE

- A. Construct and erect concrete form work in accordance with ACI 301.
- B. Tolerances:
 - 1. See ACI 117.

1.7 CONTRACTORS RESPONSIBILITY FOR FORMWORK DESIGN AND REMOVAL

- A. The form-work system shall be designed to support freshly place concrete and reinforcing materials, It shall transfer all concrete loads to the bearing soils or to completed construction in a safe manner at all times. Remove formwork, in a manner that does not damage the concrete or the elements of the project. Under the requirements of the construction documents, IBC, All local Building codes, ACI, OSHA and Local Workmen's Compensation; The contractor, and not the engineer or architect, shall provide engineering as required to meet this obligation.

PART 2 – PRODUCTS

2.1 FORM MATERIALS (Earth is not an approved forming material)(Conform to ACI 301 and ACI 347 for design, fabrication, erection and removal of forms.)

- A. Plywood: Douglas Fir or equal species; sound, undamaged sheets with straight edges, manufactured for concrete wall forms.
 - 1. Conform to Tables for form design in APA Form V-345, including strength.
- B. Glass Fiber Fabric Reinforced Plastic Forms: Matched tight fitting, stiffened to support weight of concrete without deflection detrimental to structural tolerances and appearance of finished concrete surface.
- C. Steel: Minimum 16 gauge sheet, well matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- D. Form deck: 1.5C 20 gauge (min) ASTM A653 by Vulcraft or equal, galvanized in accordance with ASTM 924-94 to a min class of G90, unless otherwise noted on plans.

- E. Circular pier or round column forms: Cardboard waxed or plasticized forms such as Sonotube or equivalent.
- F. Do not leave aluminum materials, which may cause a corrosive reaction, embedded in the concrete. Aluminum forms are acceptable.

2.2 FORMWORK ACCESSORIES

- A. Form Ties: factory fabricated, adjustable length, removable or snap off form ties which results in no metal being closer than 1 1/2" from surface of concrete when forms are removed.
- B. Form Release Agent: Colorless material that will not stain concrete, or absorb moisture.
 - 1. Do not allow form release agent to come in contact with reinforcing steel or inserts in the concrete.
- C. Fillets for Chamfered Corners: Wood strips or rigid plastic as detailed. 3/4" x 3/4".
- D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorage's: Sized as required; of strength and character to maintain form work in place while placing concrete.
- E. Shelf Angle Inserts
 - 1. Wedge type inserts for 5/8" diameter bolts. Include horseshoe shims.
 - 2. Minimum capacity 2,100 pounds
- F. Dovetail Anchor Slots:
 - 1. 1" deep with 5/8" throat, 24 gauge galvanized steel.
- G. Flashing Reglets: 3/4" deep with 1/4" throat, 26 gauge galvanized steel.
- H. PVC weeps: 3" diameter PVC pipe.
- I. Waterstops: See plans and details for location.
 - 1. Extrudable non-leaching polyurethane products that will swell upon moisture contact.
 - a. Sika Products: SikaSwell S one part water swelled extruded polyurethane sealant, including special triangular shaped nozzle.
 - b. An equal approved product with one part polyurethane makeup that is free of bentonite or other leaching materials
 - 2. PVC Waterstop.
 - a. Unless otherwise noted within the construction documents, 4" Ribbed Center Bulb style shall be used at all cold formed joints in liquid bearing structures.
 - b. Waterstop shall have a minimum design head pressure capacity of 100' or greater.
 - c. PVC Waterstop must meet or exceed the performance required by U.S. Army Corps of Engineers Specification CRD-C 572-74.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Verify lines, levels, and measurements before proceeding with formwork.
- B. Depth or thickness of concrete being formed is to be as shown on plans. No variation in thickness or depth is allowed. (i.e.) a 4" slab is not to be poured at 3-5/8".

3.2 PREPARATION

- A. Arrange and assemble formwork to permit dismantling and stripping so that concrete is not damaged during its removal.
- B. Arrange forms to allow stripping without removal of principal shores, where required to remain in place.

3.3 ERECTION

- A. Provide bracing to ensure stability of formwork. Strengthen formwork liable to be overstressed by construction loads.
- B. Construct forms in accordance with ACI 301.

3.4 TOLERANCES

- A. Set and maintain forms to provide completed surfaces meeting the tolerances given in ACI 117. See Part 1 of these specifications.

1. Tolerances given in ACI 117 are not cumulative. Maximum tolerance for any formed surface, except footings, shall be one inch.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for work embedded in or passing through concrete. Fill these voids with a readily removable material to prevent entry of concrete into voids or:
 1. Use void forming systems of correct size for openings required in the concrete. Follow manufacturers' instructions for proper strength ratings of void forms.
- B. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, including electrical boxes and conduit and other inserts.
 1. Ensure that forms will provide sufficient coverage for reinforcing. See Section 03200 for requirements.
- C. Install accessories in accordance with manufacturers' instructions level and plumb. Ensure items are not disturbed during concrete placement.
- D. Apply extruded waterstop in form locations as shown on plans and details. Form all joints as a continuous $\frac{3}{4}$ " bead strictly according to the manufacturer's instructions so that waterstops are continuous.
 1. Following manufacturers' instructions, use largest of the 2 precut triangular nozzles to insure proper form and size of bead. Apply to clean, dry flat surfaces.
 - a. Depending on concrete thickness more than one bead may be required. Consult manufacturer's instructions.
 2. Waterstop must be allowed to pass through all form bulkheads. Notch bulkheads at end of all pour intersections.
 - a. **To prevent waterstop damage**, install 2-3 hours prior to any concrete pour where vertical height is more than 20 inches. Use of a tremie to limit concrete drop to 20 inches is required if waterstop is less than 2 days old.
 - b. If wall is higher than 10'-0" contact Engineer for use of SikaSwell Hose.
- E. Build in dovetail anchor slots. Install anchor slots in concrete walls, columns, piers, beams and spandrels deeper than 14 inches and wider than 16 inches which will be in contact with masonry or elsewhere as indicated on the Drawings. Install anchor slots vertically, spaced 16 inches on center.

3.6 FORM RELEASE AGENT APPLICATION

- A. Apply agent on formwork only in accordance with manufacturer's instructions.
 1. Apply prior to installation of reinforcing steel, anchoring devices or embedments.
 2. If unable to completely remove agent from unintended items, replace the reinforcing steel, anchors or embedments.

3.7 FORM REMOVAL

- A. Replace concrete damaged by early removal of forms. Consult ACI 318, 301 and the following:
 1. Do not remove forms, shoring or bracing until concrete has sufficient strength to support its own weight, and construction and design loads that may be imposed upon it.
 2. Temperatures below 50 degrees F will prolong the timing of form removal.
- B. Form removal timing: Contractor shall verify the exact timing of form removal using these minimum removal times based on 28 day strength design of concrete and ACI 318.
 1. Footings: 24 hours minimum.
 2. 12" Walls under 5'-0" and 5'0" columns: 36 hours minimum.
 - a. For walls thicker than 12" and up to 20" add 8 hours.
 - b. For walls thicker than 20" same as 3 below.
 3. Walls and columns over 5'-0": 72 hours minimum but not until concrete, by cylinder test, has reached 50% of its 28-day design strength.

4. Beams, girders, raised decks or floors: 75% of its 28-day design strength. No time limit.
- C. Do not damage concrete surfaces during form removal.
- D. Reshoring: Reshoring is designed to allow concrete to deflect and support its own weight after initial set has occurred and forms have been removed. Remove forms and tightly place reshores only after initial concrete deflection. Do not remove reshores until concrete has reached its specified strength.
 1. Apply no construction loads or other loads to members being reshored
 2. Provide reshores for all two-way slabs until concrete reaches specified strength.
- E. At removal of forms patch all locations where wire ties protrude through the concrete or are exposed. Use primer and Non Shrink grout to solidly fill these holes. Also patch and grind to provide a smooth formed finish where required. See Part 1 of these specifications.

3.8 ALLOWABLE FACE & CORNER FINISHES

- A. Rough Form Finish: Concrete faces not exposed to view in the finished work shall have a rough form finish as defined by ACI 347.3.4 as a Class D finish. Holes shall be no larger than 3/8" and honeycombing or surface irregularities shall be no more than 1" in a 5'-0" area. However any exposed reinforcing steel or ties must be solidly grouted to match reinforcing coverage requirements.
- B. Smooth Form Finish: Concrete faces exposed to view in the finished work shall have a smooth form finish as defined by ACI 347.3.4 as a Class B surface. Class B surfaces have no more than 1/4" abrupt or gradual irregularities in a 5'-0" area and no holes larger than 1/4" on the surface. The contractor shall grind the surface where necessary to comply with these ACI requirements.
- C. Prominently exposed Class A finish: Concrete faces exposed to view as part of the architectural design or surfaces to receive finishes of any type (paint, textured paint, etc.) shall receive an class A smooth form finish as defined by ACI 347.3.4. These class A surfaces have no more than 1/8" abrupt or gradual irregularities in a 5'-0" area and no holes larger than 1/8" on the surface. The contractor shall then fill all holes and grind the exposed surface to provide a finish compatible with a heavily scrutinized surface.
- D. Corners not exposed to view may be formed either square or chamfered.
- E. Corners exposed to view shall be square, smooth, solid, unbroken lines except where a chamfered surface is called for on architectural plans
 1. Chamfered Corners shall be formed with chamfer strips to produce uniformly straight lines and tight edge joints. Unless otherwise stated the chamfers shall be 3/4" along both adjoining planes of the concrete edge. Extend the edges of the chamfers to the end of the formed surface. Match adjacent changes of direction by mitering to produce a connection without breaks in appearance. See architectural plans for where chamfers are required.

3.9 CLEANING

- A. Clean forms to remove foreign matter as erection proceeds.
- B. Ensure that water and debris drain to exterior through clean-out ports.

END OF SECTION

SECTION 03 11 00 CONCRETE FORMWORK

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Supplementary Conditions, apply to the work specified in this section.
- B. Related Work specified elsewhere:
 - 1. Concrete Reinforcement - Section 03 20 00
 - 2. Concrete Joints and Water Stop - Section 03 15 00
 - 3. Cast-in-place Concrete - Section 03 30 00

1.02 DESCRIPTION OF WORK

- A. The extent of formwork is indicated by the concrete structures shown on the drawings.
- B. The work includes providing of the form work and shoring for cast-in-place concrete, and installation into formwork of items required such as anchor bolts, setting plates, bearing plates, anchorages, inserts, frames, nosings, and other items to be embedded in concrete (but not including reinforcing steel).

1.03 QUALITY ASSURANCE

- A. Examine the substrate and the conditions under which concrete formwork is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.
- B. Codes and Standards: Unless otherwise shown or specified, design, construct, erect, maintain, and remove forms and related structures for cast-in-place concrete work in compliance with the American Concrete Institute standard ACI 34, "Recommended Practice for Concrete Formwork."
- C. Allowable Tolerances: Construct formwork to provide completed cast-in-place concrete surfaces complying with the tolerances specified in ACI 347, and as follows:
 - 1. Variation from plumb in lines and surfaces of columns, piers, walls, and arises; ¼-inch per 10-foot, but not more than 1-inch total. For exposed corner columns, control joint grooves, and other conspicuous lines, ¼-inch in any bay or 20 feet maximum; ½-inch maximum in 40 feet or more.
 - 2. Variation from level or grade in slab soffits, ceilings, beam soffits, and in arises ¼-inch in 10 feet, 3/8-inch in any bay or 20 feet maximum and ¾-inch in 40 feet or more. For exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, ¼ inch in any bay or 20 feet maximum, and ½-inch in 40 feet or more.
 - 3. Variation from position of the linear building lines and related columns, walls, and partitions, ½-inch in any bay or 20 feet maximum and 1-inch in 40 feet or more.
 - 4. Variation in sizes and locations of sleeves, floor openings, and wall openings, ¼-inch.

5. Variation in cross sectional dimensions of columns and beams and thickness of slabs and walls, minus ¼-inch and plus ½-inch.
 6. Variations in footings plan dimensions, minus ½-inch and plus 2-inch misplacement or eccentricity, 2% of the footing width in direction of misplacement but not more than 2-inch thickness reduction, minus 5%.
 7. Variation in steps: in a flight of stairs, 1/8-inch for rise and ¼-inch for treads; in consecutive steps, 1/16-inch for rise and 1/8-inch for treads.
- D. Before concrete placement, check the lines and levels of erected formwork. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems.
- E. During concrete placement, check formwork and related supports to ensure that forms are not displaced and that completed work will be within specified tolerances.

PART 2 PRODUCTS

2.01 FORM MATERIALS

- A. Unless otherwise shown or specified, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed, plywood-faced, or other panel type materials acceptable to Engineer to provide continuous, straight, smooth, as-cast surfaces. Furnish in largest practicable sizes to minimize number of joints. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
- B. Form concrete surfaces, which will be unexposed in the finished structure with plywood, lumber, metal, or other acceptable material. Provide lumber that is dressed on at least two edges and one side for tight fit.
- C. Form ties shall be of removable end, permanently embedded body type and shall have sufficient strength and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders. Unless otherwise shown, cones shall be provided on the outer ends of each tie and the permanently embedded portion shall be at least 1-inch back from the concrete face. Form ties for water bearing walls shall be provided with water seal washers located on the permanently embedded portions of the ties at the approximate center of the wall. Permanently embedded portions of form ties that are not provided with threaded ends shall be constructed so that the removable ends are readily broken off without damage to the concrete. The type of form ties used shall be acceptable to the Engineer. Form ties fabricated on the project site and the wire ties are not acceptable.
- D. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.
- E. Provide metal inserts for anchorage of materials or equipment to concrete construction not supplied by other trades and as required for the work.

2.02 FORMS FOR PAVEMENT, SIDEWALK, AND CURB & GUTTER

- A. Forms shall have a depth not less than the prescribed edge thickness of the pavement. Built up forms with horizontal joints shall not be used.
- B. When staked in place, forms shall withstand the pressure of the concrete and the impact and vibration of any equipment they are required to support, without significant springing, settlement, or lateral displacement.
- C. Bent, twisted, or broken forms and those with battered top surfaces shall be removed from the work. Repaired forms shall not be used until inspected and approved.
- D. The top face of any form shall not vary from a true plane by more than 1/8-inch in 10 feet, nor shall the contact face of a straight form vary from a true plane by more than 1/4-inch in 10 feet.
- E. Straight forms shall be metal having a thickness of not less than 1/4-inch and shall be furnished in sections not less than 10 feet in length. Each section shall have provisions for locking together the ends of abutting sections. Straight forms shall have a base width of at least eight inches with flange braces extending outward on the base at least 2/3 the height of the form.
- F. Flexible or curved forms of proper radius shall be used for curves of 100-foot radius or less. Flexible or curved forms shall be of an acceptable design.

2.03 DESIGN OF FORMWORK

- A. Design, erect, support, brace, and maintain formwork so that it will safely support vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure. Carry vertical and lateral loads to ground by formwork system and in-place construction that has attained adequate strength for that purpose. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation, and position.
- B. Design forms and false work to include assumed values of live load, dead load, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.
- C. Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof. Provide trussed supports when adequate foundations for shores and struts cannot be secured.
- D. Support form facing materials by structural members spaced sufficiently close to prevent deflection. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities and within allowable tolerances. Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads for long span members without intermediate supports.
- E. Provide temporary openings in wall forms, column forms and at other locations necessary to permit inspection and cleanout.

- F. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.
- G. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.
- H. Side forms of footings may be omitted and concrete placed directly against excavation only when requested by Contractor and accepted by Engineer. When omission of forms is accepted, provide additional concrete required beyond the minimum design profiles and dimensions of the footings as detailed.

PART 3 EXECUTION

3.01 FORM CONSTRUCTION

- A. Construct forms complying with ACI 347, to the exact sizes, shapes, lines, and dimensions shown and as required to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required. Use selected materials to obtain required finishes.
- B. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.
- C. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Brace temporary closures and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms in as inconspicuous location as possible, consistent with project requirements.
- D. Form intersecting planes to provide true, clean cut corners, with edge grain of plywood not exposed as form for concrete.
- E. Provide openings in forms to accommodate other work, including mechanical and electrical work. Accurately place and securely support items required to be built into the forms.
- F. False work:
 - 1. Erect false work and support, brace, and maintain it to safely support vertical, lateral, and asymmetrical loads applied until such loads can be supported by in-place concrete structures. Construct false work so that adjustments can be made for take-up and settlement.
 - 2. Provide wedges, jacks, or camber strips to facilitate vertical adjustments. Carefully inspect false work and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure; make necessary adjustments to produce work of required dimensions.
- G. Forms for Exposed Concrete:

1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes.
2. Do not use metal cover plates for patching holes or defects in forms.
3. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections.
4. Use extra studs, walers, and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Do not use narrow strips of form material that will produce bow.
5. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.
6. Form molding shapes, recesses, and projections with smooth finish materials, and install in forms with sealed joints to prevent displacement.

H. Corner Treatment:

1. Form exposed corners of beams and columns to produce square, smooth, solid, unbroken lines, except as otherwise shown.
2. Form chamfers with $\frac{3}{4}$ inch x $\frac{3}{4}$ inch strips unless otherwise shown, accurately formed and surface to produce uniformly straight lines and tight edge joints. Extend terminal edges to the required limit and miter chamfer strips at changes in direction.
3. Unexposed corners may be formed either square or chamfered.

I. See Section 03 15 00 for treatment of control and construction joints. Locate as indicated.

J. Provide openings in concrete formwork to accommodate work of other trades, including those under separate prime contracts (if any). Size and location of openings, recesses, and chases are the responsibility of the trade requiring such items. Accurately place and securely support items to be built into forms.

K. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is to be placed. Retighten forms immediately after concrete placement as required to eliminate mortar leaks.

3.02 FORM COATINGS

A. Coat form contact surfaces with form-coating compound before reinforcement is placed. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces that will be bonded to fresh concrete. Apply in compliance with manufacturer's instructions.

B. Coat steel forms with a non-staining, rust preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.03 INSTALLATION OF EMBEDDED ITEMS

A. Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of the items to be attached thereto.

- B. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. Provide and secure units to support types of screeds required.

3.04 REMOVAL OF FORMS

- A. Formwork not supporting concrete, such as sides of beams, walls, columns, and similar parts of the work that may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations and provided that curing and protection operations are maintained.
- B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements may not be removed in less than 14 days and not until concrete has attained design minimum 28-day compressive strength.
- C. Form facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.05 RE-USE OF FORMS

- A. Cleaned and repaired surfaces of forms may be re-used in the work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces.

* * * END OF SECTION * * *

SECTION 03 15 00 CONCRETE JOINTS AND WATERSTOPS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Supplementary Conditions, apply to the work specified in this section.
- B. Related Work Described Elsewhere:
 - 1. Concrete Formwork: 03 11 00
 - 2. Concrete Reinforcement: 03 20 00
 - 3. Cast-in-place Concrete: 03 30 00

1.02 DESCRIPTION OF WORK

- A. The extent of each type of concrete joint and waterstop required on foundation walls is shown on the drawings.

1.03 SUBMITTALS

- A. Manufacturer's catalog data and installation instructions.
- B. Certificate of compliance that waterstops meet or exceed physical property requirements of referenced specification.

PART 2 PRODUCTS

2.01 PREFORMED EXPANSION JOINT FILLER

- A. Preformed, non-extruding-type joint filler constructed of closed cell polyethylene foam of firm texture. Conform to ASTM D1752, Sections 3.1 to 3.4.

2.02 WATERSTOP

- A. Waterstop shall be extruded from virgin elastomeric PVC compound, resistant to chemical action with Portland cement, alkalis, acids, and fungi. Waterstop shall conform to Corps of Engineers CRD-C 572 and the following physical characteristics:

Physical Property Value Test Method

Sheet Material:

Tensile Strength, 2,100 psi ASTM D 412

Ultimate Elongation, 360 % ASTM D 412

Low Temperature Brittleness, -35 deg. F max ASTM D 746

Stiffness in Flexure, 750 psi min ASTM D 747

Finished Waterstop:

Tensile Strength, unaged 1750 psi min ASTM D412

Durometer Shore Hardness 70 ± 5 ASTM D1706

Ultimate Elongation, unaged 350% ASTM D412

- B. All waterstop shall be No 6380 as manufactured by W.R. Meadows, Serviced/Durajoint Type No. 5 as manufactured by W.R. Grace and company, or approved equal.

2.03 JOINT MATERIAL

- A. All joint material in contact with potable water shall meet requirements of the SD Dept of Environment & Natural Resources and be safe for use with a drinking water supply.
- B. The backer rod shall be a non-moisture absorbing, resilient material approximately 25 percent larger in diameter than the width of the joint to be sealed. The backer rod shall be compatible with the sealant and no bond or reaction shall occur between the rod and the sealant.
- C. Hot Poured Elastic Joint Sealer: The sealant shall conform to the requirements of ASTM D3405. The manufacturer shall furnish a certificate of compliance for the material.
- D. Low Modulus Silicone Sealant: Low modulus silicone sealant shall be furnished in a one-part silicone formulation. The sealant must meet the following requirements:

TEST	LIMIT	TEST METHOD
Tack Free Time	20-75 minutes	MIL S 8802
Specific Gravity	1.010-1.515	ASTM D792 (Method A)
Durometer Hardness Type A: [Cured 7 days at $77^{\circ}\text{F} \pm 3^{\circ}$ ($25^{\circ}\text{C} \pm 2^{\circ}$) and 45% to 55% R.H.]	10-25 0°F (-18°C)	ASTM D2240
Tensile Stress: [at 150% elongation, 7 day (Die C) cure at $77^{\circ}\text{F} \pm 3^{\circ}$ ($25^{\circ}\text{C} \pm 2^{\circ}$) and 45-55% R.H.]	45-psi (310 kPa) max.	ASTM D412
Elongation: [7 day cure at $77^{\circ}\text{F} \pm 3^{\circ}$ (25°C (Die C) $\pm 2^{\circ}$) & 45-55 R.H.]	1000% min.	ASTM D412
Shelf Life	6 month minimum from date of manufacture	
Ozone & Ultra Violet Resistance	No chalking, cracking or bond loss after 5000 hrs.	
Movement capability and adhesion [7 day cure in air 77°	No adhesive or cohesive failure, * all 3 specimens must	

TEST	LIMIT	TEST METHOD
F $\pm 3^\circ$ (25° C $\pm 2^\circ$)	exceed 500% extension at 0° F (-18° C)	
Bond to Concrete Mortar Concrete briquettes [air cured 7 days at 77°F $\pm 3^\circ$ □ (25° C $\pm 2^\circ$)]	50 psi (345 kPa) min. 0° F (-18°C)	AASHTO T132**

* Prepare the specimens using 1" x 2" x 3" (25 mm x 50 mm x 75 mm) concrete blocks made in accordance with ASTM D3407. A sawed face shall be used for bond surface. Seal two inches (50 mm) of block leaving ½ inch (13 mm) on each end of specimen unsealed. The depth of sealant shall be 3/8-inch (10 mm) and the width ½-inch (13 mm). Subject the sealant to movement at a rate of two inches (50 mm) per minute until failure.

** Briquettes molded in accordance with AASHTO T132 sawed in half and bonded with approximately 10 mils (0.25 mm) of sealant and tested using clips meeting AASHTO T132. Briquettes shall be dried to constant weight in oven 100°C $\pm 5^\circ$. They shall be tested in tension at a loading rate of 0.3 inches (7.6 mm) per minute.

PART 3 EXECUTION

3.01 CONSTRUCTION JOINTS

- A. Place construction joints only where shown. In case of a breakdown in concrete placement, form the resulting unscheduled joint in the same orientation as the joints shown on the drawings for similar portions of the structure and include the key, waterstop, and additional reinforcing as may be required for the design function of the structure.
- B. After the concrete has hardened on one side of a construction joint and before placing the next concrete pour, remove the surface laitance and clean exposed surface by dry sandblasting. The sand blasted, roughened joint shall leave sound, exposed aggregate with a surface roughness of 0.2-inch \pm 0.1-inch. Just prior to placing the new concrete, coat the horizontal construction joint with a 2-inch layer of cement mortar and spread uniformly and work into all irregularities of the surface. Use cement mortar of the same mixture as the structural concrete but with the coarse aggregate omitted. The mortar shall not exceed the water-cement ratio of the concrete to be placed on it and the consistency shall be suitable for placing and working. Wet the vertical surface to be joined at a construction joint and use additional spading and vibrating to prevent voids.
- C. Key construction joints unless otherwise shown. Form keyways with beveled strips or boards placed at right angles to the direction of shear. Make keyways at least 1.5 inch in depth over at least 25% of the area of the section. When necessary to make a joint because of a breakdown or emergency, place reinforcing dowels across the joint. Embed dowels 40 bar diameters on each side of the joint. Match reinforcing in size and number.
- D. Provide isolation joints in slabs on ground at all points of contact between slabs on ground and vertical surfaces such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

3.02 JOINTS WITH JOINT SEALANT

- A. On structures or surfaces, which require joint sealant, do not remove the material for forming the groove in the concrete until the concrete is cured. Upon removing the groove form,

sandblast the groove, allow it to dry, then place the primer, backup rod, and sealant into the clean groove in accordance with the manufacturer's recommendations. Prior to sealant application, the manufacturer's representative shall demonstrate joint preparation, priming, and sealant materials for the personnel performing joint work. Groove form material shall be installed prior to concrete placement.

- B. Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints. Construction joints in water holding structures shall be provided with a half inch beveled notch on the inside surface provided for caulking the joints.

3.03 CONCRETE PAVEMENT JOINTS

- A. Immediately after sawing the joints to their final configuration, the resulting slurry shall be completely removed from the joint and the immediate area by flushing with a jet of water and other tools as necessary. Curing membrane damaged or protective cover removed during the sawing operation shall be repaired or replaced by the Contractor as directed by the Engineer at no cost to the Owner.
- B. Longitudinal Sawed Joints: Deformed steel tie bars shall be placed perpendicular to the longitudinal joints by approved methods. Tie bars shall not be painted or coated with asphalt or other material, or enclosed in tubes or sleeves. Longitudinal sawed joints shall be cut to the dimensions specified. Suitable guidelines or devices shall be used to assure cutting the joint to a true line. The joint shall be cured a minimum of 24 hours before sawing. The sawed joint will not require reapplication of curing compound. The joint shall be sealed as required in Section 03 15 00.
- C. Longitudinal Construction Joints: When adjacent lanes of pavement are constructed separately, a keyway shall be formed along the construction joint. When deformed steel tie bars are required, they may be bent at right angles for the first lane constructed and straightened into final position before the concrete of the adjacent lane is placed. Tie bars shall conform to Section 03 15 00, except that rail steel shall not be used for tie bars that are to be bent and restraightened. The longitudinal construction joint shall be sawed shortly after the end of the curing period and shall be sealed as required in Section 03 15 00.
- D. Transverse Contraction Joints: Transverse contraction joints shall be created by sawing. Sawing shall commence when the concrete has hardened sufficiently to permit sawing without raveling. Joints shall be sawed before uncontrolled shrinkage cracking takes place. If necessary, the sawing operations shall be carried on both day and night, regardless of weather conditions. The sawed joint will not require reapplication of curing compound.
- E. The sawing of a joint shall be omitted if a crack occurs at or near the joint location prior to the time of sawing. Sawing shall be discontinued when a crack develops ahead of the saw. Any procedure which results in premature and uncontrolled cracking shall be revised immediately by adjusting the sequence of cutting the joints or the time interval involved between the placing of the concrete or removal of curing media and the cutting of joints.
- F. Repair or correction of uncontrolled cracks shall be as directed by the Engineer and at the expense of the Contractor.
- G. Longitudinal random cracks penetrating the full depth of the pavement shall be grooved and sealed. The top of the crack shall be grooved to a minimum depth of ¾ inch (20 mm) and to

a width of not less than 3/8 inch (10 mm) nor more than 5/8 inch (16 mm) by means of a router. The router shall be capable of following the path of the crack and widening the top of the crack to the required dimensions without spalling or damaging the concrete. Loose and fractured concrete shall be removed and the groove shall be thoroughly cleaned and sealed.

- H. For PCC Pavement with no load transfer across the contraction joint (dowel bar assemblies are not required), the following shall apply:
 - 1. When a transverse random crack terminates in or crosses a transverse contraction joint, the uncracked portion of the joint shall be filled with epoxy-resin mortar and the crack shall be routed and sealed in accordance with Section 03 15 00.
 - 2. Where a transverse random crack parallels the planned contraction joint and is within a distance of five feet (1.5 meters) from the contraction joint in the pavement, the crack shall be routed and sealed in accordance with Section 03 15 00, and the joint shall be filled with epoxy resin mortar.
 - 3. When a transverse random crack is more than five feet (1.5 meters) from the nearest contraction joint in the pavement, the joint and the crack shall be sealed in accordance with Section 03 15 00. Joints to be filled with epoxy resin mortar shall be thoroughly cleaned.
- I. For PCC Pavement with load transfer across the contraction joint (dowel bar assemblies are required), the following shall apply:
 - 1. When a transverse random crack parallels the planned contraction joint and is more than five feet (1.5 meters) from the contraction joint, the crack shall be routed, the backer rod installed, and sealed with silicone according to Section 03 15 00.
 - 2. When a transverse random crack parallels the planned contraction joint and is less than five feet (1.5 meters) from the contraction joint, the pavement shall be sawed full depth, removed, and replaced. Load transfer across the contraction joint shall be re-established.
 - 3. When a transverse random crack intersects or parallels a planned transverse contraction joint and is less than four inches (100 mm) from the planned contraction joint for more than 50 percent of the lane width, the crack shall be routed, the backer rod installed, and sealed with silicone in accordance with Section 03 15 00.
 - 4. When a transverse random crack intersects or parallels a planned transverse contraction joint and is more than four inches (100 mm) from the planned contraction joint for more than 50 percent of the lane width, the pavement shall be sawed full depth, removed, and replaced. Load transfer across the contraction joint shall be re-established.

3.04 SEALING CONCRETE PAVEMENT

- A. Joints shall be sealed with hot-poured elastic joint sealer or low modulus silicone sealant as specified. Joints shall be sealed immediately after completion of the curing period, before the pavement is opened to traffic.
- B. Joint grooves with spalls greater than ½ inch (13 mm) in depth shall be patched with an approved epoxy mortar. All loose concrete shall be removed from the spalled area and the spalled surface shall be thoroughly cleaned. After cleaning, the spalled surface shall be primed and an epoxy mortar of troweling consistency shall be placed in the spalled area and

finished as the original pavement surface. The epoxy binder components shall be proportioned and mixed as recommended by the manufacturer. After the epoxy binder is thoroughly mixed, dry silica sand shall be blended into the mixture to give an epoxy mortar of trowelable consistency.

- C. After the epoxy mortar has cured, the forming material shall be carefully removed. The finished joint shall have vertical faces and the joint width shall be maintained. Patching of spalls shall be done only when the temperature of the air and pavement are above 50EF (10EC).
- D. Joints to be sealed shall be thoroughly clean and dry. All materials such as old sealant, oil, asphalt, curing compound, paint, rust, and other foreign materials shall be completely removed. Cleaning shall be accomplished by sand blasting and other tools as necessary.
- E. Just prior to sealing, each joint shall be blown out using a jet of compressed air, at a working pressure of not less than 90 psi (620 kPa), to remove all traces of dust. Air compressors used for cleaning joints shall be equipped with traps capable of removing all free water and oil from the compressed air.
- F. Joint sealer application will not be permitted when the air or pavement temperature near the joint is less than 40EF (5EC) or is 40EF (5EC) and falling.
- G. The sealant shall be applied without spilling on the exposed surface. Sealant on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned. Failure of the joint material in either adhesion or cohesion will be cause for rejection. Repair shall be at the expense of the Contractor.
- H. Hot-Poured Elastic Joint Sealer: Hot-poured elastic joint sealer shall be stirred during heating so that localized overheating does not occur. All joints shall be sealed with an approved pressure-sealing device, equipped with a nozzle inserted into the joint, so sealing material will be forced from the bottom of the joint to the top.
- I. Silicone Sealant: Silicone sealant shall be applied with a mechanical device equipped with a nozzle or spout shaped to fit into the joint. The joint sealant shall be applied under pressure from the inside of the joint to remove entrapped air and ensure good joint contact.
 - 1. Backer rod shall be installed to the proper depth to produce the width and depth of sealant specified.
 - 2. The sealant surface shall be tooled to produce a slightly concave surface ¼-inch (6 mm) below the pavement surface. Tooling shall be accomplished before a skin forms on the sealant surface. The use of soap or oil as a tooling aid will not be permitted.
- J. Seasonal Restrictions:
 - 1. Silicone sealing operations shall be suspended after October 15, unless the Contractor has received written permission from the Engineer to continue sealing. After the October 15 seasonal restriction, only the initial cut shall be performed at all joints. Then the following spring the joints shall be widened, backer rod installed, and sealed with silicone according to Section 03 15 00.

2. All costs related to the seasonal sealing restrictions including additional labor and materials, equipment, traffic control, mobilization, and incidentals shall be at the expense of the Contractor.

3.05 WATERSTOP

- A. Install waterstops at construction and expansion joints in structures, which will contain liquid or resist the entry of ground water. Construct forms to prevent injury to waterstops. Position and secure with wire ties, continuous bars, and rings. Heat weld splices and junctions of waterstop to form a continuous water seal. Use the heat welding equipment and temperature recommended by the waterstop manufacturer.

* * * END OF SECTION * * *

SECTION 03 20 00 CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including general and Supplementary Conditions, apply to the work specified in this section.

1.02 DESCRIPTION OF WORK

- A. The extent of concrete reinforcement is shown on the drawings and in schedules.
- B. The work includes fabrication and placement of reinforcement for cast-in-place concrete, including bars, welded wire fabric, ties, and supports.

1.03 QUALITY ASSURANCE

- A. Examine the substrate and the conditions under which concrete reinforcement is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.
- B. Codes and Standards: Comply with requirements of the following codes and standards, except as herein modified.
 - 1. American Concrete Institute, ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures."
 - 2. American Concrete Institute, ACI 318, "Building Code Requirements for Reinforced Concrete."
 - 3. American Welding Society, AWS D12.1 "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction."
 - 4. Concrete Reinforcing Steel Institute, "Manual of Standard Practice."

1.04 SUBMITTALS

- A. For information only, submit 2 copies of steel producer's mill test certificates identifying chemical and physical analysis of each type of reinforcing steel delivered.
- B. Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with the ACI 315 "Manual of Standard Practice for Detailing Concrete Structures," show bar schedules, stirrup spacing, diagrams of bent bars, arrangements and assemblies, as required for the fabrication and placement of concrete reinforcement. Include special reinforcement required at openings through concrete structures.

1.05 PRODUCT DELIVERY, HANDLING, AND STORAGE

- A. Deliver reinforcement to the project site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- B. Store concrete reinforcement materials at the site to prevent damage and accumulation of dirt or excessive rust.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Reinforcing Bars shall conform to ASTM A615, Grade 60, except as otherwise indicated.
- B. Steel Wire shall be plain wire conforming to ASTM A82.
- C. Welded Wire Fabric shall be of the gauge and mesh size as shown conforming to ASTM A185.
- D. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place shall be as follows:
 - 1. For bar supports, use CRSI Class C, plastic protected or Class E, stainless steel protected.
 - 2. For slabs on grade, use supports with sand plates or horizontal runners where wetted base materials will not support chair legs.
 - 3. Over waterproof membranes, use precast concrete chairs to prevent penetration of the membrane.

2.02 FABRICATION

- A. Shop-fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with ACI 315. In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken the material.
- B. Unacceptable Materials shall be defined as reinforcement with any of the following defects and will not be permitted in the work:
 - 1. Bar lengths, depths, and bends exceeding specified tolerances.
 - 2. Bends or kinks not indicated on drawings or on the final shop drawings.
 - 3. Bars with reduced cross section due to excessive rusting or other cause.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Unless shown otherwise on drawings, comply with the specified codes and standards, and Concrete Reinforcing Steel Institute recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as herein specified.
- B. If the cover depth is not specifically indicated on the plan sheets, the reinforcing steel shall be protected by a minimum thickness of concrete as follows:
 - 1. Concrete against ground or exposed to water - 3" cover
 - 2. Concrete exposed to weather - 2" cover
 - 3. Beams and columns - 1 ½ " cover
 - 4. Slabs on grade or exposed to weather - 1" cover

- C. Clean reinforcement to remove loose rust and mill scale, earth, ice and other materials, which reduce or destroy bond with concrete.
- D. Position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
- E. Unless shown otherwise on drawings, place reinforcement to obtain the minimum coverage for concrete protection. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that ends are directed away from exposed concrete surfaces.
- F. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with 16-gage wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps.
- G. Provide sufficient numbers of supports and of strength to carry reinforcement. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
- H. Splices: Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying. Comply with requirements of ACI 318 for minimum lap of spliced bars except as shown on drawings.

* * * END OF SECTION * * *

**SECTION 03 20 00
CONCRETE REINFORCING**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Weldable and non-welded reinforcing steel bars, for cast-in-place concrete.
- B. Support chairs, bolster, bar supports, ties and spacers for supporting reinforcement.
- C. Adhesive installation of dowels and or bars into prior placed concrete, masonry or structure.

1.2 RELATED CONTRACT DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections apply to this Section

1.3 RELATED WORK

- A. Division 2 Earth and Site work.
- B. Section 03 10 00 - Concrete Forming and Accessories
- C. Section 03 30 00 – Cast-In-Place Concrete.
- D. Division 04 – Masonry
- E. Section 05 12 00 – Structural Steel

1.4 REFERENCES (Except where noted use latest edition)

- A. ACI 301 - Specification for Structural Concrete for Buildings.
- B. ACI 350 – Code Requirements For Environmental Engineering Concrete Structures
- C. ACI 318 – Building Code Requirements for Structural Concrete
- D. ACI 315 - Details and Detailing of Concrete Reinforcement.
- E. ANSI/ASTM A82 - Cold Drawn Steel Wire for Concrete Reinforcement.
- F. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- G. ASTM A 184/A - Welded Deformed Steel Bar Mats for Concrete Reinforcement.
- H. ANSI/AWS D1.4 - Structural Welding Code Reinforcing Steel.
- I. ASTM A615 – Standard Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- J. ASTM A706 – Welding Bars for Concrete Reinforcement.
- K. CRSI - Manual of Practice.

1.5 QUALITY ASSURANCE

- A. Perform concrete reinforcement work in accordance with CRSI Manual of Standard Practice, and Documents 63 and 65.
- B. Conform to ACI.
- C. Have all reinforcing inspected by local authority and testing laboratory prior to concrete pour. See section 01 45 29.

1.6 SHOP DRAWINGS

- A. Submit shop drawings in no more or no less than 4 copies. Shop drawings shall show arrangement and layout, bending and assembly diagrams, bar schedules, stirrup spacing, splicing and laps of bars and shall be prepared in accordance with CRSI standards.
- B. Allow a minimum of 7 calendar days for processing not including shipping times.
- C. Provide layout with gridline coordinates and dimensions. Provide in accordance with ACI publication SP-66 / 315R-94 and 315-92 detailing manual.
 - 1. Provide cutting / bending lists and cut through concrete details that show all sizes, spacing, concrete cover, locations, splices and quantities of reinforcing steel.
 - a. Supporting devices are part of the work and must be shown on the submittal.

- D. Make a request in writing to Heyer Engineering to use portions of original design contract document drawings for layout of their submittal. If agreed, comply with the following:
- The title block, sheet numbers and all designers' stamps, signatures and references are removed and are never to be used by the fabricator or user.
 - Dimensions shown on contract documents are not verified and are not to be reused. Detailer shall create new dimensions from architectural contract documents for erection purposes. Gridlines only should be reused.
 - Non-reinforcing elements except for concrete or masonry shall be removed.
 - Details and elevations shown on contract documents are only for design and need to be completely redone by the detailer for erection purposes.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Non Welded Reinforcing Steel: ASTM A615, 60 ksi yield grade billet-steel deformed bars, uncoated finish. Also includes smooth dowels. Use at all locations where A706 type is not specifically stated.
1. At construction joints, grease and wrap the exposed end portion of smooth dowels prior to next concrete pour.
 2. See Structural details for corner bar requirements in footings, foundations and masonry.
- B. Weldable Reinforcing Steel: ASTM A706 60 ksi yield grade low alloy steel deformed bars with uncoated finish. See locations required on plans and details.
- C. Welded Steel Wire Fabric: ASTM A185 plain type; uncoated finish. Where size not noted, use 6 x 6 W2.1 x W2.1.
1. Must be flat sheets only. Coils or wire rolls are not permitted.
- D. Reinforcing supports:
1. For footing, wall, pier or foundation supports use stirrups or wire meeting either CRSI Class 1-2 gauge tie wire meeting ASTM A82.
 2. Slab Reinforcing Supports: Use Stirrups, chairs, masonry materials, or concrete pre-placements meeting CRSI requirements. Wood materials are prohibited. Supports are to be furnished by material supplier unless masonry or concrete preplacements. Coordinate with contractor.

2.2 ACCESSORY MATERIALS

- A. Tie Wire: ASTM A82; minimum 16 gauge, annealed type, black.
- B. Adhesive Anchoring Products See Section 051200 for materials to be used when rebar must be embedded into existing structures.

2.3 FABRICATION

- A. Fabricate in accordance with ACI 315, providing concrete cover specified in this section.
- B. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate location of splices on shop drawings.
- C. If required in plans or details, weld reinforcing bars in accordance with ANSI/ASW D1.4.

2.4 JOBSITE STORAGE

- A. Reinforcing steel shall be stored at site on timbers or planks, not concrete, which will keep steel free from mud and water. If storage is during winter months cover and ventilate.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Prior to concrete placement all reinforcing shall be inspected by a Testing agency. See Section 01 45 29. This inspection shall verify that reinforcing is installed per the plans and specifications and is not contaminated with form lubricants. In case of a conflict between the plans and the submittal drawings promptly contact the Engineer for resolution.
- B. When the supporting medium is a raised platform inspect the platform or decking to insure that the substrate is the proper specified platform and that the finish of the deck is as specified.
- C. Prior to concrete placement, notify all required governmental authorities of the work to allow for their inspection and comment.
- D. Before placing concrete, clean reinforcement of foreign particles or coatings including form oils. If reinforcement cannot be completely cleaned, replace contaminated reinforcement.

3.2 COVERAGE

- A. Maintain concrete cover around reinforcing as shown on structural plans and note sheet.

3.3 INSTALLATION

- A. For slabs and exterior walkways adjacent to building if reinforcement is not shown install 6 x 6 W2.1 x W2.1 flat sheet Woven Wire Fabric. Do not use coils.
- B. Place, support, and secure reinforcement against displacement. Do not deviate from alignment or measurement.
- C. Provide ties, bar supports and other permanent methods of keeping reinforcing steel at required position in the concrete.
 - 1. Anchor bolts or dowels for structure above footings or foundations may be placed in the top of initial pour prior to set of that concrete pour, within 30 minutes. They must be placed correctly and have all concrete at the area of the insertion hand troweled to provide a smooth and level top of concrete surface.
 - 2. Retaining walls, however, must have all elements including anchor bolts or dowels placed and supported in the initial pour.
- D. Chair up all steel bar slab reinforcing. Do not allow reinforcing to be at bottom of slabs. The process of lifting up bars during slab pouring is not permitted unless it is to lift it up onto pins or chairs, during pour, for permanent placement.
 - 1. Slabs where bars are not properly placed shall be replaced at contractors' expense.
- E. Where smooth dowel construction joints are utilized, grease and wrap one end of the dowel.
- F. See plans and details for specific locations that call for weldable reinforcing steel. At these locations use A706 reinforcing steel.
- G. For drilling or placing bolts, rods, anchors or similar embedments into existing masonry or concrete whether vertical or horizontal use an adhesive anchorage system. See Section 05121 for products to use and temperature restrictions. Substrate must not be below 32° F.
- H. For masonry see placement details for horizontal, corner and vertical bars in masonry cores, bond beams, jambs and lintels on structural drawing sheets.

END OF SECTION

SECTION 03 30 00 CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work of this section.
- B. Related Work Specified Elsewhere:
 - 1. Concrete Formwork, Section 03 11 00
 - 2. Concrete Reinforcement, Section 03 20 00

1.02 DESCRIPTION OF WORK

- A. The extent of cast-in-place concrete work is shown on the drawings.
- B. The work includes providing cast-in-place concrete consisting of Portland cement, fine and coarse aggregate, water and selected admixtures; combined, mixed, transported, placed, finished and cured as herein specified.

1.03 QUALITY CONTROL AND TESTING

- A. Prior to any concrete work, the Contractor shall obtain from his concrete supplier a certificate stating the design mix used by the supplier will meet or exceed the requirements of the specifications for Class A concrete as herein specified.
- B. The Contractor is responsible for controlling the quality of his product and shall make as many tests as necessary to satisfy himself and the Owner that his product meets or exceeds all specifications contained herein. The Contractor shall employ an independent professional testing laboratory experienced in the testing of concrete materials and mixes to perform material evaluation tests and to test concrete test cylinders. The testing agency shall meet the requirements of ASTM 329. The selection of the testing laboratory shall be subject to the Owner's and Engineer's acceptance. All such tests shall be at the expense of the Contractor.
- C. In addition to the Contractor quality control, the Engineer will perform temperature, slump, air, and compressive strength testing for the determination of product acceptance. The Engineer will cast a set of 4 standard 6-inch diameter cylinders for each 10 to 50 cubic yards of concrete placed or portion thereof and care for them as set forth in ASTM C31. These specimens shall be used to determine compressive strength requirements of the product. The results of these tests shall not relieve the Contractor of his responsibility to meet specifications contained herein.
- D. The right is reserved by the Owner to order additional checking of concrete strength by use of a Swiss hammer or by boring. Testing of this nature shall be done in the presence of the Engineer at the expense of the Contractor and may be submitted to an independent testing laboratory mutually agreed upon by the Contractor, Engineer, and Owner.

1.04 SUBMITTALS

- A. The certificate from the concrete supplier as specified above shall be submitted to the Engineer.
- B. The results of all concrete cylinder tests made shall be submitted to the Engineer.
- C. Copies of the delivery tickets for each load of concrete delivered to the site shall be furnished to the Engineer at the time of delivery.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

- A. Water shall be clean and free of deleterious amounts of oils, acids, alkali, organics, silt, mud, grass, or other foreign material.
- B. Portland cement used shall meet the requirements of ASTM C150, Type II, for all usages. Only one brand of cement shall be used throughout the project unless otherwise accepted by the Engineer.
- C. Fly ash shall conform to AASHTO M 295 Class F including the optional requirements in the referenced AASHTO specification except as modified by the following:
 - Loss on ignition 2.0% Max.
 - Moisture content 2.0% Max.
 - Available alkalis as Na₂O 1.5% Max. *

* Available alkalis up to 2.0 percent may be used, provided mortar expansion test results at 14 days is less than or equal to that of the control sample. The expansion test shall be run in accordance with modified ASTM C 441. The control sample shall be made using cement that will be used on the project. The test sample shall be made using cement and fly ash that will be used on the project.
- D. Fly ash shall be from approved base loaded electric generating plants using a single coal source. Plants using a limestone injection process for controlling air pollutants are not acceptable. Fly ash from the start up and shut down of the plant shall not be used.
- E. Fine aggregate shall be clean, sharp, natural, uncoated sand free from silt, loam, and clay, dune sand, bank run sand and manufactured sand are not acceptable. Fine aggregate shall conform to ASTM C33, fine aggregate sections.
- F. Coarse aggregate shall be clean, uncoated crushed stone or gravel conforming to ASTM C33. Clay and shale particles shall not exceed 1%. Maximum size aggregate allowed is 1/5 of narrowest dimensions between forms of the concrete member or 3/4 of minimum clear spacing between reinforcing bars. For cement finish use 1/8 inch minimum and 3/8-inch maximum size aggregate.
- G. Aggregates containing soluble salts or other substances such as iron sulphides, pyrite, marcasite, or ochre, which can cause strains on exposed surfaces, will not be allowed.
- H. If noted on the plans, fiber mesh reinforcing shall be used with all concrete sidewalk and pavement. The fiber mesh shall be added at the rate of 1 bag per cubic yard or as otherwise recommended by the manufacturer. The fiber shall be added directly to the truck at the time of mixing.

2.02 CONCRETE ADMIXTURES

- A. Provide admixtures produced by established reputable manufacturers and use in compliance with the manufacturer's printed directions. Do not use admixtures, which have not been incorporated and tested in the accepted mixes unless otherwise authorized in writing by the Engineer. All admixtures shall meet standards as specified herein.
- B. Air-entraining Admixtures shall conform to ASTM C260 and shall be equal to Grace "Darex AEA," Master Builders "MB-VR"; or Sika Chemicals "AER."
- C. Calcium Chloride: Do not use calcium chloride in concrete unless otherwise authorized in writing by the Engineer.

2.03 CONCRETE CLASS

- A. Classes of concrete:

CLASS OF CONCRETE	REQ. MIN. STRENGTH @ 28 DAYS (PSI)	MAX. WATER CONTENT GAL./94 LB. BAG
A	4,000	6.0

- 1. Class A concrete shall be used for all cast-in-place concrete. Minimum cement content for Class A concrete shall be 564 lbs. It may be used for all concrete requirements.

- B. Grout and Topping:

- 1. Plain grout for channel bottoms; tank bottoms where required shall be proportioned as follows:

CONSTITUENT	BY VOLUME
Type II Portland Cement	1 Part
Sand	2 Parts
¼ " Aggregate	1 ½ Parts

- 2. Non-shrinking grout shall be Embecco, Pour-Rok, or approved equal.

2.04 CONSISTENCY

- A. Consistency required for each pour shall be established in advance by the Contractor in cooperation with the Engineer in accordance with ASTM C143 and according to the following slump ranges:

TYPE OF CONSTRUCTION	SLUMP	AIR
Sidewalk	1" - 4 ½"	5% - 7.5%
Curb & Gutter	1" - 4 ½"	5% - 7.5%

TYPE OF CONSTRUCTION	SLUMP	AIR
Pavement (Formed)	1" - 4 ½"	5% - 7.5%
Pavement (Slipformed)	≤ 2"	5% - 7.5%
Miscellaneous	1" - 4 ½"	5% - 7.5%

- B. Concrete shall be of consistency as to insure the required workability and result in compacted masses having dense, uniform surfaces. In general, the consistency of concrete mixture shall be such that:
1. The mortar will cling to the coarse aggregate.
 2. The aggregates will not segregate in the concrete.
 3. The concrete when dropped directly from the discharge chute of the mixer will flatten out at the center of the pile, but the edges of the pile will stand and not flow.
 4. The concrete and mortar will show no free water when removed from the mixer.
 5. The concrete will slide and not flow into place when transported in metal chutes at an angle of 30 degrees with the horizontal.
 6. The surface of the finished concrete will be free from a surface film of "laitance."
- C. Any concrete mix failing to meet the above outlined consistency requirements, although meeting the slump requirements, will be considered unsatisfactory; and the mix shall be changed to correct such unsatisfactory conditions.

2.05 PROPORTIONING OF MATERIALS

- A. The proper proportioning of aggregates and cement will be determined by the Contractor and the professional testing laboratory. The proportioning of aggregates will be the most suitable combination of aggregates, which will give the necessary workability and desired consistency when mixed with water and cement as specified.
- B. The ratio of cement to dry, fine aggregate shall be that necessary to provide the maximum density of the mixture when used with the minimum amount of water required to produce the specified slump in the resulting concrete. This determination of the proper ratio shall be made by a testing laboratory at the expense of the Contractor, using representative samples of the aggregates, which will be used. Laboratory recommendations shall be submitted to the Engineer.
- C. The batch proportions used shall be such that full bags of cement are used in each batch.
- D. Fly ash may be substituted for cement in concrete. The addition or deletion of fly ash from the mix will be at no cost to the Owner. If fly ash is used, the minimum amount of cement to be replaced is 15 percent and the maximum amount is 20 percent by weight.

2.06 EXPANSION JOINT MATERIAL

- A. Expansion joint material shall be pre-molded, non-extruding asphalt impregnated joint filler conforming to ASTM D1751 unless shown otherwise on the plans. Joint material shall be full depth of slab or joint and unless otherwise indicated ½-inch thick.

2.07 FIBER REINFORCEMENT

A. Synthetic Fiber Reinforcement.

1. Material: 100 percent virgin homopolymer polypropylene multifilament fibers, containing no reprocessed olefin materials.
2. Conformance: ASTM C 1116, Type III.
3. Fire Classifications:
 - a. UL Report File No. R8534-11.
 - b. Southwest Certification Services (SWCS), Omega Point Laboratories No. 8662-1.
4. Fiber Length: Single-cut lengths.
5. Alkali Resistance: Alkali proof.
6. Absorption: Nil.
7. Specific Gravity: 0.91.
8. Melt Point: 324 degrees F (162 degrees C).

PART 3 EXECUTION

3.01 STORAGE OF MATERIALS

- A. Cement shall be stored in well ventilated, weatherproof buildings, which will protect the cement from dampness. The floor supporting the cement shall clear the ground a sufficient distance to prevent the absorption of moisture by the cement. The Engineer may permit small quantities of cement to be stored in the open for short periods of time (maximum of 48 hours) if a raised storage platform and adequate waterproof covering are provided. Lumpy or partially set cement shall not be used, and such cement shall be removed from the premises.
- B. The handling and storage of concrete aggregate shall be such as to prevent the admixture of foreign materials. If the aggregates are stored on the ground, sites for stockpiles shall be grubbed, cleared of all weeds and grass and leveled off. The bottom layer of aggregate shall not be disturbed or used without cleaning. Unless otherwise authorized by the Engineer, all fine aggregate shall be stockpiled at least 24 hours to reduce the free moisture content.

3.02 MIXING CONDITIONS

- A. The concrete shall be mixed in quantities required for immediate use, and any concrete, which is not in place within 30 minutes after being discharged from the mixer, shall not be used. Retempering of concrete will not be permitted.
- B. Where work has been started and changes in weather conditions require protective measures to be used, the Contractor shall furnish adequate shelter to protect the concrete against damage from rainfall or damage due to freezing temperatures. In case it is necessary to

continue mixing operations during rainfall, the Contractor shall provide protective coverings for the material stockpiles as well as for the concrete being placed. The covering for aggregate stockpiles will be required only to the extent as may be necessary to control the moisture conditions in the aggregates so that adequate control of the consistency of the concrete mix may be maintained.

- C. No concrete shall be mixed without the approval of the Engineer when the air temperature is at or below 40° F (taken in the shade away from artificial heat) and falling. If authorized by the Engineer, concrete may be mixed when the air temperature is at 35° F and rising. When permission is given for mixing when the temperature is below 40° F, the following requirements shall govern:
1. Water used for mixing shall be heated either by steam or by dry heat to a temperature of at least 70° F but not over 150° F.
 2. Aggregates shall be heated either by steam or by dry heat to a temperature of at least 70° F but not over 150° F.
 3. The heating apparatus shall be such as to heat the mass of aggregates uniformly and preclude the occurrence of hot spots, which will burn the material. Temperature of mixed concrete shall be not less than 60° F at the time of placing in forms. After the concrete has been placed, the Contractor shall provide sufficient protection such as cover, canvas, framework, heating apparatus, etc., to enclose and protect the structure and maintain the temperature of the mix at not less than 50° F until at least 60% of the designed strength has been attained.
 4. The use of an accelerating agent in lieu of proper cold weather protection will not be authorized. In hot weather suitable precautions shall be taken to avoid drying of the concrete prior to finishing operations. Use of windbreaks, sunshades, fog sprays, or other devices shall be provided.
 5. Concrete deposited in hot weather shall not have a placing temperature that will cause difficulty from loss of slump, flash set, or cold joints. Concrete temperatures shall be less than 90° F.

3.03 CONCRETE PLACEMENT

- A. Before placing concrete, the Contractor shall see that bottoms of excavations are undisturbed earth, properly leveled off and tamped free of foreign materials. Forms shall be oiled or wetted prior to placing concrete. Water shall be removed from the excavation before any concrete is deposited.
- B. The concrete shall be placed in the structure immediately after mixing. Concrete shall be placed in continuous horizontal layers approximately 12-inch in thickness. Not more than 1 hour shall elapse between the placing of successive layers of concrete in any portion of the structure included in a monolithic placement. Special care must be used to thoroughly surround all reinforcement with concrete and to leave no air space or other void in this work. All concrete shall be well vibrated into all areas of forms.
- C. No concrete shall be used after its initial set has taken place, and no retempered concrete will be allowed under any circumstances or conditions.

- D. Concrete handling from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit shall be completed as rapidly as practicable by methods which will prevent segregation and loss of concrete mix materials.
- E. Mechanical equipment for conveying concrete shall be provided to ensure a continuous flow of concrete at the delivery end. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, snow, ice, and other deleterious materials.

3.04 CONSTRUCTION JOINTS

- A. Construction joints shall be made at the locations indicated on the plans or at such other locations as designated by the Engineer. In no case shall vertical joints be made in walls at or near corners. Proper bonding shall be obtained in accordance with the above specifications and the CRSI.
- B. Keys shall be provided in all joints where required to provide for either shear or water tightness. The width of the keys shall be approximately $\frac{1}{2}$ the thickness of the section at that point, and they shall be $\frac{1}{2}$ as deep as they are wide unless otherwise specified.
- C. All concrete shall be deposited in forms at such rate that the forms will be filled at any point with a vertical rise of concrete surface of not less than 2 feet per hour. Where necessary, the forms shall be bulk headed off and construction joint made to provide a form, which will be filled at the above specified rate. The location of these construction joints shall be approved by the Engineer.
- D. If any concrete is allowed to stand at any elevation below the finished grade or top surface for more than 2 hours without fresh concrete being applied thereon, the top surface shall be considered a construction joint and shall be constructed in accordance with these specifications and provided with keys and water sealing strips.
- E. Where practicable, vertical construction joints shall make a slight angle with the vertical, not to exceed $\frac{1}{2}$ -inch per foot, in such manner that the freshly deposited concrete will overhang the hardened concrete, allowing the new concrete to settle upon the old during the process of hardening.

3.05 PROTECTING AND CURING

- A. All concrete, regardless of temperature, weather, or season, shall be protected from premature drying. Surface cracking shall be a cause for rejection, removal, and replacement. Any concrete poured during freezing or hot weather conditions shall be protected. No salts or other non-freezing materials shall be used. All fresh concrete shall be protected from open rain. All concrete shall be kept damp for at least 6 days after pouring. Membrane curing may be used. Membrane curing compound if used shall be a resin base type approved by the Engineer. Curing will not be required longer than 72 hours if high early strength concrete is used.

3.06 FINISH OF FORMED SURFACES

- A. Rough Form Finish:

1. Provide as-cast rough form finish to formed concrete surfaces that are to be concealed in the finish work or by other construction unless otherwise indicated.
2. Standard rough form finish shall be the concrete surface having the texture imparted by the form facing material used with tie holes and defective areas repaired and patched and all fins and other projections exceed ¼-inch in height rubbed down or chipped off.

B. Smooth Form Finish:

1. Provide as-cast smooth form finish for formed concrete surfaces that are to be exposed to view or that are to be covered with a coating material applied directly to the concrete, or a covering material bonded to the concrete such as waterproofing, damp-proofing, painting or other similar system.
2. Produced smooth form finish by selecting form material to impart a smooth, hard, uniform texture and arranging them orderly and symmetrical with a minimum of seams. Repair and patch defective areas with all fins or other projections completely removed and smoothed.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off, smooth, and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces unless otherwise shown.

3.07 MONOLITHIC SLAB FINISHES

A. Float Finish:

1. Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes as hereinafter specified.
2. After placing concrete slabs do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently to permit the operation of a power-driven float or both. Consolidate the surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Check and level the surface plane to a tolerance not exceeding ¼-inch in 10 feet when tested with a 10-foot straightedge placed on the surface at not less than 2 different angles. Cut down high spots and fill all low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat the surface to a uniform, smooth granular texture.

B. Trowel Finish:

1. Apply trowel finish to monolithic slab surfaces that are to be exposed to view unless otherwise shown and slab surfaces that are to be covered with epoxy terrazzo, resilient flooring, paint, or other thin-film finish coating system.
2. After floating, begin the first trowel finish operation using a power-driven trowel if desired.
3. Consolidate the concrete surface by the final hand troweling operation, free of trowel marks, uniform in texture and appearance and with a surface plane tolerance not exceeding 1/8-inch in 10 feet when tested with a 10-foot straightedge. Grind smooth surface defects, which would telegraph through applied floor covering system.

C. Non-slip Broom Finish:

1. Apply non-slip broom finish to exterior and interior concrete platforms and bridges, steps, walks and ramps and elsewhere as shown on the drawings or in schedules.
2. Immediately after trowel finishing slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Coordinate the required final finish with the Engineer before application.

D. Exposed Aggregate Finish:

1. The Contractor shall construct an exposed aggregate sample thirty-six (36) inches long by thirty-six (36) inches wide, and receive the Owner's approval, prior to any work involving this type of surfacing.
2. Following the Owner's acceptance of the exposed aggregate sample, and immediately after removal of form work, wash concrete surfaces with water and scrub with stiff bristle brush exposing aggregate to match accepted sample panel.
3. When desired finish is achieved, wash and rinse exposed aggregate surfaces with cleaning agent.

E. Carpet Drag Finish:

1. Before the concrete has attained its initial set, the surface shall be given a final finish with a carpet drag drawn over the surface in a longitudinal direction. The drag shall be mounted on a bridge and shall be sized so that a strip of the carpet at approximately two feet (600 mm) wide is in contact with the pavement surface while the drag is operated.
2. The condition of the drag shall be maintained so the resultant surface is of uniform appearance with corrugations approximately 1/16 inch (2 mm) in depth. Drags shall be maintained clean and free of encrusted mortar. Drags that cannot be cleaned shall be discarded and replaced.
3. The carpet shall meet the following requirements:
 - a. Facing Material - Molded polyethylene pile face
 - b. Blade Length - 7/8", $\pm 1/8$ " (22 mm, ± 3 mm)
 - c. Total Fabric Weight - 70 oz. Per square yard min.
 - d. (2.37 kg per square meter min.)
4. The backing shall be of a strong, durable material, not subject to rot, which is adequately bonded to the facing.
5. Brooming may be used on irregular areas in lieu of the carpet drag and tine finish. The broom shall be drawn transversely across the pavement with adjacent strokes slightly overlapping.
6. Brooming shall be uniform in appearance and shall produce grooves 1/16 inch (2 mm) deep. Texturing shall be completed while the concrete surface can be broomed without being torn or unduly roughened by the operation.
7. The finished surface shall be free from rough and porous areas, irregularities, and depressions resulting from improper handling of the broom.

3.08 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas:

1. Repair and patch defective areas with cement mortar immediately after the removal of the forms but only after the Engineer has inspected the defective area.
2. Cut out honeycomb, rock pockets, voids over ½-inch diameter and holes left by tie rods and bolts, down to solid concrete, but, in no case, to a depth of less than 1-inch. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water, and brush coat the area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable to the Engineer.
3. For exposed-to-view surfaces blend white Portland cement and standard Portland cement so that when dry the patching mortar will match the color of the surrounding concrete. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with the patching. Compact mortar in place and strike off slightly higher than the surrounding surface.
4. Fill holes extending through concrete by means of a plunger type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to ensure complete filling.

B. Repair of Formed Surfaces:

1. Repair exposed-to-view formed concrete surfaces where possible that contain defects which adversely affect the appearance of the finish. Remove and replace the concrete having defective surfaces if the defects cannot be repaired to the satisfaction of the Engineer. Surface defects as such include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, and holes left by the rods and bolts; fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
2. Repair concealed formed concrete surfaces where possible that contain defects that adversely affect the durability of the concrete. If defects cannot be repaired, remove and replace the concrete having defective surfaces. Surface defects as such include cracks in excess of 0.01 in. wide, cracks of any width and other surface deficiencies which penetrate to the reinforcement or completely through non-reinforced sections, honeycomb, rock pockets, holes left by tie rods and bolts and spalls except minor breakage at corner.

C. Repair of Unformed Surfaces:

1. Test unformed surfaces such as monolithic slabs for smoothness and to verify surface plane to the tolerances specified for each surface and finish. Correct low and high areas as herein specified.
2. Test unformed surfaces sloped to drain for trueness of slope in addition to smoothness, using a template having the required slope. Correct high and low areas as herein specified.

3. Repair finished unformed surfaces that contain defects, which adversely affect the durability of the concrete. Surface defects as such include crazing, cracks in excess of 0.01-inch wide or that penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
4. Correct high areas in unformed surfaces by grinding after the concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.
5. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Engineer.
6. Repair defective areas except random cracks and single holes not exceeding 1-inch diameter by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least $\frac{3}{4}$ -inch clearance all around. Dampen all concrete surface in contact with patching concrete and brush with a neat cement grout coating or use concrete bonding agent. Place concrete before grout takes its initial set. Mix patching concrete of the same materials to provide concrete of the same type of class as the original adjacent concrete. Place, compact, and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
7. Repair isolated random cracks and single holes not over 1-inch in diameter by the dry-pack method. Groove the top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen all cleaned concrete surfaces and brush with neat cement grout coating. Place dry-pack before the cement grout takes its initial set. Mix dry-pack consisting of 1-part Portland cement to 2- $\frac{1}{2}$ parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patch areas continuously moist for not less than 72 hours.
8. Repair methods not specified above may be used subject to the acceptance of the Engineer.

3.09 SURFACE TEST AND TOLERANCES

- A. Ten Foot Straightedge: The concrete surface shall be tested with a 10-foot straightedge. The permissible longitudinal and transverse surface deviation shall be 1/8-inch in 10 feet.
- B. Areas where the maximum deviation exceeds the permissible deviation by not more than 3/8 inch will be subject to the following at the discretion of the Engineer.
 1. Grind down to an elevation where the area or spot will be within the permissible deviation.
 2. Accept affected area without corrective action with price reduction at a rate noted below.
- C. Areas where maximum deviation exceeds the permissible by more than 3/8 inch will be subject to the following at the discretion of the Engineer.

1. Grind down to an elevation where the area or spot will be within the permissible deviation.
 2. Accept affected area without corrective action with price reduction at a rate noted below.
 3. Satisfactorily remove and replace deficient area.
- D. Grinding shall be accomplished with specially prepared circular diamond blades mounted on a horizontal shaft. Areas that have been ground shall not be left smooth or polished, but shall have a uniform texture equal in roughness to the surrounding unground concrete.
- E. Measurements for determining the limits of deficient areas will be made in the following manner:
1. The length of the deviation will be that length out of specification tolerance at the location of the surface test as checked with a 10-foot straightedge and a 1/8-inch shim.
 2. Where the transverse surface test is out of specification, the maximum length and maximum width at a particular site shall be used in computation of the area.

3.10 DEFECTIVE WORK

- A. Concrete work, which does not conform to the specified requirements, including strength, tolerances, and finishes, shall be corrected at the Contractor's expense without extension of time therefore. The Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from corrections to the concrete work.

* * * END OF SECTION * * *

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

PART 1 - GENERAL

1.1 RELATED CONTRACT DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and 01 Specification Sections apply to this section.

1.2 WORK INCLUDED

- A. Furnish and install all cast-in-place concrete for footings, foundations, piers, columns, exterior stoops, interior slab on grade and raised slabs, equipment pads and other work as shown on plans and details.
 - 1. Equipment pads and similar concrete items. Division 15 and 16 contractors are responsible only for dimension, location and layout of the pads. Contractor of this section shall furnish and install concrete. If pad is located on top of a precast or other raised deck, provide information to the general contractor to adjust deck load prior to manufacturer's design of deck.
- B. Protection of freshly poured and concrete undergoing curing.
- C. Shelters, heat and weather protection of Cast in Place Concrete.
- D. Pumping of Concrete materials if required.
- E. Water stops. (See section 03 10 00).
- F. Installation of metal angles, embeds and anchor bolts furnished by Division 5 into the concrete.
- G. Core fill grouting of masonry (installed by mason)
- H. Precast Concrete grout (installed by precast erector).
- I. Precast Topping (installed by this concrete contractor).
- J. Admixtures, curing compounds and accessories.
- K. Sawcutting control joints.
- L. ASTM and ACI standards of level and flatness.
- M. Grouting of all control and construction joints with cementitious products compatible with flooring glues prior to flooring installation.

1.3 RELATED WORK

- A. Division 02- Earthwork
- B. Section 03 10 00 - Concrete Forming and Accessories
- C. Section 03 20 00 - Concrete Reinforcing
- D. Section 04 20 00 – Masonry
- E. Section 05 12 00 – Structural Steel Framing
- F. Section 05 31 00 – Steel Decking

1.4 REFERENCES (Use latest publication date unless otherwise noted)

- A. ACI 301 – Standard Specifications for structural concrete for buildings. (THE FIELD GUIDE)
- B. ACI 315 – Details and Detailing of Concrete Reinforcement
- C. ACI 318 – Building code requirements for structural concrete
- D. ACI 350 – Code Requirements For Environmental Engineering Concrete Structures
- E. ASTM C33 - Concrete aggregates.
- F. ASTM C618 – Standard specification for coal fly ash- type C. Use Coal Creek brand of fly ash only.
- G. ASTM C94 - Ready-Mixed concrete.

- H. ASTM C150 - Portland cement.
- I. ASTM C260 - Air-Entraining admixtures for concrete.
- J. ASTM C494 - Chemical admixtures for concrete.
- K. ASTM C309 – Curing compounds for concrete.
- L. ACI 210-Guide to durable concrete.
- M. ASTM C171- Specification for sheet material for curing concrete.
- N. ASTM E1155 – Standard test method for determining (FF) Floor flatness and (FL) Floor levelness numbers.
- O. ACI C308 - Standard practice for curing concrete.
- P. ACI C305R – Hot weather concrete work.
- Q. ACI C306R – Cold weather concrete work.
- R. AASHTO M-148 for curing materials.
- S. ASTM C192- Test methods for concrete.
- T. ASTM C156 - Test method for moisture retention for concrete.
- U. ASTM C 295 - Petrographic examination of aggregates for concrete.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301.
- B. Have a current copy of ACI 301 on the jobsite for reference during the work of this section.
- C. Dimensions as shown on Construction Drawings are as intended. Slabs listed as 4" shall be 4".
- D. If the Concrete provided does not meet these specifications, The Contractors' Independent Engineering & Testing Agency shall perform batch inspections for the design mix and shall sample and test mix ingredients until concrete quality is established to the satisfaction of these specifications.

1.6 DESIGN & TESTING

Submit the design mixes 10 days prior to placing concrete. Receive Engineers' review prior to use. Mix designs shall be no more than one-year-old from the date they are to be used. The following information shall be provided for each design mix.

- (1) Fine and coarse aggregate gradations per ASTM C33.
 - (2) Method of determination the mix design proportions.
 - (3) Water/cement ratio.
 - (4) Entrained and non-entrained air content of freshly poured concrete.
 - (5) Compressive strength at 28 days per ASTM C 39.
 - (6) Chloride ion content of the concrete per ASTM C1218.
 - (7) The proportions and types of all cementitious materials and admixtures.
 - (8) The Shale and deleterious contents of all aggregates used.
 - (9) Slump. Including slump both prior and after introduction of plasticizers; if they are used.
 - (10) Location where concrete is to be placed. (i.e.) footings, topping etc.
- B. After design mix is approved, the testing and analysis of jobsite delivered concrete will be performed under provisions of Section 01 45 23 including:
 - 1. Strength tests: 4 Cylinders (1-7day, average of 2-28 day, 1 field hold) per every 50 yards of each type of concrete for each days pour.
 - a. Contractor shall keep and test additional cylinders for use in his determination of form removal timing, for cold or hot weather verification and for OSHA required column strengths.
 - 2. Slump tests at the point of application and before and after addition of plasticizer.

Send back non-compliant trucks.

3. Air entrainment tests at same time as slump tests. Air tests in fresh concrete are intended to show current air content. Send back non-compliant trucks.
- D. Vehicles on which non-compliant concrete are delivered shall not be allowed to modify concrete to be in compliance. Vehicle shall return to redi-mix plant & offload non-compliant concrete prior to batching of new concrete. No rebatched, formerly rejected concrete shall be used.

1.7 SUBMITTALS

A. Shop Drawings

1. Construction Joints: Submit drawings of proposed construction joint locations in concrete for slab-on-grade, walls and foundations. Submit any additional or changed reinforcing that is required at construction joints that differs from that shown on drawings.
2. Openings, Sleeves, and Cores: Submit drawings of all openings to be formed, sleeved, cored, or sawcut in cast-in-place elements. Drawings shall indicate size and location of openings, sleeves, or cores.
3. Embedded Items: Submit drawing showing all items to be embedded in concrete elements, including plates, angles, bolts and any non-structural items such as conduit. Drawings shall indicate locations, size, orientation and type of embedded item.
4. Anchor Rods: Submit drawings showing layout and details for steel templates used for placing anchor rods.

PART 2 – PRODUCTS

2.1 CONCRETE PROPERTIES, MATERIALS & MIXING

- A. Concrete shall be plant redi-mix type meeting ASTM C94. Site mixed concrete is not acceptable.
- B. Proportion mixes in accordance with ACI 211.1.
- C. Compressive strength (ASTM C31) and C39): See Chart for individual requirements.
- D. Water: potable, clean and free of injurious quantities of substances known to be harmful to and conforming to ASTM C94.
1. Water / cement ratio: To be calculated for each mixed design. See Chart for individual basic requirements
 2. Maximum water to cement ratio for exterior concrete subject to freeze thaw cycles shall be 0.45. Use 8.32 lbs. per gallon.
- E. Portland Cement: ASTM C 150, Type I / II or Type I. All shall be low Alkali. If acid resistance is needed use type II. If high early strength is required use type III or add a minimum of 47 lbs. to each mix. Each bag is 94 lbs.
1. Use the minimum quantity to reach desired 28-day compressive strength +15% overage.
- F. Type C Fly Ash, meeting ASTM C618. Maximum allowable percentage and allowable time of use is stated in Chart in Article 2.6.
- G. Fine aggregate: clean, durable and sound natural sand conforming to ASTM C33, #4 and down.
1. Shale or deleterious content shall be no more than .5% for slabs and 1% for all other concrete.
- H. Course aggregate: clean, durable and sound natural processed gravel conforming to ASTM C33 and free of materials that can cause Alkali-silica reaction (ASR). See chart in Part 2 for maximum sizes.
1. Shale or deleterious content shall be no more than .5% for slabs and 1% for all other concrete.

2. Maximum size shall not exceed 33 1/3% of the depth of any slab section.
3. Test course aggregate for ASR under ASTM C295 or ASTM C1260.
- I. Air content: Tested to ASTM C231. See chart in Part 2 for required fresh entrained quantities. All concrete has some non-entrained air.
- J. Slump: Tested to ASTM C 143. See chart in Part 2 for requirements.

2.2 COMMON CONCRETE ACCESSORIES AND ADDITIVES

- A. No products containing calcium chloride in a content of more than 0.06% of the cement weight in chloride ions or Thiocyanates will be permitted. See ASTM C494 and ACI 318. - **If additional admixtures are used after mix approval, notify the Structural Engineer.**
 1. Use an exterior curing compound for all exterior horizontal and exposed vertical surfaces.
Product shall meet ASTM C309 Type 2, Class B. These products leave a white Dye.
 2. Clear interior cure and seal products are required for interior slab concrete, where no floor covering or coating will be applied; they must meet ASTM C1315 type 2.
 - a. Verify that no floor covering or finish exists with Architect.
 3. On interior slabs on grade or raised placed in an enclosed temperature controlled building where floor covering will be adhered. Use a resin type, dissipating concrete curing compound meeting AASHTO M-148, and ASTM C309 Type I Class B. Verify that product shall penetrate and not leave material on surface.
 4. Wet curing materials for interior slab on grade or raised slab work where building has not been erected and concrete is exposed.
 - a. Burlap, cotton mats and rags, rugs or similar material under polyethylene sheets. Fabric must not have been previously used for sugar, fertilizer or acidic materials storage. Take care that material does not have dye which will stain the concrete. The material shall meet AASHTO M-147 and ASTM C156.
 - b. Combination poly and cloth sheets meeting ASTM C156.
 5. Performed expansion and wall isolation joint Filler: Non extruded type joint filler constructed of asphalt impregnated fibers meeting ASTM D1751. Material shall be full depth of slab of edge joint and exposed width shall be 1/2".
 6. Super plasticizer. Meeting ASTM C494F: For workability or for pumping the contractor may use a High Range Water Reducing Admixture/ or Super Plasticizer to go to a max. temporary slump of 6. Water must not be used to obtain this increase.
 7. Mid Range Plasticizer. Meeting ASTM C494 Type D: Combination water reducer and agent to improve workability for concrete during placement, at a level less than a superplasticizer.
 8. Water reducing admixtures: Water reducing admixtures meet ASTM C494, Type A.
 9. Air Entraining: Tests to ASTM C231. Air content is shown on chart in Part 2 for individual types of concrete. Air entraining products must meet ASTM C260. All concrete does have some non-entrained air.
 - a. Adjust if using a super or midrange plasticizer.
 10. Concrete Bonding Agents: If concrete is to be placed on top of existing concrete or masonry use products meeting ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
 11. Non-Chloride Accelerating Admixtures: If a faster initial set up is desired, or is specified in chart, use products meeting ASTM C 494 Type C. Never use chlorides.

2.3 GROUT FOR STRUCTURAL METAL BASEPLATES AND DOWELS

- A. See Section 05 12 00 for non-shrink non-metallic grout.

B. Grout for dowels, See section 05 12 00 for adhesive anchoring systems.

2.4 GROUT FOR INTERIOR CONTROL JOINT, COLD JOINTS, CRACKS OR EXPANSION JOINT FILLING

- A. Fill All Control Joints, construction joints and cracks over 1/16" in width except exterior required to prior to flooring or colorant installation
1. Use a cementitious thin patch that can be applied from featheredge to 1" inch thick. Products must contain at least 80% ASTM C150 cementitious materials. Product shall self-bonding to clean dry concrete and meet ASTM C1157 performance and ASTM C191 for material set characteristics. Some of these require flooring glues to be applied within 24 hours.

2.5 CONCRETE MIXING AND TRANSPORTING

- A. Do not add water to concrete at the site except with the direct written approval of the Structural Engineer or Architect. Delivery trucks shall deliver with minimum drum revolutions. No concrete older than 90 minutes from time of mixing in the truck shall be used for the project. See Article 1.6 on non-complaint concrete trucks.

2.6 CONCRETE MATERIALS, TYPES, STRENGTHS AND ADDITIVES

- A. Install mixes that provide following minimum requirements:
1. Concrete design mixes shall have a min. 15% over-design of compressive strength.
 3. Type C fly ash from Coal Creek Station in Stanton, North Dakota may be used up to the maximum percentages shown in non-cold weather conditions. Do not use fly ash within 48 hours prior to or 72 hours after an air temperature of 50 degrees or lower exists. Do not use from November 1st till April 15th where concrete is not in a 28-day environment where the temperature is kept above 50°. Fly ash will retard initial set.

• Footings & Footing Pads

- Low Alkali Cementitious Product Types: Portland Type I or I/II
Maximum 25% Fly Ash Allowed
- Maximum Aggregate Size: 1½"
- Max Slump: 5"
- 28 Day Compressive Strength: 3,000psi
- Max w/c Ratio: 0.55
- Allowed Admixtures; Air Entrainment WRDA Series upon Approval
Use of Entrained Air is Contractors Option

• Foundation Walls, Columns, Piers, Grade Beams (IF NOT Exposed to Weather)

- Low Alkali Cementitious Product Types: Portland Type I or I/II
Maximum 20% Fly Ash Allowed
- Maximum Aggregate Size: ¾"
- Max Slump: 4"
- 28 Day Compressive Strength: 4,000psi
- Max w/c Ratio: 0.53
- Allowed Admixtures; Air Entrainment WRDA Series upon Approval
Mid-Range Plasticizer With Prior Approval
Use of Entrained Air is Contractors Option

• Foundation Walls, Columns, Piers, Grade Beams (IF Exposed to Weather)

- Low Alkali Cementitious Product Types: Portland Type I or I/II
Maximum 20% Fly Ash Allowed
- Maximum Aggregate Size: ¾"
- Max Slump: 4"
- 28 Day Compressive Strength: 4,000psi
- Max w/c Ratio: 0.45
- Allowed Admixtures; Air Entrainment WRDA Series upon Approval
Mid-Range Plasticizer OK

Super Plasticizer With Prior Approval
5%-7% Entrained Air

- **Interior Slabs on Grade and Metal Form Deck**

- Low Alkali Cementitious Product Types: Portland Type I or I/II
Maximum 20% Fly Ash Allowed (Will Retard Initial Set)
- Maximum Aggregate Size: 3/4"
- Max Slump: 5"
- 28 Day Compressive Strength: 4,000psi
- Max w/c Ratio 0.45
- Allowed Admixtures; Air Entrainment WRDA Series upon Approval
Mid-Range Plasticizer With Prior Approval
Super Plasticizer With Prior Approval
5% Entrained Air is Contractors Option

- **Exterior Horizontal Concrete on Grade and Metal Form Deck**

- Low Alkali Cementitious Product Types: Portland Type I or I/II
Maximum 25% Fly Ash Allowed
Use min. 564 Lbs. of Cementitious Materials
- Maximum Aggregate Size: 3/4"
- Max Slump: 4"
- 28 Day Compressive Strength: 4,000psi
- Max w/c Ratio 0.44
- Allowed Admixtures; Air Entrainment WRDA Series upon Approval
Mid-Range Plasticizer OK
Super Plasticizer With Prior Approval
5%-7% Entrained Air

- **Grout for CMU Wall Core Fill and CMU Bond Beams**

- Low Alkali Cementitious Product Types: Portland Type I
Maximum 25% Fly Ash Allowed
- Maximum Aggregate Size: 3/8" and min. 70% Fine Aggregate
- Max Slump: 8"
- 28 Day Compressive Strength: 3,000psi
- Max w/c Ratio 0.60
- Allowed Admixtures; Air Entrainment WRDA Series upon Approval
Mid-Range Plasticizer OK
Super Plasticizer is Prohibited
5% Entrained Air is Contractors Option

2.7 RELATED PRODUCTS

A. Post-Installed Anchors.

1. Mechanical Anchors: Only anchors having passed Acceptance Criteria 193 for use in cracked concrete and resisting wind and seismic loads shall be approved for use. Reports from the following organizations are acceptable:
 - a. ICC Evaluation Service Report.
 - b. IAPMO Uniform Evaluation Services.
2. Adhesive Anchoring Systems: Only adhesive anchor systems that comply with the latest revision of ICC-ES Acceptance Criteria 308 for use in cracked concrete and resisting wind and seismic loads shall be approved for use. Reports from the following organizations are acceptable:
 - a. ICC Evaluation Service Report.
 - b. IAPMO Uniform Evaluation Services.
3. Cold Weather Placement: See ACI 306R

B. Anchor Rods:

1. ASTM F1554, Grade 36

C. Non-Shrink Grout:

1. Type: Grout for base plates, bearing plates and grouting under precast or tilt-up wall panels shall be a non-metallic, shrinkage resistant, premixed, non-corrosive, non-staining product containing Portland cement, silica sands, shrinkage compensating agents and fluidity improving compounds.
2. Specifications: Non-shrink grout shall conform to ASTM C 1107.
3. Compressive Strength: Provide the minimum strength as shown below as determined by grout cube tests at 28 days:
 - a. 6,000 PSI for supporting concrete 3,000 PSI and less.
 - b. 8,000 PSI for supporting concrete greater than 3,000 PSI and less than or equal to 4,000 PSI.
 - c. Unless noted otherwise on the drawings, grout strength on supporting concrete greater than 4,000 PSI shall be 8,000 PSI.

PART 3 – EXECUTION

3.1 INSPECTION AND PROTECTION

- A. Notify Engineer minimum 24 hours prior to commencement of concrete placement.
- B. Verify anchors, seats, plates, reinforcement, drains and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete. Provide written verification as well as photographs of the area to be poured.
- C. Insure polyurethane waterstops have been installed for at least 3 hours prior to pour and that rigid waterstop types are continually supported.
- D. Work area and Concrete may be exposed to potentially hazardous damage after initial set has been achieved. Take measures to protect concrete from traffic, ladders, fluids and indentation during initial set and curing. Ladders and all materials with sharp edges must have protective plywood under the rungs or edges.

3.2 PREPARATION

- A. Prepare existing concrete or masonry, for additional concrete by cleaning with steel brush and a neutral pH cleaning solution to insure removal of existing solvents, greases, plant products and other solutions. Apply an ASTM C1059 bonding agent in accordance with manufacturer's instructions.
- B. If concrete is to be placed on top of metal platforms, or decks, prepare metal surface by cleaning with an acid etching solution or vinegar. Do not place concrete if rust or oxidation is present. Notify Architect.
- C. If concrete is a slab to be placed on top of soil, insure that the soil is well compacted to specifications shown in earthwork section and that no debris or organic materials are present. Dampen the surface with water but do not flood.
- D. At any location where new concrete is doweled to existing work, use an adhesive anchoring system. See section 05 12 00.
- E. Protect and tape over all surfaces to be exposed, of all floor drains, openings and devices to be set into the concrete.
- F. Protect all concrete from freezing during placement and initial set. Under no circumstances can concrete be placed on top of frozen soil, snow, ice, and frozen precast or any other frozen object.

3.3 VAPOR RETARDER

- A. For all interior Slab on Grade Concrete with flooring or a finish applied; A vapor retarder shall be placed directly above granular subbase.
- B. Use screed bars and platforms and means / methods keep vapor retarder unbroken.

3.4 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301. Keep an ACI 301 book on site for reference at all times.
 - 1. Do not allow a vertical drop of more than 5'-0" without use of a Tremie to prevent aggregate segregation.
 - 2. Hot Weather Placement: See ACI 305R
 - 3. Cold Weather Placement: See ACI 306R
- B. Ensure reinforcement, inserts, embedded parts, drains and formed joints are not disturbed during concrete placement. If movement occurs the concrete contractor must remove and replace the effected item and the effected concrete.
- C. See section 03 20 00 and structural notes sheet for minimum concrete cover.
- D. Use a minimum 1/8" per foot slope for all floor drains. Pitch entire room slab or maximum area of 20'- 0" and increase to 1/4" per foot of pitch in final 4'-0" of space around the drain. The concrete shall be worked well around all surfaces of the drain fitting.
- E. All slab reinforcing must be on chairs. Hand lifting without supports during pour is prohibited.
- F. Place concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours that would cause new cold joints to occur.
- G. Excessive honeycombing or embedded debris in concrete is not acceptable. Contractor must replace or repair. See section 03 10 00, Part 3 for acceptable finishes.
- H. Concrete may be placed by means of a Concrete pumper. A plasticizer and a decrease in course aggregate size may be used only with permission of the Engineer when pumping is used. Cementitious content will need to be raised if aggregate size is modified. See requirements on slump and super plasticizer in Part 2.
- I. The concrete shall be screeded or struck off slightly above final elevation, then consolidated.
 - 1. Consolidate concrete by vibrating, so that concrete is thoroughly worked around reinforcement, around embedded items and into corners of forms to eliminate air or stone packers that may cause honeycombing, pitting or weakness.
 - a. Vibrating shall be done by experienced workers in a manner to eliminate consolidation. Do not vibrate forms or reinforcing materials.
 - 2. After consolidation the concrete shall not be further worked until finishing.
- J. Do not add water during placement or when finishing.
- K. Depth or thickness of concrete is to be as shown on the plans. No variation in thickness or depth is allowed.
 - 1. Slab concrete that is shown as 4 inches shall not be formed and poured at 3 5/8".
- L. Do not use cement or sand to take up excess surface water.

3.5 HORIZONTAL SURFACE FINISHING (Including interior & exterior floors)

- A. Finish the concrete when the water sheen has disappeared and the surface has stiffened enough to permit the finishing operation. Follow ACI 302.1R.
- B. Types of final finishes are:
 - 1. For all interior flat exposed, resilient tile, or thin set ceramic tile covered floors float and then "Hard Steel Trowel Finish" the concrete surface in accordance with finishing class 5. This is designed to provide a smooth floor. Provide very close surface tolerances and no telegraphing of cementitious surfaces into the tile.
 - a. Use the same finish for carpet covered floors.
 - 2. For all interior floors that will have ceramic or material requiring a grout bed provide only a floated finish with a wood float surface that allows for a level but not perfectly smooth surface. Considered a class 1,2 or 3 surface, but without any final troweling.
 - 3. For all interior concrete that contains air entrainment of 3% or less, an aluminum or magnesium float followed by a "Hard Steel Trowel Finish" shall be applied. Class 2.

4. For all exterior concrete that contains air entrainment, an aluminum or magnesium float followed by a "Light Soft Bristle Broom Finish" shall be applied.
 5. For all interior concrete that requires slip resistance, an aluminum or magnesium float, followed by minimal steel trowling for levelness and a "Light Soft Bristle Broom Finish" shall be applied.
 6. See ACI 302.1R for class 6 and higher floors that are impact, high traffic or super flat.
- B. All concrete horizontal surfaces, including floors must be flat and level. The following chart shows ASTM E1155 values in an average commercial situation for a flat and level floor that shall be followed:
1. F_F defines the maximum floor curvature allowed over successive 24" measurements on a 20'-0" x 20'-0" floor or flat surface. It is concerned with floor waviness.
 2. F_L defines the maximum difference in elevations in decimals of an inch, between two points separated by 10'-0" taken any place on the floor. It is concerned with local levelness.
 3. The specified overall numbers are the maximum obtainable.
 4. The minimum localized numbers are the required expected values for the test section.
- C. A traditional method to determine floor flat and levelness is to place a 10'-0" flat level anywhere on the surface. No more than a 3/16" gap would be measured under the level at any place on the floor or interior or exterior surface. In the chart we have listed this traditional measurement **as a guide only.**
- D. The ASTM system is designed to measure 4 20' x 20' test sections randomly chosen on the floor or surface in question. The Sections should not adjoin each other unless the floor is less than 80'x 80' in size.

Types of concrete Horizontal surfaces & Their Quality Classifications	Minimum FF / FL		Numbers Required	Local Levelness Value	Maximum Clearance
	Overall Flatness Value	Local Flatness Value	Overall Levelness Value		Under a 10' Level
Flat concrete base for grout bed	20	15	15	10	3/8"
Precast Topping Surface	30	20	15	10	3/16"
Raised Slab Surface	30	20	15	10	3/16"
Interior Slab on Grade surface	35	24	30	20	1 / 8"
Exterior & garage floors, stoops, paving surfaces	20	15	13	10	1 / 4"

3.6 CRACKS, EXPANSION, CONSTRUCTION, AND CONTRACTION JOINTS

- A. Horizontal and vertical construction joints in concrete shall be made only where shown for structural drawings and or approved by Engineer. All cold construction joints shall be provided with a suitable bonding agent at all grooves and keyways, and surfaces against which new concrete is to be laid shall be thoroughly cleaned with a stiff wire brush and water.
1. Where smooth dowel construction (cold) joints are used, grease and wrap the exposed end of the dowel to allow horizontal movement.
- B. Expansion joints at edges of the building or bay shall be filled with expansion material to within 3/4" of top of all adjacent slabs or edges and shall be located where shown on

drawings. See Part 2 products for types of materials to use.

- C. Control joints shall be saw cut and located as shown on structural drawings. If not shown cut at intervals of (36 x slab thickness)" by (36 x slab thickness)" (+/- 5'-0"). Locate under wall partitions if possible.
 - 1. Saw cut control joints at an optimum time after finishing. Use 3/16-inch thick blade, cutting at least 1/4 into depth of slab thickness. (i.e.) 4" slab to be cut 1"+ deep. Fill saw cut control joint with a semi rigid joint filler, in accordance with ACI301, section 11.3.9. General Contractor is responsible for joint and semi rigid joint filler condition up to 90 days after building is occupied. After the 90 days, owner is responsible for joint maintenance.
- D. All exposed joints and cracks over 1/16" in interior concrete upon which flooring or colorants are to be applied shall be grouted solid with a cementitious grout acceptable to flooring glue manufacturer. Contractor shall install prior to flooring installation but after initial cracking and movement due to shrinkage is complete. Generally 28 days. See part 2 products for material to use. Coordinate with flooring work. Some products have a limited time for installation of flooring.
 - 1. All joints that are under walls or partitions or are unexposed shall be sealed with a semi rigid joint filler, in accordance with ACI 301, section 11.3.9.

3.7 CONCRETE CURING AND SEALING (See also ACI 308)

- A. All interior and exterior concrete must be kept between 55 and 80 degrees F and in a moist condition, to decrease water evaporation from the exposed surfaces during the first 7 days after placement.
 - 1. For building or shelter-enclosed concrete, Contractor may use temporary heaters provided that he vent all flue gases from units to the outside of the enclosure. Use only fresh outside air for combustion. All heaters of this type must also be equipped with a heat exchanger vented to the outside.
- B. All interior slabs receiving glued down flooring, either on grade or raised, that are enclosed by the building shall be kept between 55° and 80° F and cured in the following manner.
 - 1. Either use the method in Paragraph C.1. below or:
 - 2. After finish troweling apply a resin based dissipating cure product meeting ASTM C309 with no surface residue in a double cross coat application. This will provide moisture retention only. Keep foot and equipment traffic off the slab for 7 days. Use products that do not leave residue on slab surface. See Part 2 Products.
 - 3. **Do not apply to concrete that will have colorant or exposed aggregate.**
- C. All interior slabs, receiving glued down flooring either on grade or raised **that are exposed to weather and not enclosed** by the building during concrete pour and cure shall be kept between 55° and 80° F and cured in the following manner.
 - 1. Cover the slab with wet, non-ink containing burlap or similar material, under a 4-mil thick polyethylene plastic sheeting or a combination burlap / polyethylene cloth to retain moisture. Keep burlap or similar material moist and the slab cured in this manner for 7 days at a temperature range of 55 to 70 degrees F.
 - 2. Install materials to hold down the material.
 - 3. If high early strength, Type III, concrete is used and temperature is kept above 73 degrees the period of time of wet curing required may be reduced to 3 days.
- D. Allow the surface of the concrete to further cure and dry for a period of 28 days prior to exposure to epoxy finishes, flooring glues, hard surface traffic, steel wheels or shovels.
- E. All exterior exposed uncolored vertical or horizontal concrete shall have a white dye release curing compound meeting ASTM C309 Type 2 applied.
 - 1. See Part 2 Products and follow manufacturer recommendations & limitations for their use.
- F. All interior slabs, left uncovered and not receiving any finish, colorant or flooring, either on grade or raised shall have a curing and sealing compound meeting either ASTM C1315 Type 1 or C309 Type 1 applied.
 - 1. See Part 2 Products for type and Architectural Plans for locations.
- G. ***Interior athletic or vehicle traffic*** use uncolored or covered concrete slabs shall have an exterior cure and seal compound meeting ASTM C1315 Type 2 applied. See Part 2 Products for type and Architectural Plans for locations.

3.8 GROUTING OF CORES IN MASONRY UNITS

- A. Fill all cells containing reinforcing with grout once masonry units have reached sufficient strength to resist grout pressure.
 - 1. Grout masonry units in a height that allows full access to each lift's cores. Generally no more than 4'-0" in height each lift.
 - 2. If core fill grout is to be placed in more than one lift, depress level of grout in first row of cells by 2" inches to insure an adequate bond on the following upper masonry layer.
 - 3. At the top surface of the masonry stack bond, strike off any excess material above the surface.
 - 4. At the top surface of the masonry stack bond, strike off any excess material above the surface.
- B. Keep cells to be filled clean.
- C. Center metal bars and dowels in the cells.
- D. Vibrate if necessary to ensure grout has reached entire depth of cell.

3.9 SETTING AND GROUTING OF STRUCTURAL METALS AND BASEPLATES

- A. See section 05 12 00.
- B. Setting of anchor bolts is by this 03 30 00 Section using template, Contract Drawings and reviewed shop drawings from Section 05 12 00.

3.10 TOPPING CONCRETE

- A. Install after all precast is set, all welding is complete and grouting is cured and reached its 28-day strength. (Topping is supplied and installed by this concrete contractor)

3.11 GROUTING OF PRECAST CONCRETE UNITS (Grout is installed by precast erector)

- A. After all erection, bolting and welding of precast units and placement of reinforcing is completed, grout shall be placed. All edges of plank, columns or beams and all metal supports connections or embedments must be grouted full and shall match the level of the adjacent surface. (Grout is supplied and installed by the precast erector.)
 - 1. See heating and covering requirements in 03 41 00 any time temperature of air is below 55F.
 - 2. During summer comply with hot weather precautions stated in ACI 305R.

3.12 FOOTING & FOUNDATION CONCRETE

- A. Do not use earth forms for footings.
- B. Insure that all forms are braced sufficiently to handle weight and shifting from pouring of concrete.
- C. Have an inspection done of all footings prior to pouring this concrete. Correct any reinforcement or form deficiencies prior to pouring. Do not imbed horizontal or cross bracing reinforcing after concrete has been poured. Dowels may be set after pouring but must be placed while concrete is still wet and pliable not after initial set. Drilling in dowels after set is not acceptable.
- D. Use vibration to insure that all concrete is solidly placed and that no voids or honeycombs are allowed to occur.
- E. Insure that top of footing concrete is level and able to receive masonry or concrete foundations without excessive dips or void areas.
- F. Keep forms in place until the concrete is sufficiently strong enough to avoid deflection. See Section 031000.
- G. During backfilling operations, brace foundation walls to prevent flexural distortion in curing concrete.

3.13 EXTERIOR CONCRETE

- A. Insure that surface is not frozen on which concrete is to be poured. Protect finished product from freezing temperatures. See ACI 306 R.
- B. If concrete is placed in hot weather in temperature above 80 degrees, provide protection to all newly poured surfaces. See ACI 305R.
- C. Keep traffic off concrete until 75% of minimum required strength is attained by test.
- D. Follow ADA and local governmental requirements with regard to maintaining proper slope at pedestrian walkways.
- E. Provide a gradual slope to catch basins, drains and similar.

- F. Provide rounded surface to all edges of walks, drives or other horizontal concrete during finishing. Provide a light broom finish to all horizontal exposed surfaces.
- G. See Part 3 horizontal surface finishing for methods of curing and finishing exterior surfaces.

3.14 DEFECTIVE CONCRETE (See Chapter 9 of ACI 301)

- A. Modify or replace concrete not conforming to required levels and lines, thickness, details, and elevations.
- B. Repair or replace concrete not properly placed, indented or damaged, not of the specified type, frozen, spalling, under strength by more than 15%, or improperly cured. Testing agency that designed concrete, Engineer and Architect shall be final arbiters of quality.

3.15 FIELD QUALITY CONTROL

- A. See Division 01 and Part 1 of this specification

3.16 CLEANUP

- A. At completion of each day's work, remove all concrete spillage and splash from adjacent areas and work.
 - 1. If Glass has been effected carefully, remove particles using methods approved by the glazing manufacturer. Do not use products that could etch glass.
 - 2. Provide a disposal place for ready mix truck wash down. Do not allow wash down concrete to be deposited in the street, on finished landscaping or onto other work. Costs of cleanup of improperly disposed of wash down will be deducted from future payment and will include replacement of damaged or soiled property.

END OF SECTION

**SECTION 033511
CONCRETE FLOOR FINISHES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface treatments for concrete floors and slabs.
- B. Liquid densifiers and hardeners.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with concrete floor placement and concrete floor curing.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.05 MOCK-UP

- A. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.
- B. Mock-Up Size: 10 feet (3 m) square.
- C. Locate where directed.
- D. Mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.07 FIELD CONDITIONS

- A. Maintain light level equivalent to a minimum 200 W light source at 8 feet (2.5 m) above the floor surface over each 20 foot (6 m) square area of floor being finished.
- B. Do not finish floors until interior heating system is operational.
- C. Maintain ambient temperature of 50 degrees F (10 degrees C) minimum.

1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective work within a two-year period commencing on the Date of Substantial Completion.
- C. Manufacturer Warranty: Provide two-year manufacturer warranty for concrete floor finishes commencing on the Date of Substantial Completion.

PART 2 PRODUCTS

2.01 DENSIFIERS AND HARDENERS

- A. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set.
 - 1. Composition: Lithium silicate.
 - 2. Products:
 - a. ARDEX Engineered Cements; ARDEX PC-50: www.ardexamericas.com/#sle.
 - b. Euclid Chemical Company; ULTRASIL LI+: www.euclidchemical.com/#sle.
 - c. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; LiON HARD: www.lmcc.com/#sle.
 - d. PROSOCO, Inc; Consolideck LS: www.prosoco.com/consolideck/#sle.
 - e. Surface Koatings, Inc; Aqualon L-100: www.surfkoat.com/#sle.

- f. Substitutions: See Section 016000 - Product Requirements.

2.02 COATINGS

- A. Low Gloss Clear Coating: Transparent, non-yellowing, water- or solvent-based coating.
 - 1. Composition: Acrylic polymer-based.
 - 2. Nonvolatile Content: 15 percent, minimum, when measured by volume.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 GENERAL

- A. Apply materials in accordance with manufacturer's instructions.

3.03 COATING APPLICATION

- A. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.
- B. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

END OF SECTION

**SECTION 042000
UNIT MASONRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete block.
- B. Clay facing brick.
- C. Mortar and grout.
- D. Reinforcement and anchorage.
- E. Flashings.
- F. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 055000 - Metal Fabrications: Loose steel lintels.
- B. Section 061000 - Rough Carpentry: Nailing strips built into masonry.
- C. Section 079200 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- D. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- F. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.
- G. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
- H. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2023.
- I. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.
- J. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- K. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- L. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); 2023.
- M. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- N. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.
- O. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- P. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
- Q. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.
- R. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.
- S. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.04 ADMINISTRATIVE REQUIREMENTS

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

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Samples: Submit panel samples of facing brick units to illustrate color, texture, and extremes of color range.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depth as indicated on drawings for specific locations..
 - 2. Special Shapes: Provide nonstandard blocks configured for corners, lintels, and other detailed conditions.
 - a. Provide bullnose units for outside corners.
 - 3. Load-Bearing Units: ASTM C90, normal weight.
 - a. Hollow block, as indicated.
 - b. Exposed Faces: Manufacturer's standard color and texture where indicated.
 - 4. Nonloadbearing Units: ASTM C129.
 - a. Hollow block, as indicated.
 - b. Normal weight.

2.02 BRICK UNITS

- A. Manufacturers:
 - 1. Belden Brick; _____: www.beldenbrick.com/#sle.
 - 2. Endicott Clay Products Co; Face Brick - FBX: www.endicott.com/#sle.
 - 3. Yankee Hill Brick Mfg. Co; ____: www.yankeehillbrick.com/#sle.
 - 4. Glen-Gery Co..
 - 5. Substitutions: See section 016000 - Product Requirements.
- B. Facing Brick: ASTM C216, Type FBX, Grade SW.
 - 1. Color and texture: To be selected from Manufacturers Full Range. Intended to match existing brick as closely as possible.
 - 2. Nominal size: As indicated on drawings.
 - 3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

2.03 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M, Type N.

- B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
 - 1. Not more than 0.60 percent alkali.
- C. Mortar Aggregate: ASTM C144.
- D. Grout Aggregate: ASTM C404.
- E. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
 - 1. Color(s): As selected by Architect from manufacturer's full range.
- F. Water: Clean and potable.

2.04 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers:
 - 1. Blok-Lok Limited; _____: www.blok-lok.com/#sle.
 - 2. FEROCORPORATION; FEROCORPORATION Thermal Tie _____: www.ferocorp.com/#sle.
 - 3. Hohmann & Barnard, Inc; X-Seal Anchor: www.h-b.com/#sle.
 - 4. TruFast Walls, a division of Altenloh, Brinck & Co. US, Inc; Thermal-Grip MVA: www.trufastwalls.com/#sle.
 - 5. WIRE-BOND; _____: www.wirebond.com/#sle.
 - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi) (280 MPa), deformed billet bars; galvanized.
- C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- D. Single Wythe Joint Reinforcement: ASTM A951/A951M.
 - 1. Type: Truss or ladder.
 - 2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
 - 3. Size: 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not less than 5/8 inch (16 mm) of mortar coverage on each exposure.
- E. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - 1. Anchor plates: Not less than 0.075 inch (1.91 mm) thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
 - 2. Wire ties: Manufacturer's standard shape, 0.1875 inch (4.75 mm) thick.
 - 3. Vertical adjustment: Not less than 3-1/2 inches (89 mm).
- F. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.

2.05 FLASHINGS

- A. Metal Flashing Materials:
- B. Combination Non-Asphaltic Flashing Materials - Stainless Steel:
 - 1. Stainless Steel/Polymer Fabric Flashing - Self-adhering: ASTM A240/A240M; 2 mil (0.05 mm) type 304 stainless steel sheet bonded on inward facing side to a sheet of polymer fabric that has a clear adhesive with a removable release liner.
 - a. Manufacturers:
 - 1) Hohmann & Barnard, Inc; _____: www.h-b.com/#sle.
 - 2) Substitutions: See Section 016000 - Product Requirements.

2.06 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
 - 1. Manufacturers:
 - a. Blok-Lok Limited; _____: www.blok-lok.com/#sle.
 - b. Hohmann & Barnard, Inc; _____: www.h-b.com/#sle.

- c. Substitutions: See Section 016000 - Product Requirements.
- B. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
 - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
 - a. Manufacturers:
 - 1) Advanced Building Products, Inc; Mortar Break DT: www.advancedbuildingproducts.com/#sle.
 - 2) Mortar Net Solutions; MortarNet: www.mortarnet.com/#sle.
 - 3) Substitutions: See Section 016000 - Product Requirements.
- C. Weeps:
 - 1. Type: Polyester mesh.
 - 2. Color(s): As selected by Architect from manufacturer's full range.
 - 3. Manufacturers:
 - a. Blok-Lok Limited; _____: www.blok-lok.com/#sle.
 - b. Mortar Net Solutions; WeepVent: www.mortarnet.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.
- D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.07 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
 - 1. Masonry below grade and in contact with earth: Type M.
 - 2. Exterior, loadbearing masonry: Type S.
 - 3. Exterior, non-loadbearing masonry: Type N or Type S.
 - 4. Interior, loadbearing masonry: Type N or Type S.
 - 5. Interior, non-loadbearing masonry: Type O.
- B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches (50 mm) or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches (50 mm).
- C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- D. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. Maintain materials and surrounding air temperature to minimum 40 degrees F (5 degrees C) prior to, during, and 48 hours after completion of masonry work.
- B. Maintain materials and surrounding air temperature to maximum 90 degrees F (32 degrees C) prior to, during, and 48 hours after completion of masonry work.

3.04 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:

1. Bond: Running.
 2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
 3. Mortar Joints: Concave.
- D. Brick Units:
1. Bond: As indicated for different locations.
 2. Coursing: Three units and three mortar joints to equal 8 inches (200 mm).
 3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

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

3.06 WEEPS/CAVITY VENTS

- A. Install weeps in veneer and cavity walls at 24 inches (600 mm) on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.

3.07 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.08 REINFORCEMENT AND ANCHORAGE - GENERAL

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches (400 mm) on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches (150 mm).

3.09 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches (400 mm) on center vertically and 36 inches (900 mm) on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches (200 mm) on center.
- B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches (400 mm) on center vertically and 24 inches (600 mm) on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches (200 mm) on center.

3.10 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

- B. Extend metal flashings to within 1/2 inch (12 mm) of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.

3.11 GROUTED COMPONENTS

- A. Lap splices minimum 24 bar diameters.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.
- C. Place and consolidate grout fill without displacing reinforcing.

3.12 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

3.13 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

3.14 TOLERANCES

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.
- C. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).
- E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch (minus 6.4 mm, plus 9.5 mm).
- F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch (6 mm).

3.15 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Clean soiled surfaces with cleaning solution.

3.16 PROTECTION

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

END OF SECTION

SECTION 051200
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural steel framing members, support members.
- B. Base plates, expansion joint plates.
- C. Grouting under base plates.

1.02 RELATED REQUIREMENTS

- A. Section 05 3100 - Steel Decking: Support framing for small openings in deck.

1.03 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual; American Institute of Steel Construction, Inc.; 2011.
- B. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc.; 2005.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2012.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2012.
- F. ASTM A514/A514M - Standard Specification for High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding; 2005 (Reapproved 2009).
- G. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011.
- H. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2013.
- I. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.
- J. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc.; 2011.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Submit drawings showing complete details and schedules for fabrication and assembly of structural steel members. Drawings shall include the following minimum information:
 - 1. Details of cuts, connections, camber, holes, and other pertinent data.
 - 2. Indication of welds by standard AWS symbols, and show size, length, and type of each weld.
 - 3. Indication of type, size, and length of bolts, distinguishing between shop and field bolts. Identify the type of high-strength bolted connection (slip-critical, direct-tension, or bearing connections). Indicate locations of pretensioned bolts.
 - 4. Connection material specification and sizes.
 - 5. Joints or groups of joints in which a specific assembly order, welding sequence, welding technique, or other special precautions are required.
 - 6. Holes, flange cuts, slots, and openings shall be made as required by the structural drawings, all of which shall be properly located by means of templates.
 - 7. Setting drawings, templates, and directions for installation of anchor rods and other anchorages to be installed by others.
 - 8. Non-Destructive Testing (NDT) to be performed by the Fabricator, if any.
 - 9. A letter sealed by the Fabricator's Professional Engineer responsible for the design of any of the connections shown on the shop drawings attesting that the engineer has reviewed the shop drawings and that the connections detailed and shown on the shop drawings conform to the engineer's design.
- C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

- D. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.
- E. Erection-Bracing Drawings: Submit, for record purposes only, complete erection-bracing drawings.

1.05 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC "Steel Construction Manual."
- B. Fabricator: The structural steel fabricator shall have not less than 5 years of experience in the successful fabrication of structural steel similar to this project.
- C. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience.
- D. Design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- E. The Professional Engineer employed by the Fabricator for connection design shall be experienced in the specific area of structural steel connection design with demonstrated experience of not less than three projects of similar scope and complexity.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Steel Angles and Plates: ASTM A36/A36M.
- B. Steel W Shapes and Tees: ASTM A992/A992M.
- C. Rolled Steel Structural Shapes: ASTM A992/A992M.
- C. Square and Rectangular HSS: ASTM A500, Grade C (Fy=50 ksi)
- D. Steel Plate: ASTM A514/A514M.
- E. Structural Bolts and Nuts: ASTM F 3125 Grade A325 Type 1 or ASTM F 3125 Grade A490 Type 1
- F. Headed Studs used as Anchors for Structural Steel Plates and Members connecting to Concrete: AWS Type A studs manufactured in conformance with ASTM A 29 with a minimum tensile strength of 61,000 psi of sizes as specified on the drawings.
- G. Headed Studs used as Composite Member Shear Connectors: AWS type B studs manufactured in conformance with ASTM A 29 with a minimum tensile strength of 65,000 psi of sizes as specified on the drawings.
- H. All anchor rods shall conform to ASTM F 1554. unless noted otherwise on the drawings and shall be of the yield strength Grade 36. Substitution for Grade 36 anchor rods with Grade 55 anchor rods shall only be permitted provided the Grade 55 anchor rods comply with Supplementary requirements S1 of ASTM F 1554.
- I. Welding Materials: AWS D1.1; type required for materials being welded.
- J. Grout: Non-shrink, non-metallic aggregate type, complying with ASTM C1107/C1107M and capable of developing a minimum compressive strength of 7,000 psi (48 MPa) at 28 days.
- K. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- C. Fabricate connections for bolt, nut, and washer connectors.
- D. Camber of structural steel members is indicated on the drawings. Camber shall be measured in the Fabricator's shop in the unstressed condition, prior to erection. The Fabricator shall provide camber measurements of all beams and a report to the Testing Laboratory confirming this has been done. Where possible, camber of beams shall be applied by a cold bend process.
- E. Anchor Rods: Furnish anchor rods and other connectors required for securing structural steel to foundations and other in-place work. Furnish 1/8" minimum steel templates for presetting bolts and other anchors to accurate locations.

2.03 CONNECTIONS

- A. The Fabricator's detailer shall complete connection detailing using predesigned connections taken directly from the AISC "Steel Construction Manual".

2.04 FINISH

- A. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.
- B. Coordinate all shop painting of structural steel with Architect's painting requirements as specified on the architectural drawings and in the specifications. The Fabricator shall be responsible for determining all painting requirements (which surfaces are to be painted or left unpainted) on the project prior to fabrication.
- C. All structural steel items and their connections permanently exposed to exterior conditions or that are within areas of unconditioned airspace, whether specified on the drawings or not, shall be hot-dip galvanized after fabrication unless indicated on the drawings or in Specification to receive a primer and/or finish coat.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

- A. Erect structural steel in compliance with AISC "Code of Standard Practice for Steel Buildings and Bridges".
- B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. The Erector shall design and provide all required temporary shoring and bracing to hold structural framing securely in position and to safely withstand all loads as specified in the Code of Standard Practice and ASCE 37 unless larger loads are required by the local building code or specified herein. Provide all bracing, any additional structural members, and increase member sizes and/or connections shown on the drawings as required to accommodate the erection loads, methods, sequence of erection, and equipment until the lateral-load resisting or stability-providing system is completely installed. Clearly show all temporary supports and modifications to designed members on the Shop Drawings and the Erection-bracing Drawings. A qualified licensed professional engineer, hired by the Erector, shall design the temporary shoring and bracing and shall seal the erection-bracing drawings.
- D. Initial Survey: Check elevations of concrete and masonry bearing surfaces, anchor bolt locations, embedded connection plates, and all dimensions of existing structures to which new connections are to be made prior to erection and submit any discrepancies to the Engineer prior to the start of erection. Corrections or compensating adjustments to the structural steel shall be made and approved prior to the start of erection.
- E. Composite Beams:
 - 1. Studs shall be welded in the field (not the shop) using automatically timed stud welding equipment.
 - 2. The top flange of the beams must be unpainted and free of heavy rust, mill scale, dirt, sand or other foreign material which will interfere with the welding operation.
 - 3. The steel deck must be free of dirt, sand, oil, or other foreign material and must be dry and free of moisture. Steel deck must rest tightly on the beam flange. Welding must take place through only one thickness of deck.
 - 4. Stud Spacing: Studs shall be spaced on beams and girders as shown on the drawings
- C. Do not field cut or alter structural members without approval of Architect.
- D. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- E. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4523.

END OF SECTION

**SECTION 053100
STEEL DECKING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof deck.
- C. Composite floor deck.
- C. Supplementary framing for openings up to and including 18 inches (450 mm).
- D. Bearing plates and angles.

1.02 RELATED REQUIREMENTS

- A. Section 05 1200 - Structural Steel Framing: Support framing for openings larger than 18 inches (450 mm) and shear stud connectors.
- B. Section 05 2100 - Steel Joist Framing: Support framing for openings larger than 18 inches (450 mm) and shear stud connectors.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2012.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.
- D. AWS D1.3 - Structural Welding Code - Sheet Steel; American Welding Society; 2008.
- E. SDI (DM) - Publication No.31, Design Manual for Composite Decks, Form Decks, Roof Decks; Steel Deck Institute; 2007.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
- B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
- C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE

- A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Deck:
 - 1. Cordeck, Inc: www.cordeck.com.
 - 2. Nucor-Vulcraft Group: www.vulcraft.com.
 - 3. New Millenium
 - 4. Canam

2.02 STEEL DECK

- A. Non-composite Form Deck Non-composite type, fluted steel sheet:
 - 1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50 zinc coating.
 - 2. Metal Thickness: See Plan
 - 3. Nominal Height: 1 inch (1.0C deck)

4. Formed Sheet Width: 32 inch (minimum)
 5. Side Joints: See plan.
 6. End Joints: See plan.
- B. Roof Deck: Non-composite type, fluted steel sheet:
1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 50, with G90/Z275 galvanized coating.
 2. Minimum Metal Thickness, Excluding Finish: 20 gage (0.8 mm).
 3. Nominal Height: 1-1/2 inch (38 mm).
 4. Profile: Fluted; SDI NR.
 5. Formed Sheet Width: 36 inch (600 mm).
 6. Side Joints: Interlocking Side-lap.
 7. End Joints: Lapped, welded.

2.03 ACCESSORY MATERIALS

- A. Bearing Plates and Angles: ASTM A36/A36M steel, unfinished.
- B. Welding Materials: AWS D1.1.
- C. Fasteners: Galvanized hardened steel, self tapping.
- D. Acoustical Insulation: Glass fiber type, minimum 1.1 lb/cu ft (18 kg/cu m) density; profiled to suit deck.

2.04 FABRICATED DECK ACCESSORIES

- A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gage (0.8 mm) thick sheet steel; of profile and size as indicated; finished same as deck.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

- A. On steel supports provide minimum 1-1/2 inch (38 mm) bearing.
- B. Fasten deck to steel support members at ends and intermediate supports at 12 inches (300 mm) on center maximum, parallel with the deck flute and at each transverse flute using methods specified.
 1. Welding: Use fusion welds through weld washers.
- C. Clinch lock seam side laps.
- D. At welded male/female side laps weld at 18 inches (450 mm) on center maximum.
- E. Weld deck in accordance with AWS D1.3.
- F. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.
- G. Steel Deck Spans: The deck properties shown on the drawings are selected so that the spans do not exceed the maximum clear spans with unshored construction as required by SDI criteria unless indicated otherwise on the drawings. The deck manufacturer shall be responsible for supplying a deck that meets that criterion. Where possible, all steel deck shall extend over three or more spans. Simple span deck will not be permitted unless it is shored at midspan or approved by EOR.

END OF SECTION

**SECTION 061000
ROUGH CARPENTRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Subflooring.
- B. Roofing nailers.
- C. Miscellaneous framing and sheathing.
- D. Communications and electrical room mounting boards.
- E. Concealed wood blocking, nailers, and supports.
- F. Miscellaneous wood nailers, furring, and grounds.
- G. Wall sheathing.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. AWPA U1 - Use Category System: User Specification for Treated Wood; 2024.
- C. PS 20 - American Softwood Lumber Standard; 2021.

1.04 SUBMITTALS

- A. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.
- B. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.
- C. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
- B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

- A. Floor Sheathing: PS 1 or PS 2 type, rated Single Floor.
 - 1. Panel Type: Plywood.
 - 2. Span Rating: 48/24.
 - 3. Performance Category: 23/32 PERF CAT.
 - 4. Edges: Tongue and groove.
- B. Wall Sheathing: Oriented strand board wood structural panel; PS 2.
 - 1. Grade: Sheathing.
 - 2. Performance Category: 1/2 PERF CAT.
 - 3. Edges: Square.
 - 4. See Finish Legend A120 for finish requirements.

2.04 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
- B. Subfloor Adhesives: Gap-filling construction adhesive for bonding wood structural panels to wood-based floor system framing; complying with ASTM D3498.

2.05 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.
- B. Preservative Treatment:
 - 1. Products:
 - a. Lonza Group: www.wolmanizedwood.com/#sle.
 - b. Koppers Performance Chemicals, Inc; ____: www.koppersperformancechemicals.com/#sle.
 - c. Viance, LLC: www.treatedwood.com.
 - d. Osmose, Inc: www.osmose.com.
 - e. Substitutions: See Section 016000 - Product Requirements.
 - 2. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
 - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - b. Treat lumber exposed to weather.
 - c. Treat lumber in contact with roofing, flashing, or waterproofing.

PART 3 EXECUTION

3.01 PREPARATION

- A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches (100 mm) and seal.
- B. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

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

3.03 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- E. See General Notes for special locations of blocking as requested by owner.

3.04 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at each roof opening except where prefabricated curbs are specified and where specifically indicated otherwise; form corners by alternating lapping side members.

3.05 INSTALLATION OF CONSTRUCTION PANELS

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

3.06 CLEANING

- A. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 064100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Hardware.

1.02 RELATED REQUIREMENTS

- A. Section 123600 - Countertops.

1.03 REFERENCE STANDARDS

- A. BHMA A156.9 - Cabinet Hardware; 2020.
- B. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.9).
- C. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
- B. Product Data: Provide data for hardware accessories.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.07 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

- A. Cabinets:
 - 1. Finish - Exposed Exterior Surfaces: Decorative laminate.
 - 2. Finish - Concealed Surfaces: Manufacturer's option.
 - 3. Door and Drawer Front Edge Profiles: 3 mm edge band.
 - 4. Adjustable Shelf Loading: 40 psf (19.5 gm/sq cm).
 - 5. Cabinet Style: Partial Overlay.
 - 6. Drawer Side Construction: Multiple-dovetailed.
 - 7. Drawer Construction Technique: Dovetail joints.

2.02 WOOD-BASED COMPONENTS

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

2.03 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Formica.
 - 2. Substitutions: See Section 016000 - Product Requirements.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

2.04 COUNTERTOPS

- A. Countertops: See Section 123600.

2.05 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Plastic Edge Banding: Extruded PVC, flat shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
 - 1. Color: As indicated on drawings.
- C. Fasteners: Size and type to suit application.
- D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and chrome-plated finish in exposed locations.
- E. Concealed Joint Fasteners: Threaded steel.
- F. Grommets: Standard plastic grommets for cut-outs, in color to match adjacent surface.

2.06 HARDWARE

- A. Hardware: BHMA A156.9, types as indicated for quality grade specified.
- B. Adjustable Shelf Supports: Standard back-mounted system using surface mounted metal shelf standards and coordinated cantilevered shelf brackets, satin chrome, painted, or painted finish, for nominal 1 inch (25 mm) spacing adjustments.
- C. Countertop Supports:
 - 1. Material: Aluminum
 - 2. Finish/Color: Black powdercoat.
 - 3. Manufacturers:
 - a. Rakks/Rangine Corporation; Sill Supports: www.rakks.com/#sle
- D. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers ("U" shaped wire pull, steel with chrome finish, 100 mm centers).
- E. Keyed Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
- F. Cabinet Catches and Latches:
- G. Drawer Slides:
 - 1. Type: Full extension.
 - 2. Static Load Capacity: Commercial grade.
 - 3. Mounting: Side mounted.
 - 4. Stops: Integral type.
 - 5. Manufacturers:
 - a. Accuride International, Inc: www accuride.com.
 - b. Grass America Inc: www.grassusa.com.
 - c. Hettich America, LP: www.hettichamerica.com.
 - d. Knappe & Vogt Manufacturing Company: www.knappeandvogt.com.
 - e. Substitutions: See Section 016000 - Product Requirements.
- H. Hinges: European style concealed self-closing type, steel with nickel-plated finish.
 - 1. Manufacturers:
 - a. Grass America Inc: www.grassusa.com.
 - b. Hardware Resources: www.hardwareresources.com.
 - c. Hettich America, LP; _____: www.hettich.com/#sle.
 - d. Julius Blum, Inc: www.blum.com.
 - e. Substitutions: See Section 016000 - Product Requirements.

2.07 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.
 - 1. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- E. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches (400 mm) on center.
- F. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- B. Use concealed joint fasteners to align and secure adjoining cabinet units.
- C. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim for this purpose.

3.03 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

**SECTION 068316
FIBERGLASS REINFORCED PANELING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fiberglass reinforced plastic panels.
- B. Trim.

1.02 REFERENCE STANDARDS

- A. 9 CFR 416.2 - Regulatory Requirements Under the Federal Meat Inspection Act and the Poultry Products Inspection Act, Part 416-Sanitation; current edition.
- B. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2010 (Reapproved 2018).
- C. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor; 2013a.
- D. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- E. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- G. FM 4880 - Evaluating the Fire Performance of Insulated Building Panel Assemblies and Interior Finish Materials; 2017.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Samples: Submit two samples 6 by 6 inch (____x____ mm) in size illustrating material and surface design of panels.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Panels: Quantity equal to 5 percent of total installed.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fiberglass Reinforced Plastic Panels:
 - 1. Marlite: www.marlite.com/#sle.
 - 2. Creative Panel Solutions: www.creativepanelsolutions.com/#sle
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEMS

- A. FRP Wall Panels FRP-1, 2 & 3:
 - 1. Panel Size: 4 feet x 8 feet.
 - 2. Panel Thickness: 3/32".
 - 3. Color: See Finish Schedule.
 - 4. Style: See Finish Schedule
 - 5. Finish: See Finish Schedule.

2.03 MATERIALS

- A. FRP Panels: Fiberglass reinforced plastic, complying with ASTM D5319.

1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
 2. Class 1 fire rated when tested in accordance with FM 4880.
 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 4. Scratch Resistance: Barcol hardness score greater than 35, when tested in accordance with ASTM D2583.
 5. Impact Strength: Greater than 6 ft lb force per inch (320 J per m), when tested in accordance with ASTM D256.
 6. Sanitation and Cleanability: Comply with 9 CFR 416.2.
- B. Trim: Vinyl; color coordinating with panel.
- C. Adhesive: Type recommended by panel manufacturer.
- D. Sealant: Type recommended by panel manufacturer; white.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - WALLS

- A. Install panels in accordance with manufacturer's instructions.
- B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
- C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
- D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
- E. Install panels with manufacturer's recommended gap for panel field and corner joints.
- F. Place trim on panel before fastening edges, as required.
- G. Fill channels in trim with sealant before attaching to panel.
- H. Install trim with adhesive and screws or nails, as required.
- I. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.
- J. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

**SECTION 072100
THERMAL INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation at cavity wall construction, perimeter foundation wall, underside of floor slabs, and exterior wall behind _____ wall finish.
- B. Batt insulation and vapor retarder in exterior wall construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- D. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024.
- E. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.05 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.
- B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.
- C. Insulation Inside Masonry Cavity Walls: Expanded polystyrene (EPS) board.
- D. Insulation Over Metal Stud Framed Walls, Continuous: Extruded polystyrene (XPS) carbon black board.
- E. Insulation in Metal Framed Walls: Batt insulation with integral vapor retarder.
- F. Insulation over Roof Deck: Extruded polystyrene (XPS) board.

2.02 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.
 - 1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 3. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.0 (0.88), minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
 - 4. R-value (RSI-value); 1 inch (25 mm) of material at 72 degrees F (22 C): 5 (0.88), minimum.

5. Complies with fire resistance requirements indicated on drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
 6. Board Edges: Square.
 7. Water Absorption, Maximum: 0.3 percent, by volume.
 8. Products:
 - a. Dow Chemical Co: www.dow.com.
 - b. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com.
 - c. Substitutions: See Section 016000 - Product Requirements.
- B. Extruded Polystyrene (XPS) Continuous Insulation (CI) Board: Comply with ASTM C578, and manufactured using carbon black technology.
1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 3. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.6 (0.98), minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
 4. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
 5. Board Thickness: 1-3/4 inch (44.5 mm).
 6. Board Edges: Shiplap, at long edges.
- C. Extruded Polystyrene (XPS) Cavity Wall Insulation Board: Comply with ASTM C578, and manufactured using carbon black technology.
1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 3. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.6 (0.98), minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
 4. Board Size: 15-3/4 inch by 96 inch (400 mm by 2440 mm).
 5. Board Thickness: 1-3/4 inch (44.5 mm).
 6. Board Edges: Square.

2.03 MINERAL FIBER BLANKET INSULATION MATERIALS

- A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 4. Formaldehyde Content: Zero.
 5. Facing: Aluminum foil, flame spread 25 rated; one side.
 6. Products:
 - a. CertainTeed Corporation; _____: www.certainteed.com/#sle.
 - b. Johns Manville; _____: www.jm.com/#sle.
 - c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
 7. Substitutions: See Section 016000 - Product Requirements.

2.04 ACCESSORIES

- A. Interior Vapor Retarder: Modified polyethylene/polyacrylate (PE/PA) film reinforced with polyethylene terephthalate (PET) fibers, 12 mil, 0.012 inch (0.30 mm) thick.
1. Width: 4.9 feet (1.5 m).
- B. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.
- C. Nails or Staples: Steel wire; electroplated or galvanized; type and size to suit application.
- D. Wire Mesh: Galvanized steel, hexagonal wire mesh.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Install boards horizontally on foundation perimeter.
 - 1. Butt edges and ends tightly to adjacent boards and to protrusions.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Install boards horizontally on walls.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 BOARD INSTALLATION AT CAVITY WALLS

- A. Install boards to fit snugly between wall ties.
- B. Install boards horizontally on walls.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.05 BOARD INSTALLATION UNDER CONCRETE SLABS

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.06 BOARD INSTALLATION OVER ROOF DECK

- A. Board Installation Over Roof Deck, General:
 - 1. See applicable roofing specification section for specific board installation requirements.
 - 2. Ensure vapor retarder is clean and dry, continuous, and ready for application of roofing system.
 - 3. Fasten insulation to deck in accordance with roofing manufacturer's written instructions.
 - 4. Do not apply more insulation than can be covered with roofing on the same day.

3.07 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.08 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

**SECTION 072119
FOAMED-IN-PLACE INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

1.02 REFERENCE STANDARDS

- A. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- D. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- E. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

1.03 SUBMITTALS

- A. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.
- B. Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

1.04 QUALITY ASSURANCE

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

1.05 FIELD CONDITIONS

- A. Do not install insulation when ambient temperature is lower than 70 degrees F (21 degrees C).
- B. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
- C. Do not apply foam when temperature is within 5 degrees F (2.78 degrees C) of dew point.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Foamed-In-Place Insulation:
 - 1. BASF Corporation; WALLTITE US Series Closed Cell: www.spf.basf.com/#sle.
 - 2. Bayer MaterialScience; EcoBay CC : www.spf.bayermaterialscience.com.
 - 3. Demilec LLC; DEMILEC APX: www.demilec.com/#sle.
 - 4. Henry Company; PERMAX 0.5: www.henry.com.
 - 5. Huntsman Building Solutions; Heatlok HFO Pro: www.huntsmanbuildingsolutions.com/#sle.
 - 6. Johns Manville; JM Corbond High Yield Open-Cell: www.jm.com/#sle.

2.02 MATERIALS

- A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
 - 1. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
 - 2. Closed Cell Content: At least 90 percent.
 - 3. Products:
 - a. Bayer MaterialScience; EcoBay CC: www.spf.bayermaterialscience.com.
 - b. Demilec LLC;; HEATLOK SOY 200 Plus: www.demilec.com/#sle.
 - c. Henry Company; PERMAX 2.0: www.henry.com.
 - d. Icynene Inc; Icynene ProSeal Eco MD-R-210: www.icynene.com.

- e. Johns Manville; JM Corbond IV Closed Cell Spray Polyurethane Foam: www.jm.com/#sle.
- f. Rhino Linings Corporation; ThermalGuard CC2: www.rhino linings.com/#sle.
- g. Substitutions: See Section 016000 - Product Requirements.

2.03 ACCESSORIES

- A. Primer: As required by insulation manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

3.02 PREPARATION

- A. Mask and protect adjacent surfaces from over spray or dusting.
- B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION

- A. Apply insulation in accordance with manufacturer's instructions.
- B. Apply insulation by spray method, to a uniform monolithic density without voids.
- C. Apply to a minimum cured thickness of 3 inch (____ mm).
- D. Patch damaged areas.
- E. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.
- F. Trim excess away for applied trim or remove as required for continuous sealant bead.

3.04 PROTECTION

- A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION

SECTION 072400
EXTERIOR INSULATION AND FINISH SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Composite wall cladding of rigid insulation and reinforced finish coating over cementitious base coat, Class PM.
- B. Drainage and water-resistive barriers behind insulation board.
- C. Incidental uses of same finish coating applied directly to concrete and masonry.

1.02 RELATED REQUIREMENTS

- A. Section 079200 - Joint Sealants: Sealing joints between EIFS and adjacent construction and penetrations through EIFS.

1.03 REFERENCE STANDARDS

- A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- B. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- C. ASTM C297/C297M - Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions; 2016.
- D. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- E. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2022a.
- F. ASTM C1397 - Standard Practice for Application of Class PB Exterior Insulation and Finish Systems (EIFS) and EIFS with Drainage; 2013 (Reapproved 2019).
- G. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2022.
- H. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity; 2015 (Reapproved 2020).
- I. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- J. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
- K. ASTM E2273 - Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies; 2018.
- L. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).
- M. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials; 2021.
- N. ICC-ES AC219 - Acceptance Criteria for Exterior Insulation and Finish Systems; 2009, with Editorial Revision (2022).
- O. ICC-ES AC235 - Acceptance Criteria for EIFS Clad Drainage Wall Assemblies; 2015, with Editorial Revision (2022).
- P. NFPA 259 - Standard Test Method for Potential Heat of Building Materials; 2023, with Errata.
- Q. NFPA 268 - Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source; 2022.
- R. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide data on system materials, product characteristics, performance criteria, and system limitations.
- C. Verification Samples: Submit actual samples of selected coating on specified substrate, minimum 12 inches (300 mm) square, illustrating project colors and textures.

1.05 QUALITY ASSURANCE

- A. Maintain copy of specified installation standard and manufacturer's installation instructions at project site during installation.
- B. EIFS Manufacturer Qualifications: Provide EIFS products other than insulation from the same manufacturer with qualifications as follows:
 - 1. Manufacturer of EIFS products for not less than 5 years.
- C. Insulation Manufacturer Qualifications: Approved by manufacturer of EIFS and approved and labeled under third party quality program as required by applicable building code.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to project site in manufacturer's original, unopened containers with labels intact. Inspect materials and notify manufacturer of any discrepancies.
- B. Storage: Store materials as directed by manufacturer's written instructions.

1.07 FIELD CONDITIONS

- A. Do not prepare materials or apply EIFS under conditions other than those described in the manufacturer's written instructions.
- B. Do not prepare materials or apply EIFS during inclement weather unless areas of installation are protected. Protect installed EIFS areas from inclement weather until dry.
- C. Do not install coatings or sealants when ambient temperature is below 40 degrees F (5 degrees C).
- D. Do not leave installed insulation board exposed to sunlight for extended periods of time.

1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Provide manufacturer's standard material warranty, covering a period of not less than 5 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Exterior Insulation and Finish Systems Manufacturers:
 - 1. Dryvit Systems, Inc; Dryvit Outsulation EIFS, Class PB: www.dryvit.com/#sle.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.02 EXTERIOR INSULATION AND FINISH SYSTEM

- A. Exterior Insulation and Finish System: DRAINAGE type; reinforced finish coating on flat-backed insulation board adhesive-applied directly to water-resistive coating over substrate; provide a complete system that has been tested to show compliance with the following characteristics; include all components of specified system and substrate(s) in tested samples.
- B. Fire Characteristics:
 - 1. Flammability: Pass, when tested in accordance with NFPA 285.
 - 2. Ignitibility: No sustained flaming when tested in accordance with NFPA 268.
 - 3. Potential Heat of Foam Plastic Insulation Tested Independently of Assembly: No portion of the assembly having potential heat that exceeds that of the insulation sample tested for flammability (above), when tested in accordance with NFPA 259 with results expressed in Btu per square foot (mJ/sq m).
- C. Adhesion of Water-Resistive Coating to Substrate: For each combination of coating and substrate, minimum flatwise tensile bond strength of 15 psi (105 kPa), when tested in accordance with ASTM C297/C297M.
- D. Adhesion to Water-Resistive Coating: For each combination of insulation board and substrate, when tested in accordance with ASTM C297/C297M, maximum adhesive failure of 25 percent

unless flatwise tensile bond strength exceeds 15 psi (105 kPa) in all samples.

- E. Water Penetration Resistance: No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes, when tested in accordance with ASTM E331 at 6.24 psf (299 Pa) differential pressure with tracer dye in the water spray; include in tested sample at least two vertical joints and one horizontal joint of same type to be used in construction; disassemble sample if necessary to determine extent of water penetration.
- F. Drainage Efficiency: Average minimum efficiency of 90 percent, when tested in accordance with ASTM E2273 for 75 minutes.
- G. Salt Spray Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 300 hours exposure in accordance with ASTM B117, using at least three samples matching intended assembly, at least 4 by 6 inches (100 by 150 mm) in size.
- H. Freeze-Thaw Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 10 cycles, when tested in accordance with ICC-ES AC219 or ICC-ES AC235.
- I. Weathering Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 2000 hours of accelerated weathering conducted in accordance with ASTM G153 Cycle 1 or ASTM G155 Cycles 1, 5, or 9.
- J. Water Degradation Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 14 days exposure, when tested in accordance with ASTM D2247.
- K. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D3273.
- L. Abrasion Resistance Of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D968 with 113.5 gallons (500 liters) of sand.

2.03 MATERIALS

- A. Finish Coating Top Coat: Water-based, air curing, acrylic or polymer-based finish with integral color and texture.
 - 1. Texture: Sto Corp; Polymer-Enhanced Acrylic Stolit 1.0 Fine: www.stocorp.com/#sle.
 - 2. Color: As selected by Architect from manufacturer's full range.
- B. Base Coat: Acrylic- or polymer-modified, fiber reinforced Portland cement coating, Class PM.
 - 1. Portland Cement: ASTM C150/C150M, Type I or II.
 - 2. Base Coat Thickness: 1/4 inch (6 mm), minimum.
 - 3. Products:
 - a. Substitutions: See Section 016000 - Product Requirements.
- C. Reinforcing Mesh: Balanced, open weave glass fiber fabric, treated for compatibility and improved bond with coating, weight, strength, and number of layers as required to meet required system impact rating.
- D. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578, with natural skin surfaces.
 - 1. Board Size: 48 by 96 inch (1220 by 2440 mm).
 - 2. Board Size Tolerance: 1/16 inch (1.5 mm) from square and dimension.
 - 3. Board Thickness: As indicated on drawings.
- E. Water-Resistive Barrier Coating: Fluid-applied air and water barrier membrane; applied to sheathing; furnished or approved by EIFS manufacturer.

2.04 ACCESSORIES

- A. Insulation Adhesive: Type required by EIFS manufacturer for project substrate.
- B. Trim: EIFS manufacturer's standard PVC or galvanized steel trim accessories, as required for a complete project and including starter track and drainage accessories.

- C. Sealant Materials: Compatible with EIFS materials and as recommended by EIFS manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate is sound and free of oil, dirt, other surface contaminants, efflorescence, loose materials, or protrusions that could interfere with EIFS installation and is of a type and construction that is acceptable to EIFS manufacturer. Do not begin work until substrate and adjacent materials are complete and thoroughly dry.
- B. Verify that substrate surface is flat, with no deviation greater than 1/4 in (6 mm) when tested with a 10 ft (3 m) straightedge.

3.02 PREPARATION

- A. Install self-furring metal lath over solid substrates that are deemed unacceptable to receive adhesively applied insulation. Install in accordance with ASTM C1063, except for butt-lapping instead of overlapping.
 - 1. Attach to concrete and concrete masonry using corrosion-resistant power or powder actuated fasteners or hardened concrete stub nails not less than 3/4 inch (19 mm) long and with heads not less than 3/8 inch (9.5 mm) wide. Ensure that fasteners are securely attached to substrate and spaced at maximum 16 inches (406 mm) on center horizontally and 7 inches (178 mm) vertically.
- B. Apply primer to substrate as recommended by EIFS manufacturer for project conditions.

3.03 INSTALLATION - GENERAL

- A. Install in accordance with EIFS manufacturer's instructions and ASTM C1397.
 - 1. Where different requirements appear in either document, comply with the most stringent.
 - 2. Neither of these documents supercedes provisions of Contract Documents that defines contractual relationships between parties or scope of this work.

3.04 INSTALLATION - WATER-RESISTIVE BARRIER

- A. Apply barrier coating as recommended by coating manufacturer; prime substrate as required before application.
- B. Seal substrate transitions and intersections with other materials to form continuous water-resistive barrier on exterior of sheathing, using method recommended by manufacturer.
- C. At door and window rough openings and other wall penetrations, seal water-resistive barrier and flexible flashings to rough opening before installation of metal flashings, sills, or frames, using method recommended by manufacturer.
- D. Lap flexible flashing or flashing tape at least 2 inches (50 mm) on each side of joint or transition.

3.05 INSTALLATION - INSULATION

- A. Install in accordance with manufacturer's instructions.
- B. Install back wrap reinforcing mesh at all openings and terminations that are not to be protected with trim.
- C. On wall surfaces, install boards horizontally.
- D. Place boards in a method to maximize tight joints. Stagger vertical joints and interlock at corners. Butt edges and ends tight to adjacent board and to protrusions. Achieve a continuous flush insulation surface, with no gaps in excess of 1/16 inch (1.6 mm).
- E. Fill gaps greater than 1/16 inch (1.6 mm) with strips or shims cut from the same insulation material.
- F. Rasp irregularities off surface of installed insulation board.

3.06 INSTALLATION - CLASS PB FINISH

- A. Base Coat: Apply in thickness as necessary to fully embed reinforcing mesh, wrinkle free, including back-wrap at terminations of EIFS. Install reinforcing fabric as recommended by EIFS

manufacturer.

1. Lap reinforcing mesh edges and ends a minimum of 2-1/2 inches (64 mm).
 2. Allow base coat to dry a minimum of 24 hours before next coating application.
- B. Apply finish coat after base coat has dried not less than 24 hours, embed finish aggregate, and finish to a uniform texture and color.
- C. Seal control and expansion joints within the field of exterior finish and insulation system, using procedures recommended by sealant and finish system manufacturers.

3.07 CLEANING

- A. See Section 017000 - Execution and Closeout Requirements for additional requirements.
- B. Clean EIFS surfaces and work areas of foreign materials resulting from EIFS operations.

3.08 PROTECTION

- A. Protect completed work from damage and soiling by subsequent work.

END OF SECTION

**SECTION 072500
WEATHER BARRIERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air Barriers: Materials that form a system to stop passage of air through exterior walls.

1.02 DEFINITIONS

- A. Air Barrier: Air tight barrier made of amterial that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermedable air barriers are classified as vapor retarders.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on material characteristics.
- C. Shop Drawings: Provide drawings of special joint conditions.
- D. Manufacturer's Installation Instructions: Indicate preparation.

1.05 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

PART 2 PRODUCTS

2.01 AIR BARRIER MATERIALS(WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

- A. Water Vapor Permeance: 5 perms, minimum, when tested in accordance with ASTM
- B. E96/E96M Procedure A (Desiccant Method) at 73.4 degrees F.
- C. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for
- D. up to 180 days of weather exposure.
- E. Surface Burning Characteristics: Flame spread index of 25 or less, and smoke
- F. developed index of 50 or less, when tested in accordance with ASTM E84.
- G. Seam and Perimeter Tape: Polyethylene self adhering type, mesh reinforced, 2
- H. inches wide, compatible with sheet material; unless otherwise specified.
- I. Manufacturers:
 - 1. a. Carlisle Coatings and Waterproofing, Inc: www.carlisleccw.com/#sle.
 - 2. b. DuPont de Nemours, Inc; Tyvek Commercial Wrap with Tyvek Tape:www.dupont.com/#sle.
 - 3. Kimberly-Clark, distributed by Wolf Home Products: www.wolfhomeproducts.com/#sle.
 - 4.
 - 5. National Shelter Products, Inc: www.drylinewrap.com/#sle.
 - 6. VaproShield, LLC: www.vaproshield.com/#sle.
 - 7. Substitutions: See Section 016000 - Product Requirements.

2.02 ACCESSORIES

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and conditions comply with requirements of this section.

3.02 INSTALLATION

- A. Install materials in accordance with manufacturer's installation instructions.
- B. Openings and Penetrations in Exterior Water-Resistive Barriers:
 - 1. Install flashing over sills, covering entire sill framing member, and extend at least 5 inches (127 mm) onto water-resistive barrier and at least 6 inches (152 mm) up jambs; mechanically fasten stretched edges.
 - 2. At openings filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches (100 mm) wide; do not seal sill flange.
 - 3. At openings filled with nonflanged frames, seal water-resistive barrier to each side of framing at opening using flashing at least 9 inches (230 mm) wide, and covering entire depth of framing.
 - 4. At head of openings, install flashing under water-resistive barrier extending at least 2 inches (50 mm) beyond face of jambs; seal water-resistive barrier to flashing.
 - 5. At interior face of openings, seal gaps between window and door frames and rough framing using appropriate joint sealant over backer rod.
 - 6. Service and Other Penetrations: Form flashing around penetrating items and seal to surface of water-resistive barrier.

3.03 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

**SECTION 074113
METAL ROOF PANELS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Architectural roofing system of preformed steel panels.
- B. Fastening system.
- C. Factory finishing.
- D. Accessories and miscellaneous components.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Roof sheathing.
- B. Section 072100 - Thermal Insulation: Rigid roof insulation.
- C. Section 079200 - Joint Sealants: Sealing joints between metal roof panel system and adjacent construction.

1.03 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. ICC-ES AC188 - Acceptance Criteria for Roof Underlayments; 2023.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Storage and handling requirements and recommendations.
 - 2. Installation methods.
 - 3. Specimen warranty.
- C. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
 - 1. Show work to be field-fabricated or field-assembled.
- D. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches (305 mm) square, representing actual roofing metal, thickness, profile, color, and texture.
 - 1. Include typical panel joint in sample.
- F. Manufacturer Qualification Statement: Provide documentation showing metal roof panel fabricator is accredited under IAS AC472.
- G. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in the manufacture of roofing systems similar to those required for this project.
 - 1. Not less than 5 years of documented experience.

- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of 5 year period from date of Substantial Completion.
- C. Waterproofing Warranty: Provide manufacturer's warranty for weathertightness of roofing system, including agreement to repair or replace roofing that fails to keep out water within specified warranty period of 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Roof Panels:
 - 1. Berridge Manufacturing Company: www.berridge.com/#sle.
 - 2. Morin Corporation: www.morincorp.com/#sle.
 - 3. Metal Sales: <https://www.metalsales.us.com/#sle>.
 - 4. Substitutions: See Section 016000 - Product Requirements.

2.02 ARCHITECTURAL METAL ROOF PANELS

- A. Architectural Metal Roofing: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.
- B. Metal Panels: Factory-formed panels with factory-applied finish.
 - 1. Steel Panels:
 - a. Zinc-coated steel complying with ASTM A653/A653M; minimum G60 (Z180) galvanizing.
 - b. Steel Thickness: Minimum 24 gage (0.024 inch) (0.61 mm).
 - 2. Profile: Match existing profile, coordinate with Architect for final selection.
 - 3. Length: Maximum possible length to minimize lapped joints. Where lapped joints are unavoidable, space laps so that each sheet spans over three or more supports.
 - 4. Width: Maximum panel coverage of 12 inches (305 mm).

2.03 ATTACHMENT SYSTEM

- A. Match attachment of existing roofing system.
- B. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.
- C. Exposed System: Provide manufacturer's recommended stainless steel fasteners engineered to meet performance requirements and equipped with appropriate sealant separators to provide weathertight connections that will accommodate anticipated thermal movement.

2.04 FABRICATION

- A. Panels: Provide factory or field fabricated panels with applied finish and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.
- B. Joints: Provide captive gaskets, sealants, or separator strips at panel joints to ensure weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

2.05 PANEL FINISH

- A. Custom Fluoropolymer Coating System: Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, including minimum 70 percent PVDF color topcoat and minimum total dry film thickness of 0.9 mil (0.023 mm); color and gloss to match existing panels, coordinate with Architect for final selection.

2.06 ACCESSORIES AND MISCELLANEOUS ITEMS

- A. Miscellaneous Sheet Metal Items: Provide flashings, trim, moldings, closure strips, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.
 - 1. Downspouts: Open face, rectangular profile.
- B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.
- C. Sealants:
 - 1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
 - 2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
 - 3. Seam Sealant: Factory-applied, non-skinning, non-drying type.
- D. Underlayment: Self-adhering rubber-modified asphalt sheet complying with ASTM D1970/D1970M; 22 mil (0.55 mm) total thickness; with strippable release film and woven polypropylene sheet top surface.
 - 1. Minimum Requirements: Comply with requirements of ICC-ES AC188 for non-self-adhesive sheet.
 - 2. Sheet Thickness: 22 mil (0.022 inch) (0.55 mm) minimum total thickness.
 - 3. Self Sealability: Passing nail sealability test specified in ASTM D1970/D1970M.
 - 4. Low Temperature Flexibility: Passing test specified in ASTM D1970/D1970M.
 - 5. Water Vapor Permeance: 0.067 perm (38 ng/(Pa s sq m)), maximum, when tested in accordance with ASTM E96/E96M Procedure A (desiccant method).
 - 6. Products:
 - a. Henry Company: www.henry.com/#sle.
 - b. Polyglass USA, Inc: www.polyglass.us/#sle.
 - c. System Components Corporation, Inc: www.systemcomponents.net/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.

2.07 FABRICATION

- A. Panels: Fabricate panels and accessory items at factory, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.
- B. Joints: Factory-install captive gaskets, sealants, or separator strips at panel joints to provide weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Broom clean wood sheathing prior to installation of roofing system.
- B. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to assure that the completed roof will be free of leaks.
- C. Remove protective film from surface of roof panels immediately prior to installation. Strip film carefully, to avoid damage to prefinished surfaces.
- D. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by roof panel manufacturer.

- E. Where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

- A. Overall: Install roofing system in accordance with approved shop drawings and panel manufacturer's instructions and recommendations, as applicable to specific project conditions. Anchor all components of roofing system securely in place while allowing for thermal and structural movement.
 - 1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
 - 2. Install roofing system with exposed fasteners prefinished to match panels.
 - 3. Minimize field cutting of panels. Where field cutting is absolutely required, use methods that will not distort panel profiles. Use of torches for field cutting is absolutely prohibited.
- B. Accessories: Install all components required for a complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.
- C. Roof Panels: Install panels in strict accordance with manufacturer's instructions, minimizing transverse joints except at junction with penetrations.
 - 1. Install sealant or sealant tape, as recommended by panel manufacturer, at end laps and side joints.

3.04 CLEANING

- A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.05 PROTECTION

- A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.
- B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION

**SECTION 074213
METAL WALL PANELS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured metal panels for walls, with related flashings and accessory components.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wall panel substrate.
- B. Section 072500 - Weather Barriers: Weather barrier under wall panels.
- C. Section 079200 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
 - 1. Physical characteristics of components shown on shop drawings.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation instructions and recommendations.
- C. Shop Drawings: Indicate dimensions, layout, joints, construction details, methods of anchorage.
- D. Samples: Submit one samples of wall panel, 12 inch (____ mm) by 12 inch (____ mm) in size illustrating finish color, sheen, and texture.
- E. Test Reports: Submit test report verifying compliance with NFPA 285 for previously-tested exterior wall assembly.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- B. Store prefinished material off ground and protected from weather. Prevent twisting, bending, or abrasion, and provide ventilation to stored materials. Slope metal sheets to ensure drainage.
- C. Prevent contact with materials that may cause discoloration or staining of products.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion, including defects in water tightness and integrity of seals for metal wall panels.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers:
 - 1. Centria: www.centria.com.
 - 2. MBCI: www.mbc.com.
 - 3. Alucobond Plus; 4mm ACM.
 - 4. Petersen Aluminum Corporation: www.pac-clad.com.
 - 5. Metal Sales: <https://www.metalsales.us.com/#sle>.
 - 6. Substitutions: See Section 016000 - Product Requirements.

2.02 MANUFACTURED METAL PANELS

- A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
 - 1. Provide exterior panels and interior liner panels.
 - 2. Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall.
 - 3. Maximum Allowable Deflection of Panel: 1/90 of span.
 - 4. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement within system; movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
 - 5. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
 - 6. Corners: Factory-fabricated in one continuous piece with minimum 18 inch (450 mm) returns.
 - 7. Exterior Finish: Panel manufacturer's standard polyvinylidene fluoride (PVDF) coating, top coat over epoxy primer.
- B. Exterior Panels:
 - 1. Panel Depth: 1-1/4"; nominal.
 - 2. Aluminum Plate: Tension-leveled, flouropolymer PVDF painted finish, 3003-H14 manganese alloy.
 - a. Thickness: 12 gauge, .080 inch, minimum.
 - 3. Color: As selected from manufacturer's full range.
- C. Interior Liner Panels:
 - 1. Profile: Vertical.
 - 2. Side Seams: Interlocking, sealed with continuous bead of sealant.
 - 3. Material: Precoated steel sheet, 26 gage, 26 inch (___ mm) minimum thickness.
 - 4. Color: As selected by Architect from manufacturer's standard line.
- D. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.
- E. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
- F. Anchors: Galvanized steel.

2.03 MATERIALS

- A. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Structural Steel (SS) or Forming Steel (FS), with G90/Z275 coating; continuous coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.
- B. Precoated Aluminum Sheet: ASTM B209 (ASTM B209M), 3105 alloy, O temper, smooth surface texture; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.04 FINISHES

- A. Panel Backside Finish: Panel manufacturer's standard siliconized polyester wash coat.
- B. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch (0.023 mm); color and gloss as selected by Architect from manufacturer's standard line.

2.05 ACCESSORIES

- A. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.
- B. Sealants:
 - 1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
 - 2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
- C. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized. Fastener cap same color as exterior panel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that building framing members are ready to receive panels.
- B. Verify that water-resistive barrier has been installed over substrate completely and correctly.

3.02 PREPARATION

- A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane. Space at 24 inches on center, maximum (at 610 mm on center, maximum).

3.03 INSTALLATION

- A. Install panels on walls in accordance with manufacturer's instructions.
- B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.
- C. Fasten panels to structural supports; aligned, level, and plumb.
- D. Use concealed fasteners unless otherwise approved by Architect.

3.04 TOLERANCES

- A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch (1.6 mm).
- B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch (6.4 mm).

3.05 CLEANING

- A. Remove site cuttings from finish surfaces.
- B. Remove protective material from wall panel surfaces.
- C. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

END OF SECTION

**SECTION 076200
SHEET METAL FLASHING AND TRIM**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, and downspouts.
- B. Sealants for joints within sheet metal fabrications.
- C. Accessories.
- D. Precast concrete splash pads.
- E. Section 061000 - Rough Carpentry: Wood nailers for sheet metal work.
- F. Section 079200 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

1.02 REFERENCE STANDARDS

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).
- E. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Samples: Submit one samples 12x12 inch (____x____ mm) in size illustrating metal finish color.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with CDA A4050, SMACNA (ASMM), CDA A4050, and SMACNA (ASMM) requirements and standard details, except as otherwise indicated.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 SHEET MATERIALS

- A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage (0.0239 inch) (0.61 mm) thick base metal.
- B. Pre-Finished Aluminum: ASTM B209 (ASTM B209M); 20 gage (0.032 inch) (0.81 mm) thick; plain finish shop pre-coated with modified silicone coating.
 - 1. Modified Silicone Polyester Coating: Pigmented Organic Coating System, AAMA 2603; baked enamel finish system.

2.02 ACCESSORIES

- A. Fasteners: Galvanized steel , with soft neoprene washers.
- B. Primer: Zinc chromate type.

- C. Protective Backing Paint: Zinc molybdate alkyd.
- D. Sealant to be Concealed in Completed Work: Non-curing butyl sealant.
- E. Sealant to be Exposed in Completed Work: ASTM C920; elastomeric sealant, 100 percent silicone with minimum movement capability of plus/minus 25 percent and recommended by manufacturer for substrates to be sealed; clear.
- F. Sealant: specified in Section **079200**.
- G. Plastic Cement: ASTM D4586, Type I.

2.03 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18 inch (450 mm) long legs; seam for rigidity, seal with sealant.
- F. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

2.04 GUTTER AND DOWNSPOUT FABRICATION

- A. Gutters: SMACNA (ASMM), Rectangular profile. Color to match existing.
- B. Downspouts: Rectangular profile. Open faced; Color to match existing.
- C. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM).
- D. Accessories: Profiled to suit gutters and downspouts.
 1. Anchorage Devices: In accordance with SMACNA requirements.
 2. Gutter Supports: Brackets.
 3. Downspout Supports: Brackets.
- E. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3000 psi (21 MPa) at 28 days, with minimum 5 percent air entrainment.
- F. Downspout Boots: Steel.

2.05 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Primer: Zinc chromate type.
- C. Concealed Sealants: Non-curing butyl sealant.
- D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- E. Plastic Cement: ASTM D4586/D4586M, Type I.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil (0.4 mm).

3.03 INSTALLATION

- A. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Seal metal joints watertight.
- E. Connect downspouts to downspout boots, and seal connection watertight.
- F. Set splash pads under downspouts.

END OF SECTION

SECTION 078400 FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

- A. Section 092116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
- D. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2023b.
- E. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2023a.
- F. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.
- G. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- C. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.

1.06 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Manufacturers:
 - 1. A/D Fire Protection Systems Inc.; _____: www.adfire.com.
 - 2. 3M Fire Protection Products; _____: www.3m.com/firestop.
 - 3. Hilti, Inc: www.us.hilti.com/#sle.
 - 4. Nelson FireStop Products; _____: www.nelsonfirestop.com.
 - 5. Specified Technologies, Inc.; _____: www.stifirestop.com.
- B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- C. Fire Ratings: Refer to drawings for required systems and ratings.

2.02 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
- B. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.
- C. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

2.03 FIRESTOPPING FOR FLOOR-TO-FLOOR, FLOOR-TO-WALL, HEAD-OF-WALL, AND WALL-TO-WALL JOINTS

- A. Gypsum Board Walls:
 - 1. Wall-to-Wall Joints That Have Movement Capabilities (Dynamic-D):
 - a. 2 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
 - b. 1 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.

2.04 FIRESTOPPING PENETRATIONS THROUGH CONCRETE AND CONCRETE MASONRY CONSTRUCTION

- A. Blank Openings:
 - 1. In Walls:
 - a. 2 Hour Construction: UL System C-AJ-0090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- B. Penetrations Through Walls By:
 - 1. Multiple Penetrations in Large Openings:
 - a. 2 Hour Construction: UL System C-AJ-8143; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - 2. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System C-AJ-1226; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - 3. Electrical Cables Not In Conduit:
 - a. 2 Hour Construction: UL System C-AJ-3283; Hilti CP653 Speed Sleeve.
 - 4. Insulated Pipes:
 - a. 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE IMAX Intumescent Firestop Sealant.
 - 5. HVAC Ducts, Uninsulated:
 - a. 2 Hour Construction: UL System C-AJ-7111; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.05 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

- A. Blank Openings:
 - 1. 2 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
 - 2. 1 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
- B. Penetrations By:
 - 1. Multiple Penetrations in Large Openings:
 - a. 2 Hour Construction: UL System W-L-8079; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 1 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - c. 1 Hour Construction: UL System W-L-8013; Hilti CFS-BL Firestop Block.
 - 2. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 1 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - 3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:

- a. 2 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- b. 1 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- 4. Electrical Cables Not In Conduit:
 - a. 2 Hour Construction: UL System W-L-3065; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CD 601S Elastomeric Firestop Sealant, or CP 618 Firestop Putty Stick.
 - b. 1 Hour Construction: UL System W-L-3065; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CD 601S Elastomeric Firestop Sealant, or CP 618 Firestop Putty Stick.
- 5. Insulated Pipes:
 - a. 2 Hour Construction: UL System W-L-5029; Hilti FS-ONE Intumescent Firestop Sealant.
 - b. 1 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.06 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
 - 1. Fire Ratings: See drawings for required systems and ratings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

3.04 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

**SECTION 079005
JOINT SEALERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Precompressed foam sealers.

1.02 REFERENCE STANDARDS

- A. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- E. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics.
- C. Samples: Submit two samples, 1/2 x 1/2 inch (____x____ mm) in size illustrating sealant colors for selection.
- D. Manufacturer's Installation Instructions: Indicate special procedures.

1.05 FIELD CONDITIONS

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

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Gunnable and Pourable Sealants:
 - 1. Adhesives Technology Corporation: www.atc.ws.
 - 2. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
 - 3. Bostik Inc: www.bostik-us.com.
 - 4. ARDEX Engineered Cements: www.ardexamericas.com.
 - 5. Dow Corning Corporation: www.dowcorning.com.
 - 6. Hilti, Inc: www.us.hilti.com.
 - 7. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
 - 8. Pecora Corporation: www.pecora.com.
 - 9. The QUIKRETE Companies: www.quikrete.com.
 - 10. Red Devil: www.reddevil.com.
 - 11. Tremco Global Sealants: www.tremcosealants.com.
 - 12. Sherwin-Williams Company: www.sherwin-williams.com.
 - 13. Sika Corporation: www.usa-sika.com.
 - 14. W.R. Meadows, Inc: www.wrmeadows.com.
 - 15. Substitutions: See Section 016000 - Product Requirements.
- B. Preformed Compressible Foam Sealers:
 - 1. EMSEAL Joint Systems, Ltd: www.emseal.com.

2. Sandell Manufacturing Company, Inc: www.sandellmfg.com.
3. Dayton Superior Corporation: www.daytonsuperior.com.
4. Tremco Global Sealants: www.tremcosealants.com.
5. Substitutions: See Section 016000 - Product Requirements.

2.02 SEALANTS

- A. General Purpose Exterior Sealant: Polyurethane; ASTM C920, Grade NS, Class 25 minimum; Uses M, G, and A; single component.
 1. Color: To be selected by Architect from manufacturer's standard range.
 2. Applications: Use for:
 - a. Control, expansion, and soft joints in masonry.
 - b. Joints between concrete and other materials.
 - c. Joints between metal frames and other materials.
 - d. Other exterior joints for which no other sealant is indicated.
- B. Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, nondrying, nonskinning, noncuring.
 1. Applications: Use for:
 - a. Concealed sealant bead in sheet metal work.
 - b. Concealed sealant bead in siding overlaps.
- C. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
 1. Color: To be selected by Architect from manufacturer's full range.
 2. Applications: Use for:
 - a. Interior wall and ceiling control joints.
 - b. Joints between door and window frames and wall surfaces.
 - c. Other interior joints for which no other type of sealant is indicated.
- D. Bathtub/Tile Sealant: White silicone; ASTM C920, Uses I, M and A; single component, mildew resistant.
 1. Applications: Use for:
 - a. Joints between plumbing fixtures and floor and wall surfaces.
 2. Products:
 - a. Bostik Inc: www.bostik-us.com.
 - b. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
 - c. Pecora Corporation; 898NST Sanitary Silicone Sealant - Class 50: www.pecora.com.
 - d. Tremco Global Sealants; ____: www.tremcosealants.com.
 - e. Substitutions: See Section 016000 - Product Requirements.
- E. Acoustical Sealant for Concealed Locations:
 1. Composition: Acrylic latex emulsion sealant.
 2. Applications: Use for concealed locations only:
 - a. Sealant bead between top stud runner and structure and between bottom stud track and floor.
 3. Products:
 - a. Bostik Inc: www.bostik-us.com.
 - b. Pecora Corporation; AIS-919 Acoustical and Insulation Latex Sealant: www.pecora.com.
 - c. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
 - d. Tremco Global Sealants: www.tremcosealants.com.
 - e. Hilti, Inc.; CP 506 Smoke and Acoustical Sealant: www.us.hilti.com.
 - f. Substitutions: See Section 016000 - Product Requirements.
- F. Polyurea Concrete Floor Joint Filler: Self-leveling, pourable, semi-rigid sealant intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
 1. Composition: Single or multi-part, 100 percent solids by weight.
 2. Hardness: 75, minimum, after 7 days, when tested in accordance with ASTM D2240 Shore A.

2.03 ACCESSORIES

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

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Install bond breaker where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- G. Tool joints concave.
- H. Concrete Floor Joint Filler: Install concrete floor joint filler per manufacturer's written instructions. After floor joint filler is fully cured, shave joint filler flush with top of concrete slab.

3.04 CLEANING

- A. Clean adjacent soiled surfaces.

3.05 PROTECTION

- A. Protect sealants until cured.

END OF SECTION

**SECTION 081113
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Fire-rated hollow metal doors and frames.
- D. Thermally insulated hollow metal doors with frames.
- E. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

- A. Section 087100 - Door Hardware.
- B. Section 088000 - Glazing: Glass for doors and borrowed lites.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- I. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
- J. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- K. ASTM C1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus; 2011.
- L. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- M. ITS (DIR) - Directory of Listed Products; Current Edition.
- N. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.
- O. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- P. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- Q. UL (DIR) - Online Certifications Directory; Current Edition.
- R. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

1.05 QUALITY ASSURANCE

- A. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. De La Fontaine Inc: www.delafontaine.com/#sle.
 - 3. Republic Doors: www.republicdoor.com.
 - 4. Steelcraft, an Allegion brand: www.allegion.com/#sle.
 - 5. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Finish: Factory primed, for field finishing.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Exterior Doors: Thermally insulated.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 - Standard-duty.
 - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 20 gauge, 0.032 inch (0.8 mm), minimum.
 - 2. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
 - 3. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvanized) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
 - 4. Insulating Value: U-value of 0.50, when tested in accordance with ASTM C1363.
- B. Interior Doors, Non-Fire-Rated:
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 - Standard-duty.
 - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 20 gauge, 0.032 inch (0.8 mm), minimum.
 - 2. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
- C. Fire-Rated Doors:
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 - Standard-duty.

- b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
- c. Model 1 - Full Flush.
- d. Door Face Metal Thickness: 20 gauge, 0.032 inch (0.8 mm), minimum.
- 2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 - a. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - b. Attach fire rating label to each fire rated unit.
- 3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. General:
 - 1. Comply with the requirements of grade specified for corresponding door.
 - a. Frames for Wood Doors: Comply with frame requirements in accordance with ANSI/SDI A250.8 (SDI-100), Level 1, 18 gage, 0.042 inch (1.0 mm), minimum thickness.
 - 2. Finish: Same as for door.
 - 3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- C. Exterior Door Frames: Knock-down type.
 - 1. Weatherstripping: Separate, see Section 087100.
- D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
- E. Door Frames, Fire-Rated: Knock-down type.
 - 1. Fire Rating: Same as door, labeled.
- F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- G. Mullions for Pairs of Doors: Fixed, except where removable is indicated, with profile similar to jambs.
- H. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- I. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- J. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches (102 mm) high to fill opening without cutting masonry units.
- K. Frames Wider than 48 inches (1219 mm): Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Glazing: As specified in Section 088000, factory installed.
- B. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches (102 mm) as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
- C. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- D. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

2.07 FINISHES

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

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

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

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Install door hardware as specified in Section 087100.

3.04 TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.06 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

**SECTION 081416
FLUSH WOOD DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire rated.

1.02 RELATED REQUIREMENTS

- A. Section 081113 - Hollow Metal Doors and Frames.
- B. Section 087100 - Door Hardware.
- C. Section 088000 - Glazing.
- D. Section 099300 - Staining and Transparent Finishing: Field finishing of doors.

1.03 REFERENCE STANDARDS

- A. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- B. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D. Specimen warranty.
- E. Samples: Submit two samples of door veneer, 6 by 6 inch (____ by ____ mm) in size illustrating wood grain, stain color, and sheen.
- F. Manufacturer's Installation Instructions: Indicate special installation instructions.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
- C. Package, deliver and store doors in accordance with specified quality standard.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- 1. Basis of Design: Graham Wood Doors: www.grahamdoors.com.
- B. High Pressure Decorative Laminate (HPDL) Faced Doors:

2.02 DOORS AND PANELS

- A. Doors: See drawings for locations and additional requirements.
 - 1. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. Wood veneer facing for field transparent finish as indicated on drawings.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware

without through-bolting.

2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: As specified in Finish Schedule, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.

2.05 ACCESSORIES

- A. Glazed Openings:
 - 1. Heat-Strengthened and Fully Tempered Glass: {rs\#1}.
 - 2. Glazing: Single vision units, 1/4 inch (6 mm) glass.
 - 3. Tint: Clear.
- B. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
- C. Astragals for Non-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge.

2.06 DOOR CONSTRUCTION

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

2.07 FINISHES - WOOD VENEER DOORS

- A. Factory finish doors in accordance with approved sample.

2.08 ACCESSORIES

- A. Hollow Metal Door Frames: See Section 081113.
- B. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

3.03 TOLERANCES

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

3.04 ADJUSTING

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

3.05 SCHEDULE

- A. See Door and Frame Schedule appended to this section.

END OF SECTION

**SECTION 083613
SECTIONAL DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Overhead sectional doors, electrically operated.
- B. Operating hardware and supports.
- C. Electrical controls.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Rough wood framing for door opening.
- B. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.
- C. Section 260583 - Wiring Connections.

1.03 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- C. DASMA 102 - American National Standard Specifications for Sectional Doors; 2018.
- D. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- F. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
- C. Product Data: Show component construction, anchorage method, and hardware.
- D. Manufacturer's Installation Instructions: Include any special procedures required by project conditions.
- E. Maintenance Data: Include data for motor and transmission, shaft and gearing, lubrication frequency, spare part sources.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals for warranty requirements.
- B. Extended Correction Period: Correct defective work within a 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sectional Doors:
 - 1. Overhead Door Corporation; Model 430 - Sectional Steel Door: www.overheaddoor.com/#sle.
 - 2. Raynor Garage Doors; EnergyCore Series, Model ____: www.raynor.com/#sle.
 - 3. Wayne-Dalton, a Division of Overhead Door Corporation; Thermospan 125: www.wayne-dalton.com/#sle.

2.02 PERFORMANCE REQUIREMENTS

- A. Performance: Withstand positive and negative wind loads equal to 1.5 times design wind loads specified by local code without damage or permanent set, when tested in accordance with ASTM E330/E330M, using 10 second duration of maximum load.

2.03 STEEL DOORS

- A. Type SSD-1 - Doors: Flush steel, insulated; standard lift operating style with track and hardware; complying with DASMA 102, Commercial application.
 - 1. Door Panels: Steel construction; outer steel sheet of 20 gauge, 0.0359 inch (0.91 mm) minimum thickness, flush profile; inner steel sheet of 20 gauge, 0.0359 inch (0.91 mm) minimum thickness, flat profile; core reinforcement sheet steel roll formed to channel shape, rabbeted weather joints at meeting rails; polyurethane insulation.
 - 2. Door Nominal Thickness: 2 inches (51 mm) thick.
 - 3. Exterior Finish:
 - a. Factory finished with acrylic baked enamel; color as selected by Architect.
 - 4. Interior Finish:
 - a. Factory finished with acrylic baked enamel; color as selected from manufacturers standard line.
 - 5. Electric Operation: Electric control station.

2.04 COMPONENTS

- A. Track: Rolled galvanized steel, 0.090 inch (2.3 mm) minimum thickness; 2 inch (50 mm) wide, continuous one piece per side; galvanized steel mounting brackets 1/4 inch (6 mm) thick.
- B. Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of galvanized steel; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.
- C. Lift Mechanism: Torsion spring on cross head shaft, with braided galvanized steel lifting cables.
- D. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.
- E. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.
- F. Head Weatherstripping: EPDM rubber seal, one piece full length.
- G. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.
- H. Lock: Inside center mounted, adjustable keeper, spring activated latch bar with feature to retain in locked or retracted position; interior and exterior handle.

2.05 MATERIALS

- A. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G60/Z180 coating, plain surface.
- B. Insulation: Foamed-in-place polyurethane, bonded to facing.

2.06 ELECTRIC OPERATION

- A. Electric Operators:
 - 1. Mounting: Side mounted on cross head shaft.
 - 2. Motor Enclosure:
 - 3. Motor Rating: 1/3 hp (250 W); continuous duty.
 - 4. Motor Voltage: 120 volts, single phase, 60 Hz.
 - 5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
 - 6. Controller Enclosure: NEMA 250, Type 1.
 - 7. Opening Speed: 12 inches per second (300 mm/s).
 - 8. Brake: Adjustable friction clutch type, activated by motor controller.
 - 9. Manual override in case of power failure.
 - 10. See Section 260583 for electrical connections.
- B. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated; enclose terminal lugs in terminal box sized to comply with NFPA 70.
- C. Control Station: Provide standard three button (Open-Close-Stop) momentary-contact control device for each operator complying with UL 325.
 - 1. 24 volt circuit.
 - 2. Surface mounted, at interior door jamb.

3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
 - a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.
- D. Safety Edge: Located at bottom of sectional door panel, full width; electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object; hollow neoprene covered to provide weatherstrip seal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
- B. Verify that electric power is available and of the correct characteristics.

3.02 PREPARATION

- A. Prepare opening to permit correct installation of door unit to perimeter air and vapor barrier seal.
- B. Apply primer to wood frame.

3.03 INSTALLATION

- A. Install door unit assembly in accordance with manufacturer's instructions.
- B. Anchor assembly to wall construction and building framing without distortion or stress.
- C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
- D. Fit and align door assembly including hardware.
- E. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

3.04 TOLERANCES

- A. Maximum Variation from Plumb: 1/16 inch (1.5 mm).
- B. Maximum Variation from Level: 1/16 inch (1.5 mm).
- C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch (3 mm) from 10 ft (3 m) straight edge.
- D. Maintain dimensional tolerances and alignment with adjacent work.

3.05 ADJUSTING

- A. Adjust door assembly for smooth operation and full contact with weatherstripping.
- B. Have manufacturer's field representative present to confirm proper operation and identify adjustments to door assembly for specified operation.

3.06 CLEANING

- A. Clean doors and frames and glazing.
- B. Remove temporary labels and visible markings.

3.07 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.
- B. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

END OF SECTION

SECTION 084313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Infill panels of glass.
- C. Aluminum doors and frames.
- D. Weatherstripping.
- E. Door hardware.
- F. Perimeter sealant.

1.02 RELATED REQUIREMENTS

- A. Section 087100 - Door Hardware: Hardware items other than specified in this section.
- B. Section 088000 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
- C. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- H. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- I. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
- D. Samples: Submit one samples 12 x 12 inches (____x____ mm) in size illustrating finished aluminum surface, glass, infill panels, glazing materials.
- E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- F. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

- G. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- H. Designer's qualification statement.
- I. Manufacturer's qualification statement.
- J. Installer's qualification statement.

1.06 QUALITY ASSURANCE

- A. ***Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.***
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

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

1.08 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Aluminum-Framed Storefront and Doors:
 1. Kawneer North America: www.kawneer.com.
 2. Manko Window Systems, Inc: www.mankowindows.com.
 3. Oldcastle BuildingEnvelope: www.oldcastlebe.com/#sle.
 4. Tubelite, Inc: www.tubeliteinc.com.
 5. Substitutions: See Section 016000 - Product Requirements.

2.02 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 1. Glazing Position: Front-set.
 2. Finish: Class I color anodized.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 3. Finish Color: As selected by Architect from manufacturer's standard line.
 4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
- B. Performance Requirements
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Design Wind Loads: Comply with requirements of ASCE 7.
 - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
 2. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf (75 Pa) pressure difference.

2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.
 2. Glazing Stops: Flush.
 3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
- B. Glazing: See Section 088000.
- C. Swing Doors: Glazed aluminum.
1. Thickness: 1-3/4 inches (43 mm).
 2. Top Rail: 6 inches (____ mm) wide.
 3. Vertical Stiles: 6 inches (____ mm) wide.
 4. Bottom Rail: 12 inches (____ mm) wide.
 5. Glazing Stops: Square.
 6. Finish: Same as storefront.

2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209/B209M.
- C. Fasteners: Stainless steel.
- D. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch (0.81 mm) minimum thickness; finish to match framing members.
- E. Concealed Flashings: Sheet aluminum, 26 gauge, 0.017 inch (0.43 mm) minimum thickness.
- F. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.
- G. Sealant for Setting Thresholds: Non-curing butyl type.
- H. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- I. Glazing Accessories: See Section 088000.

2.05 FINISHES

- A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils (0.018 mm) thick.
- B. Color: Clear.

2.06 HARDWARE

- A. For each door, provide hardware where noted as specified in 087100.

- B. Install the hardware supplied by others as specified in Section 087100.
- C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.04 ADJUSTING

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

3.05 CLEANING

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

3.06 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

**SECTION 08 71 00
DOOR HARDWARE**

PART 1 - GENERAL

1.1 CONDITIONS

- A. Conditions of the contract (General and Supplementary Conditions) and Division 01 - General Requirements, govern the work of this section.
- B. This section includes all material, and related service necessary to furnish all finish hardware indicated on the drawings or specified herein.
- C. Furnish UL listed hardware for all labeled and 20 min. openings in conformance with the requirements for the class of opening scheduled. Underwriters' requirements shall have precedence over specification where conflicts exist.
- D. All work shall be in accordance with all applicable state and local building codes. Code requirements shall have precedence over this specification where conflicts exist.

1.2 WORK INCLUDED

- A. This section includes the following:
 - 1. Furnish door hardware (for hollow metal, wood and aluminum doors) specified herein, listed in the hardware schedule, and/or required by the drawings.
 - 2. Cylinders for Aluminum Doors
 - 3. Thresholds and Weather-stripping (Aluminum frame seals to be provided by aluminum door supplier)
 - 4. Electro-Mechanical Devices
 - 5. Access Control components and or systems specified within this section.
- B. Where items of hardware are not definitely or correctly specified and is required for the intended service, such omission, error or other discrepancy should be directed to the Architect prior to the bid date for clarification by addendum. Otherwise furnish such items in the type and quantity established by this specification for the appropriate service intended.

1.3 RELATED WORK IN OTHER SECTIONS

- A. This section includes coordination with related work in the following sections:
 - 1. Division 06 Section "Finish Carpentry".
 - 2. Division 06 Section "Cabinet Hardware"
 - 3. Division 08 Section "Hollow Metal Doors and Frames".
 - 4. Division 08 Section "Wood Doors"
 - 5. Division 08 Section "Storm Doors"
 - 6. Division 08 Section "Aluminum Entrances and Storefronts"
 - 7. Division 26 Sections "Electrical"
 - 8. Division 28 Sections "Electronic Safety and Security".

1.4 REFERENCES

- A. Publications of agencies and organizations listed below form a part of this specification section to the extent referenced.
 - 1. DHI – Installation Guide for Doors and Hardware (2020).
 - 2. NFPA 80 - Standards for Fire Doors and Windows.
 - 3. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.
 - 4. UL - Building Material Directory.
 - 5. DHI - Door and Hardware Institute
 - 6. WHI - Warnock Hersey
 - 7. BHMA - Builders Hardware Manufacturers Association
 - 8. ANSI – American National Standards Institute

9. IBC - International Building Code 2021 Edition (as adopted and amended by local building code)

1.5 SUBMITTALS

- A. Within ten days after award of contract, submit detailed hardware schedule in quantities as required by Division 01 - General Requirements.
- B. Schedule format shall be consistent with recommendations for a vertical format as set forth in the Door & Hardware Institute's (DHI) publication "Sequence and Format for the Hardware Schedule". Hardware sets shall be consolidated to group multiple door openings which share similar hardware requirements. Schedule shall include the following information:
 1. Door number, location, size, handing, and rating.
 2. Door and frame material, handing.
 3. Degree of swing.
 4. Manufacturer
 5. Product name and catalog number
 6. Function, type and style
 7. Size and finish of each item
 8. Mounting heights
 9. Explanation of abbreviations, symbols, etc.
 10. Numerical door index, indicating the hardware set/ group number for each door.
- C. When universal type door closers are to be provided, the schedule shall indicate the application method to be used for installation at each door: (regular arm, parallel arm, or top jamb).
- D. The schedule will be prepared under the direct supervision of a certified Architectural Hardware Consultant (AHC), or certified Door Hardware Consultant (DHC) employed by the hardware distributor. The hardware schedule shall be signed and embossed or stamped with the DHI certification seal of the supervising AHC or DHC. The supervising AHC or DHC shall attend any meetings related to the project when requested by the architect.
- E. Check the specified hardware for suitability and adaptability to the details and surrounding conditions.
- F. Review drawings from related trades as required to verify compatibility with specified hardware. Indicate unsuitable or incompatible items, and proposed substitutions in the hardware schedule.
- G. Provide documentation for all hardware to be furnished on labeled fire doors indicating compliance with positive pressure fire testing UL 10C.
- H. Furnish manufacturers' catalog data for each item of hardware in quantities as required by Division 01 - General Requirements.
- I. Submit a sample of each type of hardware requested by the architect. Samples shall be of the same finish, style, and function as specified herein. Tag each sample with its permanent location so that it may be used in the final work.
- J. Furnish with first submittal, a list of required lead times for all hardware items.
- K. After final approved schedule is returned, transmit corrected copies for distribution and field use in quantities as required by Division 01 - General Requirements.
- L. Furnish approved hardware schedules, template lists, and pertinent templates as requested by related trades.
- M. Furnish necessary diagrams, schematics, voltage and amperage requirements for all electro-mechanical devices or systems as required by related trades. Wiring diagrams shall be opening specific and include both a riser diagram and point to point diagram showing all wiring terminations.
- N. After receipt of approved hardware schedule, Hardware supplier shall initiate a meeting including the owner's representative to determine keying requirements. Upon completion of initial key

meeting, hardware supplier shall prepare a proposed key schedule with symbols and abbreviations as set forth in the door and hardware institute's publication "Keying Procedures, Systems, and Nomenclature". Submit copies of owner approved key schedule for review and field use in quantities as required by Division 01 - General Requirements. Wiring diagrams shall be included in final submittals transmitted for distribution of field use.

1.6 QUALITY ASSURANCE

- A. Manufacturers and model numbers listed are to establish a standard of function and quality. Similar items by approved manufacturers that are equal in design, function, and quality, may be considered for prior approval of the architect, provided the required data and physical samples are submitted for approval as set forth in Division 01 - General Requirements.
- B. Where indicated in this specification, products shall be independently certified by ANSI for compliance with relevant ANSI/BHMA standards A156.1 - A156.36 – Standards for Hardware and Specialties. All products shall meet or exceed certification requirements for the respective grade indicated within this specification. Supplier shall provide evidence of certification when requested by the architect.
- C. Obtain each type of hardware (hinges, latch & locksets, exit devices, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.
- D. Electrical drawings and electrical specifications are based on the specific electrified hardware components specified in hardware sets. When electronic hardware components other than those indicated in hardware sets are provided, the supplier shall be responsible for all costs incurred by the design team and their consultants to review and revise electrical drawings and electrical specifications. Supplier shall also be responsible for any additional costs associated with required changes in related equipment, materials, installation, or final hook up to ensure the system will operate and function as indicated in the construction documents, including hardware set operational / functional descriptions.
- E. All hardware items shall be manufactured no earlier than 6 months prior to delivery to site.
- F. Hardware supplier shall be factory trained and certified by the manufacture to provide and support all computer managed locks and system components.
- G. Installation of hardware shall be installed or directly supervised and inspected by a skilled installer certified by the manufacturer of locksets, door closers, and exit devices used on the project, or with not less than 3 years' experience in successful completion of projects similar in size and scope.
- H. Provide hardware for all labeled fire doors, which complies with positive pressure fire testing UL 10C.
- I. Comply with all applicable provisions of the standards referenced within section 1.4 of this specification.
- J. Hardware supplier shall participate when reasonably requested to meet with the contractor and or architect to inspect any claim for incorrect or non-functioning materials; following such inspection, the hardware supplier shall provide a written statement documenting the cause and proposed remedy of any unresolved items.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Hardware supplier shall deliver hardware to the job site unless otherwise specified.
- B. All hardware shall be delivered in manufacturers' original cartons and shall be clearly marked with set and door number.
- C. Coordinate with contractor prior to hardware delivery and recommend secure storage and protection against loss and damage at job site.

- D. Contractor shall receive all hardware and provide secure and proper protection of all hardware items to avoid delays caused by lost or damaged hardware. Contractor shall report shortages to the Architect and hardware supplier immediately after receipt of material at the job site.
- E. Coordinate with related trades under the direction of the contractor for delivery of hardware items necessary for factory installation.

1.8 PRE-INSTALLATION MEETING

- A. Schedule a hardware pre-installation meeting on site to review and discuss required door operating clearances and the installation of continuous hinges, locksets, door closers, exit devices, overhead stops, and electromechanical door hardware.
- B. Meeting attendees shall be notified 7 days in advance and shall include: Architect, Contractor, Door Hardware Installers (including low voltage hardware), Manufacturers representatives for above hardware items, and any other effected subcontractors or suppliers.
- C. All attendees shall be prepared to distribute installation manuals, hardware schedules, templates, and physical hardware samples.

1.9 WARRANTY

- A. All hardware items shall be warranted against defects in material and workmanship as set forth in Division 01 - General Requirements.
- B. Repair, replace, or otherwise correct deficient materials and workmanship without additional cost to owner.

PART 2 - PRODUCTS

2.1 FASTENERS

- A. All exposed fasteners shall be Phillips head or as otherwise specified and shall match the finish of the adjacent hardware. All fasteners ex-posed to the weather shall be non-ferrous or stainless steel. Furnish correct fasteners to accommodate surrounding conditions.
- B. Coordinate required reinforcements for doors and frames. Seek approval of the architect prior to furnishing through-bolts. Furnish through-bolts as required for materials not readily reinforced.

2.2 BUTT HINGES

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Ives</u>	<u>Stanley</u>	<u>Hager</u>	<u>McKinney</u>
1. Standard Weight, Plain Bearing	5PB1	F179	****	T2714
2. Standard Weight, Ball Bearing	5BB1	BB179	BB1279	TB2714
3. Standard Weight, Ball Bearing, Non-Ferrous	5BB1	FBB191	BB1191	TB2314
4. Heavy Weight, Ball Bearing	5BB1HW	FBB168	BB1168	T4B3786
5. Heavy Weight, Ball Bearing, Non-Ferrous	5BB1HW	FBB199	BB1199	T4B3386

- B. Hinges shall be independently certified by ANSI for compliance with ANSI A156.1 (2006). Hinges shall meet or exceed the following ANSI grade requirements as indicated below:
 - 1. Standard Weight, Plain Bearing Hinges: Grade 3
 - 2. Standard Weight, 2 Ball Bearing Hinges: Grade 2
 - 3. Heavy Weight, 4 Ball Bearing Hinges: Grade 1
- C. Unless otherwise specified, furnish the following hinge quantities for each door leaf.
 - 1. 3 hinges for doors up to 90 inches.
 - 2. 1 additional hinge for every 30 inches on doors over 90 inches.
 - 3. 4 hinges for Dutch door applications.
- D. Unless otherwise specified, top and bottom hinges shall be located as specified in Division 08 Section "Hollow Metal Doors and Frames". Intermediate hinges shall be located equidistant from others.

- E. Unless otherwise specified, furnish hinge weight and type as follows:
 1. Standard weight: plain bearing hinge 5PB1 or ball bearing hinge 5BB1 for interior openings through 36 inches wide without a door closer.
 2. Standard weight: ball bearing hinge 5BB1 for interior opening over 36 through 40 inches wide without a door closer, and for interior openings through 40 inches wide with a door closer.
 3. Heavyweight: 4 ball bearing hinge 5BB1HW for interior openings over 40 inches wide, and for all vestibule doors.
 4. Heavyweight: 4 ball bearing hinge 5BB1HWss for exterior openings unless otherwise listed in groups.
 5. Heavyweight: 4 ball bearing hinge 5BB1HWss 5" for all exterior doors or 4 ball bearing hinge 5BB1HW 5" for interior doors, that have an automatic operator.
- F. At existing frames receiving new hinges, match existing hinge size and weight.
- G. Unless otherwise specified, furnish brass, bronze, or stainless-steel base metal for hinges at exterior doors. Unless otherwise specified, furnish steel base metal for hinges at interior doors.
- H. Furnish stainless steel base metal for hinges at showers, pools, and wash bay doors.
- I. Unless otherwise specified, furnish hinges in the following sizes:
 1. 5" x 5" 2-1/4" thick doors
 2. 4-1/2" x 4-1/2" 1-3/4" thick doors
 3. 3-1/2" x 3-1/2" 1-3/8" thick doors
- J. Furnish hinges with width to accommodate trim and allow for 180-degree swing.
- K. Unless otherwise specified, furnish hinges with flat button tips with non-rising pins at interior doors, non-removable loose pins (NRP) at exterior, and out-swinging lockable interior doors.
- L. Unless otherwise specified, furnish all hinges to template standards.

2.3 POWER TRANSFERS

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Von Duprin</u>	<u>ASSA</u>
1. Concealed Two Wire	EPT-2	CEPT-10
2. Concealed Ten Wire	EPT-10	CEPT-10
- B. Door cords shall be armored cable with screw on caps.
- C. Concealed power transfers shall be concealed in the door and frame when the door is closed.
- D. Concealed power transfers shall have a steel tube to protect wires from being cut.
- E. Concealed power transfers with spring tubes shall be rejected.
- F. Concealed power transfers shall be supplied with a mud box to house all terminations.

2.4 FLUSH BOLTS AND DUST PROOF STRIKES

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Ives</u>	<u>Trimco</u>	<u>Hager</u>
1. Dust Proof Strike	DP2	3910	280X
2. Auto Flush Bolt (Metal Door)	FB31P	3810	292D
3. Auto Flush Bolt (Wood Door)	FB41P	3815L	291D
4. Constant Latching Bolt (Metal Door)	FB51P	3820	293D
5. Constant Latching Bolt (Wood Door)	FB61P	3825L	294D
- B. Unless otherwise specified, provide 12" rods for manual flush bolts for door 7'6" or less, 24" top rods for doors over 7'6" to 8'6".
- C. Unless otherwise specified, provide doors over 8'6" with automatic top bolts.

- D. Provide automatic flush bolts where required to maintain fire door listing and or egress requirements on pairs of doors.
- E. All flush-bolt applications shall be UL listed to be installed with top flush-bolt only. Provide auxiliary fire bolt as required for fire rated openings where less bottom bolt has been specified.
- F. Provide all bottom flush bolts with non-locking dust proof strikes.

2.5 EXIT DEVICES

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Von Duprin</u>	<u>Detex</u>
1. Wide Stile, Push Pad	99 Series	Advantex (Wide Stile)
2. Wide Stile, Electric Latch Retraction	QEL 99 Series	Advante-ER x (Wide Stile)
3. Pull Trim	990 Series	"C" Trim
- A. Exit devices shall be independently certified by ANSI for compliance with ANSI A156.3, Grade 1 (2008).
- B. Obtain exit devices from a single manufacturer, although several may be indicated as offering products complying with requirements.
- C. All exit devices shall be equipped with a sound-dampening feature to reduce touch pad return noise.
- D. Quiet Electric Latch Retraction shall be accomplished using a motor driven assembly, and shall incorporate the following features:
 - 1. Motor shall retract both the push pad assembly and latchbolt.
 - 2. Automatic calibration of latch throw and pull.
 - 3. Built-in time delay.
 - 4. On-board installation and troubleshooting diagnostics built into power supply and device.
 - 5. Retry mode if device does not pull on the first try.
- E. On full glass doors there shall be no exposed fasteners on the back of the mechanism visible through the glass.
- F. All exit devices shall be provided with flush end caps to reduce potential damage from impact.
- G. All exit devices shall be provided with dead-locking latch bolts to ensure security.
- H. All exit devices shall be U.L. listed for accident hazard. Exit device for use on fire doors shall also be U.L. listed for fire exit hardware.
- I. Provide optional strikes, special length rods, and adapter plates to accommodate door and frame conditions. Provide narrow style series devices in lieu of wide stile series devices where optional strikes will not accommodate door and frame conditions.
- J. Coordinate with related trades to ensure adequate clearance and reinforcement is provided in doors and frames. Provide thru bolts as required.
- K. Refer to hardware groups for exit device applications utilizing the option of: "less bottom rod and floor strike" (LBR)
- L. All exit devices shall be provided with optional trim designs to match other lever and pull designs used on the project.
- M. Unless specific exit device dogging options are noted within hardware sets, provide dogging options as follows:
 - 1. Fire Rated devices: Dogging not permitted.
 - 2. Non-Rated Exit Only functions not equipped with outside trim or pull: Less Dogging.
 - 3. Non-Rated Classroom functions: Less Dogging.
 - 4. Non-Rated devices utilizing electric latch retraction or electrified outside trim: Less Dogging.
 - 5. All Other Non-Rated devices: Cylinder Dogging utilizing interchangeable core cylinders. Cylinder keyway shall match locksets furnished on this project.

- N. Provide glass bead kits as required to accommodate door conditions. Screws shall not be visible through full glass doors.
- O. Where specified, provide compatible keyed mullions with cylinder for pairs of doors.
- P. Provide Von Duprin #154 or equivalent mullion/frame stabilizers at the following application(s):
 - 1. Lockable exterior or vestibule paired openings with a fixed or removable hollow metal or aluminum mullion.
 - 2. Lockable exterior or vestibule single doors in aluminum frames.
- Q. Provide reinforced crossbars for all traditional style exit devices applied to doors over 36" wide.

2.6 LOCKS AND LATCHES

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Schlage</u>	<u>No Substitution</u>
1. Grade 1 Mortise	L Series 17A	
2. Grade 1 Cylindrical	ND Series SPA	
- B. Bored locks shall be independently certified by ANSI for compliance with ANSI A156.2 (2011). Interconnected locks shall be independently certified by ANSI for compliance with ANSI A156.12 (2013). Mortise locks shall be independently certified by ANSI for compliance with ANSI A156.13 (2012).
- C. Unless otherwise specified, all locks and latches to have:
 - 1. 2-3/4" Backset
 - 2. 1/2" minimum throw latchbolt
 - 3. 1" throw deadbolt
 - 4. ANSI A115.2 strikes
- D. Provide guarded latch bolts for all locksets, and latch bolts with throw to maintain fire rating of both single and paired door assemblies.
- E. Provide strike with lip length adequate to clear surrounding trim.
- F. Provide wrought boxes for strikes at inactive doors, wood frames, and metal frames without integral mortar covers.
- G. Provide Von Duprin #154 or equivalent mullion/frame stabilizers at the following application(s) unless provided with deadbolt:
 - 1. Lockable exterior or vestibule paired openings with a fixed or removable hollow metal or aluminum mullion.
 - 2. Lockable exterior or vestibule single doors in aluminum frames.

2.7 PULLS, PUSH BARS, PUSH/PULL PLATES

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Ives</u>	<u>Burns</u>	<u>Hager</u>
1. Push Plate (.050 6"X 16")	8200 6" X 16"	56	30S 6 x 16
2. Pull Plate (1" dia., 10" CTC - .050" X 4" X 16")	8303-0 4" X 16"	5426C	34J 4 x 16
- A. Adjust dimensions of push plates to accommodate stile and rail dimensions, lite and louver cutouts, and adjacent hardware. Where required by adjacent hardware, push plates shall be factory drilled for cylinders or other mortised hardware. All push plates shall be beveled 4 sides and counter sunk.
- B. Where required on wide stile doors, install straight pull offset of cylinder to allow for access to cylinder.
- C. Where possible, provide back-to-back, and concealed mounting for pulls and push bars. Push bar length shall be 3" less door width, or center of stile to center of stile for stile & rail or full glass doors.

2.8 COORDINATORS

A. Acceptable manufacturers and respective catalog numbers:

	<u>Ives</u>	<u>Trimco</u>	<u>Hager</u>
1. Bar Coordinator	COR x FL	3094	297D x 297F
2. Mounting Bracket	MB Series	3095/3096	297 Series

B. Provide coordinators at all pairs of doors having automatic flush bolts and closers on the inactive leaf, and for pairs of doors having vertical rod/mortise exit device combinations with overlapping astragals.

C. Provide appropriate filler bars, closer mounting brackets, carry bars, and special top latch preparations as required by adjacent hardware.

2.9 CLOSERS

A. Acceptable manufacturers and respective catalog numbers:

	<u>LCN</u>	<u>Sargent</u>
1. 4040XP / 4040XP EDA	281	281P10

B. Door closers shall be independently certified by ANSI for compliance with ANSI A156.4, Grade 1 (2013).

C. Obtain door closers from a single manufacturer, although several may be indicated as offering products complying with requirements.

D. Provide extra heavy-duty arm (EDA / HD) when closer is to be installed using parallel arm mounting.

E. Hardware supplier shall coordinate with related trades to ensure aluminum frame profiles will accommodate specified door closers.

F. Closers shall use high strength cast iron cylinders, forged main arms, and one-piece forged steel pistons.

G. Closers shall utilize a stable fluid withstanding temperature range of +120deg F to -30deg F without seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with standards UL10C.

H. Unless otherwise specified, all door closers shall have full covers and separate adjusting valves for sweeps, latch, and backcheck.

I. Provide closers for all labeled doors. Provide closer series and type consistent with other closers for similar doors specified elsewhere on the project.

J. Provide closers with adjustable spring power. Size closers to ensure exterior and fire rated doors will consistently close and latch doors under existing conditions. Size all other door closers to allow for reduced opening force not to exceed 5 lbs.

K. Install closers on the room side of corridor doors, stair side of stairways and interior side of exterior doors.

L. Closers shall be furnished complete with all mounting brackets and cover plates as required by door and frame conditions, and by adjacent hardware.

M. Door closers shall be provided with a powder coat finish to provide superior protection against the effects of weathering. Powder coat finish shall successfully pass a 100 hour salt spray test.

2.10 KICK PLATES AND MOP PLATES

A. Furnish protective plates as specified in hardware groups.

B. Where specified, provide 10" kick plates, 34" armor plates, and 4" mop plates. Unless otherwise specified, metal protective plates shall be .050" thick; plastic plates shall be 1/8" thick.

C. Protective plates shall be 2" less door width, or 1" less door width at pairs. All protective plates shall be beveled 4 sides and counter sunk.

- D. Protection plates over 16" shall not be provided for labeled doors unless specifically approved by door manufacturers listing. When protection plates over 16" are provided for labeled doors, the plate shall be labeled.
- E. Where specified, provide surface mounted door edges. Edges shall butt to protective plates. Provide edges with cutouts as required adjacent hardware.
- F. Adjust dimensions of protection plates to accommodate stile and rail dimensions, lite and louver cutouts, and adjacent hardware. Where required by adjacent hardware, protection plates shall be factory drilled for cylinders or other mortised hardware.

2.11 OVERHEAD STOPS

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Glynn-Johnson</u>	<u>Rixson</u>	<u>Sargent</u>
1. Heavy Duty Surface Mount	GJ900 Series	9 Series	590
- B. Unless otherwise specified, furnish GJ900 series overhead stop for hollow metal or 1-3/4" solid core doors equipped with regular arm surface type closers that swing more than 140 degrees before striking a wall, for hollow metal or 1-3/4" solid core doors that open against equipment, casework, sidelights, or other objects that would make wall bumpers inappropriate, and as specified in hardware groups.
- C. Furnish sex bolt attachments for wood and mineral core doors unless doors are supplied with proper reinforcing blocks.
- D. Provide special stop only ("SE" suffix) overhead stops when used in conjunction with electronic hold open closers.
- E. Do not provide holder function for labeled doors.

2.12 WALL STOPS AND HOLDERS

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Ives</u>	<u>Hager</u>	<u>Burns</u>
1. Wrought Convex Wall Stop	WS406CVX	232W	570
2. Wrought Concave Wall Stop	WS406CCV	236W	575
- B. Furnish a stop or holder for all doors.
- C. Provide concave style wall stop at all adjacent integral push button locks; provide convex style wall stop at all other locations.
- D. Where wall stops are not applicable, furnish overhead stops.
- E. Furnish floor stops or hinge pin stops only where specified in hardware sets.
- F. Do not provide holder function for labeled doors.

2.13 MAGNETIC HOLD OPENS

- A. Acceptable manufacturers and respective catalog numbers:

	<u>LCN</u>	<u>ABH</u>	<u>Edwards</u>
1. Wall Holder	SEM 7800	2000	1500
- B. Magnetic hold opens shall be independently certified by ANSI for compliance with ANSI A156.15, Grade 1 (2006).
- C. Magnetic holder's housing and armature shall be constructed of a die cast zinc material.
- D. Provide types as listed in groups.
- E. Where wall conditions do not permit the armature to reach the magnet, provide extensions.
- F. Provide proper voltage and power consumption as required by Division 16.
- G. Coordinate electrical requirements and mounting locations with other trades.

2.14 WEATHERSTRIP, GASKETING

A. Acceptable manufacturers and respective catalog numbers:

	<u>Zero</u>	<u>Pemko</u>	<u>NGP</u>	<u>Reese</u>
1. Weatherstrip	429	2891_PK	700NA	755
2. Adhesive Gasket	188	S88	5050	797
3. Mullion Seal/Silencer	8780	5110	5100N	628
4. Meeting Edge Seals	8193	18041	9605	959
5. Adhesive Edge Seal	****	S771	5060	****
6. Sweep (Brush)	8192	18061_NB	B606	964
7. Sweep w/ drip	8198	345_N	C627	354
8. Drip Cap	142	346	16	R201

B. Weatherstrip and gasketing shall be independently certified by ANSI for compliance with ANSI A156.22 (2005).

C. Where specified in the hardware groups, furnish the above products unless otherwise detailed in groups.

D. Provide weatherstripping all exterior doors and where specified.

E. Provide intumescent and other required edge sealing systems as required by individual fire door listings to comply with positive pressure standards UL 10C.

F. Provide Zero 188 smoke gaskets at all fire rated doors and smoke and draft control assemblies.

G. Provide gasketing for all meeting edges on pairs of fire doors. Gasketing shall be compatible with astragal design provided by door supplier as required for specific fire door listings.

2.15 THRESHOLDS

A. Acceptable manufacturers and respective catalog numbers:

	<u>Zero</u>	<u>Pemko</u>	<u>NGP</u>	<u>Reese</u>
1. Saddle Thresholds	8655	171	425	S205

A. Thresholds shall be independently certified by ANSI for compliance with ANSI A156.21 (2001).

B. Hardware supplier shall verify all finish floor conditions and coordinate proper threshold as required to ensure a smooth transition between threshold and interior floor finish.

C. Threshold Types:

1. Unless otherwise specified, provide saddle threshold similar to Zero 8655 for all exterior openings with an interior floor finish less than or equal to 1/4" in height.
2. Unless otherwise specified, provide half saddle threshold similar to Zero 1674 for all exterior openings with an interior floor finish greater than 1/4" in height. Threshold height shall match thickness of interior floor finish.

2.16 ELECTRIC STRIKES

A. Acceptable manufacturers and respective catalog numbers:

	<u>Von Duprin</u>	<u>HES</u>
1. Type 1	6300 Series	9500 Series

B. Provide electric strikes compatible with the type of locks shown at each opening where specified.

C. Electric strikes shall be UL listed as Burglary-Resistant Electric Door Strikes and where required shall be UL listed as Electric Strike for Fire Doors.

D. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.17 DOOR POSITION SWITCHES

A. Acceptable manufacturers and respective catalog numbers:

<u>Schlage Electronics</u>	<u>GRI</u>	<u>Sargent</u>
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2.18 FINISHES AND BASE MATERIALS

A. Unless otherwise indicated in the hardware groups or herein, hardware finishes shall be applied over base metals as specified in the following finish schedule:

<u>HARDWARE ITEM</u>	<u>BHMA FINISH AND BASE MATERIAL</u>
1. Butt Hinges: Exterior, or Non-Ferrous	630 (US32D - Satin Stainless Steel)
2. Butt Hinges: Interior	652 (US26D - Satin Chromium)
3. Continuous Hinges	630 (US32D - Satin Stainless Steel)
4. Flush Bolts	626 (US26D - Satin Chromium)
5. Exit Devices	626 (US26D - Satin Chromium)
6. Locks and Latches	626 (US26D - Satin Chromium)
7. Pulls and Push Plates/Bars	630 (US32D - Satin Stainless Steel)
8. Coordinators	600 (Prime painted or mill alum.)
9. Closers	689 (Powder Coat Aluminum)
10. Protective Plates	630 (US32D - Satin Stainless Steel)
11. Overhead Stops	630 (US32D - Satin Stainless Steel)
12. Wall Stops and Holders	630 (US32D - Satin Stainless Steel)
13. Thresholds	719 (Mill Aluminum)
14. Weather-strip, Sweeps Drip Caps	Aluminum Anodized
15. Magnetic Holders	689 (Powder Coat Aluminum)
16. Miscellaneous	626 (US26D - Satin Chromium)

2.19 KEYING

- A. Provide all cylinders in keyways as required to accommodate owners existing Schlage key system.
- B. All locks under this section shall be keyed as directed by the owner to an existing Master Key System.
- C. Furnish a total of 2 keys per cylinder. Actual cut keys to be determined by owner.
- D. Master keys, control keys, and change keys shall be delivered by registered mail to the owner. Construction keys shall be delivered to the contractor.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of hardware, installer shall examine door frame installation to ensure frames have been set square and plumb. Installer shall examine doors, door frames, and adjacent wall, floor, and ceiling for conditions, which would adversely affect proper operation and function of door assemblies. Do not proceed with hardware installation until such deficiencies have been corrected.

3.2 INSTALLATION

- A. Before hardware installation, general contractor/construction manager shall coordinate a hardware installation seminar with a 1 week notice to all parties involved. The seminar is to be conducted on the installation of hardware, specifically of locksets, closers, exit devices, continuous hinges and overhead stops. Manufacturer's representative of the above products to present seminar. Seminar to be held at the job site and attended by installers of hardware (including low voltage hardware) for aluminum, hollow metal and wood doors. Training to include use of installation manuals, hardware schedule, templates and physical products samples.
- B. Shim doors as required to maintain proper operating clearance between door and frame.
- C. Install all hardware in accordance with the approved hardware schedule and manufacturer's instructions for installation and adjustment.

- D. Set units level, plumb and true to the line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- E. Provide blocking or reinforcement for all hardware mounted to drywall construction, including wall mounted door stops and holders.
- F. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accord with industry standards.
- G. Drill appropriate size pilot holes for all hardware attached to wood doors and frames.
- H. Unless otherwise specified, locate all hardware in accordance with the recommended locations for builders hardware for standard doors and frames as published by the Door and Hardware Institute (TDH-007-20).
- I. Use only fasteners supplied by or approved by the manufacturer for each respective item of hardware.
- J. Mortise and cut to close tolerance and conceal evidence of cutting in the finished work.
- K. Conceal push and pull bar fasteners where possible. Do not install through bolts through push plates.
- L. Install hardware on UL labeled openings in accordance with manufacturer's requirements to maintain the label.
- M. Apply self-adhesive gasketing on frame stop at head & latch side and on rabbet of frame at hinge side.
- N. Install hardware in accordance with supplemental "S" label instructions on all fire rated openings.
- O. Install wall stops to contact lever handles or pulls. Do not mount wall stops on casework, or equipment.
- P. Where necessary, adjust doors and hardware as required to eliminate binding between strike and latchbolt. Doors should not rattle.
- Q. Overhead stops used in conjunction with electrified hold open closers shall be templated and installed to coincide with engagement of closer hold open position.
- R. Install door closers on corridor side of lobby doors, room side of corridor doors, and stair side of stairways.
- S. Adjust spring power of door closers to the minimum force required to ensure exterior and fire rated doors will consistently close and latch doors under existing conditions. Adjust all other door closers to ensure opening force does not to exceed 5 lbs.
- T. Adjust "sweep", "latch", & "back check" valves on all door closers to properly control door throughout the opening and closing cycle. Adjust total closing speed as required to comply with all applicable state and local building codes.
- U. Install "hardware compatible" (bar stock) type weatherstripping continuously for an uninterrupted seal. Adjust templating for parallel arm door closers, exit devices, etc., as required to accommodate weatherstripping.
- V. Unless otherwise specified or detailed, install thresholds with the bevel in vertical alignment with the outside door face. Notch and closely fit thresholds to frame profile. Set thresholds in full bed of sealant.
- W. Compress sweep during installation as recommended by sweep manufacturer to facilitate a water-resistant seal.
- X. Deliver to the owner 1 complete set of installation and adjustment instructions, and tools as furnished with the hardware.

3.3 FIELD QUALITY CONTROL

- A. After installation has been completed, the hardware supplier and manufacturers representative for locksets, door closers, exit devices, and overhead stops shall check the project and verify compliance with installation instructions, adjustment of all hardware items, and proper application according to the approved hardware schedule. Hardware representative shall submit a list of all hardware that has not been installed correctly.
- B. After installation has been completed, the hardware supplier and manufacturers representative shall meet with the owner to explain the functions, uses, adjustment, and maintenance of each item of hardware. Hardware supplier shall provide the owner with a copy of all wiring diagrams. Wiring diagrams shall be opening specific and include both a riser diagram and point to point diagram showing all wiring terminations.

3.4 ADJUSTMENT AND CLEANING

- A. At final completion, and when H.V.A.C. equipment is in operation, installer shall make final adjustments to and verify proper operation of all door closers and other items of hardware. Lubricate moving parts with type lubrication recommended by the manufacturer.
- B. All hardware shall be left clean and in good operation. Hardware found to be disfigured, defective, or inoperative shall be repaired or replaced.

3.5 HARDWARE SCHEDULE

- A. The following schedule of hardware groups are intended to describe opening function. The hardware supplier is cautioned to refer to the preamble of this specification for a complete description of all materials and services to be furnished under this section.

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HW SET 01

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	POWER TRANSFER	EPT2	VON
1	SET	CONST LATCHING BOLT	FB51P / FB61P	IVE
1	EA	DUST PROOF STRIKE	DP2	IVE
1	EA	EU MORTISE LOCK	L9092EU	SCH
1	EA	COORDINATOR	COR X FL	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER
1	SET	GASKETING	429	ZER
1	EA	OVERLAP ASTRAGAL	(BY DOOR SUPPLIER)	
2	EA	DOOR SWEEP	8198	ZER
1	EA	THRESHOLD	(PROFILE AS REQUIRED)	ZER
1	EA	CREDENTIAL READER	(BY OTHERS)	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: L9092EU ELECTRICALLY UNLOCKED (FAIL SECURE)
 OUTSIDE LEVER UNLOCKED BY 24V AC OR DC. LATCHBOLT RETRACTED BY KEY OUTSIDE OR
 LEVER INSIDE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED. INSIDE
 LEVER ALWAYS FREE FOR IMMEDIATE EXIT. VALID CREDENTIAL UNLOCKS DOOR.

HW SET 02

	EA	HINGES	(AS SPECIFIED)	IVE
1	SET	CONST LATCHING BOLT	FB51P / FB61P	IVE
1	EA	DUST PROOF STRIKE	DP2	IVE
1	EA	EXIT LOCK	L9025	SCH
1	EA	COORDINATOR	COR X FL	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER
1	SET	GASKETING	429	ZER
1	EA	OVERLAP ASTRAGAL	(BY DOOR SUPPLIER)	
2	EA	DOOR SWEEP	8198	ZER
1	EA	THRESHOLD	(PROFILE AS REQUIRED)	ZER

FUNCTION: L9025 EXIT LOCK

BLANK PLATE OUTSIDE. INSIDE LEVER ALWAYS UNLOCKED.

HW SET 03

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50	SCH
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	PERIMETER GASKET	188S (2 ROWS: (1) STOP MTD, (1) RABBIT MTD)	ZER
1	EA	DOOR BOTTOM	369	ZER

FUNCTION: ND50 (F82) ENTRANCE/OFFICE LOCK

PUSH-BUTTON LOCKING. PUSH-BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED WITH KEY OR BY TURNING INSIDE LEVER.

HW SET 04

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50	SCH
1	EA	WALL STOP	WS406/407CCV	IVE

FUNCTION: ND50 (F82) ENTRANCE/OFFICE LOCK

PUSH-BUTTON LOCKING. PUSH-BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED WITH KEY OR BY TURNING INSIDE LEVER.

HW SET 05

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	PRIVACY LOCK	ND52 OS-OCC	SCH
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	SEALS	188S	ZER

FUNCTION: ND52 PRIVACY LOCK

PUSH-BUTTON LOCKING. PUSH-BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED WITH KEY OR BY TURNING INSIDE LEVER. OUTSIDE INDICATOR DISPLAYS OCCUPIED/VACANT PLATE.

HW SET 06

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50	SCH
1	EA	OH STOP	90S	GLY

FUNCTION: ND50 (F82) ENTRANCE/OFFICE LOCK
 PUSH-BUTTON LOCKING. PUSH-BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED WITH KEY
 OR BY TURNING INSIDE LEVER.

HW SET 07

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	CLASSROOM LOCK	ND70	SCH
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	PERIMETER GASKET	188S (2 ROWS: (1) STOP MTD, (1) RABBIT MTD)	ZER
1	EA	DOOR BOTTOM	369	ZER

FUNCTION: ND70 (F84) CLASSROOM LOCK
 OUTSIDE LEVER LOCKED AND UNLOCKED BY KEY. INSIDE LEVER ALWAYS UNLOCKED.

HW SET 08

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	PASSAGE SET	ND10S	SCH
1	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER

FUNCTION: ND10 (F75) PASSAGE LATCH
 BOTH LEVERS ALWAYS UNLOCKED

HW SET 09

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50	SCH
1	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER

FUNCTION: ND50 (F82) ENTRANCE/OFFICE LOCK
 PUSH-BUTTON LOCKING. PUSH-BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED WITH KEY
 OR BY TURNING INSIDE LEVER.

HW SET 10

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50	SCH
1	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	SEALS	188S	ZER
1	EA	DOOR SWEEP (BRUSH)	8192	ZER
1	EA	THRESHOLD	(PROFILE AS REQUIRED)	ZER

FUNCTION: ND50 (F82) ENTRANCE/OFFICE LOCK
 PUSH-BUTTON LOCKING. PUSH-BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED WITH KEY
 OR BY TURNING INSIDE LEVER.

HW SET 11

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	CLASSROOM LOCK	ND70	SCH
1	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER

FUNCTION: ND70 (F84) CLASSROOM LOCK
 OUTSIDE LEVER LOCKED AND UNLOCKED BY KEY. INSIDE LEVER ALWAYS UNLOCKED.

HW SET 12

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER

FUNCTION: ND80 (F86) STOREROOM LOCK
 OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED.

HW SET 13

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1	EA	OH STOP	90S	GLY
1	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER

FUNCTION: ND80 (F86) STOREROOM LOCK
 OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED.

HW SET 14

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER

FUNCTION: ND80 (F86) STOREROOM LOCK
 OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED.

HW SET 15

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	AUTO FLUSH BOLT	FB31P / FB41P	IVE
1	EA	DUST PROOF STRIKE	DP2	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50	SCH
1	EA	COORDINATOR	COR X FL	IVE
1	EA	OH STOP	90S	GLY
2	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	SEALS	188S	ZER
1	EA	MEETING STILE SEAL	S771	PEM
1	EA	OVERLAP ASTRAGAL	(BY DOOR SUPPLIER)	
2	EA	DOOR SWEEP (BRUSH)	8192	ZER
1	EA	THRESHOLD	(PROFILE AS REQUIRED)	ZER

FUNCTION: ND50 (F82) ENTRANCE/OFFICE LOCK
 PUSH-BUTTON LOCKING. PUSH-BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED WITH KEY OR BY TURNING INSIDE LEVER.

HW SET 16

1	EA	ELECTRIC STRIKE	6300 FSE	VON
1	EA	CREDENTIAL READER	(BY OTHERS)	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	
	EA	BALANCE OF HARDWARE	(TO REMAIN)	

FUNCTION: VALID CREDENTIAL UNLOCKS DOOR.

HW SET 17

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	EU MORTISE LOCK	L9092EU	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER
1	SET	GASKETING	429	ZER
1	EA	DOOR SWEEP	8198	ZER
1	EA	THRESHOLD	(PROFILE AS REQUIRED)	ZER
1	EA	CREDENTIAL READER	(BY OTHERS)	
1	EA	DOOR CONTACT	679 SERIES	SCE
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: L9092EU ELECTRICALLY UNLOCKED (FAIL SECURE)
 OUTSIDE LEVER UNLOCKED BY 24V AC OR DC. LATCHBOLT RETRACTED BY KEY OUTSIDE OR
 LEVER INSIDE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED. INSIDE
 LEVER ALWAYS FREE FOR IMMEDIATE EXIT. VALID CREDENTIAL UNLOCKS DOOR.

HW SET 18

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	KEYED REMOVABLE MULLION	KR-4954 STAB	VON
1	EA	PANIC HARDWARE	CD-99-DT	VON
1	EA	PANIC HARDWARE	CD-99-NL	VON
4	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
2	EA	SURFACE CLOSER	4040XP SHCUSH	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY
 KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. ACCESS
 FROM EXTERIOR WHEN EXIT DEVICE PUSH PAD IS DOGGED DOWN.

HW SET 19

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	POWER TRANSFER	EPT2	VON
1	EA	FIRE EXIT HARDWARE	9927-EO-F-LBR	VON
1	EA	ELEC FIRE EXIT HARDWARE	QEL-9927-NL-F-LBR	VON
1	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
2	EA	FIRE/LIFE HOLDER	4040SEH	LCN
2	EA	SURFACE CLOSER	4040XP CUSH	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
1	EA	SEALS	188S	ZER
1	EA	MEETING STILE SEAL	S771	PEM
1	EA	CREDENTIAL READER	(BY OTHERS)	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. ACCESS FROM EXTERIOR WHEN EXIT DEVICE PUSH PAD IS DOGGED DOWN.

HW SET 20

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	FIRE EXIT HARDWARE	99-L-F X 499F	VON
1	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
1	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CVX	IVE
1	EA	PERIMETER GASKET	188S (2 ROWS: (1) STOP MTD, (1) RABBIT MTD)	ZER
1	EA	DOOR BOTTOM	369	ZER

FUNCTION: (L) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY LEVER. KEY IN EXTERIOR CYLINDER LOCKS OR UNLOCKS LEVER.

HW SET 21

	EA	HINGES	(AS SPECIFIED)	IVE
2	EA	FIRE EXIT HARDWARE	9927-EO-F-LBR	VON
2	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
2	EA	FIRE/LIFE WALL MAGNET	SEM 7800	LCN
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER
1	EA	MEETING STILE SEAL	S771	PEM
1	EA	N/C F/A CONTACT	(BY F/A CONTRACTOR)	

FUNCTION: (EO) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD. NO EXTERIOR TRIM.

HW SET 22

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	ELEC FIRE EXIT HARDWARE	99-L-F-M996-FSE	VON
1	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
1	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	FIRE/LIFE WALL MAGNET	SEM 7800	LCN
1	EA	PERIMETER GASKET	188S (2 ROWS: (1) STOP MTD, (1) RABBIT MTD)	ZER
1	EA	DOOR BOTTOM	369	ZER
1	EA	CREDENTIAL READER	(BY OTHERS)	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	
1	EA	N/C F/A CONTACT	(BY F/A CONTRACTOR)	

FUNCTION: (E) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. A VALID CREDENTIAL UNLOCKS LEVER. LOSS OF POWER LOCKS PULL SIDE LEVER.

HW SET 23

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	ELEC PANIC HARDWARE	QEL-99-NL	VON
1	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER
1	SET	WEATHERSTIP	429	ZER
1	EA	DOOR SWEEP	8198	ZER
1	EA	THRESHOLD	(PROFILE AS REQUIRED)	ZER
1	EA	CREDENTIAL READER	(BY OTHERS)	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. ACCESS FROM EXTERIOR WHEN EXIT DEVICE PUSH PAD IS DOGGED DOWN.

HW SET 24

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	ELEC PANIC HARDWARE	QEL-99-NL	VON
1	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	CREDENTIAL READER	(BY OTHERS)	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. ACCESS FROM EXTERIOR WHEN EXIT DEVICE PUSH PAD IS DOGGED DOWN.

HW SET 25

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	ELEC FIRE EXIT HARDWARE	QEL-99-NL-F	VON
1	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
1	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CVX	IVE
1	EA	SEALS	188S	ZER
1	EA	CREDENTIAL READER	(BY OTHERS)	
1	EA	DOOR CONTACT	679 SERIES	SCE
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. ACCESS FROM EXTERIOR WHEN EXIT DEVICE PUSH PAD IS DOGGED DOWN.

HW SET 26

	EA	HINGE	(AS SPECIFIED)	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	KEYED REMOVABLE MULLION	KR-4954 STAB	VON
1	EA	PANIC HARDWARE	LD-99-EO	VON
1	EA	ELEC PANIC HARDWARE	QEL-99-NL	VON
2	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER
1	SET	WEATHERSTIP	429	ZER
1	EA	MULLION SEAL	8780	ZER
2	EA	DOOR SWEEP	8198	ZER
1	EA	THRESHOLD	(PROFILE AS REQUIRED)	ZER
1	EA	CREDENTIAL READER	(BY OTHERS)	
2	EA	DOOR CONTACT	679 SERIES	SCE
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. ACCESS FROM EXTERIOR WHEN EXIT DEVICE PUSH PAD IS DOGGED DOWN.

HW SET 27

	EA	HINGE	(AS SPECIFIED)	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	KEYED REMOVABLE MULLION	KR-4954 STAB	VON
1	EA	FIRE EXIT HARDWARE	99-EO-F	VON
1	EA	ELEC FIRE EXIT HARDWARE	QEL-99-NL-F	VON
2	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
2	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
2	EA	WALL STOP	WS406/407CVX	IVE
1	EA	SEALS	188S	ZER
1	EA	MULLION SEAL	8780	ZER
1	EA	CREDENTIAL READER	(BY OTHERS)	
2	EA	DOOR CONTACT	679 SERIES	SCE
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. ACCESS FROM EXTERIOR WHEN EXIT DEVICE PUSH PAD IS DOGGED DOWN.

HW SET 28

	EA	HINGE	(AS SPECIFIED)	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	KEYED REMOVABLE MULLION	KR-4954 STAB	VON
1	EA	FIRE EXIT HARDWARE	99-EO-F	VON
1	EA	ELEC FIRE EXIT HARDWARE	QEL-99-NL-F	VON
2	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
1	EA	SEALS	188S	ZER
1	EA	MULLION SEAL	8780	ZER
1	EA	CREDENTIAL READER	(BY OTHERS)	
2	EA	DOOR CONTACT	679 SERIES	SCE
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. ACCESS FROM EXTERIOR WHEN EXIT DEVICE PUSH PAD IS DOGGED DOWN.

HW SET 29

ALL HARDWARE BY DOOR SUPPLIER.

HW SET 30

NO WORK.

HW SET 31

1	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
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HARDWARE SUPPLIER SHALL VERIFY CYLINDER TYPE AND QUANTITY WITH LOCK SUPPLIER.

HW SET 32

	EA	HINGES	(AS SPECIFIED)	IVE
2	EA	PUSH PLATE	8200 6" X 16"	IVE
2	EA	PULL PLATE	8303 10" 4" X 16"	IVE
2	EA	SURFACE CLOSER	4040XP SHCUSH	LCN
2	EA	ARMOR PLATE	8400 60" X 1" LDW B-CS	IVE

FUNCTION: PUSH/PULL

HW SET 33

	EA	HINGES	(AS SPECIFIED)	IVE
2	EA	PUSH PLATE	8200 6" X 16"	IVE
2	EA	PULL PLATE	8303 10" 4" X 16"	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
1	EA	SEALS	188S	ZER
1	EA	MEETING STILE SEAL	8193 X 8193	ZER
2	EA	DOOR SWEEP (BRUSH)	8192	ZER
1	EA	THRESHOLD	(PROFILE AS REQUIRED)	ZER

FUNCTION: PUSH/PULL

HW SET 34

	EA	HINGES	(AS SPECIFIED)	IVE
2	EA	PUSH PLATE	8200 6" X 16"	IVE
2	EA	PULL PLATE	8303 10" 4" X 16"	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE

FUNCTION: PUSH/PULL

**SECTION 088000
GLAZING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing units.
- C. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 081213 - Hollow Metal Frames: Glazed borrowed lites.
- B. Section 081416 - Flush Wood Doors: Glazed lites in doors.
- C. Section 084313 - Aluminum-Framed Storefronts: Glazing furnished as part of storefront assembly.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).
- D. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- F. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- G. ITS (DIR) - Directory of Listed Products; Current Edition.
- H. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- I. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies; 2022.
- J. UL (DIR) - Online Certifications Directory; Current Edition.
- K. UL 9 - Standard for Fire Tests of Window Assemblies; Current Edition, Including All Revisions.
- L. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- M. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- N. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- D. Samples: Submit one samples 12 by 12 inch (___ by ___ mm) in size of glass units.

1.05 QUALITY ASSURANCE

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

1.06 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).

- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Float Glass Manufacturers:
 - 1. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
 - 2. Guardian Industries Corp.: www.sunguardglass.com/#sle.
 - 3. Pilkington North America Inc.: www.pilkington.com/na.
 - 4. PPG Industries, Inc.: www.ppgideasapes.com/#sle.
 - 5. Oldcastle, Inc..
 - 6. Substitutions: Refer to Section 016000 - Product Requirements.
- B. Fire-Resistance-Rated Glass: Provide products as required to achieve indicated fire-rating period.
 - 1. Manufacturers:
 - 2. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite II-XL: www.safti.com/#sle.
- C. Fire-Protection-Rated Glass: Provide products as required to achieve indicated fire-rating period.
 - 1. Manufacturers:
 - 2. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite I-XL: www.safti.com/#sle.
 - 3. Substitutions: Refer to Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Select type and thickness of exterior glazing assemblies to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of glass.
- B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
 - 1. In conjunction with vapor retarder and joint sealer materials described in other sections.
- C. Thermal and Optical Performance: Provide glass products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
 - 1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 5.2/6.3 computer program.
 - 2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 5.2/6.3 computer program.

2.03 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless noted otherwise.
 - 1. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and FT.
 - 2. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality-Q3, color and performance characteristics as indicated.
- B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
 - 1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.

2.04 INSULATING GLASS UNITS

- A. Insulating Glass Units Manufacturers:
 - 1. Any of the manufacturers specified for float glass.
 - 2. Spacer Color: Black.
 - 3. Color: Black.
- B. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.

1. Applications: Exterior glazing unless otherwise indicated.
 2. Space between lites filled with air.
 3. Outboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E (passive type), on #2 surface.
 4. Inboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
 - a. Tint: Clear.
 5. Total Thickness: 1 inch (25.4 mm).
 6. Visible Light Transmittance (VLT): 57 percent, nominal.
 7. Solar Heat Gain Coefficient (SHGC): 25 percent, nominal.
 8. Glazing Method: Dry glazing method, gasket glazing.
- C. Type IG-5 - Insulating Glass Units: Safety glazing.
1. Applications:
 - a. Glazed lites in exterior doors.
 - b. Glazed sidelights and panels next to doors.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
 2. Space between lites filled with air.
 3. Glass Type: Same as Type IG-1 except use fully tempered float glass for both outboard and inboard lites.
 4. Total Thickness: 1 inch (25.4 mm).

2.05 GLAZING UNITS

- A. Type G-3 - Fire-Resistance-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and blocks radiant heat, as required to achieve indicated fire-rating period exceeding 45 minutes.
1. Applications:
 - a. Glazing in fire-rated door assembly.
 - b. Glazing in fire-rated window assembly.
 - c. Glazing in sidelites, borrowed lites, and other glazed openings in fire-rated wall assemblies.
 2. Glass Type: Multi-laminate annealed glass with intumescent fire retardant interlayers.
 3. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
 4. Safety Glazing Certification: 16 CFR 1201 Category II.
 5. Glazing Method: As required for fire rating.
 6. Fire-Rating Period: 45 minutes.
 7. Markings for Fire-Resistance-Rated Glazing Assemblies: Provide permanent markings on fire-resistance-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction.
 - a. "W" - meets wall assembly criteria of ASTM E119 or UL 263 fire test standards.
 - b. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
 - c. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire test standards.
 - d. "T" - meets temperature rise of not more than 450 degrees F (232 degrees C) above ambient at end of 30 minutes fire exposure in accordance with NFPA 252, UL 10B, or UL 10C fire test standards.
 - e. "XXX" - placeholder that represents fire-rating period, in minutes.
- B. Type G-4 - Fire-Protection-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire-rating period of 45 minutes or less.
1. Applications:
 - a. Glazing in fire-rated window assembly.
 2. Glass Type: Heat reflective specialty tempered float glass.
 3. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
 4. Safety Glazing Certification: 16 CFR 1201 Category II.

5. Glazing Method: As required for fire rating.
6. Fire-Rating Period: 20-45 minutes.
7. Markings for Fire-Protection-Rated Glazing Assemblies: Provide permanent markings on fire-protection-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction
 - a. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
 - b. "OH" - meets fire window assembly criteria including hose stream test of NFPA 257, or UL 9 fire test standards.
 - c. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire tests standards.
 - d. "XXX" - placeholder that represents fire-rating period, in minutes.

2.06 GLAZING COMPOUNDS

- A. Manufacturers:
 1. Bostik Inc: www.bostik-us.com.
 2. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
 3. Pecora Corporation: www.pecora.com.
 4. BASF Corporation: www.basf.com/us/en.html.
 5. Substitutions: Refer to Section 016000 - Product Requirements.

2.07 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) x width of glazing rabbet space minus 1/16 inch (1.5 mm) x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch (75 mm) long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
- D. Glazing Clips: Manufacturer's standard type.
- E. Drips at head.
- F. Flashing at sill.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that the minimum required face and edge clearances are being provided.
- C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- D. Verify that sealing between joints of glass framing members has been completed effectively.

3.02 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

- A. Install glazing sealants in accordance with ASTM C1193, GANA Sealant Manual, and manufacturer's instructions.
- B. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

- C. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- E. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove non-permanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.06 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

SECTION 088300 MIRRORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass mirrors.
 - 1. Tempered safety glass.

1.02 REFERENCE STANDARDS

- A. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- C. GANA (GM) - GANA Glazing Manual; 2022.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.

1.04 FIELD CONDITIONS

- A. Do not install mirrors when ambient temperature is less than 50 degrees F (10 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Mirrors:
 - 1. Binswanger Mirror/ACI Distribution: www.binswangerglass.com/#sle.
 - 2. Lenoir Mirror Co: www.lenoirmirror.com/#sle.
 - 3. Trulite Glass and Aluminum Solutions: www.trulite.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

- A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.
- B. Mirror Glass: Clear, tempered safety glass; ASTM C1048, with copper and silver coatings, and protective overcoating.
 - 1. Thickness: 1/4 inch (6.4 mm).
 - 2. Edges: Arrised.
 - 3. Size: As indicated on drawings.

2.03 ACCESSORIES

- A. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.
 - 1. Application Temperature: Minus 35 to 140 degrees F (Minus 37 to 60 degrees C) at contact surfaces.
 - 2. Manufacturers:
 - a. Liquid Nails, a brand of PPG Architectural Coatings; LN-730 Mirror Adhesive: www.liquidnails.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.

3.03 INSTALLATION

- A. Install mirrors in accordance with manufacturer's recommendations.
- B. Set mirrors plumb and level, and free of optical distortion.
- C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.
- D. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.

3.04 CLEANING

- A. Remove labels after work is complete.
- B. Clean mirrors and adjacent surfaces.

END OF SECTION

**SECTION 092116
GYPSUM BOARD ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal stud wall framing.
- B. Metal channel ceiling framing.
- C. Acoustic insulation.
- D. Cementitious backing board.
- E. Gypsum wallboard.
- F. Joint treatment and accessories.
- G. Textured finish system.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

- A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.
- B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).
- C. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- F. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.
- G. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).
- H. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- I. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.
- J. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
- K. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
- L. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- M. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- N. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).
- O. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- P. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019, with Editorial Revision (2020).
- Q. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- R. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 METAL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.
- B. Manufacturers - Metal Framing, Connectors, and Accessories:
 - 1. ClarkDietrich; ____: www.clarkdietrich.com/#sle.
 - 2. MarinoWARE; ____: www.marinoware.com/#sle.
 - 3. Phillips Manufacturing Company: www.phillipsmfg.com.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- C. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
 - 1. Studs: C-shaped with knurled or embossed faces.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Ceiling Channels: C-shaped.
 - 4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
- D. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- E. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection and prevent rotation of studs while maintaining structural performance of partition.
 - 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
 - 2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
 - 3. Deflection and Firestop Track:
 - a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.

2.02 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. American Gypsum Company: www.americangypsum.com/#sle.
 - 2. CertainTeed Corporation: www.certainteed.com/#sle.
 - 3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
 - 4. Gold Bond Building Products, LLC provided by National Gypsum Company; ____: www.goldbondbuilding.com/#sle.
 - 5. USG Corporation: www.usg.com/#sle.
 - 6. Substitutions: See Section 016000 - Product Requirements.
 - 7. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 - 8. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 9. Thickness:
 - a. Vertical Surfaces: 5/8 inch (16 mm).
 - b. Ceilings: 5/8 inch (16 mm).
 - c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
- B. Impact Resistant Wallboard:

1. Application: As indicated on
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. Type: Fire-resistance-rated Type X, UL or WH listed.
 4. Thickness: 5/8 inch (16 mm).
 5. Edges: Tapered.
- C. Backing Board For Wet Areas: One of the following products:
1. Application: Surfaces behind tile in wet areas, including manufactured housing, tub and shower surrounds, and shower ceilings.
 2. Application: Horizontal surfaces behind tile in wet areas including countertops.
 3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
 - a. Thickness: 5/8 inch (16 mm).
 4. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
 - a. Products:
 - 1) Georgia-Pacific Gypsum; DensShield Tile Backer: www.gpgypsum.com/#sle.
 - 2) Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Tile Backer: www.goldbondbuilding.com/#sle.
 - 3) Substitutions: See Section 016000 - Product Requirements.
- D. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
 2. Thickness: 5/8 inch (16 mm).
 3. Edges: Tapered.
 4. Products:
 - a. American Gypsum; Interior Ceiling Board.
 - b. CertainTeed Corporation; ProRoc Interior Ceiling.
 - c. Lafarge North America Inc; Sagcheck.
 - d. National Gypsum Company; High Strength Brand Ceiling Board.
 - e. Pacific Coast Building Products, Inc; PABCO Ceiling Board.
 - f. USG Corporation; Sheetrock Brand Sag-Resistant Interior Gypsum Ceiling Board.
 - g. Substitutions: See Section 016000 - Product Requirements.
 5. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
 6. Core Type: Regular.
 7. Regular Board Thickness: 1/2 inch (13 mm).
 8. Glass Mat Faced Products:
 - a. CertainTeed Corporation; GlasRoc Brand.
 - b. Georgia-Pacific Gypsum; DensGlass Sheathing: www.gpgypsum.com/#sle.
 - c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Sheathing: www.goldbondbuilding.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- E. Shaftwall and Coreboard: Type X; 1 inch (25 mm) thick by 24 inches (600 mm) wide, beveled long edges, ends square cut.
1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
 2. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in ASTM C1658/C1658M.
 3. Paper-Faced Products:
 - a. CertainTeed Corporation; M2Tech Type X Shaftliner: www.certainteed.com/#sle.
 4. Glass Mat Faced Products:
 - a. American Gypsum Company; M-Glass Shaft Liner: www.americangypsum.com/#sle.
 - b. CertainTeed Corporation; GlasRoc Shaftliner Type X: www.certainteed.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.

2.03 GYPSUM BOARD ACCESSORIES

- A. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
 - 1. Products:
 - a. Franklin International, Inc; Titebond Acoustical Smoke & Sound Sealant: www.titebond.com/#sle.
 - b. Liquid Nails, a brand of PPG Architectural Coatings; _____: www.liquidnails.com/#sle.
 - c. Specified Technologies Inc: www.stifirestop.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- B. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
 - 1. Expansion Joints:
 - a. Type: V-shaped PVC with tear away fins.
- C. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
- B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.

3.03 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C1007/AISI S220 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
- C. Studs: Space studs at 16 inches on center (at 406 mm on center).
 - 1. Extend partition framing to structure where indicated and to ceiling in other locations.
 - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
 - 3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- E. Blocking: Install wood blocking for support of:
 - 1. Framed openings.
 - 2. Wall-mounted cabinets.
 - 3. Plumbing fixtures.
 - 4. Toilet partitions.
 - 5. Toilet accessories.
 - 6. Wall-mounted door hardware.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 - 1. Place one bead continuously on substrate before installation of perimeter framing members.

2. Place continuous bead at perimeter of each layer of gypsum board.
3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.05 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
 1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
- B. Corner Beads: Install at external corners, using longest practical lengths.

3.07 TEXTURE FINISH

- A. Apply finish texture coating by means of spraying apparatus in accordance with manufacturer's instructions and to match approved sample.

3.08 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

END OF SECTION

**SECTION 092216
NON-STRUCTURAL METAL FRAMING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal partition, ceiling, and soffit framing.
- B. Framing accessories.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood blocking within stud framing.
- B. Section 09 2116 - Gypsum Board Assemblies: Metal studs for gypsum board partition framing.

1.03 REFERENCE STANDARDS

- A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.
- B. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- C. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Framing, Connectors, and Accessories:
 - 1. Clarkwestern Dietrich Building Systems LLC: www.clarkdeitrich.com.
 - 2. MarinoWARE; ____: www.marinoware.com/#sle.
 - 3. Simpson Strong Tie: www.strongtie.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.

2.02 FRAMING MATERIALS

- A. Non-Loadbearing Framing System Components: AISI S220; sheet steel, of size and properties necessary for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf (L/240 at 240 Pa).
 - 1. Studs: C-shaped with flat faces.
 - 2. Runners: U-shaped, sized to match studs.
 - 3. Ceiling Channels: C-shaped.
 - 4. Furring: Hat-shaped and Z shaped sections, minimum depth of 7/8 inch (22 mm).
 - 5. Steel Stud Framing Connectors:
 - a. Products:
 - 1) Simpson Strong Tie, Bridging Connectors; DBC Bridging Connector: www.strongtie.com.
 - 2) Substitutions: See Section 016000 - Product Requirements.
- B. Loadbearing Studs: As specified in Section 054000.
- C. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- D. Partition Head to Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short .
- E. Preformed Top Track Firestop Seal:
 - 1. Products:
 - a. Hilti, Inc; Top Track Seal CFS TTS: www.us.hilti.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- F. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud.

- G. Fasteners: ASTM C1002 self-piercing tapping screws.
- H. Anchorage Devices: Powder actuated.

2.03 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

3.02 INSTALLATION OF STUD FRAMING

- A. Extend partition framing to structure where indicated and to ceiling in other locations.
- B. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- C. Align and secure top and bottom runners at 24 inches (600 mm) on center.
- D. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- E. Align stud web openings horizontally.
- F. Secure studs to tracks using crimping method. Do not weld.
- G. Fabricate corners using a minimum of three studs.
- H. Install double studs at wall openings, door and window jambs, not more than 2 inches (50 mm) from each side of openings.
- I. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet (3 mm in 3 m).

END OF SECTION

SECTION 093000 TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for wall applications.
- B. Coated glass mat backer board as tile substrate.
- C. Ceramic accessories.
- D. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

- A. Section 079200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- B. Section 092116 - Gypsum Board Assemblies: Tile backer board.

1.03 REFERENCE STANDARDS

- A. ANSI A108/A118/A136.1 - Specifications for the Installation of Ceramic Tile; 2020.
- B. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
- C. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.
- D. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs; 2020.
- E. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.
- F. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2023.
- G. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2019.
- H. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).
- I. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- J. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).
- K. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- L. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2024.
- M. TCNA (HB-GP) - Handbook for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs Installation; 2023.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

- E. Installer's Qualification Statement:
- F. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 016000 - Product Requirements, for additional provisions.
 2. Extra Tile: 5 percent of each size, color, and surface finish combination.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of and ANSI A108/A118/A136.1 and TCNA (HB) on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- C. Installer Qualifications:
 1. Company specializing in performing tile installation, with minimum of five years of documented experience.
- D. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

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

1.07 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 TILE

- A. Porcelain Wall Tile, Type PT-1: ANSI A137.1, standard grade.
 1. Moisture Absorption: 0.5 to 3.0 percent as tested in accordance with ASTM C373.
 2. Size: 12"x24, nominal.
 3. Thickness: 8.5 mm.
 4. Color(s): As indicated on drawings.
 5. Pattern: As indicated on drawings.
 6. Trim Units: Matching bead, bullnose, cove, and base shapes in sizes coordinated with field tile.
 7. Products:
 - a. Dal-Tile Corporation; _____: www.daltile.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- B. Ceramic Wall Tile, Type CT-1, CT-2, CT-3, CT-4: ANSI A137.1, standard grade.
 1. Moisture Absorption: 0.5 to 3.0 percent as tested in accordance with ASTM C373.
 2. Size: See Finish Legend
 3. Shape: Square.
 4. Edges: Square.
 5. Surface Finish: Matte.
 6. Color(s): See Finish Legend.
 7. Install Pattern: See Finish Legend.
 8. Products:
 - a. Daltile, Keystones & Color Wheel Classics..
 - b. Substitutions: See Section 016000 - Product Requirements.

2.02 TRIM AND ACCESSORIES

- A. Ceramic Accessories: Unglazed finish, same color and finish as adjacent field tile; same manufacturer as tile.
- B. Non-Ceramic Trim: See Finish Schedule, style and dimensions to suit application, for setting using tile mortar or adhesive.
 1. Applications:

- a. Open edges of wall and floor tile.
 - b. Inside and outside wall corners.
 - c. Transition between floor finishes of different heights.
 - d. Thresholds at door openings.
 - e. Expansion and control joints, floor and wall as indicated on Drawings.
 - f. Borders and other trim as indicated on drawings.
2. Products:
 - a. Schluter-Systems; Schiene: www.schluter.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.03 SETTING MATERIALS

- A. Manufacturers:
 1. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
 2. Bostik Inc: www.bostik-us.com/#sle.
 3. Custom Building Products: www.custombuildingproducts.com/#sle.
 4. LATICRETE International, Inc: www.laticrete.com/#sle.
 5. Merkrete, by Parex USA, Inc: www.merkrete.com/sle.
 6. ProSpec, an Oldcastle brand: www.prospec.com.
- B. Provide setting materials made by the same manufacturer as grout.
- C. Latex-Portland Cement Mortar Bond Coat: {rs#1}, {rs#1}.
 1. Products:
 - a. ARDEX Engineered Cements; ARDEX X 77 MICROTEC: www.ardexamericas.com.
 - b. AVM Industries, Inc; Thin-Set 780: www.avmindustries.com.
 - c. LATICRETE International, Inc; LATICRETE 254 Platinum: www.laticrete.com.
 - d. Substitutions: See Section 016000 - Product Requirements.

2.04 GROUTS

- A. Manufacturers:
 1. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
 2. LATICRETE International, Inc; _____: www.laticrete.com/#sle.
 3. Substitutions: See Section 016000 - Product Requirements.
- B. Standard Grout: ANSI A118.6 standard cement grout.
 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
 2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.
 3. Color(s): As indicated on drawings.
 4. Products:
 - a. LATICRETE International, Inc; LATICRETE 1500 Sanded Grout: www.laticrete.com/#sle.
- C. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
 1. Color(s): As indicated on drawings.
 2. Products:
 - a. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout: www.laticrete.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- D. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 1. Composition: Water-based colorless silicone.

2.05 ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
 1. Thickness: 20 mils (0.5 mm), maximum.
 2. Crack Resistance: No failure at 1/8 inch (3.2 mm) gap, minimum.
 3. Products:

- a. LATICRETE International, Inc; LATICRETE Blue 92 Anti-Fracture Membrane: www.laticrete.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- B. Backer Board: Coated glass mat type complying with ASTM C1178/C1178M; inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
 - C. Mesh Tape: 2 inch (50 mm) wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

3.03 INSTALLATION - GENERAL

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) or TCNA (HB-GP) recommendations, as applicable.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install ceramic accessories rigidly in prepared openings.
- G. Install non-ceramic trim in accordance with manufacturer's instructions.
- H. Sound tile after setting. Replace hollow sounding units.
- I. Keep control and expansion joints free of mortar, grout, and adhesive.
- J. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- K. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- L. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- M. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.
- N. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout.

1. Use uncoupling membrane under all tile unless other underlayment is indicated.
2. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.

3.05 INSTALLATION - WALL TILE

- A. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.

3.06 CLEANING

- A. Clean tile and grout surfaces.

3.07 PROTECTION

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

END OF SECTION

**SECTION 095100
ACOUSTICAL CEILINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- B. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

- A. Product Data: Provide data on suspension system components and acoustical units.
- B. Samples: Submit two samples 6 by 6 inch (____ by ____ mm) in size illustrating material and finish of acoustical units.
- C. Samples: Submit two samples each, ____ inches (____ mm) long, of suspension system main runner, cross runner, and perimeter molding.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.05 QUALITY ASSURANCE

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

1.06 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

- A. Manufacturers:
 - 1. USG: www.usg.com.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Acoustical Panels, Type ACT-2: Gypsum, with the following characteristics:
 - 1. Classification: ASTM E1264 Type XX.
 - 2. Size: 24 by 24 inches (610 by 610 mm).
 - 3. Thickness: 1/2 inch (13 mm).
 - 4. Panel Edge: Square.
 - 5. Color: As indicated on drawings.
 - 6. Suspension System: Exposed grid 15/16" DXL.
 - 7. Products:
 - a. Basis of Design: Vinylrock by USG.

- C. Acoustical Panels Type ACT-1: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
 - 1. Size: 24 by 24 inches (600 by 600 mm).
 - 2. Thickness: 3/4 inches (____ mm).
 - 3. Composition: Formed Mineral Fiber.
 - 4. NRC: .55.
 - 5. CAC: 33.
 - 6. Edge: SLT.
 - 7. Surface Color: As indicated on drawings.
 - 8. Products:
 - a. Basis of Design: Radar by USG.
 - b. Substitutions: See Section 016000 - Product Requirements.
 - 9. Suspension System: Exposed grid 15/16" Grid DXL.
- D. Acoustical Panels, Type AMP-1:
 - 1. Size: As indicated on drawings.
 - 2. Thickness: 1 inches (____ mm).
 - 3. Noise Reduction Coefficient (NRC): 0.70-0.95 when tested in accordance with ASTM C423 for Type E mounting, per ASTM E795.
 - 4. Surface Color: As indicated on drawings.
 - 5. Suspension System: Exposed grid Type 15/16" Tee Grid, Twist Lock Grid.
 - 6. Products:
 - a. Basis of Design: CSI Creative.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.02 SUSPENSION SYSTEM(S)

- A. Manufacturers:
 - 1. USG: www.usg.com.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
- C. Exposed Suspension System, Type ACT-3: Hot-dipped galvanized steel grid with steel cap.
 - 1. Profile: Tee; 15/16 inch (24 mm) face width.
 - 2. Finish: Baked enamel.
 - 3. Color: Black.
 - 4. Products:
 - a. USG 155/16" Grid DXL.

2.03 ACCESSORIES

- A. Perimeter Moldings: Same metal and finish as grid.
- B. Perimeter U-Mold.
- C. Metal Edge Trim for Suspension Systems: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system.
- D. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- B. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
- C. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- D. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- E. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- F. Do not eccentrically load system or induce rotation of runners.
- G. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
 - 2. Overlap and rivet corners.

3.04 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.

3.05 TOLERANCES

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

END OF SECTION

SECTION 095426
SUSPENDED WOOD CEILINGS - USG

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wood grilles.
- B. Metal suspension system.

1.02 RELATED REQUIREMENTS

- A. Section 095100 - Acoustical Ceilings - USG: Metal suspension systems.

1.03 REFERENCE STANDARDS

- A. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. CISCA (WC) - Wood Ceilings Technical Guidelines; 2009.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate work of this section with installation of mechanical and electrical components and with other construction activities affected by work of this section.
- B. Sequence work to ensure ceilings are not installed until building is enclosed, dust generating activities have terminated, and overhead work is completed.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning, attachment of wood ceiling components to grid, accessory attachments, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.
- C. Product Data: Provide data on wood ceiling components and suspension system components.
- D. Samples: Two samples illustrating material and finish of wood ceiling components.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wood ceiling components to project site in original, unopened packages.
- B. Store in fully enclosed space, flat, level and off the floor.
- C. Allow wood materials to acclimate to installed space in accordance with manufacturer's recommendations.

1.07 FIELD CONDITIONS

- A. Do not install suspended wood ceiling system until wet construction work is complete and permanent heat and air conditioning is installed and operating.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Design for maximum deflection of 1/360 of span.
- B. Design to support imposed loads of indicated elements without eccentric loading of supports. Where supported elements may induce rotation of ceiling system components, provide stabilizing reinforcement.
- C. Surface Burning Characteristics: Flame spread index of _____, smoke developed index of _____, when tested in accordance with ASTM E84.

2.02 COMPONENT PRODUCTS

- A. Wood Grilles: Type: ACT-4

1. Preassembled grille units of solid wood with battens, dowels, and integrated acoustical backer.
 - a. Lay-in Grille Size: 24 by 24 inches (610 by 610 mm), nominal.
 - 1) Slat Orientation: Vertical.
 - b. Solid Wood Species: Poplar or Basswood.
 - 1) Factory Finish: Wood stain matching panels, clear sealer top coat.
 - c. Surface Veneer Species: Reference Finish Legend A120.
 - d. Products:
 - 1) Basis of Design: USG Corporation; True Wood Lay-In Grilles: www.usg.com/ceilings/#sle.
 - 2) Substitutions: See Section 016000 - Product Requirements.
- B. Metal Suspension Systems:
 1. See Section: 095100 Acoustical Ceilings.

2.03 ACCESSORIES

- A. General: Manufacturer's standard accessories for installation method indicated, above-ceiling accessibility.
- B. Retention Clips: Standard accessories, as required by manufacturer or project conditions.
- C. Suspension Wire: Size and type as required for application, seismic requirements, and ceiling system flatness requirement specified.
- D. Touch-Up Paint for Exposed Surfaces: Type and color to match panels and suspension system grid and trim elements.
- E. Touch-Up Paint For Concealed Items: Zinc rich type, as recommended by ceiling system manufacturer.

2.04 FABRICATION

- A. Shop fabricate wood ceiling components to the greatest extent possible.
- B. Shop fabricate wood ceiling components to accommodate mechanical and electrical items.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.
- C. Verify that field measurements are as indicated on shop drawings.
- D. Do not install ceiling until after interior wet work is dry.
- E. Start of installation constitutes acceptance of project conditions.

3.02 PREPARATION

- A. Lay out wood ceiling components in pattern according to reflected ceiling plan and as indicated on shop drawings.
- B. Acclimate wood ceiling materials by removing from packaging in installation area a minimum of 72 hours prior to installation.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Install in accordance with ASTM C636/C636M and manufacturer's instructions and as supplemented in this section.
- B. Install suspended wood ceiling system in accordance with CISCA (WC).
- C. Install hangers and inserts coordinated with overhead work. Provide additional hangers and supports as required.
- D. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

- F. Where ducts, facility services, or equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.
- J. Edge Moldings: Install at intersection of ceiling and vertical surfaces and penetrations, using components of maximum length, set level. Provide edge moldings at junction with other ceiling finishes. Miter corners. Provide preformed edge closures to match bullnosed cornered partitions.
 - 1. Use longest practical lengths.

3.04 INSTALLATION - WOOD PANELS

- A. Install panels in accordance with manufacturer's instructions.
- B. Fit wood components in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Install panels in uniform plane, and free from twist, warp, and dents.
- D. Cut to fit irregular grid and perimeter edge trim.
- E. Make field-cut edges of same profile as factory edges, seal and finish according to manufacturer.

3.05 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

3.06 CLEANING

- A. Clean and touch up minor finish damage. Remove and replace components that cannot be successfully cleaned and repaired.

END OF SECTION

**SECTION 096500
RESILIENT FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Resilient base.
- C. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.

1.03 REFERENCE STANDARDS

- A. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2023.
- B. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Verification Samples: Submit two samples, illustrating color and pattern for each resilient flooring product specified.
- D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature as recommended by manufacturer.

PART 2 PRODUCTS

2.01 TILE FLOORING

- A. Vinyl Tile - Type LVT-1: Homogeneous polymetric calendared layers.
 - 1. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
 - 2. Size: 18 inches by 18 inch.
 - 3. Thickness: 120 inch.
 - 4. Color: As indicated on drawings.
 - 5. Wear layer thickness: 20 mil.
 - 6. Basis of Design: ID Latitude Stone, 251176017 manufactured by Tarkett.
 - 7. Substitutions: See Section 016000-Product Requirements.

2.02 RESILIENT BASE

- A. Resilient Base - Type VB-1 & VB-2: ASTM F1861, Type TS, rubber, vulcanized thermoset; style as scheduled.
 - 1. Height: As indicated on Finish Legend A120.
 - 2. Thickness: 0.125 inch (3.2 mm).
 - 3. Finish: Satin.
 - 4. Color: As indicated on drawings.
 - 5. Accessories: Premolded external corners and internal corners.
 - 6. Substitutions: See Section 016000-Product Requirements.

2.03 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Moldings, Transition and Edge Strips: Same material as flooring.
- D. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.02 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.

3.03 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.04 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.05 CLEANING

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

3.06 PROTECTION

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

END OF SECTION

**SECTION 096813
TILE CARPETING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet tile, fully adhered.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.

1.03 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- B. CRI 104 - Standard for Installation of Commercial Carpet; 2015.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and _____.

1.05 FIELD CONDITIONS

PART 2 PRODUCTS

2.01 MATERIALS

- A. Tile Carpeting, Type CPT-1:
 - 1. Product: Basis of Design: Blockade, 11470 manufactured by Trakett.
 - 2. Tile Size: 24 inch by 24 inch, nominal.
 - 3. Color: Nighttime.
 - 4. Primary Backing Material: Synthetic.
 - 5. Substitutions: See Section 016000-Product Requirements.
- B. Tile Carpeting, Type CTP-1: See Alternates
 - 1. Product: Basis of Design: Wild Dyer manufactured by Mohawk Carpet.
 - 2. Style: Curious Cluster, GT353
 - 3. Tile Size: 24 inch by 24 inch, nominal.
 - 4. Color: Days and Days
 - 5. Substitutions: See Section 016000-Product Requirements.
- C. Tile Carpeting, Type WOC-1:
 - 1. Product: Basis of Design: Succession II manufactured by Philadelphia Queen.
 - 2. Style: 500
 - 3. Color: After Dark.
 - 4. Substitutions: See Section 016000-Product Requirements.

2.02 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Embossed aluminum, _____ color.
- C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

- B. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

3.02 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- F. Trim carpet tile neatly at walls and around interruptions.
- G. Complete installation of edge strips, concealing exposed edges.

3.03 CLEANING

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

END OF SECTION

**SECTION 097200
WALL COVERINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation and prime painting.
- B. Wall covering.

1.02 REFERENCE STANDARDS

- A. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Coating Systems; 2020.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2020.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on wall covering and adhesive.
- C. Shop Drawings: Indicate wall elevations with seaming layout.
- D. Samples: Submit two samples of wall covering, 6 by 6 inch (____ by ____ mm) in size illustrating color, finish, and texture.
- E. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Wall Covering Materials: 10% of each color and pattern of wall covering; store where directed.
 - 3. Package and label each roll by manufacturer, color and pattern, and destination room number.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inspect roll materials at arrival on site, to verify acceptability.
- B. Protect packaged adhesive from temperature cycling and cold temperatures.
- C. Do not store roll goods on end.

1.06 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.
- B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.
- C. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surfaces.

PART 2 PRODUCTS

2.01 WALL COVERINGS

- A. General Requirements:
 - 1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
 - 2. Chemical and Stain Resistance: No visible staining or discoloration and no damage to surface texture when tested in accordance with ASTM D1308.

3. Air Quality: meet VOC Emissions Evaluation requirement described in Section 01 35 47 Low Emitting Materials.
- B. Wall Coverings: WC-2: See Finish Legend.
- C. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.
- D. Termination Trim: Extruded plastic, color as selected.
- E. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.
- F. Substrate Primer and Sealer: Alkyd enamel type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.
- B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.
- C. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet (3 mm in 3 m) nor vary at a rate greater than 1/16 inch/ft (1.5 mm/300 mm).

3.02 PREPARATION

- A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.
- B. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.
- C. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- D. Surfaces: Correct defects and clean surfaces that affect work of this section. Remove existing coatings that exhibit loose surface defects.
- E. Apply one coat of primer sealer to substrate surfaces. Allow to dry. Lightly sand smooth.
- F. Vacuum clean surfaces free of loose particles.

3.03 INSTALLATION

- A. Apply adhesive and wall covering in accordance with manufacturer's instructions.
- B. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.
- C. Butt edges tightly.
- D. Overlap adjacent panels as recommended by manufacturer.
- E. Horizontal seams are not acceptable.
- F. Do not seam within 2 inches (50 mm) of internal corners or within 6 inches (150 mm) of external corners.
- G. Install wall covering before installation of bases and items attached to or spaced slightly from wall surface.
- H. Do not install wall covering more than 1/4 inch (6 mm) below top of resilient base.
- I. Cover spaces above and below windows, above doors, in pattern sequence from roll.
- J. Where wall covering tucks into reveals, or metal wallboard or plaster stops, apply with contact adhesive within 6 inches (150 mm) of wall covering termination. Ensure full contact bond.
- K. Install termination trim.
- L. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.04 CLEANING

- A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.
- B. Reinstall wall plates and accessories removed prior to work of this section.

3.05 PROTECTION

- A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION

SECTION 098430
SOUND-ABSORBING WALL AND CEILING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sound-absorbing panels.
- B. Mounting accessories.

1.02 RELATED REQUIREMENTS

- A. Section 099123 - Interior Painting.

1.03 REFERENCE STANDARDS

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. ASTM E795 - Standard Practices for Mounting Test Specimens during Sound Absorption Tests; 2023.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's printed data sheets for products specified.
- C. Shop Drawings: Fabrication and installation details, panel layout, fabric orientation, and wood grain orientation.
- D. Verification Samples: Fabricated samples of each type of panel specified; 12 by 12 inch (305 by 305 mm), showing construction, edge details, and fabric covering.
- E. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Panels: Quantity equal to 5 percent of total installed, but not less than one of each type.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.
- B. Store units flat, in dry, well-ventilated space; do not stand on end.
- C. Protect edges from damage.

PART 2 PRODUCTS

2.01 CEILING PRODUCTS

- A. Manufacturers:
 - 1. G&S Acoustics; 3555 Scarlet Oak Blvd., St. Louis, MO 63122 www.gsacoustics.com
 - 2. Substitutions: See Section 016000 - Product Requirements.
- B. General:
 - 1. Prefinished, factory assembled panels.
 - 2. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- C. Acoustical Ceiling Panels: Melody mTiles-canvas Ceiling Panels (MCC)
 - 1. Panel Core: 100% PET Polyester core with factory painted finish.

2. Core Thickness: 1 inch; 7 pcf polyester
3. Sound Absorption: Noise Reduction Coefficient (NRC) or Sound Absorption Average (SAA) of .80 when tested in accordance with ASTM C423 for Type A mounting, per ASTM E795.
4. Panel Size: MCC Direct Puck mount up to 4' x 8'.
5. Edges: Square.
6. Corners: Square.
7. Color: As selected by Architect from manufacturer's full range.
8. Mounting Method: Direct mount: clear pucks.

2.02 FABRICATION

- A. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch (1.6 mm) for thickness, overall length and width, and squareness from corner to corner.

2.03 ACCESSORIES

- A. Pucks: Manufacturer's clear pucks for direct to ceiling mount applications.
- B. Panel Adhesive: Acceptable to acoustical panel manufacturer for application as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.
- B. Install mounting accessories and supports in accordance with shop drawings.
- C. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.

3.03 CLEANING

- A. Clean sound-absorptive panels upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.04 PROTECTION

- A. Provide protection of installed acoustical panels until Date of Substantial Completion.
- B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION

**SECTION 099000
PAINTING AND COATING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Exposed surfaces of steel lintels and ledge angles.
 - 2. Mechanical and Electrical:
 - a. In finished areas, paint all insulated and exposed pipes, unless otherwise indicated.
 - b. In finished areas, paint shop-primed items.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Floors, unless specifically so indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 055000 - Metal Fabrications: Shop-primed items.

1.03 REFERENCE STANDARDS

- A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.
- B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
- D. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on aluminum sheet, 4 x 8 inch (____x____ mm) in size.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures.
- F. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. 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.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
 - 1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- C. Primer Sealers: Same manufacturer as top coats.
- D. Block Fillers: Same manufacturer as top coats.
- E. Substitutions: See Section 016000 - Product Requirements.

2.02 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
 - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Supply each coating material in quantity required to complete entire project's work from a single production run.
 - 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Flammability: Comply with applicable code for surface burning characteristics.
- D. Colors: As indicated on drawings
 - 1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Paint ME-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
 - 1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
 - 2. Semi-gloss: Two coats of alkyd enamel; Devco's DevGuard Semi-Gloss Alkyd 4306-xxxx.

2.04 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck.
 - 1. Shop primer by others.
 - 2. Intermediate Coat: same as finish.

3. Top Coat: Waterborne Flat Dryfall: SW Pro Industrial Waterborne Acrylic Dryfall
 4. Flat: MPI gloss level 1; use this sheen at all locations.
- B. Paint WI-OP-3L - Wood, Opaque, Institutional Low-Odor/VOC Latex System MPI INT 6.4R, 3 Coat:
1. Prime Coat: Primer Latex, for interior wood, MPI #39.
 2. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 3. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143 and Latex, interior, institutional low odor/VOC, eggshell (Gloss Level 2), MPI #144.
- C. Paint CI-OP-3L - Concrete/Masonry, Opaque, Latex, 3 Coat:
1. One coat of block filler, latex, interior/exterior, MPI #4.
 2. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 3. Topcoat: Latex, interior, institutional low odor/VOC, eggshell (MPI Level 2), MPI #144.
- D. Paint MI-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
1. Touch-up with alkyd primer.
 2. Semi-gloss: Two coats of alkyd enamel; SW Direct-to-Metal Alkyd Enamel.
- E. Paint Mgl-OP-3A - Galvanized Metals, Water-based light industrial coating over waterbourne primer system MPI INT 5.3K, 3 Coat:
1. Prime Coat: Latex, fire-retardant, matching topcoat.
 2. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 3. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss level 5), MPI #153.
- F. Paint MaI-OP-3A - Aluminum, Unprimed, Alkyd, 2 Coat:
1. SW Acroflur
- G. Paint GI-OP-3L - Gypsum Board/Plaster, Latex, 3 Coat:
1. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
 2. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 3. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143; Latex, interior, institutional low odor/VOC, (Gloss Level 2), MPI #144 and Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin application of coatings until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Test shop-applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Gypsum Wallboard: 12 percent.
 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

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

- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- G. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- H. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- I. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-SP 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).
- J. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- K. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's instructions.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance.
- E. Sand metal surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

- A. Protect finished coatings until completion of project.
- B. Touch-up damaged coatings after Substantial Completion.

END OF SECTION

**SECTION 101100
VISUAL DISPLAY UNITS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tackstrips
- B. Markerboards and Tackboards.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Blocking and supports.
- B. Section 09 2116 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.
- C. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2020.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on chalkboard, markerboard, tackboard, tackboard surface covering, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations , special anchor details.
- D. Samples: Submit color charts for selection of color and texture of markerboard, tackboard, tackboard surface covering, and trim.
- E. Manufacturer's printed installation instructions.
- F. Maintenance Data: Include data on regular cleaning, stain removal .

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Visual Display Boards:
 - 1. MooreCo, Inc: www.moorecoinc.com.
 - 2. Claridge Products and Equipment, Inc: www.claridgeproducts.com.
 - 3. Polyvision Corporation (Nelson Adams): www.polyvision.com.
 - 4. Substitutions: See Section 016000 - Product Requirements.

2.02 VISUAL DISPLAY BOARDS

- A. Markerboards: Porcelain enamel on steel, laminated to core.
 - 1. Color: White.
 - 2. Steel Face Sheet Thickness: 24 gage, 0.0239 inch (0.61 mm).
 - 3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
 - 4. Backing: Aluminum foil, laminated to core.
 - 5. Size: As indicated on drawings.
 - 6. Frame: Extruded aluminum , with concealed fasteners.
 - 7. Frame Finish: Anodized, natural.
 - 8. Accessories: Provide chalk tray, map rail, and tack strip.
- B. Tackboards: Fabric laminated to cork.
 - 1. Cork Thickness: 1/8 inch (3 mm).
 - 2. Fabric: Vinyl coated fabric.
 - 3. Color: As selected from manufacturer's full range.
 - 4. Size: As indicated on drawings.

5. Frame: Extruded aluminum , with concealed fasteners.
6. Frame Finish: Anodized, natural.

2.03 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Vinyl Coated Fabric: ASTM F793 Category VI.
- C. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- D. Foil Backing: Aluminum foil sheet, 0.005 inch thick (0.13 mm thick).

2.04 ACCESSORIES

- A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall (; 25 mm wide overall) , full width of frame.
- B. Temporary Protective Cover: Sheet polyethylene, 8 mil (0.2 mm) thick.
- C. Chalk Tray: Aluminum, manufacturer's standard profile, one piece full length of chalkboard, molded ends, concealed fasteners, same finish as frame.
- D. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Secure units level and plumb.

3.03 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.

END OF SECTION

SECTION 101400 SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Room and door signs.

1.02 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- F. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.05 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flat Signs: Basis of Design: Inpro corporation Aspen Collection with back plate.
 - 1. Best Sign Systems, Inc: www.bestsigns.com/#sle.
 - 2. Cosco Industries (ADA signs): www.coscoarchitecturalsigns.com/#sle.
 - 3. Inpro; Aspen: www.inprocorp.com.
 - 4. Substitutions: See Section 016000 - Product Requirements.

2.02 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
 - 3. Character Height: 1 inch (25 mm).
 - 4. Sign Height: 2 inches (50 mm), unless otherwise indicated.
 - 5. Office Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings ; in addition, provide "window" section for replaceable occupant name.
 - 6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
 - 7. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
 - 8. Provide blank back panels for signs mounted to glass.

2.03 SIGN TYPES

- A. Flat Signs: Signage media in aluminum frame.
 - 1. Corners: Square.
 - 2. Frame Finish: Natural (clear) anodized.
 - 3. Wall Mounting of One-Sided Signs: Tape adhesive.
- B. Color and Font: Unless otherwise indicated:
 - 1. Character Font: Helvetica, Arial, or other sans serif font.
 - 2. Character Case: Upper case only.
 - 3. Background Color: To be selected from manufacturers full range of colors.
 - 4. Character Color: Contrasting color.

2.04 TACTILE SIGNAGE MEDIA

- A. Applied Character Panels: Acrylic plastic base, with applied acrylic plastic letters and braille.
 - 1. Total Thickness: 1/8 inch (3 mm).
 - 2. Letter Thickness: 1/8 inch (3 mm).
 - 3. Letter Edges: Square.

2.05 DIMENSIONAL LETTERS

- A. Metal Letters:
 - 1. Metal: Aluminum casting.
 - 2. Finish: Brushed, satin.
 - 3. Mounting: Concealed screws.

2.06 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs where indicated:
 - 1. Room and Door Signs: Locate on wall at latch side of door with centerline of sign at 60 inches (1525 mm) above finished floor.
 - 2. If no location is indicated obtain Owner's instructions.
- D. Protect from damage until Substantial Completion; repair or replace damage items.

END OF SECTION

**SECTION 102600
WALL AND DOOR PROTECTION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Corner guards.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Blocking for wall and corner guard anchors.
- B. Section 092216 - Non-Structural Metal Framing: Placement of supports in stud wall construction.

1.03 REFERENCE STANDARDS

- A. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2021.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- C. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
 - 1. Submit two sections of corner guards, 24 inches (610 mm) long.
- D. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Stock Materials: One minimum 96 inches (2438 mm) long unit of each kind of covers for corner guards.
- G. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.
- E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Corner Guards: Basis of Design: InPro 150BN BlueNose
 - 1. Substitutions: See Section 016000 - Product Requirements.

2.02 PRODUCT TYPES

- A. Corner Guards - Surface Mounted: CG-2
 - 1. Material: High impact vinyl with continuous vinyl retainer.
 - 2. Performance: Resist lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
 - 3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 4. Width of Wings: 3 inches (76 mm).
 - 5. Corner: Radiused.
 - 6. Color: As indicated.
 - 7. Length: 4'-0", one piece.
 - 8. Preformed end caps.
- B. Corner Guards - Surface Mounted: CG-1
 - 1. Material: Aluminum
 - 2. Performance: Resist lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
 - 3. Width of Wings: 1 inches.

2.03 FABRICATION

- A. Fabricate components with tight joints, corners and seams.
- B. Pre-drill holes for attachment.
- C. Form end trim closure by capping and finishing smooth.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.
- C. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B. Position corner guard 4 inches (102 mm) above finished floor to 52 inches high (____ mm high).

3.03 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch (6 mm).
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch (6 mm).

3.04 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

**SECTION 102800
TOILET, BATH, AND LAUNDRY ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial shower and bath accessories.

1.02 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

2.02 COMMERCIAL SHOWER AND BATH ACCESSORIES

- A. Shower Curtain Rod: Stainless steel tube, 1 inch (25 mm) outside diameter, 0.04 inch (1.0 mm) wall thickness, satin-finished, with 3 inch (75 mm) outside diameter, minimum 0.04 inch (1.0 mm) thick satin-finished stainless steel flanges, for installation with exposed fasteners.
 - 1. Products:
 - a. American Specialties, Inc: www.americanspecialties.com/#sle.
 - b. Substitutions: Section 016000 - Product Requirements.
- B. Shower Curtain:
 - 1. Material: Opaque vinyl, 0.008 inch (0.2 mm) thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
 - 2. Size: 36 by 72 inches (914 by 1830 mm), hemmed edges.
 - 3. Grommets: Stainless steel; pierced through top hem on 6 inch (150 mm) centers.
 - 4. Color: White.
 - 5. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
 - 6. Products:
 - a. American Specialties, Inc[<>]: www.americanspecialties.com/#sle.
 - b. Substitutions: Section 016000 - Product Requirements.
- C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand seat.
 - 1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of color as selected.
 - 2. Size: ADA Standards compliant.
 - 3. Products:
 - a. American Specialties, Inc[<>]: www.americanspecialties.com/#sle.
 - b. Substitutions: Section 016000 - Product Requirements.
- D. Wall-Mounted Soap Dish: Heavy duty, seamless stainless steel, surface-mounted with drain holes, without grab bar, satin finish; with concealed mechanical fastening suitable for substrate and backplate.

- E. Towel Bar: Stainless steel, 3/4 inch (20 mm) square tubular bar; rectangular brackets, concealed attachment, satin finish.
 - 1. Length: 18 inches (460 mm).
 - 2. Products:
 - a. American Specialties, Inc<>: www.americanspecialties.com/#sle.
 - b. Substitutions: Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

- A. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

END OF SECTION

**SECTION 104400
FIRE PROTECTION SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- B. FM (AG) - FM Approval Guide; Current Edition.
- C. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- C. Product Data: Provide extinguisher operational features.
- D. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.05 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers:
 - 1. Ansul, a Tyco Business; Cleanguard: www.ansul.com/#sle.
 - 2. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
 - 3. Nystrom, Inc: www.nystrom.com/#sle.
 - 4. Potter-Roemer: www.potterroemer.com/#sle.
 - 5. Pyro-Chem, a Tyco Business: www.pyrochem.com/#sle.
 - 6. Strike First Corporation of America; Water Fire Extinguisher: www.strikefirstusa.com.
 - 7. Substitutions: See Section 016000 - Product Requirements.
- B. Fire Extinguisher Cabinets and Accessories:
 - 1. Ansul, a Tyco Business: www.ansul.com/#sle.
 - 2. JL Industries, Inc: www.jlindustries.com.
 - 3. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.
 - 4. Potter-Roemer: www.potterroemer.com/#sle.
 - 5. Pyro-Chem, a Tyco Business: www.pyrochem.com/#sle.
 - 6. Strike First Corporation of America; EL-Elite Architectural Series Fire Extinguisher Cabinet, Non-Fire Rated: www.strikefirstusa.com.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Class: A:B:C type.
 - 2. Size: 10 pound (4.54 kg).

3. Finish: Baked polyester powder coat Red color.
 4. Temperature range: Minus 40 degrees F (Minus 40 degrees C) to ___ degrees F (___ degrees C).
- C. Dry Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gauge.
1. Class: K type.
 2. Size: 1.6 gallons (6 L).
 3. Size and classification as scheduled.
 4. Finish: Polished stainless steel.
 5. Temperature range: Minus 20 degrees F (Minus 29 degrees C) to 120 degrees F (49 degrees C).

2.03 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Cabinet Construction: Non-fire rated.
1. Formed primed steel sheet; .125 inch (3.175 mm) thick base metal.
- C. Fire Rated Cabinet Construction: Two-hour fire rated.
1. Steel; double wall or outer and inner boxes with 5/8 inch (15.9 mm) thick fire barrier material.
- D. Metal: Formed aluminum; .125 inch (___ mm) thick.
- E. Cabinet Configuration: Recessed type.
1. Size to accommodate accessories.
- F. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinge.
- G. Door Glazing: Acrylic plastic, clear, 1/8 inch (3 mm) thick, flat shape and set in resilient channel glazing gasket.
- H. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- I. Weld, fill, and grind components smooth.
- J. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.
- K. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

- A. Fire Blanket: Fire retardant treated wool; red, 62 by 84 inch (1575 by 2135 mm) size.
- B. Cabinet Signage: FIRE EXTINGUISHER.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, ___ inches (___ mm) from finished floor to inside bottom of cabinet.
- C. Secure rigidly in place.
- D. Place extinguishers in cabinets.

END OF SECTION

**SECTION 105617
WALL MOUNTED STANDARDS AND SHELVING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shelf standards, brackets, and accessories.
- B. Shelves.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood blocking in walls for attachment of standards.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.

PART 2 PRODUCTS

2.01 COMPONENTS

- A. Fasteners: Screws as recommended by manufacturer for intended application or as otherwise required by project conditions. Finish of exposed to view fasteners to match finish of standards and other components.

2.02 MATERIALS

- A. Heavy-Duty Shelf Standards and Brackets: Double-slotted channel standards for brackets adjustable in 1 inch (25 mm) increments along entire length of standard, drilled and countersunk for screws.
 - 1. Acceptable Product: Knap & Vogt KV 82/182.
 - 2. Load Capacity: Recommended by manufacturer for loading of 300 to 450 pounds (135 to 200 kg) per pair of standards.
 - 3. Lengths: As indicated on drawings.
 - 4. Finish: Powder-coated.
 - 5. Color: To be selected by Architect from manufacturer's full line.
 - 6. Brackets: Double tab type, locking into slots; size to suit shelves; same finish as standards.
 - 7. Bracket Quantity: Provide one bracket for each 18 inches (____ mm) of standard length.
- B. Laminate Faced Shelves: Particleboard or medium density fiberboard covered with high pressure decorative laminate on both sides.
 - 1. Edge Finish: Matching laminate, all four edges.
 - 2. Substrate Thickness: 3/4 inch (19 mm), nominal.
 - 3. Length: 36 inches (915 mm).
 - 4. Laminate Color and Pattern: To be selected by Architect from manufacturer's standard line.
- C. Fasteners: Screws as recommended by manufacturer for intended application or as otherwise required by project conditions.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install brackets, shelving, and accessories.

END OF SECTION

**SECTION 122400
WINDOW SHADES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Window shades and accessories.
- B. Electric motor operators.
- C. Motor controls.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.
- B. Section 092116 - Gypsum Board Assemblies: Substrate for window shade systems.

1.03 REFERENCE STANDARDS

- A. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments; 2019.
- B. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.
- E. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.
- F. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
 - 2. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.
- B. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of all affected installers.
- C. Sequencing:
 - 1. Do not fabricate shades until field dimensions for each opening have been taken.
 - 2. Do not install shades until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
 - 1. Motorized Shades: Include power requirements and standard wiring diagrams.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details.
- D. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.
- E. Selection Samples: Include fabric samples in full range of available colors and patterns.
 - 1. Motorized Shades: Include finish selections for controls.
- F. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

- H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

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

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

1.08 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
 - 1. Shade Hardware: 25 years.
 - 2. Electric Motors: One year.
 - 3. Electronic Control Equipment: One year.
 - 4. Fabric: 25 years.
 - 5. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manually operated and motorized roller shades shall be provided from the same manufacturer.

2.02 WINDOW SHADE APPLICATIONS

- A. ShadesWT-1: Springs Window Fashions.
 - 1. Type: Double Take, T300.
 - 2. Fabric: Basis of Design: Stone Ebony, CE312 - 3%.
 - 3. Mounting: Inside (between jambs).
 - 4. Operation: Manual.

2.03 ROLLER SHADES

- A. Roller Shades: Fabric roller shades complete with mounting brackets, roller tubes, hembars, hardware and accessories; fully factory-assembled.
 - 1. Drop: Regular roll.
 - 2. Size: As indicated on drawings.
- B. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation; PVC-free; 100 percent recycled.
 - 1. Privacy Shades: Soften the light yet still reveal some details to the outside; moderate privacy; Openness Factor approximately equal to 1 percent.
 - 2. Blackout Shades: Block virtually all the light; Openness Factor equal to zero (0).
 - 3. Flammability: Pass NFPA 701 large and small tests.
 - 4. Fungal Resistance: No growth when tested according to ASTM G21.
- C. Roller Tube: As required for type of operation, extruded aluminum with end caps.
 - 1. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
 - 2. Finish: Baked enamel; color from manufacturer's standards.
- D. Hembars and Hembar Pockets: Wall thickness designed for weight requirements and adaptation to uneven surfaces, to maintain bottom of shade straight and flat.
- E. Manual Operation: Clutch operated continuous loop; beaded ball chain.

- F. Motor Operation: Motor system housed inside roller tube, controlling shade movement via motor controls indicated; listed to UL 325.
 - 1. Audible Noise: Maximum 39 dBA measured 3 feet from the motor unit; no audible clicks when motor starts and stops.
 - 2. Motors: Size and configuration as recommended by manufacturer for the type, size, and arrangement of shades to be operated; integrated into shade operating components and concealed from view.
 - 3. Motor Type: Both AC and DC motors are acceptable; provide required transformers for DC motors.
 - 4. Coupling of Multiple Shades: Where possible, minimize number of motors by coupling adjacent shades.
 - 5. Control Compatibility: Fully compatible with the controls to be installed.

2.04 ACCESSORIES

- A. Fascias: Size as required to conceal shade mounting.
 - 1. Style: As selected by Architect from shade manufacturer's full selection.
- B. Brackets and Mounting Hardware: As recommended by manufacturer for mounting configuration and span indicated.
- C. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

2.05 FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Fabricate shades to fit openings within specified tolerances.
 - 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch (13 mm) space between bottom bar and window stool.
 - 2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.
- C. Dimensional Tolerances: As recommended in writing by manufacturer.
- D. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Installation Tolerances:
 - 1. Maximum Offset From Level: 1/16 inch (1.5 mm).
- C. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- D. Adjust level, projection and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 SYSTEM STARTUP

- A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

3.05 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

3.06 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 123600 COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Countertops for architectural cabinet work.
- B. Wall-hung counters and vanity tops.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ANSI A161.2 - Performance Standards for Fabricated High Pressure Decorative Laminate Countertops; 1998.
- B. ANSI A208.1 - American National Standard for Particleboard; 2022.
- C. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- F. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- G. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- H. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- I. PS 1 - Structural Plywood; 2023.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
- F. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- G. Installation Instructions: Manufacturer's installation instructions and recommendations.
- H. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- B. Fabricator Qualifications: Same fabricator as for cabinets on which tops are to be installed.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

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

environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
 - 1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.048 inch (1.2 mm) nominal thickness.
 - a. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - b. Finish: Matte or suede, gloss rating of 5 to 20.
 - c. Surface Color and Pattern: As indicated on drawings.
 - d. Manufacturers:
 - 1) Basis of Design: Formica
 - 2) Substitutions: See Section 016000 - Product Requirements.
 - 2. Exposed Edge Treatment: 3mm edge band, substrate built up to minimum 1-1/4 inch (32 mm) thick; covered with matching laminate.
 - 3. Back and End Splashes: Same material, same construction.
- C. Wood Countertops: One-piece, glued-laminated under pressure.
 - 1. Thickness: 1-1/4 inch (32 mm), minimum.
 - 2. Construction (Butcher Block): Maximum 1 7/8" inch (___ mm) thick strips glued perpendicular to surface.
 - 3. Species: Maple; clear grade.
 - 4. Exposed Edges: Straight edge.
 - 5. Back and End Splashes: Same material, same construction; 3/4 inch (19 mm) thick, square edges.
 - 6. Finish: Durakryl 102 UV cured polyurethane.
- D. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
 - 1. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.
 - 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Manufacturers:
 - 1) Formica Corporation: www.formica.com/#sle.
 - 2) Corian: www.corian.com/#sle.
 - 3) Substitutions: See Section 016000 - Product Requirements.
 - b. Finish on Exposed Surfaces: _____.
 - c. Color and Pattern: As indicated on drawings.
 - 3. Other Components Thickness: As indicated on drawings.
 - 4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch (32 mm) thick; square edge; use marine edge at sinks.
 - 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
 - 6. Skirts: As indicated on drawings.

2.02 MATERIALS

- A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- B. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf (20 kg/cu m) minimum density; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- C. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

2.03 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 - 1. Join lengths of tops using best method recommended by manufacturer.
 - 2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
 - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 - 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 - 2. Height: 4 inches (102 mm), unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches (3657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
 - 1. Integral sinks: Shop-mount securely to countertop with adhesives, using flush configuration, as per manufacturer's instructions, and as detailed on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

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

3.03 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch (16 mm).
- C. Attach wood countertops using screws with minimum penetration into substrate board of 5/8 inch (16 mm).
- D. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.
- B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.
- C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.05 CLEANING

- A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

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

END OF SECTION

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FIRE PROTECTION WORK SHALL INCLUDE:

SECTION 21 1000

PLUMBING WORK SHALL INCLUDE:

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VENTILATION AND AIR CONDITIONING WORK SHALL INCLUDE:

SECTION 23 0593, 23 0900 & 23 7000

& SECTIONS 23 0500, 23 0510, & 23 0700 AS APPLIES

**SECTION 21 1000
FIRE SUPPRESSION SYSTEMS**

PART 1 GENERAL

1.01 DEFINITIONS

- A. Contractor – Defined as the Contractor, Subcontractor and/or Subcontractors which are responsible for all or any part of the fire suppression system installation specified in Division 21 and/or as shown on the Contract Drawings.
- B. Wet Pipe Sprinkler System – A system in which automatic sprinklers are attached to piping filled with water allowing water to discharge immediately from sprinklers when activated. Sprinklers activate when heat bursts a frangible glass bulb or melts a fusible link. System activation or incidental flow is monitored by flow switches and/or alarm valves. Hose connections are included when required by code.
- C. Dry Pipe Sprinkler System – A system in which automatic sprinklers are attached to piping filled with compressed air until the event that heat from a fire activates a sprinkler by bursting a frangible glass bulb or melting a fusible link. Air that escapes through the activated sprinkler will cause air pressure loss in the system signaling the dry valve to open then delivering water to the piping and corresponding sprinklers. System activation or incidental flow is monitored by pressure switches, flow switches and/or alarm valves.

1.02 SCOPE

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 shall apply to this section.
- B. Where any requirements specified on the plans conflict with the specifications of this section, the specifications indicated on the plans shall govern.
- C. The Contractor shall provide all items, articles, materials, operations or methods listed, mentioned or scheduled on the Drawings and/or herein specified, including all labor, materials, equipment, accessories, wiring and incidentals necessary to be installed in accordance with manufacturer's recommendations except as otherwise approved.
- D. The fire protection system shall be a wet-pipe system consisting of two zones served by two different underground water services for protection of portions of the existing building and additions as outlined by the plans as either part of base bid or alternates. The system in office and classroom areas shall be designed for light hazardous classification. The storage, shop, and mechanical areas shall be designed for ordinary hazard, group 1 or 2 classification as defined by the plans.
- E. System(s) will be supplied by either an existing 4" underground service that is to remain located in Mech Room 139 or a new 6" underground service located in Mech A110 as part of alternate 2.
- F. The system(s) shall be complete with, but not limited to, sprinklers, piping, valves, alarm bell/horn, fire department connection, backflow preventer test connection, and controls necessary for a complete system.
- G. See the plans for water supply flow test information.

1.03 CONTRACTOR QUALIFICATIONS

- A. The Contractor for the fire protection installation shall be a qualified Fire Protection Contractor licensed in the State of South Dakota that has been regularly engaged in the installation of similar Automatic Fire Sprinkler Systems and associated fire protection equipment for a minimum of 5 years.

1.04 PERMITS AND SERVICE CHARGES

- A. All permits and service charges necessary for execution of the work under this Contract shall be obtained by and paid for by the Contractor. It shall be the responsibility of the Contractor to determine the permit requirements of the local authorities and utility companies and the cost of

required permits, service charges, tap fees and development fees shall be included in the Contractor's bid.

- B. All work shall be executed in accordance with all local, state and national rules, regulations, codes, etc., which are applicable and shall be subject to inspection by the proper authorities.

1.05 CODES AND STANDARDS

- A. All work performed and all equipment furnished under this Division of the Contract shall be manufactured and installed in strict accordance with the most recent editions of all applicable codes and standards, including the applicable provisions of the following codes and standards:
 1. Local and State Codes, Standards and Regulations
 2. National Fire Protection Association (NFPA)
 - a. NFPA 13 – Installation of Sprinkler Systems
 - b. NFPA 25 – Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
 - c. NFPA 72 – National Fire Alarm and Signaling Code
 3. National Electric Code (NEC) (NFPA 70)
 4. International Fire Code (IFC)
 5. Underwriter's Laboratory (UL)
 6. Uniform Plumbing Code
 7. International Mechanical Code
 8. American Waterworks Association (AWWA)
 9. Williams-Steiger Occupational Safety and Health Act of 1970 (OSHA)
 10. International Building Code
 11. Americans with Disabilities Act (ADA)
- B. Where specific requirements of any code vary with the requirements of another code, the higher standard as determined by the Architect/Engineer shall govern the installation.
- C. All equipment manufactured in accordance with the provisions of the above codes and standards shall bear the label of the respective association bureau thereon.
- D. All materials installed shall have composite fire and smoke hazard ratings as tested by procedures ASTM 84, NFPA 255 and UL 723 not to exceed 25 Flame Spread and 50 Smoke Developed.

1.06 AUTHORITIES AND AGENCIES

- A. All work will be installed for the approval and acceptance of the following:
 1. Faulkton Fire Marshal
 2. South Dakota State Fire Marshal
 3. Fire Protection Engineer

1.07 DRAWINGS

- A. In general, the Drawings of the fire protection systems and equipment are to scale. However, to determine exact locations of walls and partitions, the Contractor shall consult the architectural and/or structural drawings which are dimensioned. Drawings shall not take precedence over field measurements.
- B. Drawings of piping and sprinklers, although shown on scale drawings, are diagrammatic only. They are intended to indicate size and/or capacity where stipulated, approximate location and/or direction, and approximate general arrangement of one phase of work to another, but not the exact detail or exact arrangement of construction. If it is found, before installation of any or all construction phases, that a more convenient, suitable or workable arrangement of any or all phases of the project would result by varying or altering the arrangement indicated on the Drawings, the Architect/Engineer may require the Contractor to change the location or arrangement of the work without additional cost to the Owner. Such rearrangement shall be in accordance with directions from the Architect/Engineer.
- C. Where discrepancies are discovered after certain portions or phases of the work have been installed, the Architect/Engineer reserves the right to require the Contractor to make changes in

pipe, duct, fixture or equipment locations or arrangements to avoid conflicts with work at no additional cost to the Owner.

- D. Because the Drawings are to a relatively small scale to show as large a portion as is practical, the fact that only certain features of the system are indicated does not mean that other similar or different features or details will not be required. The Contractor shall furnish all incidental labor, material or equipment for the systems so that each system is a complete and operating one unless otherwise specifically stipulated in the detailed body of the specifications.
- E. The Contractor, Subcontractor's and their respective trades shall cooperate in laying out their work so it will fit properly into the space provided. Promptly report to the Architect/Engineer any delay or difficulties encountered in the installation of this work which might prevent prompt and proper installation, or make it unsuitable to connect with or receive the work of others. Failure to so report shall constitute an acceptance of the work of other trades as being fit and proper for the execution of this work.

1.08 SHOP DRAWINGS

- A. Shop drawings to be submitted in electronic PDF format unless indicated otherwise in the General Conditions.
- B. To the extent practical, complete sets of shop drawings for each specification section shall be submitted. In the case that a particular item is required to be expedited, that particular item may be submitted individually.
- C. Submit shop drawings in electronic PDF format.
- D. Furnish Shop Drawings as follows:
 - 1. For all major items of equipment or materials, regardless of whether the item is to be furnished as specified.
 - 2. For all equipment, systems or devices where Shop Drawings are specifically called for.
 - 3. For all minor items of equipment or materials where the Contractor proposes to deviate from the specified and/or scheduled manufacturer or material.
- E. Shop Drawings will be reviewed by the Architect/Engineer, a review letter will be returned to the Contractor. Shop Drawings shall be submitted sufficiently in advance of the construction schedule to allow time for checking Drawings, resubmittal and rechecking when necessary.
- F. Shop Drawings will be reviewed by the Architect/Engineer, and copies of Shop Drawings will be returned to the Contractor. Shop Drawings shall be submitted sufficiently in advance of the construction schedule to allow time for checking Drawings, resubmittal and rechecking when necessary.
- G. Any equipment or material which is installed without authorization by properly processed Shop Drawings will be subject to removal by the Contractor and reinstallation as directed, without cost to the Owner. All cost for repair for damages as may be incurred to the structure as a result of the above correction shall be paid by this Contractor.
- H. Shop drawing material quantities will not be checked by the Architect/Engineer, and review of Shop Drawings by the Architect/Engineer shall not be construed to be verification of the material quantities and sizes shown on the Shop Drawings. Quantities, sizes, dimensions and locations shown on the Drawings and as specified shall determine material requirements.
- I. Hydraulic calculations proving the system is capable of providing the required design densities to accommodate the use and occupancy of each shall be performed by the contractor. The contractor is required to perform and submit hydraulic calculations as part of their submittal packages.

1.09 COORDINATION

- A. The Contractor shall communicate with all other Contractors on this project and shall arrange his work in proper relation to the work of others. Work made necessary as a result of failure to coordinate with other Contractors shall be the responsibility of this contractor and shall first be approved by the Architect/Engineer. The contractor shall coordinate with the General

Contractor to maximize the efficiency of the onsite placement and to ensure the safe delivery and storage of the materials.

1.10 EXISTING SERVICES

- A. The Contractor shall verify the exact location of all existing building services extended and/or relocated for this project. The Contractor shall also verify the exact location and take proper precautions to protect all services which may be encountered during construction.
- B. All active services which are encountered shall be protected, braced and supported where required for proper execution of the work and without interruption of the service if possible.
- C. All inactive services which are encountered shall be protected or removed as directed by the Architect/Engineer, Owner, Utility Company or Municipal Agency having jurisdiction. The service shall also be plugged or capped as directed.
- D. When active services must be temporarily interrupted, the interruption shall be scheduled at night or at such time as approved by the Owner or authority having jurisdiction and so as to cause the minimum of interference with establishing operating routine. Arrangements shall be made to work continuously including overtime if required, to assure that services will be interrupted only as long as actually required to complete necessary work.

1.11 CLEANING

- A. The Contractor and/or Subcontractors for the various phases of the work shall clear away all debris, surplus materials, etc., resulting from their work or operations, leaving the job and equipment furnished under any or all contracts in a clean first class condition.

1.12 PAINTING

- A. Painting of materials and equipment furnished shall be as described in DIVISION 9. Contractor shall refinish and restore to the original condition and appearance, all equipment which has sustained damage to the manufacturer's prime and finish coats of enamel or paint. Materials and workmanship shall be equal to the requirements described in DIVISION 9.
- B. Where sprinklers are installed on exposed piping and in other locations where sprinklers are susceptible to paint spray or over-spray, contractor shall cover sprinklers in preparation for painting.

1.13 ACCESS TO EQUIPMENT

- A. Access shall be provided to all motors, valves, controls, specialties, etc., for maintenance purposes. All access doors, access panels, removable sections, etc., required for access shall be provided. The location of the access openings relative to the equipment shall be coordinated to assure proper access to the equipment. The door shall maintain any ratings of the wall, ceiling, etc. that it penetrates.
- B. Access openings are required for valves and other devices requiring access and shall be provided in the housings, tanks, walls, ceilings, etc., under this portion of the Contract.

1.14 INSPECTIONS, TESTING, CERTIFICATES, & WARRANTY

- A. All inspections, examinations and tests required by the authorities and agencies specified shall be arranged and paid for by the Fire Protection Contractor as necessary, to obtain complete and final acceptance of the Fire Protection System per the requirements of NFPA 13 and any other applicable codes. The Contractor shall provide a minimum 1 year warranty on the system effective starting the day of final system acceptance and also at that time be required to provide instruction to the owner or his representative to acquaint that person thoroughly with all system equipment.
- B. After completion of the fire protection installation and at the start of the guarantee year, the Fire Protection Contractor shall execute and file five (5) copies of the "Contractor's Material and Test Certificate, Sprinkler systems - Water Spray Systems" with the Architect/Engineer.

1.15 RECORD DRAWINGS

- A. The Contractor shall keep a complete set of all drawings in the jobsite office for purpose of showing the installation of mechanical systems and equipment. This set of drawings shall be

used for no other purpose. Where any equipment or system components are installed different from that shown on the Architect/Engineer's drawings, such differences shall be clearly and neatly shown on this set of drawings using ink or indelible pencil. At the completion of the project, the record set of drawings shall be turned over to the Architect/Engineer and shall become his property. Record drawings may be inspected by the Architect/Engineer at site visits.

1.16 OPERATING INSTRUCTIONS

- A. The Contractor shall furnish the Owner two (2) sets of complete catalog data, manufacturer's literature and detailed manuals covering the operation and maintenance of all equipment specified under this Section. All such literature shall be bound in an amply sized three-ring binder and submitted to the Architect/Engineer for approval and for eventual transmittal to the Owner. The manual shall have a Table of Contents at the front of the manual. In addition to a hard copy of the operating instruction, provide an electronic copy in PDF format to the Owner.
- B. The Contractor shall also supervise the initial operation of all equipment and instruct the operator selected by the Owner in such operation as required to acquaint him thoroughly with the equipment.

PART 2 - PRODUCTS

2.01 PRODUCT OPTIONS

- A. Materials or equipment specified by name of manufacturer, brand, trade name or catalog reference, shall be furnished under the contract unless changed by Addenda or a Contract modification.
- B. Where two (2) or more materials are named, the choice of these shall be limited to the items named. Where the material or equipment named is followed by the phrase "or equal" the required function, dimension, appearance and quality to be met by any proposed substitute is all that is intended to be established.
- C. Proposed substitutions for any named items shall be submitted to the Fire Protection Engineer for approval. No substitution shall be made without the approval of the Fire Protection Engineer. Any proposed substitution requests shall be submitted at least 10 days prior to bid to the Architect/Engineer for approval. Bidders shall not rely upon substitutions made in any other manner.
- D. Should a proposed substitution wish to be made within 10 days of bid the Contractor shall attach his proposed substitution along with the appropriate add or deduct to the Contract amount, should the substitution be accepted. Substitutions proposed by the Contractor will not be considered in the award of the Contract.
- E. All products shall be new and listed for fire protection use and be rated in excess of the maximum expected pressure that will be present in the systems.

2.02 SPRINKLERS

- A. Except where designated otherwise on the drawings, sprinklers shall be as follows:
 - 1. Sprinklers shall be standard semi-recessed white-plated pendant type in all locations where piping is concealed above ceilings.
 - 2. Sprinklers shall be standard upright type where piping is installed exposed in storage, garage and other locations as indicated on the Drawings. Upright sprinklers shall be plain brass finish.
 - 3. Sidewall sprinklers, where permitted, shall be white-plated semi-recessed in finished rooms, plain brass elsewhere.
- B. Temperature rating of sprinklers shall be in accordance with requirements of approving authorities, as noted on the Drawings, and per the requirements of NFPA 13.
- C. Sprinklers shall be installed centered in square ceiling tile and in the narrow dimension of rectangular ceiling tile. In rectangular tiles sprinklers shall be centered or at the quarter points along the longer dimension of the tile.

- D. Sprinklers installed in areas where damage may occur, such as gymnasiums, shall have head guards and as otherwise designated on the drawings. Sprinklers installed at elevations below 7'-0" shall have head guards.
- E. Concealed brass sprinklers with flush white-plated concealer plate shall be installed where noted on the Drawings. Sprinklers shall be Tyco, Reliable, Victaulic, Viking, or equal.

2.03 ESCUTCHEONS

- A. Escutcheons shall be installed as designated on the drawings and shall be the same make as the sprinkler head that is used.
- B. Escutcheons shall be Tyco, Reliable, Victaulic, Viking, or equal.

2.04 PIPE AND PIPE FITTINGS

- A. Furnish and install where shown on the Drawings and required for a complete system, pipe and fittings of type and material for the various services as noted below.
- B. Piping not shown on the Drawings, which is obviously necessary for complete systems, shall be provided and shall be amply sized in accordance with applicable codes and standards.
- C. Wet fire sprinkler system (water-filled) and deluge system (open-type) piping shall be ASTM A-135 standard-weight, black, Schedule 40 with factory or field formed threaded ends for sizes up to 2 inch size. Fittings used on threaded end piping shall be ASME B16.3 Class 150, ductile iron threaded fittings with NPT threads that conform to ANSI B1.20.1. Wet fire sprinkler piping shall be ASTM A-135 Schedule 10, black with factory or field formed roll-grooved ends for sizes 1-1/4" and greater. Grooved fittings shall be standard or short radius ASTM A-536, Grade 65-45-12, ductile iron fittings with cut-grooved ends and non-lead orange enamel coated. Grooved couplings shall include ductile iron, ASTM A-536, Grade 65-45-12, housings with non-lead orange enamel coatings, ASTM A-449 and ASTM A-183 bolts and nuts, and Grade "E" EPDM Type A gaskets. Grooved pipe outlets shall be tee-let, ASTM A-53, ANSI B1.20.1 threaded or cut groove, factory welded outlet fittings. Field installed outlets shall be permitted to be mechanical "T", bolted, ASTM A-536, orange enamel coated ductile iron, with ANSI B1.20.1 threaded or cut groove outlets, Grade "E" EPDM gaskets, and ASTM A-449 and ASTM A-183 bolts and nuts.
- D. Dry fire sprinkler system (compressed air-filled) piping and drain piping shall be ASTM A-135 standard-weight, Schedule 40 with factory or field formed threaded ends for sizes up to 2 inch size. Fittings used on threaded end piping shall be ASME B16.3 Class 150 ductile iron threaded fittings with NPT threads that conform to ANSI B1.20.1. Dry fire sprinkler piping shall be ASTM A-135 Schedule 40 standard-weight with factory or field formed roll-grooved ends for sizes 1-1/4" and greater. Grooved fittings shall be standard or short radius ASTM A-536, Grade 65-45-12, ductile iron fittings with cut-grooved ends. Grooved couplings shall include ductile iron, ASTM A-536, Grade 65-45-12, housings, ASTM A-449 and ASTM A-183 bolts and nuts, and Grade "E" EPDM gaskets. Grooved pipe outlets shall be tee-let, ASTM A-53 ductile iron, and ANSI B1.20.1 threaded or cut groove factory welded outlet fittings. Factory or field installed outlets shall be permitted to be mechanical "T", bolted, ASTM A-536 ductile iron, ASTM A-153, with ANSI B1.20.1 threaded or cut groove outlets, Grade "E" EPDM gaskets, and ASTM A-449 and ASTM A-183 bolts and nuts.
- E. All piping that penetrates an exterior wall shall be galvanized Schedule 40 minimum.
- F. Plastic CPVC Schedule 80 piping and fittings are not allowed for this installation.
- G. Copper piping shall be installed where designated on the drawings and as per its listing. Copper piping shall be soldered when installed concealed and brazed when installed exposed. Piping shall be Type M Mueller, Cerro, or equal.
- H. Flexible piping is allowed for this project where approved by its listing and proven hydraulically.
- I. All wet and dry system grooved pipe fittings and couplings shall be Victaulic, Anvil Gruvlok, Tyco, Star or equal. Grooved pipe fittings and couplings shall be ductile iron with an orange enamel coating for wet systems and dry systems. All components shall be supplied by one manufacturer. Pipe fittings and couplings shall be standard or short radius.

- J. All threaded fittings shall be black ductile iron for wet systems and where otherwise required by the drawings. All dry system threaded fittings shall be galvanized ductile iron. Threaded fittings shall be supplied by Tyco, Star, Anvil, or equal.
- K. All welded outlet fittings shall be Merit, Island, or equal.
- L. All flanged fittings shall be ductile iron per ASTM A536. Flanged fittings shall be Anvil, Star, or equal.
- M. Plastic CPVC fittings are not allowed for this installation.
- N. Copper fittings shall be installed where designated on the drawings and as per its listing.
- O. All pipe ends shall be smooth and burr free and cleaned of any loose debris or pipe hole cutouts prior to installation.

2.05 HANGERS AND ATTACHMENTS

- A. All piping 1/2" through 8" shall be hung through the use of galvanized ring style band hangers with a knurled swivel nut. Hangers, spacing, and rod diameters shall be per NFPA 13 requirements.
- B. 3/8" all thread rod shall be used to attach the ring to the structural attachment device for pipe sizes 1/2" through 4", 1/2" all thread rod shall be used for pipe sizes 6" through 8", and 5/8" all thread rod shall be used for pipe sizes 10" through 12".
- C. Rings shall be Tolco, Hilti, Anvil, or equal.
- D. Structural Attachments shall be Sammy, Tolco, Hilti, or equal.

2.06 FIRESTOPPING

- A. Firestopping materials shall be 3M, Hilti, MetaCaulk, Nelson or equal. Firestopping material shall have a rating resistance rating equal to or greater than the wall in the penetration exists that will be sealed with said firestopping.

2.07 WALL, FLOOR AND CEILING PLATES

- A. Furnish and install chrome-plated wall, floor and ceiling plates on all exposed pipes where they pass through walls, floors, or ceilings in finished areas. Finished areas shall be those areas which are painted or have special finishes within the room. The wall plates shall be a minimum of 3/32 inch thickness and shall have set screws or spring locks for clamping to the piping. Flush valves shall have set screw type wall plates. The plates shall be chrome-plated steel, cast iron or brass and shall set tight against the wall.

2.08 CONTROL VALVES

- A. All valves shall be new and listed for fire protection use.
- B. Furnish and install valves in piping where so indicated on the Drawings.
- C. Of the several manufacturers listed, the Contractor is to standardize on one make as much as practical but not to the extent of sacrificing quality listed. Valves shall be Tyco, Milwaukee, Victaulic, Ames, Watts, Wilkins, or equal.
- D. Butterfly valves shall be of the indicating type with two sets of factory installed internal supervisory switches. Valves shall be ductile iron conforming to ASTM A-395 with Grade EPDM "E" encapsulated rubber disc seals. Valves shall be Tyco, Victaulic, or Equal.
- E. Outside Screw and Yoke (OS&Y) gate valves shall be ductile iron, raised face with bolted bonnets. Valve shall be Kennedy, Mueller, Nibco, Watts, or equal.
- F. Ball Valves 1-1/2" and smaller shall be standard port, end entry valves with a brass valve body. The ball shall be chrome plated brass with a stainless steel stem. Valves shall be Watts, Nibco, Milwaukee, Victaulic, or equal.

2.09 RISER MANIFOLDS

- A. Riser manifolds shall be provided for each wet zone designated on the drawings. The manifold shall include a 300 psi water gauge, water flow alarm switch with paddle, Schedule 40 pipe body, ductile iron angle valve with site glass, and pressure relief valve.

- B. Riser manifolds shall be Tyco, Viking, Reliable, or equal.

2.10 AUTOMATIC AIR VENT

- A. Furnish and install an automatic air vent for each wet zone. Automatic air vent shall be located near a high point in the wet system that allows for the maximum amount of air removal from that system. Automatic air vent shall have a minimum connection size of ½" and a minimum pressure rating of 175 psi.
- B. The device shall meet the requirements of UL 2573.
- C. Automatic air vent shall be Tyco, Viking, Reliable, or equal.

2.11 WATER FLOW SWITCHES AND ALARMS

- A. Water flow switches for alarm bell/horn and tamper switches shall be furnished and installed by this Contractor. All required wiring shall be installed by the Electrical Contractor.
- B. Water flow and tamper switches shall be Potter.

2.12 FIRE DEPARTMENT CONNECTION

- A. Furnish and install a Guardian Series 6100 or equal projecting connection where shown on the Drawings. Wall plate shall read "AUTOMATIC SPRINKLER." Finish shall be rough brass. Inlets shall be 2-1/2 inch size and outlet shall be 4 inch size. Install an automatic ball drips between the connection and the check valve.
- B. Connections shall have rough brass plugs and chains. Locking Fire Department connection plugs shall be provided where required by the fire code official and where the responding fire department carries appropriate key wrenches for removal. Outlets shall be 36 inches above finished grade. Threads for Fire Department connections shall be National Standard. Verify threads and plug type with the local Fire Department.
- C. Fire department connection shall be Guardian, Potter Roemer, Central, Elkhart, or equal.

2.13 DOUBLE CHECK VALVE BACKFLOW PREVENTER

- A. Furnish and install an Ames Fire & Waterworks Colt Series C200 or equal double check backflow preventer where shown on the Drawings. The backflow preventer shall be a complete assembly including tight closing shut-off valves before and after the device and also be protected by a strainer. It shall be a complete assembly including four ball type test cocks.
- B. The device shall meet the requirements of A.S.S.E. standard 1015 and A.W.W.A. standard C506.
- C. Double check valve backflow preventer shall be Ames, Watts, Hersey, Conbraco, Febco, Wilkins or equal.

2.14 PRESSURE GAUGES

- A. Furnish and install U.S. Gauge Model 5105 or equal pressure gauges in pipelines and on equipment as indicated herein and/or where shown on the Drawings. Gauges shall have phosphor bronze bourdon tube with brass movement.
- B. Gauges shall be compound, pressure or vacuum as required with 4-1/2 inch diameter dial. Each gauge shall be complete with Trerice No. 872 pressure snubbers, and brass ball valves.
- C. The normal operating pressure of each gauge shall be 50-70 percent of full scale. The range of the scale shall be suitable for the application.
- D. The gauges shall be located and mounted such that they can be conveniently read by a person standing on the equipment room floor. Accuracy shall be Grade "A". Case shall be aluminum.
- E. Pressure gauges shall be U.S. Gauge, Trerice, Weksler, Ashcroft, Weiss or equal.

PART 3 - EXECUTION

3.01 PIPING CONNECTIONS

- A. Pipe connection shall be through the use of grooved couplings attached to roll or cut grooves on the piping, female threaded fittings screwed on to threaded end pipe, and flanged fittings

with bolts, nuts and rubber gaskets. Mechanical joint couplings may be used only with the approval of the Fire Protection Engineer.

3.02 PIPE HANGERS, SUPPORTS AND ANCHORS

- A. Anchors and other attachments to the building structure shall be installed where designated and as detailed on the Drawings and specified herein and/or as required. The hangers shall adequately support the piping system. They shall be located near or at changes in piping direction and as otherwise required by NFPA 13. They shall provide vertical adjustment to maintain pitch required for proper drainage. They shall allow for expansion and contraction of the piping. Hangers shall bear directly on piping.
- B. Pipe hangers shall not be attached to the roof deck. Hangers shall be attached to the structure with beam clamps, beam attachment and brackets bolted to joists and beams, wood lag bolts, steel self tapping screws, and any other approved means of attachment that is rated to support five times the weight of the water filled pipe plus 250 lbs of additional load.
- C. Hanging from one pipe to another is prohibited.

3.03 PIPING INSTALLATION

- A. All pipes shall be round and straight, of required size. Cutting shall be done with proper tools and pipes shall be reamed to full size after cutting.
- B. Piping shall be properly enclosed, supported, guided, anchored, sway braced, connected, tested, cleaned and flushed out and shall be properly insulated and protected where required.
- C. All pipes shall be run with proper grade to provide for easy draining and in group runs where applicable and in a neat and orderly manner, to the satisfaction of the Architect/Engineer. Lines required to be enclosed in ceiling, chase ways or similar spaces shall be installed to permit such enclosure as intended. All pipe runs shall be carefully laid out and scheduled to avoid necessary interferences with other work. If shown, pipe sizes on the Drawings are nominal pipe sizes and not outside diameters.
- D. Pipes shall be run substantially as indicated on the Drawings. However, the Architect/Engineer reserves the right to require this Contractor to make changes in pipe locations where conflicts occur with other trades. Such changes shall be made without extra cost to the Owner.
- E. Piping shall be installed with ample provisions for expansion and contraction to prevent injury to the same and to the building construction. Such provision shall be made by means of piping offsets, changes in direction, expansion loops and/or suitable expansion joints. Suitable anchors and guides shall be provided to permit proper deflection and compression of offset loops and expansion joints. Expansion joints shall not be used in lieu of offsets, changes in direction or loops, except where specified and/or indicated on the Drawings or where otherwise obviously necessary.
- F. Exposed piping shall be installed in a sanitary manner for ease in cleaning. Pipe shall be cut and threaded to fit the installation. Wherever possible, rough-in exposed pipe connections at the wall rather than the floor for ease in cleaning.

3.04 SLEEVES

- A. Any pipe passing through building construction including walls, floors, roofs or masonry partitions or as noted on the Drawings shall be encompassed with sleeves. Piping passing through any fire rated barrier, walls, or floor shall be installed as follows:
 - 1. Sleeves shall have an inside diameter 1/2 inch greater than the outside diameter of pipe passing through. All sleeves shall be fabricated from new Schedule 40 steel pipe material cut square and reamed.
 - 2. Sleeves shall be provided in all masonry partition walls including locations above suspended ceilings where masonry partition walls extend from floor slab to slab above. Sleeves shall be Schedule 40 steel pipe finishing flush with the wall surface.
 - 3. Sleeves through exterior building walls shall be Schedule 40 steel pipe with welded flange in the middle of the sleeve and ends finishing flush with finished surfaces. Space between pipe and sleeve shall be packed to provide a watertight joint.

4. Sleeves through roof slabs and floor slabs in concealed locations shall be Schedule 40 galvanized steel or linear polyethylene. Concealed sleeves shall be considered as pipe sleeves in shafts, pipe chases and within walls and partitions.
 5. Sleeves through floor slabs in exposed areas shall be Schedule 40 steel pipe and sleeves shall extend 1/4 inch above the finished floor surface. For slabs in equipment rooms and in other wet areas, sleeves shall be Schedule 40 steel pipe and shall extend 2 inches above finished floor surface.
 6. Floor sleeves in membraned floors shall be furnished with flashing rings and clamps.
 7. All sleeves in exposed locations, except equipment rooms, shall be set so plates specified will cover the sleeves.
 8. All pipe sleeves where wet conditions exist, except sleeves through exterior walls, shall be caulked with a plastic caulking, including sleeves in concealed locations. The space between the pipe and the sleeves shall be caulked in both ends of sleeve, even with the ends of the sleeve. The sealer shall be suitable for temperatures from minus 50 degrees to 300 degrees, suitable for painting, non-corrosive and have good adhesion.
- B. Sleeves in fire rated construction, equipment rooms, and/or where designated on the Drawings shall consist of schedule 40 steel pipe. Seal sleeves with a fire retardant sealant. When applied according to manufacturer's recommendations, sealant shall have a 3-hour U.L. fire rating.
 - C. All sleeves shall be set and maintained in place by this Contractor during the progress of the work. This Contractor shall be responsible for locating all sleeves at the proper location.
 - D. Sleeves are not required for core drilled masonry wall and floor holes, masonry wall and floor holes formed by polyethylene plastic (removable) sleeves, or for masonry holes made in another neat manner except in equipment rooms and other wet areas.
 - E. Sleeves are not required in metal or wood stud wall construction. Rated systems shall be provided as required to provide the necessary rating of the penetration.

3.05 DRAINS

- A. Drains shall be located and piped to discharge to the locations designated on the plans. Where required drains are not noted on the plans system drains shall be piped to a floor drain or mop sink where said drains or sinks are capable of accepting full system flow without excessive deflection of discharging water. Drain shall be piped through the wall of the building to atmosphere when a floor drain or mop sink is not available and where piping through the wall of the building to atmosphere is most convenient and has been approved by the Architect/Engineer.

END OF SECTION

**SECTION 22 0500
GENERAL PLUMBING REQUIREMENTS**

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. The mechanical contractor shall perform all work and furnish all materials as indicated in the mechanical plans and specifications as necessary for the successful completion of this project.

1.3 PERMITS AND SERVICES

- A. The mechanical contractor shall obtain all permits and arrange all inspections, give notices and pay all fees as required by the Authority Having Jurisdiction.
- B. This contractor shall coordinate any necessary site utilities including water, natural gas, and sewer work with local utility, owner, and other contractors to minimize disruption and downtime. ANY AND ALL CHARGES ASSESSED BY THE UTILITY OR CITY TO ACCOMMODATE THE REQUIREMENTS OF THIS PROJECT ARE THE SOLE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR. VERIFY ALL CHARGES AND COORDINATE ALL EQUIPMENT NECESSARY WITH THE UTILITY BEFORE SUBMITTING BID.

1.4 DRAWINGS AND MEASUREMENTS

- A. Verify all dimensions and conditions with Architectural and Structural drawings. The small scale of the drawings prohibits the indication of all offsets, fittings and accessories necessary and shall be furnished by this Contractor and required for complete and proper operation.
- B. "Existing Conditions" shown on drawings are based on existing plans and limited field investigation. The field survey was conducted to verify, as much as possible, the accuracy of the locations shown. The Contractor shall verify the accuracy of the "Existing Conditions" as shown on the drawings. As the demolition work progresses perform modifications and additions as necessary to correct for these hidden conditions and allow for the completion of the new work.
- C. The general arrangement of the mechanical systems shall be as shown on the drawings. Field changes shall have the written acceptance of the Engineer.
- D. Consult the drawings and specifications of all other trades. Layout work and coordinate with other trades, before installing any equipment, to avoid interfering with these trades or conflicting with applicable codes.
- E. The mechanical contractor shall bear full responsibility for coordinating his work with other trades to avoid conflicts in space requirements, clearances, etc. Problems arising due to lack of coordination will be the responsibility of the mechanical contractor to resolve. Extra work and/or equipment as a result of not coordinating work shall be the responsibility of the installing contractor and at no cost to the Owner.

1.5 INSPECTION OF SITE AND DOCUMENTS

- A. Before submitting a proposal on the work contemplated, the bidder shall thoroughly familiarize himself with the contract documents, the site, and all existing conditions and limitations that may affect the performance of his work. Any conflict noted shall be brought to the attention of the Engineer before bidding. If there is not sufficient time prior to bidding, the Contractor shall bid the larger quantity or better quality of work.
- B. No extra compensation will be allowed, because of misunderstanding the amount of work involved or the bidder's lack of knowledge, for obvious conflicts which could have been discovered or reasonably anticipated prior to bidding.

1.6 REGULATIONS AND CODES

- A. All work, materials, and equipment in this contract shall comply with all applicable local, city, state and federal ordinances, regulations, and codes.

1.7 INSTRUCTIONS

- A. Furnish verbal and engineer approved written instructions to Owner on all systems. Instruction shall include operating procedures, adjustments, and periodic maintenance. Furnish a copy of the written instructions and attach a letter to the Engineer, prior to final inspection, signed by Owner, attesting to date and satisfaction of instructions.

1.8 OPERATING AND MAINTENANCE MANUALS (3 Hard Copies & 1 Electronic Submittal via Submittal Exchange)

- A. PRIOR TO FINAL INSPECTION, The mechanical contractor shall furnish (3) hard copies (including 1 USB drive containing electronic copy) and (1) electronic submittal via Submittal Exchange of the O&M Manuals to the Engineer, containing all pertinent data to the mechanical systems. Information shall be indexed and labeled per system and shall include catalog cuts, installation manuals, maintenance manuals, manufacturer's names, replacement parts list. Include balancing reports as specified. Include written instructions and warranty info as specified.
- B. The first section shall be indexed/labeled "WRITTEN INSTRUCTIONS & TRAINING" noting written instructions with company service contact info and shall include a list of filters for each unit. Also include document with owners signature attesting to date and satisfaction of training.
- C. The second section shall be indexed/labeled "WARRANTY INFO" and shall include a statement of guarantee on the contractors company letter head and shall include warranty statements of all equipment provided/installed under his contract with specific dates. This will note any longer/special warranties.

1.9 AS-CONSTRUCTED DRAWINGS (Red Lined on Plans & USB Drive containing scanned PDF)

- A. During construction, each trade shall keep track of the major changes in the rerouting of piping and equipment, and shall note these in red on one set of drawings. This set of drawings shall be submitted with the Operation and Maintenance Manuals along with a USB drive containing a single PDF file with these same red line plans in electronic form. Most printing shops will be able to scan your trade's large plan sheets into electronic form. Contact the engineer's office if there are any questions.

1.10 WORKMANSHIP

- A. Qualified individuals that are properly licensed to perform the work involved shall perform all mechanical work.

1.11 CUTTING AND PATCHING

- A. This Contractor shall be responsible for all cutting and patching of holes required for passage of piping, equipment, and ducts. This also applies to the removal or installation of new equipment.
- B. All cutting of existing construction required to install or join new work, except where otherwise indicated on the plans, shall be the responsibility of this Contractor and coordinated with the Construction Manager. Before making any cuts, verify exact locations and sizes with the Construction Manager to confirm that no structural members will be cut. Contractor shall make every effort to minimize extent of cutting existing construction.
- C. The mechanical contractor shall be responsible for patching any openings left in floors, walls, and ceilings that were caused by his/her actions. Patching shall match existing surface in color, texture and quality so that patch is indistinguishable from original surface.

1.12 PAINTING

- A. Any equipment which becomes rusted or damaged during construction shall be repaired, cleaned, and repainted by this Contractor. Painting shall always be applied in two coats, one primer and one finish.

1.13 EQUIPMENT AND PIPE SUPPORTS

- A. Provide all structural supporting frames, steel stands, concrete bases, and hangers as required for mechanical equipment. All floor equipment shall be set on 4" high concrete bases furnished by this Contractor, unless otherwise noted.
- B. Paint all unprotected metal, except galvanized and copper, with metal protective paint.
- C. **Hangers for piping shall be large enough to encompass insulation. It shall not be acceptable for insulation to envelope hangers/saddles, or for insulation to stop on either side of hangers.**
- D. Provide saddles at all hangers or supports of insulated piping. Saddles for 4" and larger piping shall be fabricated of 14 gauge galvanized iron, and for smaller piping shall be fabricated of 16 gauge galvanized iron. Saddles shall be one-half the circumference of the pipe insulation and 4" shorter than the insulation inserts.
- E. Under no condition shall any pipe or duct structure be used to support another.

1.14 ACCESS TO EQUIPMENT

- A. Access shall be provided to all motors, valves, dampers, controls, specialties, etc., for maintenance purposes. All access doors, access panels, removable sections, etc., required for access shall be provided. The location of the access openings relative to the mechanical equipment shall be coordinated to assure proper access to the equipment.
- B. Access openings are required for manual, motorized, fire, and smoke dampers and other devices requiring access and shall be provided in the ductwork, plenums, housings, tanks, etc., under this portion of the contract.

1.15 EXCAVATING AND BACKFILLING

- A. When work to be completed by this contractor requires trenching, digging, etc. this contractor shall be responsible for properly protecting open trenches in accordance with required safety procedures. Backfill shall be placed in horizontal layers, not exceeding 9 inches in thickness. Moisten and hand or machine compact to 95% of standard proctor density. Bring fill to elevations indicated. If backfill fails the proctor density test in accordance with ASTM D-2049 and conducted by an independent testing laboratory retained by the owner, Contractor shall recompact and retest until satisfactory density is reached. This contractor shall restore the surface (whether grass, asphalt, concrete, etc.) to its original condition. Grass shall be seeded to match surrounding turf.
- B. When work is in public street, paving repairs shall be equal to and comply with municipal agency requirements. If repairs are done by municipal agency, make necessary arrangement with such agency to make the repairs. Contractor shall include cost for permits, inspection fees, work, etc. in Mechanical Bid.

1.16 TESTING AND ADJUSTING

- A. At the completion of work, all parts of the installation under Division 22 shall be cleaned, lubricated, tested, and adjusted for proper operation.
- B. All piping and ductwork shall be tested and cleaned as required, by all local, state and federal codes. Tests shall be performed in the presence of the authority having jurisdiction. Written notification of test, date, and results shall be furnished to the Engineer before concealing or covering the installation.
- C. All controls shall be tested and adjusted for proper operation. Adjustments shall be made when all systems are operating which may affect the control system.
- D. An Independent Testing & Balancing Agent shall test and balance all mechanical systems as specified in Section 23 0593.

1.17 GUARANTEE

- A. Warranty: The mechanical contractor shall warrant his work against failure and workmanship for a period of at least one year from the date of substantial completion, for all new work. Any work that is defective within that one-year period shall be replaced by the Contractor without

charge. If longer/special warranties are noted elsewhere in the specifications, those warranties shall apply.

1.18 EQUIPMENT IDENTIFICATION

- A. Major mechanical equipment, rooftop units, energy recovery ventilators, electric duct heaters, heat pumps, exhaust fans, etc. shall be provided with identification as designated on the plans. Labels shall be black laminate three-layer plastic with engraved 1/2 inch white letters, adhered, screwed, or riveted to the equipment. Manufactured by Brady, Champion America/Seton.
- B. Piping shall be identified as to contents and flow direction with plastic, color coded, snap-on or adhesive labels. Manufactured by Brady, Champion America/Seton.
 - 1. Labeling shall be located:
 - a. Adjacent to each valve.
 - b. At each side of and at each obstruction.
 - c. At each branch.
 - d. At each cap for future.
 - e. At each takeoff.
 - f. At each side of penetration of structure or enclosure.
 - g. At each equipment connection.
 - h. At all access doors.
 - i. A maximum of every 40 feet on straight runs of piping including rises and drops.
 - j. Minimum one label per room/space.
- C. Valve tags shall be brass with stamped letters, tag size 1-1/2" minimum in diameter.
 - 1. Provide typed valve lists in each O&M binder. Valve lists shall include the valve number, location, and purpose of each valve, and any other necessary information such as the required opening or closing of another valve when one valve is to be opened or closed.
- D. Color coded indicators shall be installed on the ceiling grid or access door to hard lid areas to indicate all valves and other ceiling mounted equipment requiring service (example – VAV's). Each trade shall be responsible for equipment provided under their respectable trade.
 - 1. Each ceiling label shall be color coded laminated engraved plastic, 1/16" thick, 2.5" wide by 0.75" tall, with white lettering centered on each label. Label to be adhered to the acoustic ceiling tile grid. Seton Style AV0175 or similar.

1.19 MECHANICAL SUBMITTAL

- A. All equipment shall be as listed on the equipment schedules or approved equal.
- B. Prior Approval: Manufacturers whose product is not specified or specifically listed on the plans or in the specifications are allowed to submit information on a product that they would like to be considered as an equal to those specified or listed. By submitting this information for consideration, the product representative is indicating that the product being presented for consideration equals or exceeds the specified product in quality, performance and operating parameters. Proof of equality rests with the party making the request. The procedure for this submittal is listed below.
- C. Submit literature on product that is to be considered for prior approval. This literature shall include catalog cuts with all pertinent technical specifications, dimensions and pictures of the product.
- D. Final approval of all equipment shall be contingent on shop drawing acceptance, compliance with the specifications and performance criteria as required. General approval to bid a product does not relieve the supplier or contractor of meeting specific specification requirements.
- E. The Mechanical Contractor shall pay, provide, install and be responsible for any extra materials required due to his use of alternate accepted equipment which has installation requirements different than the specified equipment. This includes paying other trades for any extra work they are involved in due to this substitution of equipment.
- F. Literature shall be submitted so that the engineer receives it no later than 7 days prior to bid date.

- G. All approvals will be in the form of an addendum issued to all plan holders.
- H. List of Acceptable Substitutions:
 - 1. Equipment Identification, Pipe Labeling, Valve Tags, Ceiling Grid Labeling: Seton, Brady Corporation, Marking Services Incorporated
 - 2. All Drains (Floor): Wade, Zurn, Smith, Josam, Ancon, Watts.
 - 3. Valves: Crane, Hammond, Watts, Rockwell, Milwaukee Valve Co., Mueller.
 - 4. Compressed Air Dryer: Ingersoll Rand
 - 5. Plumbing Fixtures: American Standard, Kohler, Crane, Elkay, Just, Zurn, Fiat Products, Gerber, Bradley, Stingray
 - 6. Fixture Brass: American Standard, Kohler, Zurn, Sloan, T & S Brass, Chicago, Bradley, Swan, Woodford Mfg.
 - 7. Flush Valves: Zurn AquaVantage, Sloan, American Standard
 - 8. Lav Premolded Insulation Kit: Plumberex, Truebro, Proflo
 - 9. Toilet Seats: Kohler, Church, Beneke, Bemis, Olsonite, Zurn, Proflo
 - 10. Electric Water Coolers: Elkay

1.20 SHOP DRAWINGS

- A. Before ordering any item, Contractor shall review, stamp with his approval and submit shop drawings of equipment as to be furnished under this contract.
 - 1. Electronic submittals are REQUIRED. Electronic submittals can be one combined .pdf. for each of the following mechanical trades: Fire Sprinkler Drawings, Fire Sprinkler Calcs, Fire Sprinkler Materials, Temperature Controls, HVAC, Plumbing, and Hydronics.
- B. Where the contractor is submitting shop drawings that differ from the plans and specifications, the contractor must notify the engineer in writing each variance from the plans and specifications and the Mechanical Contractor shall pay, provide, install and be responsible for any extra materials required due to his use of alternate accepted equipment which has installation requirements different than the specified equipment. This includes paying other trades for any extra work they are involved in due to this substitution of equipment.
- C. Product Data shall include, but are not limited to, the following: Manufacturer's product specifications, Manufacturer's installation instructions, standard color charts, catalog cuts, roughing-in diagrams and templates, and standard wiring diagrams.

1.21 TEMPORARY HEAT

- A. Temporary heating of the building during construction will be provided as specified in the General Conditions and Supplemental General Conditions. Under no circumstance shall the proposed HVAC equipment be brought into service as temporary heating prior to project completion without written permission from the mechanical engineer & owner.

1.22 EXECUTION

- A. Remove equipment as indicated. Demolition work shall be coordinated with the Owner. Should questions arise regarding the removal of equipment, confer with the owner before such equipment is demolished.
- B. Materials removed by demolition shall remain the property of the Owner unless specifically noted. Material the Owner does not wish to retain shall be removed and properly disposed of by the Contractor.
- C. The existing building will be in use during this construction. Schedule and carry out the work in such a manner as to cause the Owner a minimum of inconvenience due to service interruptions. Temporary services shall be installed if one area or phase of construction disrupts service to another area of the building or if equipment has to be relocated to allow construction to progress. Service interruptions shall be confined to the smallest area possible at any one time and interruptions shall be scheduled with the Owners site representative. After service has been restored following an interruption, inspect areas affected by the interruption and be responsible for returning automatically controlled equipment to the same operating condition that existed prior to the interruption.

- D. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
- E. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- F. Coordinate mechanical equipment and materials installation with other building components. Verify all dimensions by field measurements. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.
- G. Final locations of equipment may differ slightly from those shown on these plans. Coordinate exact location of equipment with equipment supplier, structural members, furniture layout and other trades before rough in and adjust accordingly. Pricing shall allow for a minimum of 10 ft. of difference in the actual location of items as compared to the location shown on the drawings.
- H. All penetrations for piping, ductwork, etc. which penetrate floors, fire and/or smoke walls, roofs, full height partitions and similar structures shall be sealed by the mechanical contractor with a UL system specifically approved for the application. This system must maintain the required fire rating.
- I. All mechanical systems shall be tested and cleaned as required by Authority Having Jurisdiction.
- J. The mechanical contractor shall have the full responsibility of ensuring that his/her work is performed in a safe manner and shall bear all liability associated with his/her job site safety.
- K. Upon completion of the work, the Contractor shall notify the A/E and make arrangements for a final inspection. Contactor shall provide A/E with copy of all required balance reports prior to the final inspection.
- L. After the final inspection is made, the Contractor will receive a list of items requiring adjustment, correction, replacement, or completion.
- M. The Contractor shall comply completely with all listed requirements within (40) days of receipt of list. Should the Contractor fail to perform within this time limit, the A/E and/or Owner reserves the right to have the work completed by others and the cost deducted from the contract price.

END OF SECTION 22 0500

SECTION 22 0510
BASIC PLUMBING MATERIALS AND METHODS

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 basic mechanical materials and methods to complement other Division 22 Sections.
 1. Piping materials and installation instructions common to most piping systems.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Sleeves.
 5. Escutcheons.
 6. Grout.
 7. Mechanical Demolition.
 8. Concrete bases.
 9. Installation requirements common to equipment specification sections.

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, 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 duct shafts.
- 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.

1.4 QUALITY ASSURANCE

- A. All piping shall be specified in this section. Material and installation shall also be subject to state, local codes and ordinances of the area encompassing this project.
- B. Welder's Qualifications: All welder shall be qualified in accordance with ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- C. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."
- D. Uninsulated plastic waste, vent and roof drain piping is not allowed above any ceiling in a return air plenum.
- E. Electrical Characteristics for Mechanical 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.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Provide piping and factory fabricated fittings as indicated for each service and pipe size. Fitting sizes and types shall match piping or equipment connections. Where not indicated, comply with governing regulations or manufacturer's recommendations.

2.2 WATER SERVICE OUTSIDE OF BUILDING (BY ALTERNATE)

- A. Domestic water service below ground shall be ductile iron, bell and spigot. Ductile iron shall be Class 52 water pipe with mechanical joint fittings meeting AWWA Standard C153. Pipe and fittings shall be coated with asphaltum and internally cement lined.
- B. Furnish and install thrust blocks and/or tie-rods in accordance with the local water department standards and regulations.
- C. Provide a copy of the plot plan showing exact locations of all underground services direct to the engineer with accurate dimensions from the building such that all the underground service can be located.

2.3 WATER PIPING IN BUILDING UNDERGROUND

- A. Domestic water piping in building below ground shall be ductile iron. The ductile iron shall be AWWA ductile iron, bell and spigot, class B water pipe with fittings being Class D ductile iron AWWA bell and spigot coated with asphaltum and/or Class 150 C.I. mechanical joints, Federal Specification WW-P-421 with rubber gaskets.
- B. Furnish and install thrust blocks and/or tie-rods in accordance with the local water department standards and regulations.
- C. Provide a copy of the plot plan showing exact locations of all underground services direct to the engineer with accurate dimensions from the building such that all the underground service can be located.

2.4 SANITARY WASTE & VENTING PIPING

- A. Below Grade: Extra heavy weight, coated cast iron soil pipe, hub-&-spigot, ASTM A 74, with TY-seal double seal, premolded one piece Neoprene compression type gasket, ASTM C 564, or lead/oakum joint materials, FSQQ-C-40.
 - 1. Service weight "No-Hub" cast iron soil pipe, FS WW-P-401, with Neoprene gasket, ASTM C564, and stainless steel drawband.
 - 2. Where permitted by plumbing and building codes, schedule 40 Polyvinyl Chloride sewer pipe (PVC), ASTM D 2729, with sewer fittings ASTM D 2729, and solvent cement, ASTM D 2564.
- B. Above Grade: Service weight cast iron soil pipe, Hub-&-Spigot, ASTM A 74, with premolded one piece Neoprene compression type gasket, ASTM C 564, or lead/oakum joint materials, FS QQ-C-40.
 - 1. Service weight "No-Hub" cast iron soil pipe, CISPI standard 301, or FS WW-P-401, with Neoprene gasket, ASTM C564, and stainless steel drawband, conforming to CISPI standard 310.
 - 2. Where permitted by plumbing and building codes, schedule 40 Polyvinyl Chloride (PVC), type DWV, ASTM D 2665; with schedule 40 DWV fittings, ASTM D 2665 and patterns conforming to ASTM D 3311. Solvent cement, ASTM D 3138.
- C. Provide a copy of the plot plan showing exact locations of all underground services direct to the engineer with accurate dimensions from the building such that all the underground service can be located.
- D. Before building footings are formed, this contractor shall start excavating for sewer services and shall confirm that depth of existing sewer is such that the building sewer services will drain into it by gravity. If existing sewer is not deep enough, the contractor shall notify the engineer at once.

2.5 DOMESTIC WATER (COLD, HOT, & RECIRCULATING HOT WATER) IN BUILDING ABOVE GROUND

- A. Piping shall be Type "L" hard drawn copper water tube. Fittings wrought copper, solder joints. Joints 95-5 or lead free solder.
- B. Uponor PEX-A potable water piping system with Uponor expandable F1960 fittings (no crimp fittings to be accepted) provided the contractor is trained and following all manufacturer's recommendations thus fulfilling all available Uponor warranty coverage.

2.6 COMPRESSED AIR PIPING & FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black with ends threaded according to ASME B1.20.1.
 - 1. Steel 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 Fittings: ASME B16.3, Class 150 or 300, threaded.
 - 3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
 - 4. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.
 - 5. Wrought-Steel Butt-Welding Fittings: ASME B16.9, Schedule 40.
 - 6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.
 - 7. See detail for Quick Connects, confirm layout with Owner prior to installation.

2.7 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. 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.

2.8 MECHANICAL SLEEVE SEALS

- A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.9 SLEEVES

- A. The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
 - 2. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
 - 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
 - 4. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.10 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, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

2.11 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.

2.12 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.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 8. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 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. Do not run piping through electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces, if approved by local authority.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing.
- H. Install piping to allow maximum possible headroom unless specific mounting heights or slopes are indicated.
- I. Install piping at indicated slopes, or level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install piping to allow application of insulation.
- M. Select system components with pressure rating equal to or greater than system operating pressure.
- N. Install escutcheons for penetrations of walls, ceilings, and floors.
- O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- P. 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.
- Q. 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.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials conforming to the 25/50 flame spread and smoke developed rating.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 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 mechanical 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.

END OF SECTION 22 0510

**SECTION 22 0700
PLUMBING SYSTEMS INSULATION**

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. The work in this section of the specification and the accompanying drawings consists of performing all labor, equipment, accessories, and materials and in performing all operations necessary for the installation of all insulation for the plumbing, circulating hot water heating piping systems, and sealing of sleeves.
- B. Work to be insulated includes the following:
 - 1. All domestic cold water piping, valves, and fittings.
 - 2. All domestic hot & recirculating hot water piping, valves, and fittings.
 - 3. All sleeves.
- C. All insulation work shall be installed in a workmanlike manner by skilled workmen engaged in this type of work.
- D. Fire-Test-Response Characteristics: Provide products with flame-spread and smoke-developed indices of 25 and 50, respectively, according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction.

1.3 SUBMITTALS

- A. Shop drawings/product data as specified in Section 22 0500 shall include the following:
 - 1. Product Data: Identify thermal conductivity, thickness, and jackets (both factory installed and field applied, if any), for each type of product indicated.

1.4 COORDINATION

- A. Coordinate clearance requirements with duct Installer for insulation application.
- B. Coordinate clearance requirements with piping Installer for insulation application.
- C. Coordinate size and location of supports, hangers, and insulation shields.
 - 1. All hangers and insulation shields for piping shall be large enough to encompass insulation without penetrating vapor barrier.
 - 2. It shall not be acceptable for insulation to envelope hangers/saddles.
 - 3. It shall not be acceptable for insulation to terminate on either side of hangers not properly sized to encompass insulation.

PART 2 - PRODUCTS

2.1 NEW DOMESTIC COLD, HOT, & RECIRCULATING WATER PIPING INSULATION

- A. All piping in concealed and exposed areas shall be insulated with fiberglass pipe insulation with all service jacket. Jacket shall be factory-applied, and, where specified, with white foil scrim-kraft vapor barrier. Insulation shall be Johns-Manville Micro-Lok 850 APT, or accepted equal.
- B. For pipe sizes 1" and less – insulation thickness shall be ½". For pipe sizes of 1-1/4"-2" – insulation thickness shall be 1". For pipe sizes of 2-1/2" and larger – insulation thickness shall be 1-1/2".
- C. Fittings, valves, flanges, etc. shall be insulated with fiberglass blanket, Johns-Manville Microlite or pre-cut mitered sections for elbows, J-M Micro-Lok (1lb/cu. ft. density).
- D. Encase pipe fitting insulation with one piece pre-molded PVC fitting covers having flame spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.
- E. Provide sheet metal insulation shields at all hanger locations.

PART 3 - EXECUTION

3.1 GENERAL APPLICATION

- A. All insulation shall be applied on clean, dry surfaces. All joints shall be snugly butted against the adjoining piece and all joints, seams, voids, flat spots, etc., shall be filled with insulation cement. Do not use cut pieces or scraps abutting each other.
- B. Where double layers are installed, the first layer shall be fastened with binding wire. All joints shall be staggered between the two layers.
- C. Insulation on all cold surfaces must be applied in a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.
- D. All surface finishes shall be extended to protect all surfaces, ends, and raw edges of insulation.
- E. All insulation materials shall be installed in strict accordance with manufacturer's instructions, using recommended adhesives, mastics and coatings applied at specific coverage per gallon and temperature conditions.
- F. Extend insulation without interruption through walls, floors and similar penetrations, except where otherwise indicated.
- G. Maintain integrity of vapor-barrier jackets on insulation, and protect to prevent puncture or other damage.
- H. Do not apply insulation to equipment, breechings, or stacks while hot.
- I. Do not insulate boiler manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- J. Provide removable insulation sections to cover parts of equipment, which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.
- K. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.
- L. Insulation installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

3.2 MINERAL-FIBER PIPE INSULATION APPLICATION

- A. Fittings, valves, and flange insulation shall be wrapped firmly under compression (minimum 2:1) to a thickness equal to the adjoining insulation, secured with No. 20 gauge galvanized annealed steel wire, and finished with a smoothing coat of mastic, Johns-Manville No. 375 Insulating and Finishing Cement or equal.
- B. Cold Fittings, Valves, Flanges, etc., shall be additionally sealed with a layer of resin coated glass mesh, such as Johns-Manville Duramesh 207 glass cloth, embedded between two 1/16" thick coats of vapor barrier coating, Benjamin Foster 30-35 or equal. Lap the sealed glass cloth at least 2" on itself and the adjoining insulation.
- C. Premolded Insulation Valve and Fitting Covers shall be installed by tack fastening, banding, or taping as required by manufacturer.
- D. Expansion Joints: For expansion joints, a tube of pipe insulation shall be fabricated that will allow the expansion joint to move within the tube. The insulating tube shall be fastened at one end of the pipe or equipment and the other end shall be free to slide over the adjacent insulated piping. Provide an aluminum jacket over the insulated pipe to provide a smooth surface on which the insulated tube may slide.
- E. Insulation Under Hangers: Pipe hangers shall encompass the insulation and shall have sheet metal saddles furnished by the Mechanical Contractor.
- F. Inserts shall be installed at all hanger locations. Inserts between the pipe and pipe hangers shall consist of 13lb/cubic foot hydrous calcium silicate pipe insulation, or wood blocking, of

thickness equal to the adjoining insulation and shall be provided with vapor barriers where required. Insulation inserts shall not be less than the following lengths:

1. 1/2" to 1-1/2" pipe size 10" long
2. 3" to 6" pipe size 12" long
3. 8" and larger pipe size 16" long

- G. On all piping the full thickness of insulation and jacket shall run continuously under the sheet metal pipe saddle and through the pipe hanger (pipe hanger shall be large enough to permit full insulation thickness.)

3.3 SEALING OF SLEEVES

- A. All sleeves for pipes, ductwork, etc., furnished under Division 22 of specifications, penetrating floors, fire and/or smoke walls and full height partitions, including chase walls, shall be sealed in accordance with the following:
1. All insulated services shall have the specified insulation terminated on either side of sleeve. Services which require a vapor barrier jacket shall have segment through sleeve insulated with calcium silicate having a minimum thickness same as specified for service. Vapor barrier jacket shall be uninterrupted. Entire void space between inside of sleeve and outside of duct, pipe, and/or calcium silicate insulation shall be packed with fiber insulation, conforming to HHI-521E Type 3 or HHI-558B Form A and having an ASTM fire class E-84 with fiber melt point in excess of 2000 degrees F., to a point 1/8 inch from ends of pipe sleeve. After void is packed with fiber insulation, services which are specified to be insulated shall have a section of insulation installed on each side of sleeve, insulation to be fitted tight to sleeve insulation. Balance of space in sleeve to be filled with nonhardening silicone conforming to TTS-00230 and of type which will allow 50 percent movement in one direction.
 2. Contractor is herein given the option to provide Pipe Shield, Inc., fire rated wall and floor sleeves for insulated and noninsulated piping in lieu of sealing sleeves as outlined above. Shields shall be installed in strict accordance with manufacturer's recommendations.

END OF SECTION 22 0700

**SECTION 22 4000
PLUMBING**

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. The work in this specification and the accompanying drawings consists of performing all labor and furnishing of all material and equipment necessary to install complete systems listed below, including minor items obviously necessary for complete and operating systems.
 - 1. Plumbing Fixtures
 - 2. Domestic Cold, Hot, & Recirc Water Piping
 - 3. Soil, Waste, Sanitary Drainage, and Vent Piping
 - 4. Compressed Air Systems
 - 5. Condensate Systems
- B. The plumbing work shall be installed in strict accordance with all applicable local, state, national plumbing regulations, and authority having jurisdiction.
- C. Also included is the work involved to remove existing associated equipment, remodeling of existing systems, including connections between new and existing systems.

1.3 SUBMITTALS

- A. Shop drawings as specified in Section 22 0500 shall include the following:
 - 1. Domestic Water/Fire Sprinkler Service Stub Out Piping. (BY ALTERNATE)
 - 2. Domestic Water System Piping, Valves, and Fittings.
 - 3. Dual Check Back Flow Prevention Assemblies. (BY ALTERNATE)
 - 4. City Utility Provided Water Meters. (BY ALTERNATE)
 - 5. Uponor PEX A Tubing & F1960 expandable fittings. (if using)
 - 6. Sanitary Waste & Vent System Piping and Fittings.
 - 7. Compressed Air Piping, Valves, Fittings, & Quick Connects.
 - 8. Compressed Air System.
 - 9. Plumbing Fixtures.
 - 10. Floor Drains.
 - 11. Floor Sinks.
 - 12. Interior & Exterior Cleanouts.
 - 13. Shock Absorbers & Mfgr's Recommended Locations to be Installed.
 - 14. Domestic Hot Water Recirculation Manual Balancing Valves.
 - 15. Drain Valves with Chained Caps.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Before proceeding with this part of the work, the Contractor shall carefully survey the existing conditions, and, if necessary, modify the service installation, in order to avoid unforeseen obstructions such as in the floor ductwork, etc. This Contractor shall include all costs for this work, including saw cutting & patching, permits, etc., in his bid.

2.2 DOMESTIC WATER/FIRE SPRINKLER SERVICE STUB OUT (BY ALTERNATE)

- A. Provide new water service stub out as indicated on the plans. Provide minimum 7'-0" of cover over water line outside of building. Install city provided water meter(s) as shown on the plans and in accordance with the manufacturer's recommendations. Make all arrangements with Water Department and comply with all requirements. Include all costs and fees associated with meter and water service in bid.
- B. Furnish and install sleeves, thrust blocks and/or tie-rods in accordance with the local water department standards and regulations.

- C. Provide & Install dual check back flow prevention assembly(s) suitable for continuous pressure application. Include shutoff valves on inlet and outlet, strainer on inlet, and test cocks with two positive seating check valves. Manufacturer and model shall be as specified on plans or approved equal.

2.3 AIR COMPRESSOR SYSTEM COMPONENTS

- A. Existing air compressor relocated by PC from existing ag shop to proposed shop area.
 - 1. PC to provide and install automatic electronic timer drain valve on existing air compressor.
- B. Air Dryer
 - 1. One (1) Ingersoll Rand Air Dryer D54IN, non-cycling, air-cooled, 115/1/60, refrigerated air dryer.
- C. Filters
 - 1. One (1) Ingersoll Rand general Purpose G Series F71IG Filter, 3/4" NPT, general purpose, compressed air filter with one (1) replacement element..
 - 2. One (1) Ingersoll Rand General Purpose H Series F71IH Filter, 3/4" NPT, high efficiency, oil removal, compressed air filter with one (1) replacement element.
- D. Flex Connector
 - 1. Provide and install one flex connector from existing relocated air compressor to proposed piping system.
- E. Compressed air quick connects – provide Style to match owner’s exg. Equipment, verify with owner prior to ordering.
- F. Hose Reels
 - 1. See plans for make model & quantity.

2.4 PLUMBING FIXTURES

- A. Furnish and install plumbing fixtures where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings.
- B. Where indicated on the drawings to be a future fixture, this contractor shall provide all waste, vent, and water supplies as indicated on the drawings and according to local code.
- C. Exposed flush, waste, and supply pipes at the fixtures shall be chromium plated brass pipe, iron pipe size. Fittings for brass pipe shall be cast brass, chromium plated.
- D. Install chromium plated wall or floor plates (escutcheons) with set-screw where piping passes through walls or floors.
- E. All handicap laboratories supply pipe and drain pipe will be fitted with removable safety covers that comply with handicap code requirements.
- F. All fixtures fitted to the walls or floors shall be ground and true and be sealed with a non-hardening white silicone caulk bead.
- G. All plumbing fixtures shall be supported per manufacturer’s recommendations.

2.5 FLOOR DRAINS

- A. Furnish and install floor drains where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings. Connect outlet of drain to “P” trap. Venting installation requirements of floor drains whether or not shown on plans shall be according to code and approved by the code official.
- B. Furnish and install any floor drains required by the authority having jurisdiction to meet the Uniform Plumbing Code 2009 704.3.

2.6 FLOOR SINKS

- A. Furnish and Install floor sinks where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings. Connect outlet of drain to “P” trap.

Venting installation requirements of floor sinks whether or not shown on plans shall be according to code and approved by the code official.

2.7 CLEANOUTS (INTERIOR & EXTERIOR)

- A. Furnish and install clean outs where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings. Install proper traffic rating and floor pattern shape for intended use.
- B. Cleanouts shall be provided at the base of all vertical stacks with the cleanout plug located approximately 12" above the floor and extended to wall access cover. Cleanouts in floors on grade shall be located as shown on plans and at changes in direction of pipe run and shall consist of Y fittings and eighth bends. Cleanouts must be provided in accordance with the local code and as shown on the drawings.
- C. Floor cleanouts – frame and cover threaded for 2" vertical adjustment, threads protected with shield to be removed when concrete is set. Covers-nickel bronze round frame and cover, deep flange tractor type. Extra heavy type in heavy traffic areas, and with carpet cleanout marker for carpeted floors.
- D. Wall Cleanouts – access covers shall be stainless steel.
- E. Provide exterior ground cleanouts up to grade from sewer mains where service exits the building, as shown on drawing, and using service weight cast iron soil pipe up to grade (regardless of the type of material for the line). If not in concrete, pour an 18"x18"x6" concrete pad around cleanout and install flush with surrounding surface. Cleanout to be Zurn Z-1474-VP Heavy Duty Cleanout with dura-coated cast iron top and vandal proof screws or equal by Zurn, Blake, Josam, or Smith.

2.8 ROOF JACKET

- A. Roof extension from soil, waste, and vent pipes shall be extended at least 18 inches above the roof, and must be encased in frostproof jackets, each having an air space at least 1" between the outside surface of the pipe and a cap over the top of the pipe so that it will be unnecessary otherwise to plug the inside of the vent pipes at the top when the test is made. These plugs must be of a type readily seen until removed. Remove them at once after the piping system has been tested and approved.

2.9 SHOCK ABSORBERS

- A. Piping shall be installed with proper safeguards to prevent water hammer. This will be done by installing a sufficient number of shock absorbers/water hammer arrestors. Shock absorbers shall be Watts or equal. Shock absorbers to be sized and located as per manufacturer's recommendations.
- B. Contractor to indicate installed locations on as-built drawings.

2.10 DOMESTIC HOT WATER RECIRCULATION MANUAL BALANCING VALVES AND STRAINERS

- A. Calibrated Balance Valve
 1. Valve body shall be constructed out of lead free brass
 2. Valve shall include a ball valve constructed in 304 Stainless Steel.
 3. Valve shall be AB1953 and CSA certified and compliant with NSF/ANSI-372.
 4. Valve body shall include two pressure/temperature ports.
 5. Valve body shall include an optional drain valve port.
 6. Valve shall utilize a calibrated nameplate with a memory stop.
 7. Valve shall utilize a reduced port design that provides velocity head recovery.
 8. Valve temperature range shall be from -4°F (-20°C) to 250°F (121°C).
 9. Valve shall have either NPTF thread or SWTF end connections.
 10. Valves with NPT end connections shall be rated for 400 PSIG working pressure.
 11. Valves with SWTF end connections shall be rated for a maximum of 300 PSIG working pressure.
- B. Provide strainer valve body constructed out of lead free brass, see detail.
- C. Install in accordance with manufacturer's instructions.

2.11 MISCELLANEOUS CONNECTIONS

- A. Make all domestic water, waste, vent, gas, air, etc., connections to all equipment in this building whether or not such equipment is furnished under this section or under other sections of the specification. This includes furnishing piping, traps (if required) and shut-off valves on branches to and from each piece of equipment from mains or branch mains.
- B. Make all plumbing connections to existing piping and to all equipment shown on the plans as requiring same. If specific piping details are not shown, the equipment shall be roughed in for and connected in accordance with the manufacturer's recommendations. It will be this contractor's responsibility to obtain shop drawings from whomever furnishes the equipment.

2.12 TESTING/CLEANING

- A. The mechanical contractor is responsible for the testing & cleaning of each respective system in accordance with applicable state and local codes. Tests shall be repeated until each system is proven acceptable.

END OF SECTION 22 4000

**SECTION 23 0500
GENERAL HVAC REQUIREMENTS**

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. The mechanical contractor shall perform all work and furnish all materials as indicated in the mechanical plans and specifications as necessary for the successful completion of this project.

1.3 PERMITS AND SERVICES

- A. The mechanical contractor shall obtain all permits and arrange all inspections, give notices and pay all fees as required by the Authority Having Jurisdiction.
- B. This contractor shall coordinate any necessary site utilities including water, natural gas, and sewer work with local utility, owner, and other contractors to minimize disruption and downtime. ANY AND ALL CHARGES ASSESSED BY THE UTILITY TO ACCOMMODATE THE REQUIREMENTS OF THIS PROJECT ARE THE SOLE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR. VERIFY ALL CHARGES AND COORDINATE ALL EQUIPMENT NECESSARY WITH THE UTILITY BEFORE SUBMITTING BID.

1.4 DRAWINGS AND MEASUREMENTS

- A. Verify all dimensions and conditions with Architectural and Structural drawings. The small scale of the drawings prohibits the indication of all offsets, fittings and accessories necessary and shall be furnished by this Contractor and required for complete and proper operation.
- B. "Existing Conditions" shown on drawings are based on existing plans and limited field investigation. The field survey was conducted to verify, as much as possible, the accuracy of the locations shown. The Contractor shall verify the accuracy of the "Existing Conditions" as shown on the drawings. As the demolition work progresses perform modifications and additions as necessary to correct for these hidden conditions and allow for the completion of the new work.
- C. The general arrangement of the mechanical systems shall be as shown on the drawings. Field changes shall have the written acceptance of the Engineer.
- D. Consult the drawings and specifications of all other trades. Layout work and coordinate with other trades, before installing any equipment, to avoid interfering with these trades or conflicting with applicable codes.
- E. The mechanical contractor shall bear full responsibility for coordinating his work with other trades to avoid conflicts in space requirements, clearances, etc. Problems arising due to lack of coordination will be the responsibility of the mechanical contractor to resolve. Extra work and/or equipment as a result of not coordinating work shall be the responsibility of the installing contractor and at no cost to the Owner.

1.5 INSPECTION OF SITE AND DOCUMENTS

- A. Before submitting a proposal on the work contemplated, the bidder shall thoroughly familiarize himself with the contract documents, the site, and all existing conditions and limitations that may affect the performance of his work. Any conflict noted shall be brought to the attention of the Engineer before bidding. If there is not sufficient time prior to bidding, the Contractor shall bid the larger quantity or better quality of work.
- B. No extra compensation will be allowed, because of misunderstanding the amount of work involved or the bidder's lack of knowledge, for obvious conflicts which could have been discovered or reasonably anticipated prior to bidding.

1.6 REGULATIONS AND CODES

- A. All work, materials, and equipment in this contract shall comply with all applicable local, city, state and federal ordinances, regulations, and codes.

1.7 INSTRUCTIONS

- A. Furnish verbal and engineer approved written instructions to Owner on all systems. Instruction shall include operating procedures, adjustments, and periodic maintenance. Furnish a copy of the written instructions and attach a letter to the Engineer, prior to final inspection, signed by Owner, attesting to date and satisfaction of instructions.

1.8 OPERATING AND MAINTENANCE MANUALS (3 Hard Copies & 1 Electronic Submittal via Submittal Exchange)

- A. PRIOR TO FINAL INSPECTION, The mechanical contractor shall furnish (3) hard copies (including 1 USB drive containing electronic copy) and (1) electronic submittal via Submittal Exchange of the O&M Manuals to the Engineer, containing all pertinent data to the mechanical systems. Information shall be indexed and labeled per system and shall include catalog cuts, installation manuals, maintenance manuals, manufacturer's names, replacement parts list. Include balancing reports as specified. Include written instructions and warranty info as specified.
- B. The first section shall be indexed/labeled "WRITTEN INSTRUCTIONS & TRAINING" noting written instructions with company service contact info and shall include a list of filters for each unit. Also include document with owners signature attesting to date and satisfaction of training.
- C. The second section shall be indexed/labeled "WARRANTY INFO" and shall include a statement of guarantee on the contractors company letter head and shall include warranty statements of all equipment provided/installed under his contract with specific dates. This will note any longer/special warranties.

1.9 AS-CONSTRUCTED DRAWINGS (Red Lined on Plans & USB Drive containing scanned PDF)

- A. During construction, each trade shall keep track of the major changes in the rerouting of piping and equipment, and shall note these in red on one set of drawings. This set of drawings shall be submitted with the Operation and Maintenance Manuals along with a USB drive containing a single PDF file with these same red line plans in electronic form. Most printing shops will be able to scan your trade's large plan sheets into electronic form. Contact the engineer's office if there are any questions.

1.10 WORKMANSHIP

- A. Qualified individuals that are properly licensed to perform the work involved shall perform all mechanical work.

1.11 CUTTING AND PATCHING

- A. This Contractor shall be responsible for all cutting and patching of holes required for passage of piping, equipment, and ducts. This also applies to the removal or installation of new equipment.
- B. All cutting of existing construction required to install or join new work, except where otherwise indicated on the plans, shall be the responsibility of this Contractor and coordinated with the Construction Manager. Before making any cuts, verify exact locations and sizes with the Construction Manager to confirm that no structural members will be cut. Contractor shall make every effort to minimize extent of cutting existing construction.
- C. The mechanical contractor shall be responsible for patching any openings left in floors, walls, and ceilings that were caused by his/her actions. Patching shall match existing surface in color, texture and quality so that patch is indistinguishable from original surface.

1.12 PAINTING

- A. Any equipment which becomes rusted or damaged during construction shall be repaired, cleaned, and repainted by this Contractor. Painting shall always be applied in two coats, one primer and one finish.

1.13 EQUIPMENT AND PIPE SUPPORTS

- A. Provide all structural supporting frames, steel stands, concrete bases, and hangers as required for mechanical equipment. All floor equipment shall be set on 4" high concrete bases furnished by this Contractor, unless otherwise noted.
- B. Paint all unprotected metal, except galvanized and copper, with metal protective paint.
- C. **Hangers for piping shall be large enough to encompass insulation. It shall not be acceptable for insulation to envelope hangers/saddles, or for insulation to stop on either side of hangers.**
- D. Provide saddles at all hangers or supports of insulated piping. Saddles for 4" and larger piping shall be fabricated of 14 gauge galvanized iron, and for smaller piping shall be fabricated of 16 gauge galvanized iron. Saddles shall be one-half the circumference of the pipe insulation and 4" shorter than the insulation inserts.
- E. Under no condition shall any pipe or duct structure be used to support another.

1.14 ACCESS TO EQUIPMENT

- A. Access shall be provided to all motors, valves, dampers, controls, specialties, etc., for maintenance purposes. All access doors, access panels, removable sections, etc., required for access shall be provided. The location of the access openings relative to the mechanical equipment shall be coordinated to assure proper access to the equipment.
- B. Access openings are required for manual, motorized, fire, and smoke dampers and other devices requiring access and shall be provided in the ductwork, plenums, housings, tanks, etc., under this portion of the contract.

1.15 EXCAVATING AND BACKFILLING

- A. When work to be completed by this contractor requires trenching, digging, etc. this contractor shall be responsible for properly protecting open trenches in accordance with required safety procedures. Backfill shall be placed in horizontal layers, not exceeding 9 inches in thickness. Moisten and hand or machine compact to 95% of standard proctor density. Bring fill to elevations indicated. If backfill fails the proctor density test in accordance with ASTM D-2049 and conducted by an independent testing laboratory retained by the owner, Contractor shall recompact and retest until satisfactory density is reached. This contractor shall restore the surface (whether grass, asphalt, concrete, etc.) to its original condition. Grass shall be seeded to match surrounding turf.
- B. When work is in public street, paving repairs shall be equal to and comply with municipal agency requirements. If repairs are done by municipal agency, make necessary arrangement with such agency to make the repairs. Contractor shall include cost for permits, inspection fees, work, etc. in Mechanical Bid.

1.16 TESTING AND ADJUSTING

- A. At the completion of work, all parts of the installation under Division 23 shall be cleaned, lubricated, tested, and adjusted for proper operation.
- B. All piping and ductwork shall be tested and cleaned as required, by all local, state and federal codes. Tests shall be performed in the presence of the authority having jurisdiction. Written notification of test, date, and results shall be furnished to the Engineer before concealing or covering the installation.
- C. All controls shall be tested and adjusted for proper operation. Adjustments shall be made when all systems are operating which may affect the control system.
- D. An Independent Testing & Balancing Agent shall test and balance all mechanical systems as specified in Section 23 0593.

1.17 GUARANTEE

- A. Warranty: The mechanical contractor shall warrant his work against failure and workmanship for a period of at least one year from the date of substantial completion, for all new work. Any work that is defective within that one-year period shall be replaced by the Contractor without

charge. If longer/special warranties are noted elsewhere in the specifications, those warranties shall apply.

1.18 EQUIPMENT IDENTIFICATION

- A. Major mechanical equipment, rooftop units, energy recovery ventilators, electric duct heaters, heat pumps, exhaust fans, etc. shall be provided with identification as designated on the plans. Labels shall be black laminate three-layer plastic with engraved 1/2 inch white letters, adhered, screwed, or riveted to the equipment. Manufactured by Brady, Champion America/Seton.
- B. Piping shall be identified as to contents and flow direction with plastic, color coded, snap-on or adhesive labels. Manufactured by Brady, Champion America/Seton.
 - 1. Labeling shall be located:
 - a. Adjacent to each valve.
 - b. At each side of and at each obstruction.
 - c. At each branch.
 - d. At each cap for future.
 - e. At each takeoff.
 - f. At each side of penetration of structure or enclosure.
 - g. At each equipment connection.
 - h. At all access doors.
 - i. A maximum of every 40 feet on straight runs of piping including rises and drops.
 - j. Minimum one label per room/space.
- C. Valve tags shall be brass with stamped letters, tag size 1-1/2" minimum in diameter.
 - 1. Provide typed valve lists in each O&M binder. Valve lists shall include the valve number, location, and purpose of each valve, and any other necessary information such as the required opening or closing of another valve when one valve is to be opened or closed.
- D. Color coded indicators shall be installed on the ceiling grid or access door to hard lid areas to indicate all valves and other ceiling mounted equipment requiring service (example – VAV's). Each trade shall be responsible for equipment provided under their respectable trade.
 - 1. Each ceiling label shall be color coded laminated engraved plastic, 1/16" thick, 2.5" wide by 0.75" tall, with white lettering centered on each label. Label to be adhered to the acoustic ceiling tile grid. Seton Style AV0175 or similar.

1.19 MECHANICAL SUBMITTAL

- A. All equipment shall be as listed on the equipment schedules or approved equal.
- B. Prior Approval: Manufacturers whose product is not specified or specifically listed on the plans or in the specifications are allowed to submit information on a product that they would like to be considered as an equal to those specified or listed. By submitting this information for consideration, the product representative is indicating that the product being presented for consideration equals or exceeds the specified product in quality, performance and operating parameters. Proof of equality rests with the party making the request. The procedure for this submittal is listed below.
- C. Submit literature on product that is to be considered for prior approval. This literature shall include catalog cuts with all pertinent technical specifications, dimensions and pictures of the product.
- D. Final approval of all equipment shall be contingent on shop drawing acceptance, compliance with the specifications and performance criteria as required. General approval to bid a product does not relieve the supplier or contractor of meeting specific specification requirements.
- E. The Mechanical Contractor shall pay, provide, install and be responsible for any extra materials required due to his use of alternate accepted equipment which has installation requirements different than the specified equipment. This includes paying other trades for any extra work they are involved in due to this substitution of equipment.
- F. Literature shall be submitted so that the engineer receives it no later than 7 days prior to bid date.

- G. All approvals will be in the form of an addendum issued to all plan holders.
- H. List of Acceptable Substitutions:
1. Equipment Identification, Pipe Labeling, Valve Tags, Ceiling Grid Labeling: Seton, Brady Corporation, Marking Services Incorporated
 2. Fan Coil with DX Cooling: Daikin, York, Trane, Greeheck
 3. Packaged Cooling Only Rooftop Unit: Aeon (must provide technical submittal during prior approval process)
 4. Air Cooled DX Condensing Unit: Daikin, York, Trane, Fraser/Johnson
 5. Duct Mounted Hot Water Heating Coils: Daikin, Trane, York/JCI, Super Radiator, Precision Coil, Capital Coil
 6. Air Handling Unit with Chilled Water and Heating Water Coils: Daikin (must provide technical submittal during prior approval process)
 7. Shutoff VAV Terminal Units: Carrier, Price, Krueger, Nailor, Trane, Tuttle & Bailey, Titus, JCI
 8. Inline Exhaust Fans: PennBarry, Greenheck, Loren Cook, ACME, ILG Air Specialties Express/Carnes, Aerovent, Twin City Fan & Blower
 9. Power Roof Ventilators: PennBarry, Greenheck, Loren Cook, ACME, ILG Air Specialties Express/Carnes, Aerovent, Twin City Fan & Blower
 10. Stationary Louvers: ACME, Ruskin, Pottorff, Arrow United Industries, Greenheck, Air Balance, Nailor, NCA, Safe-Air Dowco
 11. Dust Collector: Nederman, (must provide technical submittal during prior approval process)
 12. Slotted Fume Exhaust Hood: Monoxivent, CarMon, Venteaire
 13. Rangehood Exhaust: Broan, Nutone
 14. Registers, Grilles, & Diffusers: Metalaire, Price, Tuttle & Bailey, Krueger, Nailor, Hart & Cooley, Anemostat, Nailor, J & J Register, Air Specialties Express/Carnes, Titus
 15. Smoke, Fire, & Combination Dampers: Ruskin, Safe Air, Air Balance, Nailor, Cesco, Advance Air, Air Control Products, International Air, Greenheck, Pottoff, Lloyd, NCA, United Enertech
 16. Exposed Spiral Duct: SPOT, Spiral Pipe of Texas
 17. Propylene Glycol: Dow Chemical, match existing.
 18. Inline Hydronic Circulating Pumps: Bell & Gossett, Armstrong, Taco, Grundfos, Patterson, Thrush
 19. Pressure-compensating Flow Control and Strainer Valves: Pro Hydronics, Griswold, Autoflow, B&G, Nexus, Flow Design, IMI Flow Design, HCI
 20. Manual Flow Control Valves: Pro Hydronics, Griswold, Autoflow, B&G, Nexus, Flow Design, IMI Flow Design, HCI
 21. Hot Water Cabinet Unit Heaters: Sigma, Sterlin, Airtherm, Vulcan, Rittling, Modine, Airtherm, IEC
 22. DDC Temperature Controls: Johnson Controls (extend existing system by base bid), Siemens by G&R Controls (new by alternate).

1.20 SHOP DRAWINGS

- A. Before ordering any item, Contractor shall review, stamp with his approval and submit shop drawings of equipment as to be furnished under this contract.
1. Electronic submittals are REQUIRED. Electronic submittals can be one combined .pdf. for each of the following mechanical trades: Fire Sprinkler Drawings, Fire Sprinkler Calcs, Fire Sprinkler Materials, Temperature Controls, HVAC, Plumbing, and Hydronics.
- B. Where the contractor is submitting shop drawings that differ from the plans and specifications, the contractor must notify the engineer in writing each variance from the plans and specifications and the Mechanical Contractor shall pay, provide, install and be responsible for any extra materials required due to his use of alternate accepted equipment which has installation requirements different than the specified equipment. This includes paying other trades for any extra work they are involved in due to this substitution of equipment.

- C. Product Data shall include, but are not limited to, the following: Manufacturer's product specifications, Manufacturer's installation instructions, standard color charts, catalog cuts, roughing-in diagrams and templates, and standard wiring diagrams.

1.21 TEMPORARY HEAT

- A. Temporary heating of the building during construction will be provided as specified in the General Conditions and Supplemental General Conditions. Under no circumstance shall the proposed HVAC equipment be brought into service as temporary heating prior to project completion without written permission from the mechanical engineer & owner.

1.22 EXECUTION

- A. Remove equipment as indicated. Demolition work shall be coordinated with the Owner. Should questions arise regarding the removal of equipment, confer with the owner before such equipment is demolished.
- B. Materials removed by demolition shall remain the property of the Owner unless specifically noted. Material the Owner does not wish to retain shall be removed and properly disposed of by the Contractor.
- C. The existing building will be in use during this construction. Schedule and carry out the work in such a manner as to cause the Owner a minimum of inconvenience due to service interruptions. Temporary services shall be installed if one area or phase of construction disrupts service to another area of the building or if equipment has to be relocated to allow construction to progress. Service interruptions shall be confined to the smallest area possible at any one time and interruptions shall be scheduled with the Owners site representative. After service has been restored following an interruption, inspect areas affected by the interruption and be responsible for returning automatically controlled equipment to the same operating condition that existed prior to the interruption.
- D. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
- E. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- F. Coordinate mechanical equipment and materials installation with other building components. Verify all dimensions by field measurements. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.
- G. Final locations of equipment may differ slightly from those shown on these plans. Coordinate exact location of equipment with equipment supplier, structural members, furniture layout and other trades before rough in and adjust accordingly. Pricing shall allow for a minimum of 10 ft. of difference in the actual location of items as compared to the location shown on the drawings.
- H. All penetrations for piping, ductwork, etc. which penetrate floors, fire and/or smoke walls, roofs, full height partitions and similar structures shall be sealed by the mechanical contractor with a UL system specifically approved for the application. This system must maintain the required fire rating.
- I. All mechanical systems shall be tested and cleaned as required by Authority Having Jurisdiction.
- J. The mechanical contractor shall have the full responsibility of ensuring that his/her work is performed in a safe manner and shall bear all liability associated with his/her job site safety.
- K. Upon completion of the work, the Contractor shall notify the A/E and make arrangements for a final inspection. Contactor shall provide A/E with copy of all required balance reports prior to the final inspection.
- L. After the final inspection is made, the Contractor will receive a list of items requiring adjustment, correction, replacement, or completion.

- M. The Contractor shall comply completely with all listed requirements within (40) days of receipt of list. Should the Contractor fail to perform within this time limit, the A/E and/or Owner reserves the right to have the work completed by others and the cost deducted from the contract price.

END OF SECTION 23 0500

SECTION 23 0510
BASIC HVAC MATERIALS AND METHODS

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 basic mechanical materials and methods to complement other Division 23 Sections.
 1. Piping materials and installation instructions common to most piping systems.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Sleeves.
 5. Escutcheons.
 6. Grout.
 7. Mechanical Demolition.
 8. Concrete bases.
 9. Installation requirements common to equipment specification sections.

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, 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 duct shafts.
- 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.

1.4 QUALITY ASSURANCE

- A. All piping shall be specified in this section. Material and installation shall also be subject to state, local codes and ordinances of the area encompassing this project.
- B. Delete first paragraph below if no welding. AWS states that welding qualifications remain in effect indefinitely unless welding personnel have not welded for more than six months or there is a specific reason to question their ability.
- C. Welder's Qualifications: All welder shall be qualified in accordance with ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- D. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."
- E. Electrical Characteristics for Mechanical 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.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Provide piping and factory fabricated fittings as indicated for each service and pipe size. Fitting sizes and types shall match piping or equipment connections. Where not indicated, comply with governing regulations or manufacturer's recommendations.

2.2 SLEEVES

- A. The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
 - 2. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
 - 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
 - 4. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.3 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, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

2.4 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.

2.5 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.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 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. Do not run piping through electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces, if approved by local authority.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing.
- H. Install piping to allow maximum possible headroom unless specific mounting heights or slopes are indicated.
- I. Install piping at indicated slopes, or level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install piping to allow application of insulation.
- M. Select system components with pressure rating equal to or greater than system operating pressure.
- N. Install escutcheons for penetrations of walls, ceilings, and floors.
- O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- P. 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.
- Q. 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.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials conforming to the 25/50 flame spread and smoke developed rating.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 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 mechanical 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.

END OF SECTION 23 0510

SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING

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 testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
 - 1. Balancing AIRFLOW and WATER flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
 - 2. Adjusting total HVAC systems to provide indicated quantities.
 - 3. Verifying that automatic control devices are functioning properly.
 - 4. Reporting results of activities and procedures specified in this Section.
- B. Also include all balancing of existing equipment and systems where indicated on the plans.**

1.3 DEFINITIONS

- A. Retain acronyms and abbreviations that remain after this Section has been edited for Project.
- B. AABC: Associated Air Balance Council.
- C. AMCA: Air Movement and Control Association.
- D. NEBB: National Environmental Balancing Bureau.
- E. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

- A. Certified Testing, Adjusting, and Balancing Reports: Prepared on approved forms certified by the testing, adjusting, and balancing Agent.

1.5 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by AABC or NEBB or Engineer's approved equal.
- B. Certification of Testing, Adjusting, and Balancing Reports: Certify testing, adjusting, and balancing field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - 2. Certify that testing, adjusting, and balancing team complied with approved testing, adjusting, and balancing plan and procedures specified and referenced in this Specification.
- C. Testing, Adjusting, and Balancing Reports: Use standard forms approved by the Engineer.
- D. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by the instrument manufacturer.

1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.7 COORDINATION

- A. Coordinate 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 testing, adjusting, and balancing activities.
- B. Provide 7 day's advance notice for each test including scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine approved submittal data of HVAC & domestic recirc pump systems and equipment.
- B. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- C. Examine system and equipment test reports.
- D. Examine HVAC & domestic recirc pump 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 their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- E. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- F. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- G. Examine strainers for clean screens and proper perforations.
- H. Examine hydronic & domestic recirc equipment for correct piping connections and for clean and straight fins.
- I. Examine equipment for installation and for properly operating safety interlocks and controls.
- J. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices operate by the intended controller.
 - 2. Verify 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. Sensors are located to sense only intended conditions.
 - 6. Sequence of operation for control modes is according to the Contract Documents.
 - 7. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 - 8. Interlocked systems are operating.
- K. Report to the Engineer deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to procedures contained in AABC national standards.

- B. Perform testing and balancing procedures on each system according to procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- C. 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 the insulation Specifications for this Project.
- D. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.3 TOLERANCES

- A. Set HVAC system airflow and domestic & hydronic water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans: Plus 10 to minus 10 percent.
 - 2. Air Outlets and Inlets: Plus 10 to minus 10 percent.
 - 3. Hydronic Water Flow Rate: 0 to minus 10 percent.

3.4 REPORTS

- A. 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.
- B. Final Report: Typewritten, or computer printout in letter-quality font, on standard bond paper, bound in three-ring, loose-leaf binder, and tabulated and divided into sections by tested and balanced systems.
 - 1. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing agent.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
 - 3. Final Report Contents: In addition to certified field report data, include the following:
 - a. Pump curves.
 - b. Fan curves.
 - c. Manufacturers' test data.
 - d. Field quality-control test reports prepared by system and equipment installers.
 - e. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
 - 4. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - f. Title page.
 - g. Name and address of testing, adjusting, and balancing Agent.
 - h. Project name.
 - i. Project location.
 - j. Architect's name and address.
 - k. Engineer's name and address.
 - l. Contractor's name and address.
 - m. Report date.
 - n. Signature of testing, adjusting, and balancing Agent who certifies the report.

3.5 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

- B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION 23 0593

**SECTION 23 0700
HVAC SYSTEMS INSULATION**

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. The work in this section of the specification and the accompanying drawings consists of performing all labor, equipment, accessories, and materials and in performing all operations necessary for the installation of all insulation for the duct systems and sealing of sleeves.
- B. Work to be insulated includes the following:
 - 1. All voids within roof curbs.
 - 2. All supply air, return air, transfer air, outside air, relief air, and exhaust air ducts.
 - 3. All circulating above ground heating water piping, valves, and fittings.
 - 4. All circulating above ground heating water equipment as required.
 - 5. All circulating above ground chilled water piping, valves, and fittings.
 - 6. All circulating above ground chilled water equipment as required.
 - 7. All above ground cooling condensate drainage piping.
 - 8. All sleeves.
- C. All insulation work shall be installed in a workmanlike manner by skilled workmen engaged in this type of work.
- D. Fire-Test-Response Characteristics: Provide products with flame-spread and smoke-developed indices of 25 and 50, respectively, according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction.

1.3 SUBMITTALS

- A. Shop drawings/product data as specified in Section 23 0500 shall include the following:
 - 1. Product Data: Identify thermal conductivity, thickness, and jackets (both factory installed and field applied, if any), for each type of product indicated.

1.4 COORDINATION

- A. Coordinate clearance requirements with duct Installer for insulation application.
- B. Coordinate clearance requirements with piping Installer for insulation application.
- C. Coordinate size and location of supports, hangers, and insulation shields.
 - 1. All hangers and insulation shields for piping shall be large enough to encompass insulation without penetrating vapor barrier.
 - 2. It shall not be acceptable for insulation to envelope hangers/saddles.
 - 3. It shall not be acceptable for insulation to terminate on either side of hangers not properly sized to encompass insulation.

PART 2 - PRODUCTS

2.1 DUCTWORK INSULATION

- A. RIGID BOARD DUCT INSULATION
 - 1. Rigid Board shall be fiberglass, CertainTeed type IB with FSK reinforced foil scrim-kraft jacket or accepted equal. Board density shall be 3 lb/cubic foot with thermal conductivity of .23 at 75 degrees F mean temperature. ASTM C 612, Class 1.
- B. FLEXIBLE DUCT INSULATION
 - 1. Flexible insulation shall be fiberglass, CertainTeed standard duct wrap with FSK reinforced foil scrim-kraft jacket or accepted equal. Flexible insulation density shall be 1-1/2 lb/cubic foot with thermal conductivity of .24 at 75 degrees F mean temperature. ASTM C 553, Type I, Class B-4.
- C. DUCTWORK INSULATION ACCESSORIES

1. Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
- D. DUCTWORK INSULATION COMPOUNDS
 1. Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.
- E. INSULATION THICKNESS FOR DUCTWORK: All ducts are to be insulated unless otherwise noted. Insulation thickness and type shall be as follows:
 1. VAV System Supply Air:
 - a. Rectangular Supply duct insulation before the VAV shall be exterior and 1-1/2" thick.
 - b. Round Supply duct insulation before the VAV shall be exterior and 1-1/2" thick.
 - c. Rectangular Supply duct insulation after the VAV shall be interior and 1/2" thick.
 - d. Round Supply duct insulation after the VAV shall be exterior and 1-1/2" thick.
 2. Single Zone System Supply Air:
 - a. Rectangular Supply Air duct insulation shall be interior and 1/2" thick.
 - b. Round Supply duct insulation shall be exterior and 1-1/2" thick.
 3. Rectangular Return Duct Insulation shall be interior and 1/2" thick.
 4. Outside Air Duct Insulation shall be exterior and 2" thick.
 5. Relief Air Duct Insulation shall be exterior and 2" thick between the fan and louver termination.
 6. Transfer Duct Insulation shall be interior and 1/2" thick.
 7. Transfer Sleeves Insulation shall be interior and 1/2" thick.
 8. Exhaust Air Duct Insulation shall be exterior and 1-1/2" thick within 15' of exterior wall termination unless otherwise noted.
 - a. Welding Exhaust Air duct to be uninsulated spiral paint grip unless otherwise noted.
 - b. All Dust collector exhaust ductwork to be uninsulated.
 - c. All exhaust ductwork serving inline exhaust fans shall be insulated between inline exhaust fan and louver termination.
 9. **For exposed ducts as noted on the Drawings with exterior insulation: Ducts shall be insulated with rigid fiberglass insulation only, including ducts routed above open exposed grid. See HVAC and architectural ceiling plans.**
 10. Where ductwork does not have exterior wrapped insulation, and sheet metal is exposed, sheet metal ductwork to be paint grip (spiral where round), see plans.

2.2 CIRCULATING ABOVE GROUND HEATING PIPING INSULATION

- A. All piping in concealed and exposed areas shall be insulated with fiberglass pipe insulation with all service jacket. Jacket shall be factory-applied, and, where specified, with white foil scrim-kraft vapor barrier. Insulation shall be Johns-Manville Micro-Lok 850 HP, or accepted equal.
- B. For pipe sizes to individual terminal units 1" and less – insulation thickness shall be 1/2". For pipe sizes of 1-1/4" thru 2" – insulation thickness shall be 1". For pipe sizes of 2-1/2" and larger – insulation thickness shall be 1-1/2".
- C. Fittings, valves, flanges, etc. shall be insulated with fiberglass blanket, Johns-Manville Microlite or pre-cut mitered sections for elbows, J-M Micro-Lok (1lb/cu. ft. density).
- D. Encase pipe fitting insulation with one piece pre-molded Zeston 2000 PVC fitting covers having flame spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.
- E. Provide sheet metal insulation shields at all hanger locations.
- F. **Hangers for piping shall be large enough to encompass insulation. It shall not be acceptable for insulation to envelope hangers/saddles, or for insulation to stop on either side of hangers.**

2.3 HEATING WATER PUMP BODIES, & OTHER HEATING WATER EQUIPMENT INSULATION

- A. All surfaces shall be insulated with 3 lb. density fiberglass board Johns-Manville #814-450 °F at a thickness of 3".

- B. Insulation shall be cut or mitered where necessary to fit the contour of the equipment. All voids shall be packed with light density glass fiber insulation. Insulation sections shall be banded in place with $\frac{3}{4}$ inch x 0.015 inch thick galvanized steel bands at 18 inch o.c. for all large equipment. Insulation shall be covered with one inch galvanized hexagonal wire mesh. Apply $\frac{1}{2}$ inch of insulating cement such as OC-110 or equal in 2 layers over the wire mesh.

2.4 CIRCULATING ABOVE GROUND CHILLED WATER PIPING INSULATION

- A. All piping in concealed and exposed areas shall be insulated with fiberglass pipe insulation with all service jacket. Jacket shall be factory-applied, and, where specified, with white foil scrim-kraft vapor barrier. Insulation shall be Johns-Manville Micro-Lok 850 APT, or accepted equal.
- B. For pipe sizes to individual terminal units 1" and less – insulation thickness shall be 1". For pipe sizes of 1-1/4" thru 2" – insulation thickness shall be 1". For pipe sizes of 2-1/2" and larger – insulation thickness shall be 1-1/2".
- C. Fittings, valves, flanges, etc. shall be insulated with fiberglass blanket, Johns-Manville Microlite or pre-cut mitered sections for elbows, J-M Micro-Lok (1lb/cu. ft. density).
- D. Encase pipe fitting insulation with one piece pre-molded PVC fitting covers having flame spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.
- E. Provide sheet metal insulation shields at all hanger locations.
- F. ***All autoflow valves & strainers to be insulated & allow access to ports. Include valve extensions as necessary.***
- G. ***Hangers for piping shall be large enough to encompass insulation. It shall not be acceptable for insulation to envelope hangers/saddles, or for insulation to stop on either side of hangers.***

2.5 CHILLED WATER EQUIPMENT INSULATION

- A. All surfaces shall be insulated with 3 lb. density fiberglass board Johns-Manville #814-450 °F at a thickness of 3".
- B. Insulation shall be cut or mitered where necessary to fit the contour of the equipment. All voids shall be packed with light density glass fiber insulation. Insulation sections shall be banded in place with $\frac{3}{4}$ inch x 0.015 inch thick galvanized steel bands at 18 inch o.c. for all large equipment. Insulation shall be covered with one inch galvanized hexagonal wire mesh. Apply $\frac{1}{2}$ inch of insulating cement such as OC-110 or equal in 2 layers over the wire mesh.

2.6 COOLING CONDENSATE PIPING

- A. All new piping in concealed and exposed areas shall be insulated with flexible elastomeric thermal insulation consisting of closed-cell, sponge- or expanded rubber materials. Comply with ASTM C 534, Type I for tubular materials, Type II for sheet materials. Maximum thermal conductivity of 0.28 at 75 degrees.
 - 1. Provide adhesives as recommended by insulation material manufacturer.
 - 2. Provide ultraviolet-protective coating as recommended by insulation material manufacturer.
- B. Insulation thickness shall be $\frac{1}{2}$ " and shall include a vapor retarder.
- C. Fittings, valves, flanges, etc. shall be insulated with prefabricated thermal insulating fitting covers complying with ASTM C 450 for dimensions used in performing insulation to cover valves, elbows, tee, and flanges.
- D. Install per manufacturer's recommendations.

PART 3 - EXECUTION

3.1 GENERAL APPLICATION

- A. All insulation shall be applied on clean, dry surfaces. All joints shall be snugly butted against the adjoining piece and all joints, seams, voids, flat spots, etc., shall be filled with insulation cement. Do not use cut pieces or scraps abutting each other.

- B. Where double layers are installed, the first layer shall be fastened with binding wire. All joints shall be staggered between the two layers.
- C. Insulation on all cold surfaces must be applied in a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.
- D. All surface finishes shall be extended to protect all surfaces, ends, and raw edges of insulation.
- E. All insulation materials shall be installed in strict accordance with manufacturer's instructions, using recommended adhesives, mastics and coatings applied at specific coverage per gallon and temperature conditions.
- F. Extend insulation without interruption through walls, floors and similar penetrations, except where otherwise indicated.
- G. Maintain integrity of vapor-barrier jackets on insulation, and protect to prevent puncture or other damage.
- H. Do not apply insulation to equipment, breechings, or stacks while hot.
- I. Do not insulate boiler manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- J. Provide removable insulation sections to cover parts of equipment, which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.
- K. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.
- L. Insulation installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

3.2 DUCT APPLICATION

- A. Rigid Insulation shall be secured to duct or sheet metal work by impaling over pin anchors space no more than 12" centers and secured with washers and clips. Pins shall be spot welded to the duct surface by a welding procedure which will not distort the sheet metal or burn through or mar interior finish of the duct plenums of casings but which develop full strength of the pin. Pin sizes and diameters shall be as recommended by manufacturer for type and thickness of insulation specified. Insulation on the underside of all horizontal or sloping ducts shall be additionally secured with 3M Insulation Adhesive 35.
- B. Insulation shall be applied with all joints tightly butted and all points of impalement shall be pointed up and sealed with approved mastic before positioning clips. Where vapor barrier is specified, all joints, breaks, punctures and voids shall be filled with vapor barrier coating compound and covered with vapor seal material identical to the surrounding material.
- C. All joints, duct attachments, and junctions (including those caused by ducts entering walls, projections such as hanger, etc.) shall be pointed and sealed with approved mastic and taped. Where no further finish is required over the vapor barrier, taping shall be carefully done to obtain a neat finished appearance.
- D. Flexible Insulation shall be adhered to duct with fire-retardant adhesive in sufficient quantities to prevent sagging. Ducts with a width over 30" shall be further secured on the underside with mechanical fasteners on 12" maximum centers. Insulation shall be butted with facing overlapping all joints at least 2" and sealed with fire-retardant vapor barrier adhesive. Seal all breaks and punctures with vapor barrier tape and same type of fire retardant adhesive.

3.3 MINERAL-FIBER PIPE INSULATION APPLICATION:

- A. Fittings, valves, and flange insulation shall be wrapped firmly under compression (minimum 2:1) to a thickness equal to the adjoining insulation, secured with No. 20 gauge galvanized annealed steel wire, and finished with a smoothing coat of mastic, Johns-Manville No. 375 Insulating and Finishing Cement or equal.

- B. Cold Fittings, Valves, Flanges, etc., shall be additionally sealed with a layer of resin coated glass mesh, such as Johns-Manville Duramesh 207 glass cloth, embedded between two 1/16" thick coats of vapor barrier coating, Benjamin Foster 30-35 or equal. Lap the sealed glass cloth at least 2" on itself and the adjoining insulation.
- C. Premolded Insulation Valve and Fitting Covers and valve insulating bags shall be installed by tack fastening, banding, or taping as required by manufacturer.
- D. Expansion Joints: For expansion joints, a tube of pipe insulation shall be fabricated that will allow the expansion joint to move within the tube. The insulating tube shall be fastened at one end of the pipe or equipment and the other end shall be free to slide over the adjacent insulated piping. Provide an aluminum jacket over the insulated pipe to provide a smooth surface on which the insulated tube may slide.
- E. Insulation Under Hangers: Pipe hangers shall encompass the insulation and shall have sheet metal saddles furnished by the Mechanical Contractor.
- F. Inserts shall be installed at all hanger locations. Inserts between the pipe and pipe hangers shall consist of 13lb/cubic foot hydrous calcium silicate pipe insulation, or wood blocking, of thickness equal to the adjoining insulation and shall be provided with vapor barriers where required. Insulation inserts shall not be less than the following lengths:
 - 1. 1/2" to 1-1/2" pipe size 10" long
 - 2. 3" to 6" pipe size 12" long
 - 3. 8" and larger pipe size 16" long
- G. On all piping the full thickness of insulation and jacket shall run continuously under the sheet metal pipe saddle and through the pipe hanger (pipe hanger shall be large enough to permit full insulation thickness.)

3.4 FLEXIBLE ELASTOMERIC PIPE INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
 - 1. Follow manufacturer's written instructions for applying insulation.
 - 2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- B. Apply insulation to fittings and elbows as follows:
 - 1. Apply mitered sections of pipe insulation.
- C. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- D. Insulation Under Hangers: Pipe hangers shall encompass the insulation and shall have sheet metal saddles furnished by the Mechanical Contractor.
- E. Inserts shall be installed at all hanger locations. Inserts between the pipe and pipe hangers shall consist of 13lb/cubic foot hydrous calcium silicate pipe insulation, or wood blocking, of thickness equal to the adjoining insulation and shall be provided with vapor barriers where required. Insulation inserts shall not be less than the following lengths:
 - 1. 1/2" to 1-1/2" pipe size 10" long
 - 2. 3" to 6" pipe size 12" long
 - 3. 8" and larger pipe size 16" long
- F. On all piping the full thickness of insulation and jacket shall run continuously under the sheet metal pipe saddle and through the pipe hanger (pipe hanger shall be large enough to permit full insulation thickness.)

3.5 SEALING OF SLEEVES

- A. All sleeves for pipes, ductwork, etc., furnished under Division 23 of specifications, penetrating floors, fire and/or smoke walls and full height partitions, including chase walls, shall be sealed in accordance with the following:
 - 1. All insulated services shall have the specified insulation terminated on either side of sleeve. Services which require a vapor barrier jacket shall have segment through sleeve insulated with calcium silicate having a minimum thickness same as specified for service. Vapor barrier jacket shall be uninterrupted. Entire void space between inside of sleeve

and outside of duct, pipe, and/or calcium silicate insulation shall be packed with fiber insulation, conforming to HHI-521E Type 3 or HHI-558B Form A and having an ASTM fire class E-84 with fiber melt point in excess of 2000 degrees F., to a point 1/8 inch from ends of pipe sleeve. After void is packed with fiber insulation, services which are specified to be insulated shall have a section of insulation installed on each side of sleeve, insulation to be fitted tight to sleeve insulation. Balance of space in sleeve to be filled with nonhardening silicone conforming to TTS-00230 and of type which will allow 50 percent movement in one direction.

2. Contractor is herein given the option to provide Pipe Shield, Inc., fire rated wall and floor sleeves for insulated and noninsulated piping in lieu of sealing sleeves as outlined above. Shields shall be installed in strict accordance with manufacturer's recommendations.

END OF SECTION 23 0700

**SECTION 23 0900
CONTROLS & CONTROL SEQUENCES**

(THIS TEMPERATURE CONTROL WORK TO BE THE RESPONSIBILITY OF THE HVAC CONTRACTOR AND SHALL BE AN EXTENSION OF THE EXISTING DDC SYSTEM, & BE BY JOHNSON CONTROLS INC. CONTACT GREG HINTGEN AT 605-362-5315)

OR

BY ALTERNATE: (THIS TEMPERATURE CONTROL WORK TO BE THE RESPONSIBILITY OF THE HVAC CONTRACTOR AND SHALL BE A NEW DDC SYSTEM, & BE SIEMENS BY G&R CONTROLS INC. CONTACT PAUL DOOHEN AT 605-336-3788)

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. ALL TEMPERATURE CONTROLS INSTALLED BY THIS CONTRACTOR SHALL BE FIELD INSTALLED.
- B. **BY BASE BID:** This system shall be an extension of the existing DDC controls. This new DDC system must be fully integrated into the existing DDC system for complete operator access and control through the existing color graphic workstation. Custom graphical displays for the proposed floor plan & all proposed equipment shall be generated at the existing workstation.
- C. **BY ALTERNATE:** This system shall be a stand alone DDC control system. This new DDC system must be fully integrated into a new DDC system for complete operator access and control through a new color graphic workstation. Custom graphical displays for the proposed floor plan & all proposed equipment shall be generated at the new workstation.
 - 1. **THIS SYSTEM IS ONLY TO BE INSTALLED IN AREAS A, B, & C WHERE NEW CONTROLS ARE INDICATED. REFER TO TEMPERATURE CONTROL ZONE PLAN. EXISTING CONTROLS OUTSIDE THE WORK AREA ARE TO REMAIN.**
- D. ALL TEMPERATURE CONTROLS INSTALLED BY THIS CONTRACTOR SHALL BE FIELD INSTALLED. If there are any discrepancies, contact the engineer's office at least 7 days prior to bidding.
- E. Exact thermostats or space sensors to be located in the space shall be SUBMITTED TO & APPROVED BY SICHMELLER ENGINEERING & OWNER. Sensor only thermostats with no digital display or adjustability to be used in all vestibules & at fan forced radiation sensor locations. Digital display thermostats with adjustable range are to be used in all other areas (limit to 68F-73F, adj).
- F. This Section includes controls & control sequences for HVAC systems, subsystems, and equipment.
- G. The work in this section of the specification and the accompanying drawings consists of performing all labor and furnishing of all material and equipment necessary to install a complete Automatic Temperature Control System for the heating, ventilating, and air conditioning systems as indicated on drawings and specified herein, including minor items obviously necessary for complete and operating systems. Automatic Temperature Control System shall provide the "Sequence of Operation" as described in this section.

- H. The control system shall consist of all room sensors, floor sensors, thermostats, valves, damper operators and other accessories to fulfill the intent of the specifications. The temperature control system shall be installed by trained mechanics regularly employed by the manufacturer of the temperature control system.
- I. Each microprocessor based digital controller will be able to maintain its programmed memory in a non-volatile state during power failures without the use of batteries. All components and related temperature control components such as sensors, control valves, actuators, thermostats, control panels, etc. shall be manufactured by the same vendor.

1.3 QUALITY ASSURANCE

- A. Agent Qualifications: An Independent Engineer Approved Temperature Control Contractor shall provide and install all temperature controls and control sequences as specified in this section.

1.4 PROJECT CONDITIONS

- A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the trades and HVAC contractor to minimize conflicts with the Owner's operations.

1.5 BALANCING OF SYSTEMS

- A. The Temperature Controls Contractor shall cooperate and work with the mechanical contractors to properly balance out all mechanical systems to obtain a satisfactory working system.

1.6 ADJUSTMENT AND CALIBRATION OF SYSTEMS

- A. After the system is completely installed, the Temperature Controls Contractor with the presence of the mechanical engineer shall verify the various temperature control cycles as herein specified to the satisfaction of the engineer. The Temperature Controls Contractor shall submit direct to the engineer, a tabulation of all outdoor air, mixed air, discharge air, and all room temperatures for each unit. All thermostats and their thermometers shall be calibrated after installation.

1.7 SUBMITTALS

- A. Shop drawings as specified in Section 230500 shall include the following:
 - 1. All control devices, valves, dampers and auxiliary devices to be used.
 - 2. Written descriptions and diagrams to describe the operational sequences.
 - 3. Room thermostat schedule.
 - 4. NO2/CO Gas Detector.
 - 5. Variable Frequency Drives as follows:
 - a. Refer to HVAC Motor Schedule and Mechanical Schedules on Plans for VFD's provided by TC. If there are any discrepancies or questions, contact the engineer's office prior to bidding.

1.8 CONTROLLERS & WEB-ACCESSED SYSTEM WITH CUSTOM COLOR GRAPHICS

- A. Provide BACnet Controllers that are BACnet Testing Laboratory Listed. Network communication protocol used throughout entire DDC system shall be native BACnet Communication certified by the BTL open to Owner and available to other companies for use in making future modifications to DDC system.
- B. Unless otherwise specified, all equipment described below shall be controlled and monitored via a Web-accessed system. The Web-accessed system shall allow for any owner's designated personnel to change schedules and setpoints through a PC user on the Local Area Network or remotely via the Internet. This system shall provide complete custom color graphics and password protection. This system shall allow for remote monitoring, control, and troubleshooting via the Internet.
- C. Custom Graphics of Floor Plan: Display the following data:
 - 1. Equipment Designation/Label.

2. Outside-Air Temperature Indication.
3. Cooling or Heating/Economizer System Mode Indication.
4. Zone temperature indication and setpoints.
5. Alarms (as recommended by T.C.C.).

PART 2 - CONTROL SEQUENCES

2.1 EXHAUST/RELIEF/SUPPLY FAN CONTROL (EF-X, RF-1, SF-1)

- A. See electrical plans for J-box locations provided by EC for use by TC for relays. Coordinate with EC
- B. EXG EF-1 – Area A Existing Locker Rooms & Exercise Room Exhaust – existing sequences shall remain as is.
- C. EF-2 – Project Room A112 Exhaust – shall operate with lighted pilot switch by EC.
 1. BAS to monitor fan operation and adjust makeup airflow accordingly.
- D. EF-3 – Area C Locker Rooms Exhaust - shall operate during occupied hours as determined by the BAS System.
 1. D.D.C. controls shall prevent fan operation during Unoccupied Operation (as determined by the BAS).
- E. EF-4 – Classroom A111 Rangehood Exhaust – shall operate with switch by EC.
 1. No DDC integration.
- F. EXG EF-A – Area B Locker Rooms Exhaust - shall operate during occupied hours as determined by the BAS System.
 1. D.D.C. controls shall prevent fan operation during Unoccupied Operation (as determined by the BAS).
- G. EXG EF-B – Area B Rooms Exhaust - shall operate during occupied hours as determined by the BAS System.
 1. D.D.C. controls shall prevent fan operation during Unoccupied Operation (as determined by the BAS).
- H. RF-1 – Classroom A111, Wood Shop A113, & Metal Shop A114 Relief – shall operate during occupied hours as determined by the BAS System.
 1. D.D.C. controls shall prevent fan operation during Unoccupied Operation (as determined by the BAS).
- I. EF-5 – Shop Addition Exhaust – shall operate with Hand/Off/Auto switch by TC, and shall also operate with signal from NO2CO detector provided & installed by TC. Interlock operation with SF-1.
- J. SF-1 – Shop Addition Make Up Air – shall operate with Hand/Off/Auto switch by TC, and shall also operate with signal from NO2CO detector provided & installed by TC. Interlock operation with EF-3.

2.2 PACKAGED ROOFTOP UNIT WITH MODULATING DX COOLING, MODULATING HOT GAS REHEAT, POWERED EXHAUST, & DUCT MOUNTED HOT WATER COIL (RTU-1 & HC-1)

- A. Occupied and Unoccupied cycles of operation shall be determined by the DDC controller serving this unit. During occupied operation, the RTU supply fan will run continuously with the outside air damper open to its minimum open setting (adjustable). A discharge air temperature sensor will maintain the discharge air temperature at its setting (reset based on space demand determined by space heating/cooling) by modulating the outdoor air dampers in sequence with the modulating hot water heating coil, the DX cooling, and modulating hot gas reheat. Upon a call for cooling in economizer conditions, the outside air dampers will be modulated open beyond their minimum setting, the return air dampers will be modulated closed, and the powered exhaust will be enabled. If the economizer cannot satisfy the cooling requirements, the DX cooling will be modulated. The outdoor air damper position, powered exhaust, and supply fan speed will be balanced to maintain a slight positive pressure in the space relative to outdoors (0.05" w.c., adj., BAS to monitor). A mixed air low limit sensor will prevent the mixed air temperature from dropping below 55F (adj.) in cooling mode. An outdoor air sensor will over-

ride the outdoor air damper & powered exhaust back to minimum setting whenever the outdoor air temperature is above 60F (adj.). The modulating 3-way valve for the duct mounted hot water heating coil will be modulated as necessary to maintain the discharge air temperature at its setting. A manual reset, safety low limit freeze protection thermostat on the leaving side of the heating coil will open the 3-way modulating hot water injection valve to 100% open (injecting heat into coil loop), close the outdoor air dampers, and disable the powered exhaust if a freeze condition is sensed. Note: 3-way valve to have normal/fail position such that hot water flows through the coil. Fail to last position shall not be acceptable.

- B. Minimum Outside Air Ventilation - Carbon Dioxide (CO₂) Control: When in the occupied mode, the controller shall measure the zone CO₂ levels and override normal damper operation to maintain a CO₂ setpoint of 800 ppm (adj.). When zone CO₂ levels are at 800 ppm or below, the outside air damper shall be closed shall be disabled. When CO₂ levels are between 800 ppm and 1000 ppm, the outside air damper shall linearly modulate open, from closed at 800 ppm to scheduled minimum value at 1000 ppm. When CO₂ levels are above 1000ppm, the outside air damper shall be set at their scheduled minimum values.
- C. Dehumidification (both occupied and unoccupied operation)
 - 1. When the space air enthalpy levels are at or below 21 btu/lb (adj.) (10-minute average), the RTU shall operate under normal conditions to maintain the required discharge air temperatures.
 - 2. When the space air is above 22 btu/lb (adj.) (10-minute average), the DX cooling will be modulated in cooling mode as necessary to lower the discharge air enthalpy level to 21 btu/lb (adj), and the hot gas reheat in the RTU with be modulated as necessary to maintain the required discharge air temperatures required by the standard operating sequences.
 - 3. Dehumidification to be disabled when outside air temperatures are at or below 25 degrees F.
- D. During Unoccupied operation the RTU supply fan and powered exhaust fan will be off, and the outdoor air dampers will be closed. If the space temperature falls below 60F during the unoccupied cycle, the rooftop unit will be started with the outdoor air dampers closed, powered exhaust disabled, and the modulating hot water heating coil will be controlled to supply 90F (adj.) air to the space until heating is satisfied. This same cycle will take place during cold weather on morning warm up except that the unit will operate in the heating mode with the outside air dampers closed and powered exhaust disabled until the return air temperature reaches 68F (adj.). During unoccupied operation if the space temperature rises above 78F (adj) during the unoccupied cycle, the rooftop unit will be started with the outdoor air dampers closed, powered exhaust disabled, and the DX cooling will be controlled to supply cooling air to the space until cooling is satisfied.
- E. Safeties: The following device(s) will close the outdoor air damper, modulate the hot water valve to fully open position, and send an alarm to the workstation and printer when activated: Coil low limit freeze protection.
- F. Smoke detectors (provided & installed by E.C.), located in the return & supply air, signal alarm, stops fans, and close smoke dampers when products of combustion are detected in airstream.
- G. Operator's Workstation shall display the following:
 - 1. Equipment Designation/Label.
 - 2. System Occupied/Unoccupied Mode.
 - 3. System On-Off Indication.
 - 4. Room/Area Served.
 - 5. Room/Area Temperature.
 - 6. Room/Area Temperature Setpoint, Occupied.
 - 7. Room/Area Temperature Setpoint, Unoccupied.
 - 8. Room/Area CO₂ Indication.
 - 9. Room/Area Relative Humidity% Indication.
 - 10. Building Pressure Sensor Indication and Location.
 - 11. Outside Air Damper Position.

12. Outside Air Temperature and Relative Humidity.
13. Powered Exhaust Fan Status.
14. Powered Exhaust Fan VFD Speed.
15. Powered Exhaust Fan VFD Fault.
16. Powered Exhaust Fan On-Off Command.
17. Return air damper position.
18. Return Air Temperature Indication.
19. Mixed Air Temperature Indication.
20. Economizer Mixed Air Temperature Set-Point.
21. Economizer Status.
22. Each Compressor Stage On-Off Indication.
23. Lead Compressor Modulation %.
24. Each Compressor Stage Run-Time Hours.
25. DX Cooling command.
26. DX Cooling modulation.
27. Hot Gas Reheat command.
28. Hot Gas Reheat modulation.
29. Hot Water Heat Enable/Disable.
30. Hot Water Heat Modulation % On.
31. Supply Fan Status.
32. Supply Fan VFD Speed.
33. Supply Fan VFD Fault.
34. Supply Fan On-Off Command.
35. Supply Fan High Static Shutdown Alarm Status.
36. Supply Fan High Static Shutdown Setpoint.
37. Supply Air Discharge Air-Temperature Indication.
38. Supply Air Discharge Air-Temperature Set-Point.
39. Supply Air Discharge Relative Humidity Indication.
40. Alarm Status (Alarms as Recommended By T.C.)

2.3 EXISTING AIR HANDLING UNIT WITH CHILLED WATER COOLING AND HOT WATER HEATING COILS (EXG AHU-3) – CONSTANT VOLUME MULTI-ZONE APPLICATION

- A. Occupied and Unoccupied cycles of operation shall be determined by the DDC controller serving this unit. During occupied operation, the AHU supply fan will run continuously with the outside air damper open to its minimum open position (adjustable). A discharge air temperature sensor will maintain the discharge air temperature at its setting (reset based on building demand determined by HC's for AHU-3) by modulating the normally closed outdoor air damper in sequence with the modulating hot water coil valve and modulating chilled water cooling coil valve. Upon a call for cooling, the outside air damper will be modulated open beyond the minimum setting, and the normally open return air damper will be modulated closed. If economizer cannot satisfy the cooling requirements, the chilled water cooling will be modulated. The normally open return air damper shall operate inversely to the outside air damper. The outdoor air damper position will be modulated to maintain a slight positive pressure in the space relative to outdoors (0.05" w.c., adj., BAS to monitor), relief is achieved through an existing barometric relief damper and hood. Building pressure sensor will monitor only and will be used for a reference point. A mixed air low limit sensor will prevent the mixed air temperature from dropping below 55F (adj.) when in economizer mode. An outdoor air sensor will over-ride the outdoor air damper back to minimum position whenever the outdoor air temperature is above 60F (adj.). The modulating hot water coil valve and the modulating chilled water cooling coil valve will be modulated open as necessary to maintain the discharge air temperature at its setting. An automatic reset, safety low limit freeze protection thermostat on the leaving side of the heating coil will stop the fans and close the outdoor air dampers if a freeze condition is sensed. Note: Hot water valve is existing, and chilled water valve is existing.
- B. Minimum Outside Air Ventilation – Return air duct mounted Carbon Dioxide (CO₂) Control: When in the occupied mode, the controller shall measure the zone CO₂ levels and override normal damper operation to maintain a CO₂ setpoint of 800 ppm (adj.). When zone CO₂ levels

are at 800 ppm or below, the outside air damper shall be closed. The outside air damper shall modulate open on rising CO2 concentrations to the scheduled minimum outside air level for 1000 ppm (adj.) or above.

- C. A duct static pressure high limit will stop the unit fan if its setting is exceeded (2.5" wc, adj.).
- D. During Unoccupied operation the AHU supply fan will be off and the outdoor air dampers will be closed. If any space temperature in zones served by this unit fall below 60F during the unoccupied cycle, the air handling unit will be started with the outdoor air dampers closed and the hot water coil valve will be controlled to supply 80F (adj.) air to the spaces until the zone requiring heating is satisfied. This same cycle will take place during cold weather on morning warm up except that the unit will operate in the heating mode with the outside air dampers closed until the return air temperature reaches 68F (adj.). During unoccupied operation if a space temperature rises above 78F (adj) during the unoccupied cycle, the unit will be started with the outdoor air dampers closed, and the chilled water cooling will be controlled to supply cooling air to the space until cooling is satisfied.
- E. Safeties: The following device(s) will close the outdoor air damper, modulate the hot water valve to fully open position, and send an alarm to the workstation and printer when activated: Coil low limit.
- F. A smoke detector (provided & installed by E.C.), located in the supply air and return air connections of AHU-3, signals alarm, stops AHU-3 fans, and closes smoke dampers when products of combustion are detected in airstream.
- G. Operator's Workstation shall display the following:
 - 1. Equipment Designation.
 - 2. System on-off indication.
 - 3. System occupied/unoccupied mode.
 - 4. Building Pressure Sensor indication & location.
 - 5. Return Damper Position.
 - 6. Outside-air Damper Position.
 - 7. Outside-air temperature indication.
 - 8. Outside-air relative humidity indication.
 - 9. Return air temperature indication.
 - 10. Return air relative humidity indication.
 - 11. Return air relative humidity setpoint.
 - 12. Return air CO2 level indication.
 - 13. Return air CO2 level setpoint.
 - 14. Mixed-air temperature indication.
 - 15. Mixed-air relative humidity indication.
 - 16. Mixed-air damper position.
 - 17. Economizer Mixed Air Temperature Setpoint.
 - 18. Economizer Status.
 - 19. Supply Fan Status.
 - 20. Supply Fan On-Off Command.
 - 21. Supply Fan High Static Shutdown.
 - 22. Supply Air Discharge Air-Temperature Indication.
 - 23. Supply Air Discharge Air-Temperature Set-Point.
 - 24. Supply Air Discharge Relative Humidity Indication.
 - 25. Supply Air Duct Static Pressure Indication.
 - 26. Modulating Heating Water Heat Enable/Disable.
 - 27. Modulating heating water valve position as percent open (through coil).
 - 28. Heating Hot Water Temperature Available. (Can be global value)
 - 29. Modulating Chilled Water Heat Enable/Disable.
 - 30. Modulating Chilled water valve position as percent open (through coil).
 - 31. Chilled Water Temperature Available. (Can be global value)
 - 32. Alarm Status (Alarms as recommended by T.C.C.).

2.4 DUCT MOUNTED HOT WATER HEATING COIL CONTROL

- A. The hot water heating coil will be controlled by the space temperature sensor. On a call for heat, the 2-way modulating hot water valve will modulate open as necessary to meet the heating demand. The space served by the heating water coil is controlled in occupied and unoccupied modes as follows:
- B. OCCUPIED MODE
 - 1. The controller monitors the room temperature sensor and modulates the 2-way heating valve open to maintain the space temperature at occupied set point.
- C. UNOCCUPIED
 - 1. The controller monitors the room temperature sensor and modulates the 2-way heating valve open to maintain the space temperature at unoccupied set point.
- D. Operator Workstation:
 - 1. Display the following data:
 - a. Equipment Designation
 - b. Room/area served.
 - c. Room occupied/unoccupied.
 - d. Room temperature actual.
 - e. Room temperature set point, occupied.
 - f. Room temperature set point, unoccupied.
 - g. 2-Way Modulating hot water valve position as percent open.
 - h. Heating Coil Discharge Air Temperature.
 - i. Heating Coil Discharge Air Temperature Setpoint.
 - j. Alarm Status (alarms as recommended by T.C.C.).

2.5 FAN COIL UNIT WITH DX COOLING, AIR-COOLED CONDENSING UNIT, AND DUCT MOUNTED HOT WATER HEATING COIL CONTROL (FC-1, FC-2, FC-3, CU-1, HC-1, HC-2, & HC-3)

- A. Occupied Operation:
 - 1. While the space is occupied, the fan coil fan operates continuously supplying a constant volume of supply air.
 - 2. While there is no call for heating or cooling from any space thermostats, the fan coil fan shall run continuously with the outside air damper open to provide minimum ventilation air CFM to spaces. The DX cooling coil shall be enabled and hot water reheat coil shall be modulated as necessary to discharge room neutral temperature air.
 - 3. Minimum Outside Air Ventilation - Carbon Dioxide (CO₂) Control: When in the occupied mode, the controller shall measure the zone CO₂ levels and override normal damper operation to maintain a CO₂ setpoint of 800 ppm (adj.). When zone CO₂ levels are at 800 ppm or below, the outside air damper shall be closed. When CO₂ levels are between 800 ppm and 1000 ppm, the outside air damper shall linearly modulate open, from closed at 800 ppm to scheduled minimum value at 1000 ppm. When CO₂ levels are above 1000ppm, the outside air damper shall be set at the scheduled minimum value. CO₂ sensor to be mounted in the return air duct.
 - 4. Cooling Mode:
 - a. When outside air is less than or equal to 55 F (economizer):
 - 1) On an increase in space temperature, modulate the outside air damper open past the ventilation minimum to increase the flow of cool outside air from the louver to the fan coil mixing box. Modulate the return air damper/outside air damper proportionally to satisfy room cooling requirements.
 - 2) On a decrease in space temperature, modulate the outside air damper closed to decrease the flow of cool outside air to the fan coil mixing box back to the ventilation minimum CFM. The 2-way modulating control valve on the reheat coil shall be proportionally modulated to maintain room neutral temperature discharge.
 - b. When outside air is greater than 55 F:

- 1) On an increase in space temperature, enable DX cooling on condensing unit.
 - 2) On a decrease in space temperature past setpoint, disable DX cooling on condensing unit. The 2-way modulating control valve on the reheat coil shall be proportionally modulated to maintain room neutral temperature discharge if necessary.
5. Heating Mode:
- a. On a decrease in space temperature, the 2-way modulating control valve on the reheat coil shall be modulated to increase the discharge air temperature proportionally to the room demand.
 - b. On an increase in space temperature, modulate close the 2-way modulating control valve on the reheat coil as necessary.
- B. Unoccupied mode:
1. While the space is unoccupied, the fan coil fan is disabled and the outside air damper is closed. The fan is only enabled to supply a constant volume of supply air when there is a call for heating or cooling. During unoccupied operation, the outside air damper shall remain fully closed.
 2. Heating Mode:
 - a. On a decrease in space temperature below unoccupied setpoint (60F, adj), the fan is enabled, and the 2-way modulating control valve on the reheat coil is modulated to increase the discharge air temperature to 90F, adj. This same cycle will take place during cold weather on morning warm up except that the unit will operate in the heating mode with the outside air dampers closed until the return air temperature reaches 68F (adj.).
 3. Cooling Mode:
 - a. On an increase in space temperature above unoccupied setpoint (78F, adj), the fan and condensing unit are enabled to maintain the space temperature.
- C. Dehumidification (both occupied and unoccupied operation)
1. When the space air enthalpy levels are at or below 21 btu/lb (adj.) (10-minute average), the fan coil shall operate under normal conditions to maintain the required discharge air temperatures.
 2. When the space air is above 22 btu/lb (adj.) (10-minute average), the DX cooling will be modulated in cooling mode as necessary to lower the discharge air enthalpy level to 21 btu/lb (adj), and the hot water heat will be modulated as necessary to maintain the required discharge air temperatures required by the standard operating sequences.
 3. Dehumidification to be disabled when outside air temperatures are at or below 25 degrees F.
- D. Operator Workstation: Display the following data:
1. Room/area served.
 2. Room occupied/unoccupied.
 3. Room temperature.
 4. Room temperature set point, occupied.
 5. Room temperature set point, unoccupied.
 6. Heating Occupied/Unoccupied Setpoints
 7. Cooling Occupied/Unoccupied Setpoints
 8. Mode indication, heating/cooling/satisfied.
 9. Return Air Damper Position (% open).
 10. Outside Air Damper Position (% open).
 11. Room CO2 indication.
 12. Room CO2 setpoint.
 13. Room relative humidity indication.
 14. Return Air temperature.
 15. Outside Air temperature.
 16. Economizer Mixed Air Temperature Setpoint.
 17. Economizer Status.

18. Heating Coil Water valve position (% open).
19. Heating Coil Leaving Air Temperature.
20. Heating Coil Leaving Air Temperature Setpoint.
21. Fan Coil Discharge Air Temperature.
22. Fan Coil Discharge Air Temperature Setpoint.
23. Condensing Unit DX Cooling Enabled/Disabled
24. Condensing Unit Stage Enabled/Disabled
25. Condensing Unit Run Time (hours)
26. Alarm Status (alarms as recommended by T.C.C.).

2.6 AIR HANDLING UNIT WITH CHILLED WATER COILS, HOT WATER REHEAT COILS, & RETURN/RELIEF FAN CONTROL – VAV APPLICATION (AHU-1)

- A. Occupied and Unoccupied cycles of operation shall be determined by the DDC controller serving this unit. During occupied operation, the AHU supply fan and return/relief fan will run continuously with the outside air damper open to its minimum open position (adjustable). A discharge air temperature sensor will maintain the discharge air temperature at its setting (reset based on building demand determined by VAV's for AHU-1) by modulating the normally closed outdoor air damper in sequence with the modulating 3-way hot water coil valve and modulating 3-way chilled water cooling coil valve. Upon a call for cooling, the outside air dampers and relief air dampers will be modulated open beyond their minimum setting, and the normally open return air damper will be modulated closed. If economizer cannot satisfy the cooling requirements, the chilled water cooling will be modulated. The normally open return air damper shall operate inversely to the outside air damper. The normally closed relief air damper will be modulated based off of outside air damper position. The outdoor air damper position, relief air damper position, and return air damper position will be modulated to maintain a slight positive pressure in the space relative to outdoors (0.05" w.c., adj., BAS to monitor). Building pressure sensor will monitor only and will be used for a reference point. A mixed air low limit sensor will prevent the mixed air temperature from dropping below 55F (adj.) when in economizer mode. An outdoor air sensor will over-ride the outdoor air damper back to minimum position whenever the outdoor air temperature is above 60F (adj.). The 3-way modulating hot water coil valve and the 3-way modulating chilled water cooling coil valve will be modulated open as necessary to maintain the discharge air temperature at its setting, An automatic reset, safety low limit freeze protection thermostat on the leaving side of the heating coil will stop the fans and close the outdoor air dampers if a freeze condition is sensed. Note: Hot water 3-way valve to have normal/fail position such that water flows through coils, chilled water 3-way valve to have normal/fail position such that water bypasses coils. Fail to last position shall not be acceptable.
- B. Minimum Outside Air Ventilation – Return air duct mounted Carbon Dioxide (CO₂) Control: When in the occupied mode, the controller shall measure the zone CO₂ levels and override normal damper operation to maintain a CO₂ setpoint of 800 ppm (adj.). When zone CO₂ levels are at 800 ppm or below, the outside air damper shall be closed. The outside air damper shall modulate open on rising CO₂ concentrations to the scheduled minimum outside air level for 1000 ppm (adj.) or above.
- C. A static pressure sensor in the supply air duct 2/3 way to furthest VAV box will maintain its set point (1.0" wc., adj.) by modulating the speed of the VFD on the unit's supply fans. A duct static pressure controller in the return fan discharge plenum will control the speed of the return/relief fan via its' Variable Speed Drive (0.01" adj.). A duct static pressure high limit will stop the unit fans if its setting is exceeded (2.5" wc, adj.).
- D. During Unoccupied operation the AHU supply fan and the return fan will be off and the outdoor air dampers will be closed. If any space temperature in zones served by this unit fall below 60F during the unoccupied cycle, the air handling unit will be started with the outdoor air dampers closed and the hot water coil valve will be controlled to supply 90F (adj.) air to the spaces until the zone requiring heating is satisfied. This same cycle will take place during cold weather on morning warm up except that the unit will operate in the heating mode with the outside air dampers closed until the return air temperature reaches 68F (adj.). During unoccupied operation if a space temperature rises above 78F (adj) during the unoccupied cycle, the unit will

be started with the outdoor air dampers closed, and the chilled water cooling will be controlled to supply cooling air to the space until cooling is satisfied.

- E. Safeties: The following device(s) will close the outdoor air damper, modulate the hot water valve to fully open position, and send an alarm to the workstation and printer when activated: Coil low limit.
- F. A smoke detector (provided & installed by E.C.), located in the supply air and return air connections of AHU-1, signals alarm, stops AHU-1 fans, and closes smoke dampers when products of combustion are detected in airstream.
- G. Operator's Workstation shall display the following:
 - 1. Equipment Designation.
 - 2. System on-off indication.
 - 3. System occupied/unoccupied mode.
 - 4. Building Pressure Sensor indication & location.
 - 5. Relief Damper Position.
 - 6. Outside-air Damper Position.
 - 7. Outside-air temperature indication.
 - 8. Outside-air relative humidity indication.
 - 9. Return air temperature indication.
 - 10. Return air relative humidity indication.
 - 11. Return air relative humidity setpoint.
 - 12. Return air CO2 level indication.
 - 13. Return air CO2 level setpoint.
 - 14. Return/Relief Fan Status.
 - 15. Return/Relief Fan VFD Speed.
 - 16. Return/Relief Fan VFD Fault.
 - 17. Return/Relief Fan On-Off Command.
 - 18. Mixed-air temperature indication.
 - 19. Mixed-air relative humidity indication.
 - 20. Mixed-air damper position.
 - 21. Economizer Mixed Air Temperature Setpoint.
 - 22. Economizer Status.
 - 23. Supply Fan Status.
 - 24. Supply Fan VFD Speed.
 - 25. Supply Fan VFD Fault.
 - 26. Supply Fan On-Off Command.
 - 27. Supply Fan High Static Shutdown.
 - 28. Supply Air Discharge Air-Temperature Indication.
 - 29. Supply Air Discharge Air-Temperature Set-Point.
 - 30. Supply Air Discharge Relative Humidity Indication.
 - 31. Supply Air Duct Static Pressure Indication.
 - 32. Supply Air Duct Static Pressure Set-Point.
 - 33. 3-way modulating Heating Water Heat Enable/Disable.
 - 34. 3-way modulating heating water valve position as percent open (through coil).
 - 35. Heating Hot Water Temperature Available. (Can be global value)
 - 36. 3-way modulating Chilled Water Heat Enable/Disable.
 - 37. 3-way modulating Chilled water valve position as percent open (through coil).
 - 38. Chilled Water Temperature Available. (Can be global value)
 - 39. Alarm Status (Alarms as recommended by T.C.C.).

2.7 SHUTOFF VARIABLE AIR VOLUME (VAV's) TERMINAL UNIT CONTROL

- A. VAV UNITS WITH HYDRONIC CONTROLS
 - 1. The VAVs will be controlled by the space temperature sensor to vary the primary air flow to the space to provide cooling or heating whenever the air handling unit is operational. On a call for cooling in the space, the primary damper will be modulated open beyond the minimum position to meet the cooling demand. On a call for heating in the space the

primary air damper will be modulated to the heating position (adj.) as scheduled and the HW 2-way modulating normally open control valve will modulate open as necessary (0-100%) to provide heat to the space. 2-way valve normal (fail) to last position.

2. All VAV Units shall operate in either the occupied or unoccupied mode and the space sensor with adjustable setpoint shall have an over-ride button on the face to return the terminal unit to its occupied mode of operation if the terminal unit is in "Unoccupied" mode.
- B. Operator's Workstation shall display the following:
1. Equipment Designation/Label.
 2. Room/area/equipment served.
 3. Room occupied/unoccupied.
 4. Room temperature.
 5. Room temperature set point, occupied.
 6. Room temperature set point, unoccupied.
 7. Actual Air Temperature Delivered to the VAV.
 8. Mode indication, heating/cooling/satisfied.
 9. Entering Hot Water Temperature
 10. 2-way Modulating hot water valve position as percent open.
 11. Air-damper position as percent open
 12. Supply airflow rate, target.
 13. Supply airflow rate, actual.
 14. VAV Discharge Air Temperature.
 15. Alarm Status (Alarms as recommended by T.C.C.).

2.8 CABINET UNIT HEATER CONTROL

- A. Cabinet unit heaters to have 3-way 2-position temperature control valve with normal/fail position to flow through coil. Normal/fail to last position shall not be acceptable.
- B. The unit heaters will be controlled by the space temperature sensor. On a call for heat, the first stage of heat shall be water flow through the coil at 100% flow with the fan disabled. If the room temperature drops more than 1 degree below setpoint after first stage heating, the fan will be enabled, with the hot water valve open to meet the heating demand. Once, setpoint is satisfied, the fan shall be disabled and the hot water valve will close. The BAS will prevent the fan from operating unless minimum 100 degree F. (adj.) hot water is available from the hot water plant. The control valve shall have normal (fail) position as flowing through heating coil, fail to last position shall not be acceptable.
- C. OPERATOR WORKSTATION
1. Display the following data:
 - a. Equipment Designation.
 - b. Room/area served.
 - c. Room occupied/unoccupied.
 - d. Room temperature.
 - e. Room temperature set point.
 - f. Hot water valve position as percent open to coil.
 - g. Fan Enable
 - h. Alarm Status (alarms as recommended by T.C.C.).

2.9 EXISTING HYDRONIC RADIATION CONTROL

- A. Where radiation is being used as supplemental heat, radiation shall be modulating first stage of heat for that zone with VAV reheat as second stage.
- B. The radiation will be controlled by the space temperature sensor. On a call for heat, the 2-way modulating normally open hot water valve will open as necessary to meet the heating demand. Valve normal (fail) position to flow through coil, fail to last position shall not be acceptable. The space served by the radiation is controlled in occupied and unoccupied modes as follows:
1. OCCUPIED MODE

- a. The controller monitors the room temperature sensor and modulates the 2-way heating valve open/closed to maintain the space temperature at occupied set point.
2. UNOCCUPIED
 - a. The controller monitors the room temperature sensor and modulates the 2-way heating valve open/closed to maintain the space temperature at unoccupied set point.
3. Operator Workstation: Display the following data:
 - a. Equipment Designation
 - b. Room/area served.
 - c. Room occupied/unoccupied.
 - d. Room temperature.
 - e. Room temperature set point, occupied.
 - f. Room temperature set point, unoccupied.
 - g. 2-way modulating hot water valve position.
 - h. Alarm Status (alarms as recommended by T.C.C.).

2.10 INFLOOR HEAT CIRCULATOR (CP-1) CONTROL

1. On a call for heat by either the slab stat or air stat, the infloor heat circulator CP-1 shall run, the 3-way modulating temperature control valve shall modulate as necessary to meet the desired infloor loop setpoint of 130F (adj.).
2. Operator Workstation: Display the following data:
 - a. Outside Air Temperature.
 - b. Zone # Designation.
 - c. Room/area served.
 - d. Slab temperature indication.
 - e. Slab temperature setpoint.
 - f. Room temperature indication.
 - g. Room temperature setpoint.
 - h. 3-way modulating hot water injection valve position as percent open (%injecting heat into loop).
 - i. Infloor Heat Circulator CP-1 On-Off Indication.
 - j. Infloor Heat HWS Temperature Indication.
 - k. Infloor Heat HWS Temperature Setpoint.
 - l. Alarm status (alarms as recommended by TC).

2.11 TRAINING

- A. The Temperature Control Contractor shall provide (8) hours of training to the owner's representative.

2.12 WARRANTY

- A. The entire control system shall be warranted for a period of 1 year from the date of beneficial use of the system.

PART 3 - PRODUCTS

3.1 NO2CO DETECTOR

- A. Furnish and install combination nitrogen dioxide (NO2) detector/carbon monoxide (CO) detector as noted on plans. Provide start-up and training and confirm proper operation.

3.2 VARIABLE FREQUENCY DRIVES

- A. WARRANTY
 1. Warranty shall be 24 months from the date of start-up, not to exceed 30 months from the date of shipment.
 2. Warranty shall include all parts.
- B. GENERAL
 1. VFD shall be current rated at 8 kHz carrier frequency for VFD's 1-75 HP and 4 kHz for VFD's 100-400 HP. All HP ratings shall meet or exceed Table 430-150 of the National

Electric Code. Three Phase Motor Full Load Currents, HP, Maximum Current, and Rated Voltage shall appear on the drive nameplate.

2. VFD shall not generate damaging voltage pulses at the motor terminals when applied within 500 feet of each other. Both Drive and Motor shall comply with NEMA MG1 section 30.40.4.2 which specifies these limits at a maximum peak voltage of 1600 Volts and a minimum rise time of .1 microseconds.

C. CODES/STANDARDS

1. VFD and options shall be c UL-508 listed.
2. NEMA 12 enclosed VFD shall be UL-1995 approved for mounting in conditioned air ducts and plenums.
3. The drive and options shall comply with the applicable requirement of the latest standards of ANSI, NEMA, National Electric Code NEC, NEPU-70, IEEE 519-1992, FCC Part 15 Subpart J, CE 96.

D. QUALITY ASSURANCE

1. Every VFD shall be functionally tested under motor load. During this load test the VFD shall be monitored for correct phase current, Phase voltages, and motor speed. Correct Current Limit operation shall be verified by simulating a motor overload.
2. Verification of proper factory presets by scrolling through all parameters shall be performed to ensure proper microprocessor settings. The computer port should also verify that the proper factory settings are loaded correctly in the drive.
3. All options shall be functionally tested. Proper heater coil installation in motor overload, if supplied, shall be verified.

E. SERVICE

1. Factory authorized representative start-up shall be included for each VFD provided.
2. Service engineers shall be employed by the manufacturer or be certified by the manufacturer and provide start-up service including physical inspection of drive and connected wiring and final adjustments to meet specified performance requirements.

F. DRIVE FUNCTIONS

1. An electronic overload circuit designed to protect an AC motor operated by the VFD output from extended overload operation on an inverse time basis. This Electronic overload shall be UL® and NEC recognized as adequate motor protection. No additional hardware such as motor overload relays or motor thermostats shall be required.
2. An LED display mounted on the door of the cabinet that digitally indicates:
 - a. Frequency output
 - b. Voltage output
 - c. Current output
 - d. Motor RPM
 - e. Input kW
 - f. Elapsed Time
 - g. Time Stamped Fault Indication
 - h. DC Bus Volts
3. The VFD shall have the capability of riding through power dips up to 10 seconds without a controller trip depending on load and operating condition. In this extended ride through, the drive shall use the energy generated by the rotating fan as a power source for all electronic circuits.
4. RS232 Port and Windows based software for Configuration, Control, and Monitoring.
5. An isolated 0-20mA, 4-20mA or 0-4, 0-8, 0-10 volt analog speed input follower.
6. An isolated 0-10 V or 4-20 mA output signal proportional to speed or load.

G. PROTECTIVE CIRCUITS AND FEATURES

1. Motor current exceeds 200% of drive continuous current rating.
2. Output phase-to-phase short circuit condition.
3. Total ground fault under any operating condition.
4. High input line voltage.
5. Low input line voltage.

6. Loss of input or output phase.
 7. External fault. (This protective circuit shall permit wiring of remote N.C. safety contact to shut down the drive). User supplied end switches, thermal switches, fire-stats, freeze-stats inputs will be connected to this VFD supplied circuit.
 8. Metal oxide varistors for surge suppression shall be provided at the VFD input terminals.
- H. GENERAL OPTIONS AND MODIFICATIONS
1. Input line fuses shall provide protection for the input rectification circuit using Class J fuses with interrupting rating of 200,000 AIC. The series interrupting rating of the VFD and fuses shall be a minimum of 30,000 AIC and shall be stated in the VFD Instruction Manual as required by UL
 2. A main input disconnect shall mount within the standard NEMA 1 or NEMA 12 enclosure for positive power disconnect of the VFD. It shall have the capability for door padlocking.
 3. A three phase 3% impedance Input Line Reactor shall be provided to minimize drive harmonics on the AC line and protect the drive from damaging electrical system transients.
- I. INSTALLATION
1. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the AFD's in accordance to the manufacturer's recommendation as outlined in the instruction manual.
 2. The electrical contractor shall complete power wiring. The contractor shall install the AFD's in accordance to the manufacturer's recommendation as outlined in the instruction manual.
- J. TRAINING
1. The contractor shall provide a training session for owner's representatives
 2. The training shall be conducted by the manufacturer's authorized representative and shall include:
 3. Instructions on the proper operation of the equipment
 4. Instructions on the proper maintenance of the equipment.

PART 4 - EXECUTION

4.1 INSTALLATION

- A. All devices in mechanical rooms shall be panel mounted whenever possible. Wiring to remote mounted devices in mechanical rooms and inaccessible spaces shall be run in conduit. Wiring in accessible ceilings may be run with plenum rated cable providing it is securely fastened to the structural members at 4' intervals. In general, all wiring in conjunction with the automatic temperature control system shall be furnished by the Temperature Control Contractor under this section of the specifications in accordance with Division 26 of the specifications.
- B. All automatic valves shall be furnished by the Temperature Control Contractor and installed under his supervision by the Heating Contractor. All automatic dampers, not furnished with the equipment, shall be furnished by the Temperature Control Contractor and installed under his supervision by the Sheet Metal Contractor.
- C. **Room thermostats and remote sensors shall be wall mounted type and shall be mounted to match installation height of adjacent switches/sensors by EC, or where there are no adjacent switches/sensors, 46" on center above finished floor. Coordinate mounting location with EC to locate t-stats/sensors and wall switches. Thermostats and sensors shall not be mounted on outside walls.**

4.2 PROJECT COMPLETION AND ACCEPTANCE

- A. Upon completion of this project, it will be this Contractors responsibility to insure that the control system is functioning properly. The Contractor shall also insure that the control diagrams for the project are brought up to date and that they reflect the control system "as built". These control diagrams and screen shots of the various screens of the color graphics system shall be included in the Operation and Maintenance Manuals, which shall be turned over to the Owner following the acceptance of the above procedure by the A/E.

4.3 ON-SITE ASSISTANCE

- A. **ON-SITE Adjustments:** Within one year of date of Substantial Completion, provide 8 hours EVERY OTHER MONTH to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions and improve efficiency. Certain off-site adjustments may be acceptable if owner and engineer approved.

END OF SECTION 23 0900

**SECTION 23 2113
HYDRONIC PIPING SYSTEMS**

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. The work in this specification and the accompanying drawings consists of performing all labor and furnishing of all material and equipment necessary to install complete systems listed below, including minor items obviously necessary for complete and operating systems. Piping materials and equipment specified in this Section include the following:
 - 1. All new heating water hydronic piping systems
 - 2. All new chilled water hydronic piping systems
 - 3. Cooling Condensate Piping
 - 4. Pipes, fittings, and specialties.
 - 5. Special-duty valves.
 - 6. Meters and gages.
 - 7. Hydronic specialties.
- B. See Division 23 Section "Basic HVAC Materials and Methods" for general piping installation requirements.
- C. Also included is the work involved to remove existing associated equipment, remodeling of existing systems, including connections between new and existing systems.
- D. Hydronics contractor to be responsible for all condensate piping.

1.3 SUBMITTALS

- A. Shop Drawings: Shop drawings as specified in Section 230500 shall include the following:
 - 1. Hydronic Specialties
 - 2. Infloor Heat Hydronic Circulating Pumps
 - 3. Heating Water Hydronic Pipe, Valves, and Fittings
 - 4. Chilled Water Hydronic Pipe, Valves, and Fittings
 - 5. Infloor Heat Manifold(s)
 - 6. Infloor Heat Tubing Organizer(s)
 - 7. Infloor Heat Tubing
 - 8. Cooling Condensate Piping
 - 9. Flow Control and Strainer Valves
 - 10. Hot Water Finned Tube Radiation
 - 11. Heating Water Propylene Glycol – 30% Concentration
 - 12. Chilled Water Propylene Glycol – 40% Concentration
 - 13. Hydronic Solution Analysis & Water-Treatment Program: After proposed work is complete, provide a complete analysis to confirm proper glycol % and treatment. If solution analysis is not satisfactory, make adjustments as recommended by glycol supplier and retest until analysis is satisfactory.
 - 14. Spare Parts
- B. Product Data: For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.
- C. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure.
- D. Detail location of anchors, alignment guides, and expansion joints and loops.
- E. Field quality-control test reports.

- F. Operation and maintenance data.

1.4 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work shall be as specified in Section 23 0510.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. 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 the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- C. Uponor PEX-a tube and fitting systems must be installed by a trained installer. Installer must be able to provide verification from the manufacturer that the training has been completed.

1.6 COORDINATION

- A. Coordinate pipe sleeve installations for foundation wall penetrations.
- B. Coordinate layout and installation of piping with equipment and with other installations.
- C. Coordinate pipe fitting pressure classes with products specified in related Sections.
- D. Coordinate with requirements for firestopping for fire and smoke wall and floor assemblies.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Copper Tube and Fittings:
 - 1. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
 - 2. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
 - 3. Wrought-Copper Fittings: ASME B16.22.
 - 4. Wrought-Copper Unions: ASME B16.22.
 - 5. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
 - 6. At the contractor's option, Nibco Press System or Viega may be used on domestic or hydronic water in lieu of soldered copper fittings. Fittings shall be suitable for working pressures to 200 psig CWP and maximum operating temperatures to +230 degrees F. The fitting manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of tools, marking and preparation of pipe, and installation of products. The representative shall periodically visit the job site and review contractor's installation and verify the correct procedures are being followed.
- B. Steel Pipe and Fittings:
 - 1. Steel Pipe, NPS 2 and Smaller: ASTM A 53, Type S (seamless), Grade A, Schedule 40, black steel, plain ends.
 - 2. Steel Pipe, NPS 2-1/2 through NPS 12: ASTM A 53, Type E (electric-resistance welded), Grade A, Schedule 40, black steel, plain ends.
 - 3. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedule 40, black steel; seamless for NPS 2 and smaller and electric-resistance welded for NPS 2-1/2 and larger.
 - 4. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250.
 - 5. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
 - 6. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
 - 7. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, 125, and 250; raised ground face, and bolt holes spot faced.
 - 8. Wrought-Steel Fittings: ASTM A 234 (ASTM A 234M), Standard Weight.
 - 9. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.

- b. End Connections: Butt welding.
- c. Facings: Raised face.
- 10. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47, Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.
- 11. Grooved Mechanical-Joint 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.
- 12. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body, steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 220 deg. F and pressures up to 150 psig.
- 13. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.
- C. Polyethylene PEX Pipe and Fittings:
 - 1. 2" and smaller Cross linked Polyethylene Uponor PEX a Pipe: ASTM 877, SDR 9 with oxygen diffusion penetration per DIN 4726. Fittings consisting of Engineered polymer ASTM F 1960 Cold expansion fitting with reinforcing ring. Two piece compression fitting ASTM 877 with cold expansion fitting with reinforcing ring.
 - 2. Groove Fittings for PEX Tube: One-piece brass F1960 cold-expansion fitting and groove fitting CSAB242-05.

2.2 COOLING CONDENSATE DRAIN PIPING

- A. Above Grade: Drain piping shall be type "M" copper, ASTM B 88, with cast-copper solder-joint drainage fittings, ANSI B 16.23, or wrought-copper solder joint, ANSI B 16.29, non-corrosive past flux and 50/50 tin-lead solder ASTM B 32.
 - 1. Where permitted, schedule 40 PVC or ABS, solvent weld fittings.

2.3 VALVES

- A. General-Duty Valves, NPS 2 and Smaller: Bronze body, ball type, threaded ends, unless otherwise indicated. Valve pressure and temperature ratings not less than indicated and as required for system pressures and temperatures. Valve size shall be the same size as upstream pipe, unless otherwise indicated. Quarter-turn lever handle valve actuators. Extended valve stems on insulated valves.
- B. Safety Valves: Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.
- C. Pump Discharge Valves: 175-psig maximum working pressure, 250 deg F maximum operating temperature, cast-iron or ductile iron body, replaceable bronze disc with EPDM seat insert, bronze seat, stainless steel stem and spring, and "Teflon" packing. Valves shall have NPT, grooved or flanged connections and straight or angle pattern. Features shall include non-slam check valve with spring-loaded weighted disc, pressure taps, and calibrated adjustment feature to permit regulation of pump discharge flow, shutoff and valve design to permit repacking under full system pressure.

2.4 METERS AND GAGES

- A. Liquid-In-Glass Thermometers
 - 1. Description: ASTM E 1.
 - 2. Range: Temperature range of: 40 to 240 deg F on heating water & condenser water systems, and 0 to 160 deg F on geothermal, evaporator, and chilled water systems, with 2-degree scale divisions (minus 18 to plus 70 deg C, with 1-degree scale divisions).

Accuracy shall be plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

3. Case: Die cast and aluminum finished in baked-epoxy enamel, glass front, spring secured, 9 inches long.
 4. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
 5. Tube: Red or blue reading, organic-liquid filled with magnifying lens.
 6. Scale: Satin-faced nonreflective aluminum with permanently etched markings.
 7. Stem: Copper-plated steel, aluminum, or brass for separable socket; of length to suit installation.
- B. Bimetal Dial Thermometers
1. ASME B40.3; direct-mounting, universal-angle dial type.
 2. Case: Stainless steel with 5-inch diameter lens.
 3. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
 4. Element: Bimetal coil.
 5. Scale: Satin-faced nonreflective aluminum with permanently etched markings.
 6. Stem: Stainless steel for separable socket, of length to suit installation.
- C. Thermometer Wells
1. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.
 2. Material: Brass, for use in copper piping.
 3. Material: Stainless steel, for use in steel piping.
 4. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
 5. Insertion Length: To extend 2 inches into pipe.
 6. Cap: Threaded, with chain permanently fastened to socket.
- D. Pressure Gages
1. Description: ASME B40.1, phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type is indicated.
 2. Case: Drawn steel, brass, or aluminum with 4 1/2" diameter, glass lens.
 3. Connector: Brass, NPS 1/4.
 4. Scale: White-coated aluminum with permanently etched markings
 5. Accuracy: Grade A, plus or minimum 1 percent of middle 50 percent of scale.
 6. Range: Comply with the following:
 - a. Fluids under Pressure: Two times the operating pressure.
- E. Pressure Gage Fittings
1. Hydronic Indicator: Brass body with four inlets and valves by Flow Conditioning Corp. (314) 878-7898 or equal.
 2. Valves: NPS 1/4 brass or stainless-steel needle type
 3. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
 4. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.
- F. Test Plugs
1. Description: Nickel-plated, brass –body test plug in NPS 1/2 fitting.
 2. Body: Length as required to extend beyond insulation.
 3. Pressure Rating: 500 psig minimum.
 4. Core Inserts: Two self-sealing valves, suitable for inserting 1/8-inch OD probe from dial-type thermometer or pressure gage.

5. Core Material for Air, Water, and Gas: 20 to 200 deg F (Minus 7 to plus 93 deg C), chlorosulfonated polyethylene synthetic rubber.
 6. Test-Plug Cap: Gasketed and threaded cap, with retention chain or strap.
 7. Test Kit: Pressure gage and adapted with probe, two bimetal dial thermometers, and carrying case.
- G. Pressure Gage and Thermometer Ranges: Approximately two times the system's operating conditions.

2.5 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig working pressure; 225 deg F operating temperature; manually operated 1/2" full port ball valve with gooseneck down; with NPS 1/2 discharge connection and NPS 1/2 inlet connection, and chained cap hose connection.
- B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection.
- C. Heating & Chilled Water Bladder Style Expansion Tanks: Welded carbon steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature. Provide taps for pressure gage and air-charging fitting, and drain fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Fabricate and test tank with taps and supports, and label according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- D. High flow bypass filter feeders across the hot water pumps and chilled water pumps as indicated on the plans. Basis of design shall be Vector Industries FA-900AL with stainless steel basket & "Sock" filter bag (5 micron), or equal. Unit shall have adjustable leg set from factory; it shall not be acceptable for unit to be set on floor. Installation shall comply with manufacturer's installation requirements. Provide with one additional 5 micron filter bag per filter feeder for owner's use.
- E. Heating Water & Chilled Water Air Separator: Welded black steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature; perforated stainless-steel air collector tube designed to direct released air automatic air vent; tangential inlet and outlet connections; threaded connections for 2-inch NPS (DN50) and smaller; flanged connections for 2-1/2-inch NPS (DN40) and larger; threaded blow-down connection. Provide units in sizes for full-system flow capacity.
- F. Y-Pattern Strainers: 125-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 and larger, threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.
- G. Propylene Glycol: Industrially inhibited propylene glycol-based heat transfer fluid, Dowfrost HD with Inhibitor and Deionized Water (match existing), with the following features:
 1. Industrially inhibited propylene glycol (phosphate-based).
 2. Dyed (bright yellow/green) to facilitate leak detection.
 3. Easily analyzed for glycol concentration and inhibitor level.
 4. For systems containing more than 250 gallons of fluid, annual analysis must be provided free of charge by the fluid manufacturer.
 5. Fluid must pass ASTM D1384 (less than 0.5 mils penetration per year for all systems metals).
 6. Reserve alkalinity of the fluid must be at least 15 to provide long-term resistance to acidic pH.

2.6 INFLOOR HEATIGN CIRCULATOR PUMPS

- A. See section 23 2123 HVAC Hydronic Pumps.

2.7 INFLOOR HEAT MANIFOLD(S) & TUBING ORGANIZERS

- A. Furnish and install, as shown on plans, manifold(s) for infloor hydronic heating system. Manifolds shall be manufactured by same manufacturer as infloor heat tubing.
- B. Manifolds to be located as shown on plans. Manifolds shall have loop valves and shall be the size as shown in In-Floor Heat Manifold Detail(s).
- C. Furnish and install, as shown on plans, tubing organizer for infloor hydronic heating system.

2.8 FLOW CONTROL AND STRAINER VALVES

- A. Furnish and install pressure-compensating flow control valves in a union (or flanges)/flow-control-device/ball-valve configuration. One piece configuration for valves 3" and smaller.
- B. Valves are to be installed where indicated on plans and in hydronic piping systems, serving hydronic coils, and hydronic radiation. Flow control valves will be installed in the return line.
- C. All valves shall have access capability to allow field-exchange of internal components without removing valve body from pipeline.
 - 1. All valves shall be permanently marked to show direction of flow, flow rate, and pressure range.
 - 2. All flow control valve cartridges shall be of stainless steel construction. Brass/Bronze cartridge construction shall **not** be acceptable.
- D. Furnish and install an in-line strainer for each flow control valve furnished that is 2" and smaller. Strainer to be in a union/strainer/ball valve configuration.
- E. Furnish and install as part of each flow control valve and strainer valve a Pete's plug 1/4" MPT fitting to receive either a temperature or pressure probe. Fitting shall be solid brass.
 - 1. Chilled water flow control valve and strainer valves shall have extended Pete's plug ports to accommodate chilled water insulation.
- F. Flow control valve shall be Pro Hydronics, Autoflow FV Series, Griswold Controls, or approved equal.
- G. Strainer valves shall be Pro Hydronics, Autoflow SV Series, Griswold Controls, or approved equal.
- H. If any flow controls are found to be installed backwards when balancing is performed, entire autoflow valve shall be replaced by this contractor.
- I. Furnish and install manual calibrated balancing valves in a union (or flanges)/flow-control/ball valve configuration. Valves are to be installed where indicated on plans and details. All valves shall be permanently marked to show direction of flow, flow rate, and pressure range.
 - 1. Valve body shall be constructed out of cast iron and rated for 175 psig working pressure.
 - 2. Valve body shall include two pressure/temperature ports.
 - 3. Valve body shall include an optional drain valve port.
 - 4. Valve shall utilize a calibrated nameplate with a memory stop.
 - 5. Valve temperature range shall be from -4deg F to 250deg F.
 - 6. Chilled water balancing valves (and any valves with P/T ports on geothermal system in building) shall have extend P/T plug ports to accommodate chilled water insulation.
- J. Manual calibrated balancing valves shall be Bell & Gossett Circuit Setter model CB or equal.

2.9 SPARE PARTS

- A. Provide each cabinet unit heater with one set of spare filters.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Coordinate applications below with materials specified in this Section. Pipe sizes at which joining methods change are between NPS 2 and NPS 2-1/2 (DN 50 and DN 65). Adjust this change point to suit personal preference. Soldered joints for pipes larger than NPS 2 (DN 50) may not meet system pressures.

- B. Chilled Water and Hot Water Heat Piping Systems: Type L drawn-temper copper tubing with soldered joints.
- C. Chilled Water and Hot Water Heat Piping Systems: Schedule 40 steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints and fittings for 2-1/2 inch and larger.
- D. Chilled Water and Hot Water Heat Piping Systems: Schedule 40 steel pipe with mechanical couplings.
- E. Chilled Water and Hot Water Heat Piping Systems: Type L drawn-temper copper tubing with mechanical couplings.
- F. Chilled Water Piping Systems: Uponor SDR 9 PEX-A tubing with Uponor one-piece cold expansion F1960 fittings. Crimp ring fittings shall not be acceptable. Uponor fittings must be used with Uponor pipe and must meet all requirements to achieve full warranty coverage.

3.2 VALVE APPLICATIONS

- A. Unless otherwise indicated, use the following general-duty valve types for applications indicated:
 - 1. Shutoff Duty: Ball, and butterfly valves.
 - 2. Throttling Duty: Ball, and butterfly valves.
- B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, and elsewhere as indicated.
- C. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- D. Install calibrated plug or automatic flow control valves on the outlet of each heating or cooling element and elsewhere as indicated to facilitate system balancing.
- E. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.
- F. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- G. Install safety relief valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.

3.3 METER AND GAGE INSTALLATION

- A. Calibrate and install meters, gages, and accessories according to manufacturer's written instructions for applications where used.
- B. Thermometer Installation
 - 1. Install thermometers and adjust vertical and tilted positions.
 - 2. Install in the following locations:
 - a. As shown on piping details of plans.
 - 3. Install remote-reading dial thermometers in control panels with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
 - 4. Install thermometer wells in vertical position in piping tees where test thermometers are indicated.
 - a. Install with stem extending a minimum of 2 inches into fluid.
 - b. Fill wells with oil or graphite and secure caps.
- C. Pressure Gage Installation
 - 1. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.
 - 2. Install dry-type pressure gages in the following locations:
 - a. As shown on piping details of plans.
 - 3. Install liquid-filled-type pressure gages at suction and discharge of each pump.

- D. Install pressure-gage needle valve and snubber in piping to pressure gages.

3.4 HYDRONIC PIPING INSTALLATIONS

- A. Install piping according to Section 23 0510 "Basic Mechanical Materials and Methods."
- B. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- C. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- D. Install piping at a uniform grade of 0.2 percent upward in direction of flow. Install condensate piping at a uniform grade of 1/4 inch per foot downward in direction of flow.
- E. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- F. Install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
- G. Install unions in pipes 2-inch NPS (DN50) and smaller, adjacent to each valve, at final connections of each piece of equipment, and elsewhere as indicated. Unions are not required at flanged connections.
- H. Install flanges on valves, apparatus, and equipment having 2-1/2-inch NPS (DN65) and larger connections.
- I. Install flexible connectors at inlet and discharge connections to pumps (except in-line pumps) and other vibration-producing equipment.
- J. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger.
- K. Anchor piping for proper direction of expansion and contraction.
- L. Uponor PEX-a piping with F1960 expandable fittings shall be installed in accordance with Uponor's Hydronic Piping Design Assistance Manual to ensure a 25 year system warranty.
- M. Install in floor heat tubing as shown on plans and per manufacturer's requirements.

3.5 HANGERS AND SUPPORTS

- A. Piping support must account for expansion and contraction, vibration, and dead load of piping and its contents, and seismic bracing requirements.
- B. Hanger, support, and anchor devices shall comply with requirements below for maximum spacing of supports. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - a. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - b. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - c. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - d. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - e. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 - f. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 - 6. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - a. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.

- b. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
- c. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
- d. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
- e. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
- f. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
7. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.
8. PEX-a Piping Hanger Spacing: Install hangers for PEX-a piping with the following maximum spacing:
 - a. 1 inch and below: Maximum span, 32 inches.
 - b. 1-1/2 inch and above: Maximum span, 48 inches.
9. PEX-a Piping Hanger Spacing with PEX-a Support Channel: Install hangers for PEX-a piping with horizontal support channel in accordance with local jurisdiction and manufacturer's recommendations, with the following maximum spacing:
 - a. Maximum span, 8 feet.
10. PEX-a Riser Supports: Install CTS riser clamps at the base of each floor and at the top of every other floor. Install mid-story guides between each floor.
11. Pipe Joint Connections: Install per manufacturer's recommendations. Use manufacturer-recommended cold-expansion tool for F1960 connections.

3.6 PIPE JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Basic HVAC Materials and Methods" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping.
- B. Mechanical Joints: Assemble joints according to fitting manufacturer's written instructions.

3.7 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual (not automatic) full port ball valve operated air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting. Install ball isolation valves with chained caps.
 1. Existing hydronic systems being tied into:
 - a. The plumbing contractor shall be responsible for cleaning and flushing the new hydronic piping. The existing hydronic system shall be drained as necessary for proposed tie ins and filled with existing drained and/or new hydronic solution, no cleaning and flushing on existing piping.
 - b. Upon completion of the proposed work & system flushing, the salvaged solution shall be pumped back in.
 - c. After proposed work is complete, the plumbing/hydraulics contractor is to provide a complete analysis of the hydronic system to confirm proper water treatment. Submit analysis/recommendations to Sichmeller engineering & owner. If solution analysis indicates solution is not satisfactory, this contractor to make adjustments as recommended by inhibitor supplier & retest until analysis is satisfactory.
 2. Install automatic air vents in mechanical equipment rooms only at high points of system piping, at heat-transfer coils, and elsewhere as required for system air venting.

3.8 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be same as for equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install flow control valves and strainer valves as shown on piping details.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

- B. Prepare hydronic piping and perform testing according to ASME B31.9. Prepare written report of testing.

3.10 ADJUSTING AND CLEANING

- A. After completing systems installation, including outlet fittings and devices, inspect finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.
- C. Preparation for testing: Prepare hydronic piping in accordance with ASME B 31.9.
- D. Testing: Test hydronic piping as specified in ASME B 31.9 "Building Services Piping."
- E. System Cleaning:
 1. Fill the entire system with clean, fresh water and properly vent. Repair piping leaks as early in this procedure as they are discovered. Inspect existing piping system and notify engineer immediately for any leaks requiring repairs. With valves positioned by bypass the boiler and terminal equipment, start the pump to circulate water through the system. Check strainers at pumps and at terminal equipment (new and existing) frequently and clean as often as needed. If the water is extremely dirty or murky, flush continuously, using the system pump, until the water being flushed out of the pipe loop has become clear. To flush in this manner requires care to be certain that make-up water is being added fast enough to replace what is being flushed out. Accomplish this by opening the make-up water bypass valve around the automatic pressure reducer valve and adjust the manual valve so that the pump suction pressure gauge continues to indicate the same positive pressure that existed before the manual drain and make-up valves were opened. Continue for at least two hours. Once the water is clear and debris flushed out, stop the pump.
 2. To complete the cleaning, fill the system with fresh water, adding a cleaning agent such as trisodium phosphate (TSP). Disconnect all power to the terminal units so that they will not operate while the system is being cleaned. Then circulate cleaning solution throughout the system, with boiler controls temporarily adjusted to raise the solution temperature to about 105 deg F to 110 deg F. Do not allow the temperature to rise above 110 deg F. Alternate operation of the primary and standby pumps and circulate the warm solution for several hours. Then turn off the boiler and pump, completely drain the system, and refill with fresh water. Repeat the cleaning process only if there is indication of foreign matter still in the system or if a test of the water indicated that it is slightly acid.
 3. Water should be slightly alkaline, with a pH no higher than 8.0 and no lower than 7.0.
 4. HEATING SYSTEM: Add propylene glycol to hydronic piping system to provide a total of 30% by volume.
 5. CHILLED SYSTEM: Add propylene glycol to hydronic piping system to provide a total of 40% by volume.
- F. Install laminated engraved placard near boilers & central heat pumps with 1" engraved letters indicating glycol type & concentration.
- G. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- H. Chemical Treatment: Provide a water analysis prepared by chemical treatment supplier to determine type and level of chemicals required to prevent scale and corrosion. Perform treatment after completing system testing and retest as necessary. If solution analysis is not

satisfactory, make adjustments as recommended by glycol supplier and retest as necessary until analysis is satisfactory.

3.11 COMMISSIONING

- A. Fill system and perform initial chemical treatment.
- B. Check expansion tanks to determine that they are not air bound and that system is completely full of water.
- C. Perform these adjustments before operating the system:
 - 1. Open valves to fully open position. Close coil bypass valves.
 - 2. Check pump for proper direction of rotation.
 - 3. Set automatic fill valves for required system pressure.
 - 4. Check 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. Check operation of automatic bypass valves.
 - 7. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.
 - 8. Lubricate motors and bearings.

3.12 MISCELLANEOUS CONNECTIONS

- A. Make all hydronic connections. This includes boiler connections, connections of heating coils to equipment supplied and/or mounted under HVAC Section. This includes piping, valves, strainers, air vents, thermometers, immersion bulbs, flow switches, drains, unions, etc.
- B. Install all control valves supplied by Automatic Temperature Control Contractor.

3.13 AUTOMATIC TEMPERATURE CONTROL

- A. Install the automatic temperature control dampers, air flow monitoring devices, openings for air flow switches, alarms and control devices as provided by the Automatic Temperature Control Contractor. These dampers and devices shall be installed under the direct supervision of the Section 23 0900, CONTROLS & CONTROL SEQUENCES Temperature Control Contractor and in strict accordance with the manufacturer's recommendations.

END OF SECTION 23 2113

**SECTION 232123
HVAC HYDRONIC PUMPS**

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. The Work covered in this section of the Specifications is intended to include the furnishing of all equipment, materials and labor reasonably incidental to the complete operating installation of the base mounted end-suction ground loop pumps and pertaining equipment as indicated on the drawing.

- B. This Section includes the following:

- 1. In-Line Circulator Pumps for Infloor Heating by Alternate

1.3 PERFORMANCE REQUIREMENTS

- A. Pump Pressure Ratings: At least equal to system's maximum operating pressure at point where installed, but not less than specified.

1.4 SUBMITTALS

- A. Shop Drawings: Shop drawings as specified in Section 230500 shall include the following:
 - 1. In-Line Circulator Pumps.
- B. Product Data: Include certified performance curves and rated capacities; furnished specialties; final impeller dimensions; and accessories for each pump indicated. Indicate pump's operating point on curves.
- C. Shop Drawings: Shop drawings as specified in Section 230500 shall include the following:
 - 1. Power, signal, and control wiring diagrams differentiating between manufacturer-installed wiring and field-installed wiring.
- D. Show pump layout and connections. Include Setting Drawings with templates for installing foundation and anchor bolts and other anchorages.
- E. Operation and maintenance data including startup instructions.

1.5 QUALITY ASSURANCE

- A. UL Compliance: Fabricate and label pumps to comply with UL 778, "Motor-Operated Water Pumps," for construction 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. Single-Source Responsibility: Obtain each category of pumps from one source and by a single manufacturer.
- D. Provider shall be responsible for providing certified factory authorized equipment start-up and, when noted, an in the field certified training session. New pump start-up shall be for the purpose of determining pump alignment, lubrication, voltage, and amperage readings. All proper electrical connections, pump's balance, discharge and suction gauge readings, and adjustment of head, if required. A copy of the start-up report shall be made and sent to both the contractor and to the Engineer.

PART 2 - PRODUCTS

2.1 IN LINE CIRCULATOR PUMPS (BY ALTERNATE)

- A. The contractor shall furnish and install inline pumps as illustrated on the plans and in accordance with the following specifications:
 - 1. The pumps shall be of the horizontal, permanently lubricated type, specifically designed and guaranteed for quiet operation.
 - 2. The pumps shall have a steel shaft supported by permanently lubricated, sealed precision ball bearings. The pumps are to be equipped with a water-tight seal to prevent leakage. Mechanical seal faces to be carbon on silicon carbide. The motor shall be non-overloading at any point on the pump performance curve.

3. The motor shall be of the drip-proof, sealed precision ball-bearing, quiet-operating construction. The permanent split-capacitor motor shall be equipped with thermal overload protection.
4. Pumps to be suitable for 225°F (107°C) operating temperature at 150 psig (10 bar)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment foundations, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting performance of the pumps.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine supporting structure for suitable conditions where pumps are to be installed.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Install pumps according to manufacturer's written installation and alignment instructions.
- B. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.
- C. Support pumps and piping separately so piping is not supported by pumps.
- D. Set base mounted pumps on concrete foundation. Provide & install inertia bases where shown on plans. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.
 1. Support pump base plate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of ¾ 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.

3.3 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting them on foundations, after grout has been set and foundation bolts have been tightened, and after piping connections have been made.
- B. Comply with pump and coupling manufacturer's written instructions.
- C. Adjust alignment of pump and motor shafts for angular and parallel alignment by 1 of 2 methods specified in the H.I.'s Standards for Centrifugal, Rotary & Reciprocating pumps, "Instructions for Installation, Operation, and Maintenance."
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Fill base plate completely with nonshrink, nonmetallic grout, with metal blocks and shims or wedges in place. After grout has cured, fully tighten foundation bolts.
- E. Alignment Tolerances: According to manufacturer's recommendations.

3.4 CONNECTIONS

- A. Install shutoff valve and strainer on pump suction and check valve and shutoff valve on pump discharge, except where other arrangement is indicated.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to pumps. Install valves that are the same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Retain paragraph above or first three paragraphs below if specialty valves are required for vertical in-line pumps.
- F. Install suction diffuser and shutoff valve on suction side of pumps.
- G. Install manual balancing valve on discharge side of pumps where indicated.
- H. Install non-slam check valve on discharge side of pumps where indicated.
- I. Install flexible connectors on suction and discharge sides of base-mounted pumps and where indicated. Install between pump casing and valves, except where other arrangement is indicated.
- J. Install thermometers where indicated.
- K. Install pressure gages on pump suction diffuser, pump suction, and pump discharge per details on plans. Install at integral pressure-gage tappings where provided.
- L. Install temperature and pressure gage connector plugs in suction and discharge piping around each pump.

- M. Install electrical connections for power, controls, and devices. Electrical power and control wiring and connections are specified in Division 26 Sections.

3.5 FIELD QUALITY CONTROL

- A. Check suction piping connections for tightness to avoid drawing air into pumps.
- B. Clean strainers.
- C. Set pump controls.

3.6 AUTOMATIC TEMPERATURE CONTROL

- A. Install the automatic temperature control dampers, air flow monitoring devices, openings for air flow switches, alarms and control devices as provided by the Automatic Temperature Control Contractor. These dampers and devices shall be installed under the direct supervision of the Section 23 0900, CONTROLS & CONTROL SEQUENCES Temperature Control Contractor and in strict accordance with the manufacturer's recommendations.

END OF SECTION 232123

**SECTION 23 7000
VENTILATION AND AIR CONDITIONING**

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. The work in this section of the specification and the accompanying drawings consists of performing all labor and furnishing of all material and equipment necessary to install air handling systems as indicated on drawings and specified herein, including minor items obviously necessary for complete and operating systems.
- B. Also included is the work involved to remove existing associated equipment, remodeling of existing systems, including connections between new and existing systems.

1.3 SUBMITTALS

- A. Shop Drawings: Shop drawings as specified in Section 23 0500 shall include the following:
 - 1. Paintgrip duct where exposed, EZ Flange with Barrel Clamp on Exposed Spiral
 - 2. Air Handling Units
 - 3. Shutoff VAV/Reheat Terminals
 - 4. Fan Coil with DX Cooling
 - 5. Packaged Rooftop Units
 - 6. Air Cooled Condensing Units
 - 7. Duct Mounted Hot Water Heating Coils
 - 8. Shutoff VAV Fresh Air Terminals
 - 9. Inline Exhaust Fans
 - 10. Power Roof Ventilators
 - 11. Wall Propeller Fans
 - 12. Custom Fabricated Plasma Table Exhaust Hood
 - 13. Slotted Welding Fume Exhaust Hoods
 - 14. Range Exhaust Fan Hoods
 - 15. Air Cleaners
 - 16. Dust Collectors
 - 17. Dust collector flex duct
 - 18. Smoke, Fire, and Combination Dampers
 - 19. Stationary Louvers
 - 20. Registers, Grilles, Diffusers
 - 21. Motorized Control Dampers
 - 22. Filter List & Filters – At the end of the project the HVAC contractor to provide an additional set of disposable filters.
 - 23. Spare Parts

PART 2 - PRODUCTS

2.1 INTERNAL DUCT INSULATION

- A. See HVAC Systems Insulation.
- B. All internal duct insulation shall be 1/2" as specified duct liner with black fire resistant skin surface. Liner shall have an overall density of 2.0 lbs./cu. ft. Installation shall meet NFPA 90A and 90B fire resistant requirements.

- C. Apply the insulation in fabricated pieces sized to the interior duct surfaces with the black coated or denser surface exposed to the air stream. Insulation shall be firmly held in place with B.F. 85-10 or 85-60, C.M.C. 17-477, 1-C 225 fire resistant adhesive covering no less than 100% of the duct surface. Further secure insulation on the top and sides of horizontal ducts and all sides of vertical ducts with Omark or KSM capacitor discharge studs and caps on 15" centers. Secure transverse edges with capacitor discharge studs and caps on 6" centers.
- D. Duct sizes indicated on the drawings are the internal dimensions. Where insulation is applied to the inside of ducts, the metal size of the duct shall be increased to result in internal dimensions equal to that shown on the drawings.

2.2 SHEET METAL WORK – LOW & MEDIUM PRESSURE SYSTEMS

- A. See plans and insulation specifications for exposed ducts to be paint grip.
- B. Unless otherwise specified, construct ducts from galvanized iron fabricated and erected in a workmanlike manner. Fabricate plenums and special fittings, as shown on the Drawings, or as required. Access doors to plenums shall be double wall construction with heavy hardware. All ductwork shall be of the gauges hereinafter specified and constructed to the best grade Inland, U.S. Steel, United Sheet Metal or equal brands, heavily galvanized.
- C. Metal gauges for low and medium pressure duct systems shall be of metal gauges and reinforcing as recommended by SMACNA or as follows:

Max. Dimension of Rect.
Ducts or Dia. of Round

Low Pressure Ducts	Galvanized Sheet Steel Gauge Number
Up thru 12"	26
Over 12" thru 30"	24
Over 30" thru 54"	22
Over 54" thru 84"	20
Over 84"	18

Maximum Dimension of
Rectangular Ducts or
Diameter of Round

Medium Pressure Ducts	Galvanized Sheet Steel Gauge Number
Up thru 18"	24
Over 19" thru 48"	22
Over 49" thru 72"	20
Over 73" thru 96"	18

- D. Ductwork shall be constructed, braced, reinforced and sealed as recommended by ASHRAE and SMACNA. Low pressure ductwork shall be suitable for pressures up to 2 inch w.g. Medium pressure ductwork shall be suitable for pressures up to 3 inch w.g. All ductwork 18 inches and greater in width shall be cross-broken. See SMACNA requirements for proper sealing of ductwork. All supply air ductwork between VAV air handling units and VAV terminals shall be medium pressure construction.
- E. Low pressure ductwork with the longest side 36" wide and over, or medium pressure ductwork shall be constructed using Ductmate 35/25 or equal slide on systems, per Ductmate Industries Installation Procedures and Duct Construction Standards, latest edition. The non-proprietary SMACNA T-22 Flanged Connection may be used as defined on Page 1-25 and 1-37, of the 1985 SMACNA Manual, First Edition. Ductmate 35/25 may be used for transverse joint construction, 35" wide and smaller. Ductmate 440 Butyl Gasket, or equal, shall be used between all rectangular transverse flanged duct connections, Ductmate's 440 Butyl Gasket, shall be used with the Ductmate Systems. For rectangular ductwork located outdoors, exposed to weather, construct ductwork per, 'Transverse Joints Rectangular' with using a continuous

metal cleat on top joints of ducts for added weather protection. Slide on systems shall be Ductmate, Ward Industries, Inc., or equal.

- F. No obstruction shall be permitted in the ductwork to retard the flow of air. If it is necessary to run a pipe or conduit through a duct, the duct size shall be increased to compensate for the obstruction.
- G. Where space permits, duct turns shall be constructed with an inside radius equal to or greater than the duct width or duct turn vanes may be used. Where space does not permit duct turns as described above, duct turn vanes shall be used.
- H. Where interior duct insulation is required, increase the duct size to maintain the free area shown on the Drawings.
- I. Provide exterior insulated drip pans, 3 inches deep, under or adjacent to all roof and wall openings including but not limited to under all intake or relief hoods and louvers. Drip pans to be soldered watertight.
- J. Power operated dampers not furnished as a component of the ventilating machines will be furnished under the Temperature Control Specifications. They shall be installed in the ductwork under this specification. Caulk around all sides of high efficiency damper frames.
- K. Flexible connections shall be installed between suction and discharge openings in fan units and the ducts with which they are connected as shown on the Drawings, to prevent transmission of vibration noises. Material shall be watertight and fire retardant canvas weighing not less than 20 ounces per square yard, or shall be glass fabric on high temperature systems where fire hazard exists. Both materials shall be approved by Underwriter's Laboratories. The flexible material shall be furnished with all necessary angles, bolts, clips or other fasteners.
- L. Furnish and install access panels in the ductwork adjacent to all motorized dampers, fire dampers, louvers, reheat coils, and equipment which may require servicing or cleaning. Panels shall be tight fitting and shall be located so as to make them easily accessible. All panels installed in insulated ductwork shall be double wall, insulated type. Panels shall be Ruskin, Air Balance, Ventlok, ADCO, or equal.
- M. Dynamic rated fire dampers shall have an 18 inch square access panel or an 18 inch long removable duct section shall be installed adjacent to dynamic rated fire dampers in addition to a smaller inspection access panel. The removable section shall be assembled using Ductmate or equal duct joints. The joint at the damper shall be assembled with plastic fastener clips. Ductwork 24 inches and wider shall have an 18 inch by 18 inch access door in lieu of removable section.
- N. Ductwork installed above UL fire rated ceiling assemblies shall be installed in strict accordance with the provisions required by the UL Design Number designated in the Underwriters Laboratories Fire Resistance Directory.
- O. All ductwork visible through the face of a register or grille shall be painted with a flat black paint.
- P. All rigid and flexible ductwork materials installed shall have composite fire and smoke hazard ratings as tested by procedures ASTM 84, NFPA 255 and UL 723 not to exceed 25 Flame Spread and 50 Smoke Developed.
- Q. Concealed low pressure round ductwork may be rigid spiral ductwork or snaplock type with adjustable elbows.
- R. All exposed round ductwork and round ductwork to the inlet of VAV terminals shall be United, Semco, Norlock, Foremost or equal, rigid spiral duct and fittings.
- S. All exposed ductwork to be PAINTGRIP and shall be United, Semco, Norlock, Foremost or equal, rigid spiral duct and fittings. Refer to architectural reflected ceiling plans.
- T. Round ductwork shall be supported at 6 feet o.c. where building framing does not provide such support. Support shall be minimum 3/4 inch metal strap suspended from the roof or framing.

Flexible duct shall not exceed 8 feet in length or pass through walls. Flexible round ductwork may only be used for final connections to supply registers and diffusers and shall not be used on return or exhaust ductwork.

2.3 DUCT HANGERS AND SUPPORTS

- A. Securely attach all ductwork to the building construction in a manner to be free of vibration and swaying under all conditions of operation. Hanger attachments shall be appropriate for the building structure and shall be subject to the A/E's approval. Hang ducts from beams and joist whenever possible.
- B. Ducts shall be substantially supported with hangers located according to SMACNA standards.

2.4 DUCT INSTALLATION

- A. Duct sizes shown on the drawings are nominal inside dimensions. Where internal insulation is provided, duct sizes must be increased appropriately to maintain indicated inside dimensions.
- B. All ductwork will be run substantially as shown on the plans with bends and curves. Changes in size or cross section shall be made with long tapers. The A/E reserves the right to slightly change the run of certain ducts without extra cost to the Owner, if necessary to avoid unforeseen structural or other interferences.
- C. Where ducts run through bar joists or other ceiling spaces and structural, mechanical, or electrical interference is encountered, maintain same cross sectional area as indicated on plans with a maximum of 4-1/2 to 1 aspect ratio.
- D. All openings in duct for grilles, registers, etc. shall be capped dust-tight with G.I. Metal caps during the construction period.
- E. Round branch duct connections to rectangular mains shall be made with round manual balancing dampers meeting the following specifications: Dampers shall consist of a 20 ga. Galvanized steel; 3/8" square plated steel axles turning in acetal bearings. Damper shall include optional 1-1/2" standoff bracket (with extended pin) to accommodate for the thickness of external duct insulation. Dampers have quadrant operator and shall be suitable for pressures to 1.0" w.g., velocities to 2000 f.p.m. and temperatures to 180 degrees F. Testing and ratings to be in accordance with AMCA Standard 500. Basis of design is Greenheck model MBDR-50.
- F. Exhaust/relief air, and air intake ducts shall be equipped with 3" deep watertight pans to collect moisture and condensate. Seal all joints with sealant.
- G. All changes in direction shall be made with curved elbows having a centerline radius equal to 1-1/2 times the duct width. Where space conditions prevent the use of curved elbows and/or where square turns are indicated, provide square turn elbows with turning vanes. Vanes may be either commercial type ducturns or equal, or shop fabricated to conform to SMACNA standards. Vanes shall be double thickness type pre-assembled on runners before installing in each elbow. Brace adequately and avoid rough edges to prevent objectionable noise.

2.5 ACCESS PANELS

- A. Provide access panels to permit inspection and maintenance of all hot water coils, motorized volume dampers, smoke dampers, control equipment, and other equipment requiring maintenance. Panels shall be located in position dictated by the equipment such that maintenance may be performed. Panels shall not be located in top side of ducts.
- B. Panels shall be attached to duct with zinc plated cam latches. 18" x 18" and smaller panels shall have a minimum of two (2) latches. Larger panels shall have a minimum of four (4) latches. Panel shall set in rigid frame with sponge rubber gasketing to prevent air leakage. Where ductwork is insulated, panels shall be of double wall construction with 1" rigid insulation fill.
- C. Where duct size permits, access panels shall be a minimum 18" x 16" or 2" smaller than duct size, whichever is smaller.

2.6 CURBS AND FLASHING

- A. Curb for roof mounted equipment shall be provided by this contractor, unless otherwise specified and scheduled. This contractor shall also provide counterflashing. The counterflashing shall be galvanized sheet metal, and all joints shall be soldered watertight.
- B. Curb on all roof-mounted equipment shall be fully insulated.
- C. Curbs on equipment with fresh air intake shall be minimum 18" high.
- D. Flashing will be provided under the General Contract.
- E. Roofing work to be by the roofing contractor.
- F. Coordinate the roof slope with construction manager prior to submitting shop drawings.

2.7 AIR HANDLING UNIT WITH CHILLED WATER COOLING, HOT WATER HEATING COILS AND RETURN FAN (AHU-1)

A. GENERAL DESCRIPTION

- 1. Configuration: Fabricate as detailed on drawings.
- 2. Performance: Conform to AHRI 430. See schedules on prints. (NOTE: above does not apply to fan array)
- 3. Acoustics: Sound power levels (dB) for the unit shall not exceed the specified levels shown on the unit schedule. The manufacturer shall provide the necessary sound treatment to meet these levels if required.

B. UNIT CONSTRUCTION

- 1. Fabricate unit with heavy gauge channel posts and panels secured with mechanical fasteners. All panels, access doors, and ship sections shall be sealed with permanently applied bulb-type gasket. Shipped loose gasketing is not allowed.
- 2. Panels and access doors shall be constructed as a 2-inch nominal thick; thermal broke double wall assembly, injected with foam insulation with an R-value of not less than R-13.
 - a. The inner liner shall be constructed of G90 galvanized steel.
 - b. The outer panel shall be constructed of G90 galvanized steel.
 - c. The floor plate shall be constructed as specified for the inner liner.
 - d. Unit will be furnished with solid inner liners.
- 3. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, maximum 5 inches of positive or 6 inches of negative static pressure. Deflection shall be measured at the panel midpoint.
- 4. The casing leakage rate shall not exceed .5 cfm per square foot of cabinet area at 5 inches of positive static pressure or 6 inches of negative static pressure (0.0025 m³/s per square meter of cabinet area at 1.24 kPa static pressure).
- 5. Module to module field assembly shall be accomplished with an overlapping, full perimeter internal splice joint that is sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.
- 6. Access doors shall be flush mounted to cabinetry, with minimum of two six inch long stainless steel piano-type hinges, latch and full size handle assembly. Access doors shall swing outward for unit sections under negative pressure. Access doors on positive pressure sections, shall have a secondary latch to relieve pressure and prevent injury upon access.
- 7. A 6-inch formed G60 galvanized steel base rail shall be provided by the unit manufacturer for structural rigidity and condensate trapping.. The base rail shall be constructed with 12-gauge nominal for unit sizes 003 - 035 and 10-gauge nominal for unit sizes 040 - 090. The following calculation shall determine the required height of the baserail to allow for adequate drainage. Use the largest pressure to determine base rail height. $[(\text{Negative})(\text{Positive}) \text{ static pressure (in)}] (2) + 4" = \text{required baserail height}$. Should the unit baserail not be factory supplied at this height, the contractor is required to supply a concrete housekeeping pad to make up the difference.

8. A 8-inch formed G60 galvanized steel base rail shall be provided by the unit manufacturer for structural rigidity and condensate trapping.. The base rail shall be constructed with 12-gauge nominal for unit sizes 003 - 035 and 10-gauge nominal for unit sizes 040 - 090. The following calculation shall determine the required height of the baserail to allow for adequate drainage. Use the largest pressure to determine base rail height. $[(\text{Negative})(\text{Positive}) \text{ static pressure (in)}] (2) + 4'' = \text{required baserail height}$. Should the unit baserail not be factory supplied at this height, the contractor is required to supply a concrete housekeeping pad to make up the difference.

C. FAN ASSEMBLIES

1. Acceptable fan assembly shall be a single width, single inlet, class II, direct-drive type plenum fan dynamically balanced as an assembly, as shown in schedule. Maximum fan RPM shall be below first critical fan speed. Fan assemblies shall be dynamically balanced by the manufacturer on all three planes. Provide access to motor and fan assembly through hinged access door.
2. Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of the unit if removal is required. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on 2" deflection spring vibration type isolators inside cabinetry.

D. BEARINGS, SHAFTS, AND DRIVES

1. Bearings: Basic load rating computed in accordance with AFBMA - ANSI Standards. The bearings shall be provided on the motor with the fan wheel mounted directly on the motor shaft, AMCA arrangement 4.
2. Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.
3. The fan wheel shall be direct coupled to the motor shaft. The wheel width shall be determined by motor speed and fan performance characteristics.

E. ELECTRICAL

1. Fan motors shall be manufacturer provided and installed, Open Drip Proof, premium efficiency (meets or exceeds EPA requirements), 1750 RPM, single speed, 208V / 60HZ / 3P. Complete electrical characteristics for each fan motor shall be as shown in schedule.
2. Fan motors shall be manufacturer provided and installed, Open Drip Proof, premium efficiency (meets or exceeds EPA requirements), 1160 RPM, single speed, 208V / 60HZ / 3P. Complete electrical characteristics for each fan motor shall be as shown in schedule.
3. The air handler(s) shall be ETL and ETL-Canada listed by Intertek Testing Services, Inc. Units shall conform to bi-national standard ANSI/UL Standard 1995/CSA Standard C22.2 No. 236.
4. Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclosed terminal lugs in terminal box sized to NFPA 70.
5. Manufacturer shall provide ASHRAE 90.1 Energy Efficiency equation details for individual equipment to assist Building Engineer for calculating system compliance.
6. Installing contractor shall provide GFI receptacle within 25 feet of unit to satisfy National Electrical Code requirements.
7. All electrical connection components shall be field provided and mounted as shown on project schedule.

F. COOLING AND HEATING COILS

1. Certification: Acceptable water cooling, water heating, steam, and refrigerant coils shall be certified in accordance with AHRI Standard 410 and bear the AHRI label. Coils exceeding the scope of the manufacturer's certification and/or the range of AHRI's standard rating conditions will be considered provided the manufacturer is a current member of the AHRI Forced Circulation Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with AHRI Standard 410. Manufacturer must be ISO 9002 certified.

2. Water cooling coil shall be provided. Provide access to coil(s) for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 5" beyond unit casing for ease of installation. Drain and vent connections shall be provided exterior to unit casing. Coil connections must be factory sealed with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly. If not factory packaged, Contractor must supply all coil connection grommets and sleeves. Coils shall be removable through side and/or top panels of unit without the need to remove and disassemble the entire section from the unit.
 - a. Headers shall consist of seamless copper tubing to assure compatibility with primary surface. Headers to have intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility. Header diameter should vary with fluid flow requirements.
 - b. Fins shall have a minimum thickness of 0.0075 inch aluminum plate construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.
 - c. Coil tubes shall be 5/8 inch OD seamless copper, 0.020 inch nominal tube wall thickness, expanded into fins, brazed at joints.
 - d. Coil connections shall be carbon steel, NPT threaded connection. Connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent and drain fittings shall be furnished on the connections, exterior to the air handler. Vent connections provided at the highest point to assure proper venting. Drain connections shall be provided at the lowest point to insure complete drainage and prevent freeze-up.
 - e. Coil casing shall be a formed channel frame of galvanized steel.
3. Water heating coil shall be provided. Provide access to coil(s) for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 5" beyond unit casing for ease of installation. Drain and vent connections shall be provided exterior to unit casing. Coil connections must be factory sealed with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly. If not factory packaged, Contractor must supply all coil connection grommets and sleeves. Coils shall be removable through side and/or top panels of unit without the need to remove and disassemble the entire section from the unit.
 - a. Headers shall consist of seamless copper tubing to assure compatibility with primary surface. Headers to have intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility. Header diameter should vary with fluid flow requirements.
 - b. Fins shall have a minimum thickness of 0.0075 inch aluminum plate construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.
 - c. Coil tubes shall be 5/8 inch OD seamless copper, 0.020 inch nominal tube wall thickness, expanded into fins, brazed at joints.
 - d. Coil connections shall be carbon steel, threaded connection. Connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent and drain fittings shall be furnished on the connections, exterior to the air handler. Vent connections provided at the highest point to assure proper venting. Drain connections shall be provided at the lowest point to insure complete drainage and prevent freeze-up.

- e. Coil shall be furnished as an uncased galvanized steel track to allow for thermal movement and slide into a pitched track for fluid drainage.

G. FILTERS

1. Furnish flat filter section with 2-inch pleated (MERV 8) filter with microbial resistant Intersept coating. Provide side loading and removal of filters.
2. Filter media shall be UL 900 listed, Class I or Class II.
3. Filter Magnehelic gauge(s) shall be furnished and mounted by others.

H. ADDITIONAL SECTIONS

1. Access section shall be provided for access between components.
2. Blender / air mixer section to provide proper air mixing and distribution of the outside and return airstreams. Provide proper spacing provided in the direction of airflow as recommended by the blender manufacturer..
3. Economizer section shall be provided with top outside air opening and end return air opening and top exhaust air opening with or without parallel low leak airfoil damper blades. Dampers shall be hollow core galvanized steel airfoil blades, fully gasketed and have continuous vinyl seals between damper blades in a galvanized steel frame. Dampers shall have stainless steel jamb seals along end of dampers. Linkage and ABS plastic end caps shall be provided when return and outside air dampers sized for full airflow. Return and outside air dampers of different sizes or very large dampers and exhaust dampers must be driven separately. Damper Leakage: Leakage rate shall be less than two tenths of one percent leakage at 2 inches static pressure differential. Leakage rate tested in accordance with AMCA Standard 500.

I. INSTALLATION

1. Install in accordance with manufacturer's Installation & Maintenance instructions.

J. ENVIRONMENTAL REQUIREMENTS

1. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

K. EXTRA MATERIALS

1. Provide replacement set of filters for each unit as shown on project schedule.

L. Provide & install accessories as scheduled on the plans.

2.8 SHUTOFF VAV/REHEAT TERMINALS

A. GENERAL

1. Furnish and install single duct, variable volume air distribution assemblies with hydronic reheat of the type, size, and performance shall be as tabulated in the schedule and on the drawings.
2. The assemblies shall be pressure independent and shall reset to any air flow between zero and the maximum cataloged air volume. At an inlet velocity of 2,000 fpm, the differential static pressure for any unit with attenuator section, sizes 4 through 16, shall not exceed 0.11" w.g.
3. Sound ratings of air distribution assemblies, shall not exceed 25 NC.
4. Performance shall be ARI Certified.
5. The air flow sensor shall be of a cross configuration located at the inlet of the assembly. The sensor shall have twelve total pressure sensing ports and a center averaging chamber designed to accurately average the flow across the inlet of the assembly. Sensor shall provide accuracy within 5% with a 90° sheet metal elbow directly at the inlet of the assembly. The air flow sensor shall amplify the sensed air flow signal.
6. The assembly casing shall be constructed of 22 gauge zinc coated steel, internally lined with 1/2 inch thick, dual density fiberglass insulation which complies with UL-181 and NFPA-90A. Any cut edges of fiberglass exposed to the airstream shall be coated with NFPA-90A approved sealant.
7. The primary air valve damper shall be heavy gauge metal, with peripheral gasket, pivoted in self-lubricating bearings. In the full closed position, air leakage past the closed damper

shall not exceed 2% of the nominal catalog rating at 3" inlet static pressure, as rated by ARI Standard 880.

B. CONTROLS

1. The terminal unit controller shall be a dedicated, microprocessor-based, pressure independent VAV controller complete with electronic flow transducer. The controller shall be capable of stand-alone operation and have the ability to network with a building automation system, personal computer or portable operator interface device.
2. The electric actuator shall be 24 VAC bi-directional, direct coupled to the damper shaft. The actuator must be capable of operating in the stalled position without overheating or mechanical damage.
3. The terminal unit manufacturer shall provide a flow cross or two (2) pipe sensor suitable for interfacing with a differential pressure sensor.
4. The temperature control contractor shall furnish the terminal equipment controller, flow transducer, and electric actuator for installation on each terminal unit by the terminal unit manufacturer. The cost of factory mounting, wiring, enclosure to meet local code and any factory testing and programming of the terminal equipment controller shall be included by the terminal manufacturer.
5. All components shall be calibrated and pretested to ensure a fully functional unit.
6. The zone sensor shall be furnished by the Temperature Control Contractor and shall include temperature setpoint adjustment and access for connection of a hand-held operator terminal or portable computer.
7. The DDC control package shall be calibrated and factory set for the maximum and minimum flow rates as scheduled on the drawings.
8. The air terminal unit shall be designed, installed and field adjusted, if necessary, to maintain controlled pressure independent air flow.
9. All control components shall be mounted inside a protective metal enclosure.

C. WATER REHEAT COILS

1. Provide factory mounted hot water reheat coils as scheduled.
2. The coils shall be aluminum plate fin with copper tubes and sweat connections. Coil connections can be right hand or left hand and shall be coordinated with heating contractor. Control valves, automatic air vents and drain vents, shall be supplied and field installed by others.

D. Provide and install options and accessories as noted on plans.

2.9 FAN COIL WITH DX COOLING

A. GENERAL

1. Provide fan coil with DX cooling coil as shown and scheduled on the construction drawings. Basis of design is the Daikin DVMT vertical fan coil.

B. CONSTRUCTION

1. All unit chassis shall be fabricated of heavy gauge galvanized steel panels able to meet 125 hour salt spray test per ASTM B-117. All exterior panels shall be insulated with 1/2" thick insulation with a maximum k value of .24 (BTU • in) / (hr • ft² • °F) and carry a 25/50 rating for flame spread/smoke developed per ASTM E-84, UL 723 and NFPA 90A.
2. The front panel shall include quarter turn quick open fasteners to allow for easy removal and access for service.
3. All exposed units shall have exterior panels fabricated of not less than 18 gauge galvanized steel. The front panel shall be attached with quarter turn quick open fasteners to allow for easy removal and access for service.

C. FAN ASSEMBLY

1. Motors shall be high efficiency, Electronically Commutated (EC) Motor capable of variable speed operation. Motor shall be capable of accepting a 2-10 VDC output from BAS. Single speed motors are not acceptable.
2. The fan assembly shall be removed and serviced through the front and safety panels.

D. COILS

1. All cooling coils shall optimize rows and fins per inch to meet the specified capacity. Coils shall have seamless copper tubes and shall be mechanically expanded to provide an efficient, permanent bond between the tube and fin. Fins shall have high efficiency aluminum surface optimized for heat transfer, air pressure drop and carryover.
2. All coils shall be hydrostatically tested at 450 PSIG air pressure under water, and rated for a maximum 300 PSIG working pressure at 200°F.

E. DRAIN PANS

1. Primary condensate drain pans shall extend under the entire coil section, and have an Antimicrobial Performance Rating of 0, no observed growth, per ASTM G-21. Drain pans shall be of one piece construction and be positively sloped for condensate removal. A P-Trap shall be furnished, factory piped to the condensate drain riser. The P-Trap shall be easily removed and serviced through the front panel.

F. FILTERS

1. All units shall be furnished with a minimum 1" nominal glass fiber 30% efficient MERV 8 throwaway filter. Filters shall be tight fitting to prevent air bypass. Filters shall be easily removable from the return air plenum, without the need for tools.

G. ELECTRICAL

1. Units shall be furnished with single point power connection. Provide an electrical junction box with terminal strip for motor and other electrical terminations. The factory mounted terminal wiring strip consists of a multiple position screw terminal block to facilitate wiring terminations for the electric control valves and thermostats

2.10 AIR COOLED CONDENSING UNIT (CU-X)

- A. Furnish & install where indicated and as scheduled on the plans, a complete factory assembled, high efficiency outdoor air-cooled condensing units. The units shall be precharged with sufficient refrigerant for operation with evaporator coil and refrigerant tubing and be equipped with refrigerant line fittings which permit soldered or flare connections. Unit shall include brass service valves with fitting and gauge ports located on the exterior of the cabinet.
- B. Refrigeration line sets & insulation to be UV resistant (exterior).
 1. See plans for proposed refrigerant lineset routing.
- C. Provide & install accessories as scheduled on the plans.

2.11 PACKAGED GROUND MOUNTED ROOFTOP UNIT WITH MODULATING DX COOLING, MODULATING HOT GAS REHEAT, AND POWERED EXHAUST

- A. General Description
 1. This section includes the design, controls and installation requirements for packaged rooftop units / outdoor air handling units.
- B. Quality Assurance
 1. Packaged air-cooled condenser units shall be certified in accordance with ANSI/AHRI Standard 340/360 performance rating of commercial and industrial unitary air-conditioning and heat pump equipment.
 2. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
 3. Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.
 4. Unit shall be certified in accordance with ANSI Z21.47b/CSA 2.3b and ANSI Z83.8/CSA 2.6, Safety Standard Gas-Fired Furnaces.
 5. Unit Energy Efficiency Ratio (EER) shall be equal to or greater that prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.
 6. Unit shall be safety certified by ETL and ETL US listed. Unit nameplate shall include the ETL/ETL Canada label.

C. Submittals

1. Product Data: Literature shall be provided that indicates dimensions, operating and shipping weights, capacities, ratings, fan performance, filter information, factory supplied accessories, electrical characteristics and connection requirements. Installation, Operation, and Maintenance manual with startup requirements shall be provided.
2. Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, construction details, clearances and connection details. Computer generated fan curves for each fan shall be submitted with specific design operation point noted. Wiring diagram shall be provided with details for both power and control systems and differentiate between factory installed and field installed wiring.

D. Delivery, Storage, and Handling

1. Unit shall be shipped with doors screwed shut and outside air hood closed to prevent damage during transport and thereafter while in storage awaiting installation.
2. Follow Installation, Operation, and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.
3. Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation, and Maintenance manual.

E. Warranty

1. Manufacturer shall provide a limited "parts only" warranty for a period of 12 months from the date of equipment startup or 18 months from the date of original equipment shipment from the factory, whichever is less. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer's written instructions for Installation, Operation, and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts and filters.

F. Manufacturer

1. Products shall be provided by the following manufacturers:
 - a. AAON
 - b. Substitute equipment may be considered for approval that includes at a minimum:
 - 1) R-454b refrigerant
 - 2) Variable capacity compressor with 10-100% capacity control
 - 3) Direct drive supply fans
 - 4) Double wall cabinet construction
 - 5) Insulation with a minimum R-value of 13
 - 6) Stainless steel drain pans

G. Rooftop Units

1. General Description
 - a. Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fans, dampers, air-cooled condenser coils, condenser fans, reheat coil, exhaust fans, and unit controls.
 - b. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
 - c. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
 - d. Unit components shall be labeled, including refrigeration system components, and electrical and controls components.
 - e. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
 - f. Installation, Operation, and Maintenance manual shall be supplied within the unit.
 - g. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
 - h. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

2. Construction
 - a. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
 - b. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.
 - c. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, reduces heat transfer through the panel, and prevents exterior condensation on the panel.
 - d. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
 - e. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
 - f. Access to filters, dampers, cooling coils, reheat coil, heaters, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
 - g. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
 - h. Units with cooling coils shall include double sloped 304 stainless steel drain pans.
 - i. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
 - j. Unit shall include lifting lugs on the top of the unit.
3. Electrical
 - a. Unit shall be provided with factory installed and factory wired circuit breaker.
 - b. Unit shall be provided with a factory installed and factory wired 115V, 12 amp GFI outlet disconnect switch in the unit control panel.
 - c. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.
4. Supply Fans
 - a. Unit shall include direct drive, unhooded, backward curved, plenum supply fans.
 - b. Blowers and motors shall be dynamically balance and mounted on rubber isolators.
 - c. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
 - d. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.
5. Exhaust Fans
 - a. Exhaust dampers shall be sized for 100% relief.
 - b. Fans and motors shall be dynamically balanced.
 - c. Unit shall include barometric relief dampers.
 - d. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.

- e. Access to exhaust fans shall be through double wall, hinged access doors with quarter turn lockable handles.
 - f. Unit shall include belt driven, unhooded, backward curved, plenum exhaust fans.
 - g. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.
6. Cooling Coils
- a. Evaporator Coils
 - 1) Coils shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.
 - 2) Coils shall have interlaced circuitry and shall be 6 row high capacity.
 - 3) Coils shall be hydrogen or helium leak tested.
 - 4) Coils shall be furnished with factory installed expansion valves.
7. Refrigeration System
- a. Unit shall be factory charged with R-454B refrigerant.
 - b. Compressors shall be scroll type with thermal overload protection and carry a 5 year non-prorated warranty, from the date of original equipment shipment from the factory.
 - c. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.
 - d. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.
 - e. Each refrigeration circuit shall be equipped with expansion valve type refrigerant flow control.
 - f. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides and a factory installed liquid line filter driers.
 - g. Unit shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity.
 - h. Unit shall include factory provided and installed compressor sound jackets on all compressors.
 - i. Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.
 - j. Unit shall be provided with a fixed 55F compressor lockout.
8. Condensers
- a. Air-Cooled Condenser
 - 1) Condenser fans shall be a vertical discharge, axial flow, direct drive fans.
 - 2) Coils shall be designed for use with R-454B refrigerant. Coils shall be multi-pass and fabricated from aluminum microchannel tubes.
 - 3) Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
 - 4) Coils shall be hydrogen or helium leak tested.
 - 5) Condenser fans shall be high efficiency electrically commutated motor driven with factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35°F with adjustable compressor lockout.
9. Filters
- a. Unit shall include 2 inch thick, pleated panel filters with an ASHRAE MERV rating of 8, upstream of the cooling coil.

10. Outside Air/Economizer
 - a. Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return actuator. Unit shall include outside air opening bird screen, outside air hood, and relief dampers.
11. Controls
 - a. Controls shall be field provided & installed by temperature controls contractor.
- H. Curbs
 1. Curbs shall be minimum 48" high fully insulated plenum curb for side discharge.
- I. Installation, Operation, and Maintenance
 - a. Installation, Operation, and Maintenance manual shall be supplied with the unit.
 - b. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation, and Maintenance manual instructions.
 - c. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

2.12 DUCT MOUNTED HEATING COILS

- A. Contractor will furnish and install, where indicated on the plans, coils as described in the following specifications:
- B. Primary surface ½-inch & 5/8-inch OD seamless copper tube, of staggered configuration. Tubes will be mandrel expanded to ensure a permanent mechanical fin bond. Return bends will be die-formed and brazed to tubes.
- C. Extended surface will consist of die-formed continuous aluminum fins with formed channels and surface treatment to minimize moisture carryover. Fins will have fully-drawn collars to accurately space fins, and to form a protective sheath for the primary surface. Face velocity for coils condensing moisture will not exceed 600 fpm.
- D. Casing will be constructed of galvanized for HW coils and stainless steel for CW & DX coils to protect the coil during shipment and stacking of coils. Tube sheets on each end will have drawn collars to support tubes. A single intermediate coil support will be provided on coils with a finned length of more than 62 inches, two (2) intermediate supports above 100 inches in length, and three (3) intermediate supports on coils with a finned length of more than 141 inches. Casing channels will be free-draining, without depressions to collect moisture and contaminants. Casing channels will not block fin area.
- E. Certified in accordance with ARI Standard 410 for coil capacity and pressure drop. All coils will be circuited to operate at design load with water velocity within the ARI range of certified rating conditions.
- F. Headers will be of heavy seamless copper (or red brass) tubing silver-brazed to tubes. Connections will be of steel (or red brass) with male pipe threads silver brazed to headers. A ¼-inch FPT, plugged vent, or drain tap will be provided on each connection. All coils must have same-end connections, regardless of number of rows deep.
- G. Circuiting will be to provide free draining and venting, through one vent and one drain on each coil, when installed with casing level. Coils will be circuited, and have connections arranged for counter-flow of air and water, with supply on bottom and return on top of coil headers. Coil circuited will provide for design water velocity in tubes without exceeding total water pressure drops in schedule.
- H. Testing will be performed on every coil. The completed coil, including headers, connections, and return bends, will be tested with 325 psig of compressed air under water. Coils will be designed for operation at 250 psig design working pressure and up to 300°F.

2.13 IN-LINE EXHAUST FANS

- A. Furnish and install inline exhaust fan where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings. Provide & install accessories as scheduled on the plans.
- B. Fan shall be duct mounted, belt driven centrifugal square inline.
- C. Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories (UL 705) and UL listed for Canada (cUL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance.
- D. The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18 gauge galvanized steel with integral duct collars. Bolted access doors shall be provided on three sides, sealed with closed cell neoprene gasketing. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM and static pressure. Unit shall be shipped in ISTA certified transit tested packaging.
- E. Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA standard 204-05, balance quality and vibration levels for fans.
- F. Motor shall be NEMA design B with a minimum of class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.
- G. Motor shall be a permanent split capacitor motor rated for continuous duty and furnished with factory wired and mounted speed controller.
- H. Provide and install options and accessories as described in schedule.

2.14 POWER VENTILATOR EXHAUST FANS

- A. Furnish and install power roof ventilator where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings. Provide & install accessories as scheduled on the plans.
- B. Spun aluminum exhaust fans shall be belt or direct drive type. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure.
- C. Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Drive frame assembly shall be constructed of heavy gauge steel. Motors and drives shall be constructed of heavy gauge steel. Motors and drives shall be mounted on vibration isolators, out of the air stream. Fresh air for motor cooling shall be drawn into the motor compartment through a large space between the fan shroud and the motor cover. Motors and drives shall be readily accessible for maintenance.
- D. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the cast type, keyed and securely attached to the wheel and motor shafts.
- E. Motor pulleys shall be adjustable for final system balancing. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment. A conduit chase shall be provided through the base to the motor compartment for ease of electrical wiring.

- F. All fans shall bear the AMCA Certified Ratings Seal for sound and air performance. Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number for future identification.
- G. Provide and install options and accessories as noted on plans.
- H. All power roof ventilator exhaust fan drops to have fully insulated field installed 3" deep watertight drip pan.

2.15 WALL PROPELLER EXHAUST & SUPPLY FANS & WEATHER HOODS

- A. Furnish and install wall propeller exhaust fans where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings.
- B. Description: Fan shall be a wall mounted, belt driven, steel propeller exhaust fan with integral housing, shutter and inlet guard.
- C. Certifications: Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories (UL 705) and UL listed for Canada (CUL 705).
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The motor, bearings and drives shall be mounted on a minimum 14 gauge steel power assembly. The power assembly shall be bolted to a minimum 14 gauge wall panel with continuously welded corners and an integral venturi. Fan shall be enclosed in minimum 18 gauge galvanized steel wall housing with factory installed shutter and inlet guard. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure and maximum fan RPM. Unit shall be shipped in ISTA Certified Transit Tested Packaging.
- E. Coating: All steel fan components shall be Lorenized™ with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a 1.5 to 2.5 mil thick baked powder finish. Paint must exceed 1,000 hour salt spray under ASTM B117 test method.
- F. Propeller: Propeller shall be a high-efficiency fabricated steel design with blades securely fastened to a minimum 7 gauge hub. The hub shall be keyed and locked to the fan shaft utilizing two setscrews. Propeller shall be balanced in accordance with AMCA Standard 204-05, Balance Quality and Vibration Levels for Fans.
- G. Exhaust Shutter: Shutter shall be heavy duty galvanized steel construction. Material thickness shall be minimum 20 gauge for frame and 28 gauge for blades. Blades shall have mechanically fastened vinyl edge seals.
- H. Supply Shutter: Shutter shall be heavy duty galvanized steel construction, utilizing center pivot blades and motorized actuator. Material thickness shall be minimum 16 gauge for frame and 20 gauge for blades.
- I. Motor: Motor shall be NEMA Design B with Class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.
- J. Bearings: Belts shall be oil and heat resistant, static conducting. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- K. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- L. Provide & install accessories as scheduled on the plans.

2.16 CUSTOM FABRICATED PLASMA FUME EXHAUST HOOD

- A. See details and schedule for custom fabricated hood. Construct, install, and support per SMACNA standards and applicable codes and regulations.

- B. Provide & install blast gates at 8'6" AFF or as necessary above hood for balancing purposes.

2.17 SLOTTED WELDING FUME EXHAUST HOODS

- A. The contractor will field-fabricate the overhead rigid duct in the sizes as shown on the drawings. The rigid duct is mounted in such a way that it is fully supported in an approved manner. All elbows, fittings, and transitions are made according to SMACNA standards. The rigid duct is connected to the exhaust fan or fume collector by means of a flexible connector to minimize noise and vibration.
- B. The contractor will install a complete fume exhaust system at the location as shown on the drawings.
- C. The exhaust system includes, but is not limited to, slotted fume hoods, rigid overhead duct, and exhaust fan with exhaust stack/vent, or fume collector.
- D. Each slotted hood is constructed of formed 18 gauge galvanized steel.
- E. The overall dimension of the hood is as indicated on the drawings.
- F. All materials and labor required for the complete installation of the system are included in the bid.
- G. Provide & install blast gates 8'6" AFF for balancing purposes.
- H. Provide & install accessories as scheduled on the plans.

2.18 RANGEHOOD EXHAUST FANS

- A. Hood to be 30" in width and shall be constructed of stainless steel. All exposed edges to be hemmed. Range hood will be convertible between 8" round, and recirculating discharges. Hood shall have a washable aluminum filter and covered LED light. Range hood to be controlled with optional remote control module capable of being mounted to meet ADA requirements. Air delivery shall be no less than 290 CFM and sound levels no greater than 8 Sones. All air and sound ratings shall be certified by HVI. Range Hood shall be U.L. listed.
- B. Provide & install factory stainless steel shroud and shroud extension to conceal ductwork from hood to above finished ceiling.
- C. Furnish and install rangehood exhaust fans where shown on the Drawings.
- D. Provide and install options and accessories as described in schedule.

2.19 WOOD DUST COLLECTOR (DC-1)

- A. Dust collector shall be outdoor type with bag type filters. Designed for continuous usage for wood dust collection application and automatic shaker cleaning.
- B. Materials
 - 1. Housing.
 - a. Dust collector filter housing shall be constructed of galvanized 14 ga steel panels. Filter housing shall be designed to withstand -16" w.g. working pressure.
 - b. Provide optional catwalk and ladder for filter servicing.
 - 2. Control Panel.
 - a. The NFPZ Control Panel shall meet the following:
 - 1) UL Approval of Panel Assembly
 - 2) NEMA 12 Enclosure
 - 3) 208 VAC/ 3 PH / 60 Hz Input Power Requirement
 - 4) Step down transformer to low voltage control circuitry
 - 5) Siemens LOGO! PLC Controller.
 - 6) 7.5 HP Variable frequency drive.
 - 7) Contactors for fractional(.15) HP two shaker motors
 - 8) Run and Stop illuminated Selector Switch
 - 9) Capability for Remote Run and Stop Switch
 - 10) Multiple fault inputs for interlocks – hopper door and explosion door
 - 11) Temperature rating of -4 to 140°F
 - 12) Maximum Installed Altitude of 10,000 ft ASL

3. Explosion Relief System
 - a. Dust collector shall have an ATEX compliant explosion relief system.
4. Filters.
 - a. Dust collector shall contain 50 filter bags within two modules. The filters shall be 8.6 sq ft surface area per bag.
 - 1) Material: 100% woven polyester with integrated carbon fiber
 - 2) Construction: Vertically seamless
 - 3) Maximum Operating Temperature: 289 °F
 - 4) Material Basis Weight 16 Oz. per Sq. Ft.
 - 5) Electrostatic Behavior:
 - 6) Surface Resistance: 2.6×10^7 Ohm – DIN 54 345 TEIL 1
 - 7) Charging Toward PA: .7 kV TEFO Method 40-77
 - 8) BIA Filter Efficiency: G
 - b. The maximum standard static pressure drop across the unit shall be 3" w. g. filter exchange shall be performed on the clean side of the filters.
 - c. Dust collector manufacturer must guarantee a minimum of 6,000 hours of run time per set of filters or replace at no cost to the owner.
5. Shaker Cleaning System.
 - a. During stop downs, the filter bags shall be cleaned by mechanical agitation created from vibration \ shaker system. The integrated main control box shall have settings for offline cleaning and will be controlled based on accumulated time of uptime operation. The unit is fitted with two vibration mechanisms.
6. Dust Container
 - a. The dust collector shall have four, 42 gallon Quickfit barrels. The collection barrels shall connect to the dust collector by means of QF clamp and will not require a tool for assembly or disassembly. Access to the barrels shall be from either side of the dust collector.
7. Fan
 - a. The unit shall have a top mounted FM625 integral fan with 7.5 HP TEFC electrical motor. Assembly shall be fitted with silencer to attenuate sound from fan discharge and breakout sound from housing. Include duct transition to return ductwork.
 - b. Construction: Galvanized panels
 - c. Rated Performance: 3,000 SCFM @ 12" wg FSP
 - d. Nominal RPM: 3,500
 - e. Rated Power: 208 V / 3 PH / 60 Hz
 - f. Design Type: Backward curve blade and non-overloading
 - g. VFD controlled.
8. Explosion Isolation Flap Valve.
 - a. A explosion isolation flap valve (CARZ) should be included. Explosion Isolation Flap Valve type CARZ is designed as an explosion pressure resistance equipment, which is able to prevent the transmission of dangerous effects from an explosion pressure wave and flame front to upstream areas.
 - 1) ATEX Compliant
 - 2) Third Party Certification and Validation of System Performance
 - 3) Suitable for up to class St1 dust
 - 4) Push and Pull installations
 - 5) Flap anti-lock design ensures flap will not lock during normal use
 - 6) Welded construction
9. Spark detection and Extinguishment
 - a. The spark detection system must include the following components.
 - 1) Control panel
 - 2) alarm horn / strobe light
 - 3) primary spark detector(s) & installation kit
 - 4) primary extinguishment sets
 - 5) zone control unit(s) and wiring base(s)

- 6) zone control unit(s) mounting bracket(s)
 - 7) cable for solenoid valves, flow monitors, spark detectors and test lights
 - 8) System commissioning by factory certified technician.
- C. DC-1 ducting shall comply with SMACNA, NFPA 664, & NFPA 654
1. Duct hangers and supports for horizontal ductwork serving the dust collection system shall meet NFPA 664 requirements for supporting the weight of the duct system plus the weight of the duct half filled with water.
 2. Exhaust
 - a. Round ductwork shall be clamp-together round duct and fittings. Flanged connections with gasket seals shall be used for all exterior exhaust air ductwork.
 - b. 45 degree take-offs shall be used in the duct system.
 - c. Pressure class: Negative 15 inch W.G.
 - d. Minimum SMACNA seal class C.
 - e. 12 GA. Vanstone flange or welded duct required between inlet isolation device and dust collector rated for 15 psi.
 3. Return
 - a. Round and oval ductwork shall be spiral seam construction.
 - b. Pressure class: Positive 3 inch W.G.
 - c. Minimum SMACNA seal class C.
- D. Interconnections:
1. Installer shall locate the custom control panel inside the shop (coordinate location with owner) and supply it with 120V/1-ph/60hz power sufficient to operate controls and 208V/3-ph/60Hz suitable for powering the fan motor via dust collector control panel. The interconnections required between the custom control box (located inside) and the collector (located outside) will include but are not limited to:
 - a. Wiring (in separate conduit) as required by electrical code suitable for operating the 3-phase fan motor.
 2. Additional Interconnections Required for DC-1.
 - a. Wire from Inlet Isolation Device to control panel (by E.C.).
 - b. Wire for the spark detection and extinguishment system. (by E.C.)
 - c. Wire from explosion vent to dust collector control panel, if applicable. (by E.C.)
 - d. All other wiring and piping required for proper operation or recommended by the manufacturer.
- E. Installation
1. Install in accordance with manufacturer's Installation & Maintenance instructions.
 - a. Install required spark detection and extinguishment per all related codes and manufacturer's requirements/recommendations.
 - b. Install required inlet isolation air valve in the exhaust ductwork per Manufacturer's requirements/recommendations.
 2. Use all factory provided lifting lugs to rig the units or modules. Ensure that spreader bars are used to prevent damaging the cabinets.
 3. Lift modules in an upright position.
 4. Level unit horizontally and vertically, using steel shims under legs where required. Shims shall have a corrosion resistant coating.
 5. Support collector silencer and transition independently from the dust collector.
 6. Contractor shall protect the dust collector inlet and outlet during construction to prevent construction debris from entering the collector prior to making duct connection to the unit. Do not operate fan system until filters are in place.
 7. Connect exhaust and return ducts to dust collection unit, flexible connections shall not be used.
 8. Perform preliminary start-up unit check per the dust collector manufacture's installation guidelines.
 9. Check fan motors for rotation and amp draw for each phase. Record information on the start-up data sheets.

10. **Provide & install drops to all equipment with rigid spiral ductwork to 5' AFF with blast gate. Provide & install 10' of flexible duct for each piece of equipment from blast gate termination to owner's equipment. Trim as necessary, coordinate with Owner.**
11. **Flex duct must be flexible clear polyurethane hose with wire reinforcement, abrasion resistant (Nordfab, Masterduct, Aget, or approved equivalent).**

- F. Prior to final inspection, factory authorized start-up of the Dust Collection system will be required. Dust collector Manufacturer shall provide the services of a factory trained representative who shall supervise all final preparation for start-up, inspect the complete installation, make necessary final adjustments, and instruct the Owner's personnel in the proper operation and maintenance of the equipment. Factory authorized start-up documentation to be submitted to the engineer prior to final inspection.
- G. Provide a written warrantee for a period of one year from date of shipment for all components.

2.20 WELDING DUST COLLECTOR (DC-2)

- A. Dust collector shall be outdoor type with cartridge type filters. Designed for continuous usage for wood dust collection application and compressed air cleaning.
- B. Housing
 1. The Dust Collector shall be a high efficiency filtration unit. It shall be bolted galvanized steel construction, clean air chamber 14 gauge thick galvanized steel, dirty air chamber 14 gauge galvanized steel and hopper typically 14 gauge galvanized steel.
 2. This construction shall be designed to withstand a maximum -24" w. g. to +6" w.g. working pressure.
- C. Hopper
 1. The dust collector shall use one hopper. Each hopper shall be 14 gauge, bolted, galvanized steel construction. Each hopper will include 26 gallon bin with wheels. Bin seal to be tight to the bottom of hopper utilizing quick release type handle.
- D. Filter
 1. The collector shall include quantity 16, vertical orientated, Blended paper with nanofiber, flame retardant cartridges. Quantity 4 cartridges installed per filter tray.
 - a. Media Type: Blended paper with nanofiber, flame retardant
 - b. Filter Area: 88 ft² each. Total filter area: 1408 ft²
 - c. Filter Length: 34.4 inch
 - d. Cartridge Equivalent Diameter: 7.86 inch
 - e. Cartridge Shape: Squircle (Square with rounded corners)
 - f. Maximum Media Pleat Depth: 0.96 inch
 - g. Maximum Cartridge Pleat Spacing: 8.3 / inch
 - h. Minimum Cartridge Pleat Continuous Media Length: 33.4 inch
 - i. Minimum MERV #: 14
 - j. Maximum operating temperature: 140°F
 - k. Average Material Basis Weight: 132 g/m²
 - l. Average Permeability: 538 m³/m²/h
 2. The maximum standard operating static pressure drop across the filter cartridges shall be 6 inch H₂O. Filter Exchange shall be performed on the dirty side of the filters through the side access doors.
 3. The filter cartridge shall be cleaned by an automatic reverse pulse compressed air cleaning system, utilizing immersion valve technology which maximizes pulse cleaning power. Each immersion valve shall be connected to a single diaphragm valve that pulses 4 cartridges (1 filter tray) at a time utilizing 90-100 psi compressed air (supplied by PC). Diaphragm valves shall be activated by pneumatic solenoid valves controlled through the system control panel.
- E. Control Panel

1. The dust collector shall be controlled with the Control Panel utilizing a 7 inch, easy to operate HMI touch screen. Fan on/off, filter monitoring of pressure drop, filter cleaning settings, and other customer interfaces are all made through this HMI. All alarms related to system operation are in conformance with the latest IEC/ISA global industrial standards.
 2. Motor shall be controlled with a VACON 100 Flow VFD rated for 208/60/3 phase power. VFD is preset by factory for 25 HP operation and for connection to the Nederman Control Panel.
 3. The dust collector shall include a broken bag detector to be included on the clean side of the cartridges and provide a signal when dust concentration indicates potential loss of efficiency.
- F. Fan
1. Dust collector shall use one 25HP direct drive fan on the clean air side. Fans shall be steel construction, straight blade, backward inclined, high efficiency type of fan wheels. Fan housing shall be galvanized steel. Motor shall be 25 HP output rated each and shall be TEFC.
 2. Each fan shall include a complete silencer enclosure, covering the fan discharge and motor. Silencer shall be galvanized steel construction with sound insulating foam inside for maximum sound attenuation. Silencer shall include flanged outlet.
- G. Interconnections:
1. Installer shall locate the custom control panel inside the shop (coordinate location with owner) and supply it with 120V/1-ph/60hz power sufficient to operate controls and 208V/3-ph/60Hz suitable for powering the fan motor via dust collector control panel. The interconnections required between the custom control box (located inside) and the collector (located outside) will include but are not limited to:
 - a. Wiring (in separate conduit) as required by electrical code suitable for operating the 3-phase fan motor.
 - b. 1" compressed air pipe to compressed air cleaning manifold. (by P.C.)
 - c. All other wiring and piping required for proper operation or recommended by the manufacturer.
- H. Installation
1. Install in accordance with manufacturer's Installation & Maintenance instructions.
 - a. Install required spark detection and extinguishment per all related codes and manufacturer's requirements/recommendations.
 - b. Install required inlet isolation air valve in the exhaust ductwork per Manufacturer's requirements/recommendations.
 2. Use all factory provided lifting lugs to rig the units or modules. Ensure that spreader bars are used to prevent damaging the cabinets.
 3. Lift modules in an upright position.
 4. Level unit horizontally and vertically, using steel shims under legs where required. Shims shall have a corrosion resistant coating.
 5. Support collector silencer and transition independently from the dust collector.
 6. Contractor shall protect the dust collector inlet and outlet during construction to prevent construction debris from entering the collector prior to making duct connection to the unit. Do not operate fan system until filters are in place.
 7. Connect exhaust and return ducts to dust collection unit, flexible connections shall not be used.
 8. Perform preliminary start-up unit check per the dust collector manufacture's installation guidelines.
- I. Check fan motors for rotation and amp draw for each phase. Record information on the start-up data sheets
- J. Prior to final inspection, factory authorized start-up of the Dust Collection system will be required. Dust collector Manufacturer shall provide the services of a factory trained

representative who shall supervise all final preparation for start-up, inspect the complete installation, make necessary final adjustments, and instruct the Owner's personnel in the proper operation and maintenance of the equipment. Factory authorized start-up documentation to be submitted to the engineer prior to final inspection.

- K. Provide a written warranty for a period of one year from date of shipment for all components.

2.21 STATIONARY LOUVERS

- A. Furnish and install louvers as hereinafter specified where shown on plans or as described in schedules. Louvers shall be stationary drainable type with drain gutters in each blade and downspouts in jambs and mullions. Louvers shall have a minimum of 57% free area based on a 48" x 48" high size. Stationary drainable blades shall be contained within a 4" frame. Louver components shall be factory assembled by the louver manufacturer. Louver sizes too large for shipping shall be built up by the contractor from factory assembled louver sections. Blades shall be 0.080 inch thick extruded aluminum at 37-1/2 degree angle on approximately 5" centers. A birdscreen shall be contained within a removable frame.
- B. Provide & install access door in ductwork to access birdscreen.
- C. Provide & install accessories as scheduled on the plans.

2.22 REGISTERS, GRILLES, AND DIFFUSERS

- A. Furnish and install registers, grilles, and diffusers where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings. Provide & install accessories as scheduled on the plans.
- B. Provide and install options and accessories as described in schedule.

2.23 MOTORIZED CONTROL DAMPER

- A. Furnish and install, as shown on plans, Ruskin CD-50 low leakage damper OR equal.
- B. Damper blade shall be of not less than 16 gauge galvanized steel formed for strength and high velocity performance with closed-cell neoprene edging. Damper blades shall not exceed 8 inches in width. Blades shall be secured to 1/2 inch diameter zinc plated axles by zinc plated bolts and nuts. All blade bearings shall be nylon. Blade side edges shall seal off against spring stainless steel seals. Teflon coated thrust bearings shall be provided at each end of every blade to minimize torque requirements and ensure smooth operation. All blade linkage hardware shall be constructed of corrosion resistant, zinc plated steel and brass. Dampers shall be suitable for operation within the following temperature limits, -40 degrees to 200 degrees F. and have a maximum leakage of 6 cfm per square foot at 4" water gauge.
- C. Dampers for Vertical Air Handler discharge to be Low Voltage normally closed spring return.
- D. Backdraft dampers for Exhaust/Relief Fans shall be 120V normally closed spring return.
- E. Provide & install accessories as scheduled on the plans.

2.24 FIRE DAMPERS

- A. Fire Dampers meeting the following specifications shall be furnished and installed where shown on plans.
- B. Fire Dampers:
 1. Fire dampers shall meet requirements in accordance with NFPA 80, 90A, and 101. Fire dampers shall be tested, rated and labeled in accordance with UL555. This model carries a 1 1/2 hour UL fire damper rating.
 2. Dampers shall be constructed of 2.188 in. galvanized steel frame, galvanized curtain style blades in gauges required by UL listing R13317. Each fire dampers shall be equipped with a factory installed heat responsive device, fusible link, rated to close the damper when temperature at the dampers reaches 165 F. Dampers shall have a

minimum UL555 differential pressure rating of 4 in. wg and minimum velocity rating of 2,000 ft/min.

- C. Requirements for an approved installation include the following:
1. Openings in wall shall be 1/4" to 1/2" larger than overall size of fire damper and sleeve assembly.
 2. Sleeve gauge shall be at least equal to the gage of the duct as defined by the appropriate SMACNA Duct Construction Standard, as described in NFPA90A, when one or more of the following Duct Sleeve Connections are used (Plain S Slip, Hemmed S Slip, Standing S Slip, Reinforced Standing S Slip, Inside Slip Joint, Double S Slip).
 3. If any other Duct Sleeve Connections are used, the sleeve shall be a minimum 16 gauge for dampers up to 36"W x 24"H and 14 gage if width exceeds 36" or height exceeds 24".
 4. Mounting angles shall be minimum of 1-1/2" x 1-1/2" x 14 gauge and bolted, tack welded or screwed to sleeve at max spacing of 12" and with minimum of two connections in each side, top, and bottom. Mounting angles shall overlap wall a minimum of one inch on all four sides.
 5. Damper shall be bolted, tack welded or screwed to sleeve on same spacing as angles. Sleeves shall not extend more than 6 inches outside of wall or floor.
 6. Provide tight fitting access doors in ductwork at each damper – sized and located so that damper can be readily reset. Service openings shall be identified with stenciled letters no less than 1/2" in height to indicate the location of the fire protection devices.

2.25 SMOKE DAMPERS

- A. General Requirements: Label according to UL 555S by an NRTL.
- B. Smoke Detector: Integral, factory wired for single-point connection.
- C. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded interlocking, gusseted or mechanically attached corners and mounting flange.
- D. Vertical blades are available for special applications.
- E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch-thick, galvanized sheet steel.
- F. Leakage: Class I.
- G. Rated pressure and velocity to exceed design airflow conditions.
- H. Mounting Sleeve: Factory-installed, 0.039-inch-thick, galvanized sheet steel; length to suit wall or floor application.
- I. Damper Motors: two-position action.
- J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors as required for the application.
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 15900 "HVAC Instrumentation and Controls."
 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 4. 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.
 5. Outdoor Motors and Motors in Outdoor-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.
 6. 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.
 7. Electrical Connection: 115 V, single phase, 60 Hz.

- K. Smoke dampers shall be by the same manufacturer and shall be smoke tight, and shall be complete with 120V electric actuator. Actuator shall be wired by Division 26.

2.26 COMBINATION SMOKE/FIRE DAMPERS

- A. Furnish and install, at locations shown on plans, combination fire/smoke dampers constructed and tested in accordance with UL Safety Standard 555. Each fire damper shall have a 1-1/2 hour fire protection rating, 165°F fusible link, and shall include a UL label in accordance with established UL labeling procedure. Damper Manufacturer's literature submitted for approval prior to installation shall include comprehensive performance data developed from testing in accordance with AMCA Standard 500 and shall illustrate pressure drops for all sizes of dampers required at all anticipated air flow rates. Fire dampers shall be equipped for vertical or horizontal installation as required by the location shown. Fire/smoke dampers shall be installed in wall and floor openings utilizing steel sleeves, angles, other materials, and practices required to provide an installation equivalent to that utilized by the manufacturer when dampers were tested at UL. Installation shall be in accordance with the damper manufacturer's instructions. Fire/smoke dampers shall be Ruskin Type FSD36 with jamb seals with auxiliary operating shaft for electric actuator. Smoke dampers shall be complete with factory installed 120V electric operator. Dampers shall be Class II, with leakage no greater than 10 CFM/sq. ft. @ 1" SP.
- B. Requirements for an approved installation include the following:
 - 1. Openings in wall shall be 1/4" to 1/2" larger than overall size of fire damper and sleeve assembly.
 - 2. Sleeve gage shall be at least equal to the gage of the duct as defined by the appropriate SMACNA Duct Construction Standard, as described in NFPA90A, when one or more of the following Duct Sleeve Connections are used (Plain S Slip, Hemmed S Slip, Standing S Slip, Reinforced Standing S Slip, Inside Slip Joint, Double S Slip).
 - 3. If any other Duct Sleeve Connections are used, the sleeve shall be a minimum 16 gauge for dampers up to 36"W x 24"H and 14 gage if width exceeds 36" or height exceeds 24".
 - 4. Mounting angles shall be minimum of 1-1/2" x 1-1/2" x 14 gauge and bolted, tack welded or screwed to sleeve at max spacing of 12" and with minimum of two connections in each side, top, and bottom. Mounting angles shall overlap wall a minimum of one inch on all four sides.
 - 5. Damper shall be bolted, tack welded or screwed to sleeve on same spacing as angles. Sleeves shall not extend more than 6 inches outside of wall or floor.
 - 6. Provide tight fitting access doors in ductwork at each damper – sized and located so that damper can be readily reset. Service openings shall be identified with stenciled letters no less than 1/2" in height to indicate the location of the fire protection devices.
- C. Fire and smoke dampers shall be by the same manufacturer and shall be smoke tight, and shall be complete with 120V electric actuator. Actuator shall be wired by Division 26.
- D. Combination dampers shall be dynamically rated, Style B, and shall be appropriate for vertical or horizontal installation as required.
- E. Combination dampers shall be appropriate for radiation style installation as required.

2.27 THROWAWAY FILTERS

- A. Provide one additional set of throwaway filters for the entire system. Furnish and install throwaway type filters for air handling systems and return grilles, 1 or 2-inch thick disposable type, ASHRAE 52.1, U.L. Class 2, 30% Efficient MERV 13, filters as manufactured by Flanders Airpure, American Air Filter, Farr, Cambridge, or equal where shown on the Drawings.
- B. Provide entire system with one additional set of disposable filters for the owner's use.

2.28 AUTOMATIC TEMPERATURE CONTROL

- A. Install the automatic temperature control dampers, air flow monitoring devices, openings for air flow switches, alarms and control devices as provided by the Automatic Temperature Control

Contractor. These dampers and devices shall be installed under the direct supervision of the Section 23 0900, CONTROLS & CONTROL SEQUENCES Temperature Control Contractor and in strict accordance with the manufacturer's recommendations.

2.29 SPARE PARTS

- A. Provide all air handlers, fan coils, and DOAS units with one additional set of disposable filters.

END OF SECTION 23 7000

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SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves for raceways and cables.
 - 2. Sleeve seals.
 - 3. Grout.
 - 4. Common electrical installation requirements.

1.2 SUBMITTALS

- A. Product Data: For sleeve seals.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
3. 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.
4. Pressure Plates: Plastic. Include two for each sealing element.
5. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR 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 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors [2 inches (50 mm)] above finished floor level.
- G. Size pipe sleeves to provide [1/4-inch (6.4-mm)] annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70.
- B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.
- C. Multiconductor Cable: Multiconductor cable shall not be used.
- D. Aluminum Conductors: Aluminum conductors may not be used.

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.

Professional Design Engineers

2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.

- 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. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:
1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
- D. 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: Plastic. Include two for each sealing element.
 3. 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.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- I. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- J. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- I. Wiring at Outlets: Install conductor at each outlet, with at least [6 inches (150 mm)] of slack.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration 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. 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.
- D. Cut sleeves to length for mounting flush with both wall surfaces.
- E. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- F. 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.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- H. 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."
- I. 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."

- J. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- K. 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.
- L. 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.

3.5 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.

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.7 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.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Grounding systems and equipment.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 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.

2.2 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install barecopper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.

3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- B. 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.
- C. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
1. 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.
 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.
 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- D. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches (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.
 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.

1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 LABELING

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
 1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.5 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.

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2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Make tests at ground rods before any conductors are connected.
- B. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.3 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

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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:
 - 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.
 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 6. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
- a. 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) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) 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: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (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. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (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.

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- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. See Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks and manholes, and underground handholes, boxes, and utility construction.

1.2 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. IMC: ANSI C80.6.
- C. EMT: ANSI C80.3.
- D. FMC: Zinc-coated steel.
- E. LFMC: Flexible steel conduit with PVC jacket.

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- F. 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, set-screw type.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. ENT: NEMA TC 13.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- C. LFNC: UL 1660.
- D. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- E. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
- E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hoffman.

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2. Lamson & Sessions; Carlon Electrical Products.

- B. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
- 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. Manufacturer's standard enamel finish in color selected by Architect.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

- D. Metal Floor Boxes: Sheet metal, semi-adjustable, rectangular and equal to Steel City No. 664 with color selected by Architect from manufacturers standards.
- E. Nonmetallic Floor Boxes: Nonmetallic floor boxes shall not be used.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- H. 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.
- I. 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: EMT.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC, 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.
- 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. 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.
 7. Raceways for Optical Fiber or Communications Cable: EMT.
 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 1/2-inch (16-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.

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. Raceways Embedded in Slabs:
 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- 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. Raceways for Optical Fiber and Communications Cable: Install as follows:
1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
 2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- L. 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.
- M. 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.
- N. 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 in damp or wet locations not subject to severe physical damage.
- O. 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.
- P. Set metal floor boxes level and flush with finished floor surface.
- Q. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
 2. Install backfill as specified in Division 31 Section "Earth Moving."
 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.

- b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of conduit.

3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Conduit, ducts, and duct accessories for direct-buried duct banks, and in single duct runs.
2. Handholes and pull boxes.

1.2 QUALITY ASSURANCE

- A. Comply with IEEE C2.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 HANDHOLES AND PULL BOXES

A. Description: Comply with SCTE 77.

1. Color: Green.
2. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering,
 - a. As indicated for each service..
 - b. Tier level number, indicating that the unit complies with the structural load test for that tier according to SCTE 77.

6. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 7. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.
- B. Fiberglass Handholes and Pull Boxes with Polymer Concrete Frame and Cover: Complying with SCTE 77 Tier 5 loading. Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. Christy Concrete Products.
 - d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.

PART 3 - EXECUTION

3.1 CORROSION PROTECTION

- A. Aluminum shall not be installed in contact with earth or concrete.

3.2 EARTHWORK

- A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses" and "Plants."
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.3 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1220 mm), both horizontally and vertically, at other locations unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Manholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 ft. (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
 - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 ft. (3 m) outside the building wall without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in ducts, including spares.
- H. Direct-Buried Duct Banks:
 - 1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
 - 2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 ft. (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.
 - 3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.

4. Install backfill as specified in Division 31 Section "Earth Moving."
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
 - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

3.4 INSTALLATION OF HANDHOLES AND PULL BOXES

- A. Install handholes and pull boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use pull box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
- B. Unless otherwise indicated, support units on a level 6-inch- (15-cm-) thick bed of crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: Set so cover surface will be flush with finished grade.
- D. Install handholes and pull boxes with bottom below the frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Retain arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

- F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on.
 - 1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
 - 2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

3.5 GROUNDING

- A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Prepare test and inspection reports.

3.7 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.2 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.3 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.

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.

- 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.
- D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- D. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.4 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.

2.5 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.
 - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,.

2.6 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
 - 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).

- D. 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: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).
- C. 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. 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.
- B. 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).
- C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.9 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. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.
- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- E. 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.
- F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.
- G. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: 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. Power.
 - 3. UPS.
- 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. 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. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Limit use of underground-line warning tape to direct-buried cables.
 - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. 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.
- I. 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.

- J. 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.
- K. 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.
- L. 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.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Time switches.
 - 2. Outdoor photoelectric switches.
 - 3. Indoor occupancy sensors.
 - 4. Outdoor motion sensors.
 - 5. Lighting contactors.
 - 6. Emergency shunt relay.
- B. See Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Area Lighting Research, Inc.; Tyco Electronics.
 - 2. Grasslin Controls Corporation; a GE Industrial Systems Company.
 - 3. Intermatic, Inc.
 - 4. Leviton Mfg. Company Inc.
 - 5. Lightolier Controls; a Genlyte Company.

6. Lithonia Lighting; Acuity Lighting Group, Inc.
7. Paragon Electric Co.; Invensys Climate Controls.
8. Square D; Schneider Electric.
9. TORK.
10. Touch-Plate, Inc.
11. Watt Stopper (The).

B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: DPDT.
2. Contact Rating: 30-A inductive or resistive, 240-V ac 20-A ballast load, 120/240-V ac.
3. Program: 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
4. Programs: Two channels; each channel shall be individually programmable with 8 on-off set points on a 24-hour schedule.
5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
6. Astronomic Time: All channels.
7. Battery Backup: For schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Area Lighting Research, Inc.; Tyco Electronics.
2. Grasslin Controls Corporation; a GE Industrial Systems Company.
3. Intermatic, Inc.
4. Lithonia Lighting; Acuity Lighting Group, Inc.
5. Novitas, Inc.
6. Paragon Electric Co.; Invensys Climate Controls.
7. Square D; Schneider Electric.
8. TORK.
9. Touch-Plate, Inc.
10. Watt Stopper (The).

B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), 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.

2.3 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Lighting.
 2. Leviton Mfg. Company Inc.
 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 4. Novitas, Inc.
 5. RAB Lighting, Inc.
 6. Sensor Switch, Inc.
 7. TORK.
 8. Watt Stopper (The).
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 6. Bypass Switch: Override the on function in case of sensor failure.
 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.
 8. Sensors shall be dual technology, PIR and Ultrasonic.

2.4 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allen-Bradley/Rockwell Automation.
 2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
 3. Eaton Electrical Inc.; Cutler-Hammer Products.
 4. GE Industrial Systems; Total Lighting Control.
 5. Grasslin Controls Corporation; a GE Industrial Systems Company.

Professional Design Engineers

6. Hubbell Lighting.
7. Lithonia Lighting; Acuity Lighting Group, Inc.
8. MicroLite Lighting Control Systems.
9. Square D; Schneider Electric.
10. TORK.
11. Touch-Plate, Inc.
12. Watt Stopper (The).

B. Description: Electrically operated and electrically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.

2.5 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. 22 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. 16 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- B. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.
- C. Field quality-control reports.
- D. Panelboard schedules for installation in panelboards.
- E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 4. Directory Card: Inside panelboard door, mounted in transparent card holder.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 1. Material: Tin-plated aluminum.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus Configured Terminators: Mechanical type.
 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- 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. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

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.; 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. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. External Control-Power Source: 120-V branch circuit.
- F. Doors: Door in Door type, concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE 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. 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. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable 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.
 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 6. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
 - g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407.

- B. Mount top of trim 84 inches above finished floor unless otherwise indicated.
- C. 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.
- D. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- H. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

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2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Wall-box motion sensors.
 - 3. Snap switches and wall-box dimmers.
 - 4. Solid-state fan speed controls.
 - 5. Wall-switch and exterior occupancy sensors.
- B. See Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 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, 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.
 - c. Hubbell;
 - d. Leviton;

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).
- C. Pilot Light Switches, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.

- d. Pass & Seymour; PS20AC1-PLR for 120 V.
 2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- D. Key-Operated Switches, 120/277 V, 20 A:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221L.
 - b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.
 2. Description: Single pole, with factory-supplied key in lieu of switch handle.
- E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995.
 - b. Hubbell; HBL1557.
 - c. Leviton; 1257.
 - d. Pass & Seymour; 1251.
- F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995L.
 - b. Hubbell; HBL1557L.
 - c. Leviton; 1257L.
 - d. Pass & Seymour; 1251L.

2.5 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

2.6 OCCUPANCY SENSORS

- A. Wall or Ceiling -Switch Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper;
 - b. Hubbell;
 - c. Leviton;
 - d. Pass & Seymour;
 - e. Watt Stopper (The);
2. Description: Passive-infrared and ultra sonic 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. (84 sq. m).

2.7 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: Stainless steel 302.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.8 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 1. Wiring Devices Connected to Normal Power System: color to match existing, unless otherwise indicated or required by NFPA 70 or device listing.

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.

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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. Pigtailling 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 (152 mm) 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 up, 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. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
 - 1. Receptacles: Identify panelboard and circuit number from which served for all electrical devices connected to the emergency generator. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Test Instruments: Use instruments that comply with UL 1436.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 3. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 4. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 5. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed and switches enclosed controllers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA FU 1 for cartridge fuses.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 FUSE APPLICATIONS

- A. Motor Branch Circuits: Class RK5, time delay.
- B. Other Branch Circuits: Class RK5, time delay.
- C. Control Circuits: Class CC, fast acting.

3.2 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.3 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Enclosures.

1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.3 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
- 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. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
- D. Field quality-control reports.
- E. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. 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. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 4. Lugs: Suitable for number, size, and conductor material.
 - 5. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

- 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. Type HD, Heavy Duty, Single Throw, 240-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.
- C. 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: 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.; 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. 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. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I^2t response.
- E. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

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 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.

PART 3 - EXECUTION

3.1 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.

3.2 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.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

END OF SECTION 262816

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes the following types of LED luminaires:
 - 1. Downlight.
 - 2. Linear industrial.
 - 3. Lowbay.
 - 4. Recessed, linear.
 - 5. Strip light.
 - 6. Surface mount, linear.
- B. Related Requirements:
 - 1. None.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.

4. Include emergency lighting units, including batteries and chargers.
 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 6. Photometric data and adjustment factors based on laboratory tests[, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project] [IES LM-79] [and] [IES LM-80].
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
 2. Suspended ceiling components.
 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches (300 mm) of the plane of the luminaires.
 4. Structural members to which luminaires will be attached.
 5. Initial access modules for acoustical tile, including size and locations.
 6. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Ceiling-mounted projectors.
 7. Moldings.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.

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- C. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.

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- b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.
- D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- F. California Title 24 compliant.
- G. With integral mounting provisions.
 - 1. UL Listing: Listed for damp location.

2.2 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Steel:
 - 1. ASTM A 36/A 36M for carbon structural steel.
 - 2. ASTM A 568/A 568M for sheet steel.
- C. Stainless Steel:
 - 1. 1. Manufacturer's standard grade.
 - 2. 2. Manufacturer's standard type, ASTM A 240/240 M.
- D. Galvanized Steel: ASTM A 653/A 653M.
- E. Aluminum: ASTM B 209.

2.3 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

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- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, [12 gage (2.68 mm)] .
- D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaires:
 - 1. Secured to outlet box.

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2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaires:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:

1. Ceiling Mount:
 - a. Two 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 10 feet (3 m) in length.
 - b. Hook mount.
2. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

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- C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."
- B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

END OF SECTION 265119

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for pathways and cables.
2. Sleeve seals.
3. Grout.
4. Common communications installation requirements.

1.2 SUBMITTALS

A. Product Data: For sleeve seals.

PART 2 - PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

- a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
- b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Advance Products & Systems, Inc.
- b. Calpico, Inc.

- c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
 3. Pressure Plates: Plastic. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [steel] [cast-iron] pipe sleeves and 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.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 270500

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications service entrance pathways.
4. Grounding.

B. Related Sections:

1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Division 27 Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.
3. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies, and location and size of each field connection.
2. Equipment racks and cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail.

C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- D. Grounding: Comply with ANSI-J-STD-607-A.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.5 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 2. Record agreements reached in meetings and distribute them to other participants.
 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.
1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
 2. Support brackets with cable tie slots for fastening cable ties to brackets.
 3. Lacing bars, spools, J-hooks, and D-rings.
 4. Straps and other devices.

- B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
 - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

2.3 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
 - 1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
 - 2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
 - 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with ANSI-J-STD-607-A.

2.4 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

3.2 Install underground entrance pathway complying with Division 26 Section "Raceway and Boxes for Electrical Systems."INSTALLATION

- A. Comply with NECA 1.

- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

3.3 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping." Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.4 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems." Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- B. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion of TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration including optional identification requirements of this standard.
- C. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cabling.
3. Cable connecting hardware, patch panels, and cross-connects.
4. Telecommunications outlet/connectors.
5. Cabling identification products.
6. Cabling administration system

B. Related Sections:

1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.2 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 3. Cabling administration drawings and printouts.
 4. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
- C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
- B. 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.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- E. Grounding: Comply with ANSI-J-STD-607-A.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. Cable Support: NRTL labeled for support of Category 6a cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 2. Lacing bars, spools, J-hooks, and D-rings.
 - 3. Straps and other devices.
- B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
 - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Cable
 - 2. Or approved equal.
- B. Description: 100-ohm, 4-pair UTP, covered with a blue thermoplastic jacket, Category 6a and 6 for communications as shown on the drawings.
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 - 3. Comply with TIA/EIA-568-B.2, Category 6a.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 - b. Communications, Riser Rated: Type CMR, complying with UL 1666.

2.4 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Panduit Corp.
 - 2. Leviton Corp.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.
- D. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- E. Patch Cords: Factory-made, four-pair cables in 36-inch (900 mm) lengths; terminated with eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6a performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Provide two patch cords for each communications jack installed.
- F. Provide floor mounted data racks as shown on the drawings for termination of communications cabling. Provide cable management devices for rack.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

2.6 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.7 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.8 SOURCE QUALITY CONTROL

- A. Factory test UTP cables on reels according to TIA/EIA-568-B.1.
- B. Factory test UTP cables according to TIA/EIA-568-B.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 3 inches (76 mm) above finished floor.
- G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 8. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
 - 9. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
 - 10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
 - 11. Provide three communications drops for each communications outlet shown, three communications drops for each cubicle, and one communications drop for each wall

mounted telephone shown on the drawings routed to the data rack located at the data room. Coordinate labeling format with owners IT representative.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

- b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 1. Administration Class: [1] [2].
 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration, including optional identification requirements of this standard.

- D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- F. Cable and Wire Identification:
 - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
 - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 - 6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
 - 1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.8 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Visually inspect UTP cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.

2. Visually confirm Category 6a, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
5. UTP Performance Tests:
 - a. Test for each outlet. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
 - 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.
 - B. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
 - C. Prepare test and inspection reports.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION 271500

SECTION 27 51 23
INTEGRATED IP BASED SAFETY & INTERCOMMUNICATION SYSTEM WITH CLASSROOM
SOUND ENHANCEMENT.

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The requirements of the contract documents, including the General and Supplementary General Conditions and Division 1 – General Requirements shall apply to the work of this section.
- B. At the time of proposal, any exceptions taken of these specifications, all variances from these specifications and all substitutions of operating capabilities or equipment called for in these specifications shall be listed in writing and forwarded to the Architect / Engineer. Any such exception, variances or substitutions which were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval with comment.

1.02 SCOPE OF WORK

- A. The work covered by this section of the specifications shall include all material, labor, hardware, software, firmware and programming to install a completed operating system as described herein and shown in the drawings. The system shall utilize the school's shared data network, and not require the use of any proprietary switches, routers, or other network components. The physical network components shall be provided by the owner or the contractor, the scope of this document does not include the physical network including switches, routers, or network cabling. Beyond the shared data network hardware, the rest of the system shall be complete with all necessary materials, labor, hardware, software, firmware and programming specifically tailored for the installation. It shall be possible to permanently modify the software on site by using a system administrator software network interface.
- B. The intent of this specification shall maximize communications between the classroom and administrative areas utilizing VoIP (Voice over Internet Protocol) Technology while enhancing school safety and reducing maintenance, operational, and installation cost. Intended system shall integrate seamlessly as a complete system for local sound reinforcement as well as supporting intercom, paging, and bells functionality.
- C. Under this specification, the system shall provide a complete VoIP Communication System for all classrooms and flex spaces as indicated on the drawings. An analog solution using speakers and volume controls in the offices, corridors, exterior locations, restrooms, gymnasium, cafeteria, and ancillary support buildings shall also be part of this project.
- D. System shall support strobes or Visual Messaging Displays to alert of notifications as an integrated component of the system.
- E. The Communication System shall provide VoIP or network distribution of intercom, overhead paging, emergency paging, class change time tones, emergency tones and program material. The system shall also support visual messaging that will match the audible messages from the system including automated setup of the devices.
- F. Any and all miscellaneous materials, labor, hardware, software, firmware and programming that is not listed in the specification section that is required to provide a complete and operating system shall be provided as part of the scope of work for this installation.
- G. The work covered by this section of the specifications shall be coordinated with all trades that are affected by the installation of this system. All work shall be complete and as required and specified elsewhere under these project specifications.
- H. All the actual required system components and cabling are not shown or specified as this carries between acceptable manufactures and suppliers. It shall be the responsibility of the contractor to obtain this information from the acceptable supplier and or manufacturer and include the cost of the same in his bid.

1.03 APPLICABLE CODES AND STANDARDS

- A. Any devices that are subject to UL (Underwriters Laboratory) requirements using high voltage will bear the UL Label.
- B. The system shall be installed in strict accordance with all the requirements of the National Electric Code.
- C. The system shall be installation in strict accordance with the requirements of the Americans with Disabilities Act (ADA).
- D. The system shall be installed in strict accordance with the requirements of all other applicable codes as well as all Federal, State, and local codes.

1.04 RELATED DOCUMENTS

- A. Secure all required permits and approvals prior to installation.

1.05 RELATED WORK

- A. The contractor shall coordinate work in this section with all related trades that the system effects of integrates with. Work and / or equipment provided in other sections and related to the system shall include but not be limited to the following:
 - 1. Cable support system
 - 2. Structured Cabling System installer
 - 3. Network Infrastructure Supplier – switches/routers

1.06 SUBMITTALS

- A. Furnish to the Architect / Engineer complete equipment submittal technical specification sheets and shop drawing submittals in .pdf format for this system including but not limited to the following:
 - 1. A material list with the quantity of each piece of equipment, names of manufacturers, model numbers and the technical data information on all equipment the contractor proposes to install. This material list shall be broken out and listed by Specification Section, per piece of equipment. If a piece of equipment is needed but not listed in this specification section, it shall be listed in the area of the submittal it pertains to. The technical information shall be a piece of the manufacturer's printed literature that is produced by the equipment manufacturer. Internet web page listings will not be accepted. Provide a description of any special installation procedures that will differ from what is specified or shown on drawings.
 - 2. Complete system circuit diagrams of the entire system, point to point on scaled floor plans scaled to match that of the scale of the project documents. The shop drawings are required to clearly illustrate how all components are related to each other and how they interconnect to each other. A complete point to point wiring diagram of any and all panels and how they interconnect with all the components and or devices that are part of the system as well as any ancillary devices that are being provided by other trades. All cables run shall be shown of the shop drawing submittals. Cable tags shown on the shop drawing submittals shall correspond with cable tags that are located inside equipment enclosures as well as documented on the as-built drawing. The shop drawing submittals shall include scaled drawings of all racks, panels, consoles and special assemblies. The show drawing shall include all circuit numbers of all cables and terminal connections as well as how they are labeled. Each drawing shall have a descriptive title and all subparts of each drawing shall be completely described. All drawings shall have the name of the project, Architect / Engineer and contractor in the title block. The floor plans, rooms names and numbers for the submittal drawings shall match that of the project documents. The symbol used on the submittal drawings shall match that of the project documents. The only information to be shown on the submittal drawings for this Specification Section shall be information that pertains to the system that is being submitted on.

3. Provide a detailed custom description of the operation of the submitted system for this installation and a statement listing every technical and operation parameter wherein the submitted equipment varies from what was originally specified. If the submitter fails to list a particular variance and his submittal is accepted; but subsequently, deemed to be unsatisfactory because of the unlisted variance, the submitter shall replace or modify such equipment at once without cost to the Owner. A letter or certificate from the manufacturer stating that the system contractor is an authorized distributor and installer of the submitted equipment shall be supplied.
4. The contractor shall be responsible for providing to the Architect / Engineer any and all additional information required and as deemed necessary by the Architect / Engineer for submittal and shop drawing submittal review.

1.07 QUALITY ASSURANCE

- A. This specification section shall be a one (1) manufacturer responsibility or as specified herein with no exceptions. Any variances to this specification item shall be submitted to the Architect / Engineer ten (10) working days prior to proposal for review by the Architect / Engineer. The equipment manufacturer for this specification section has been in business manufacturing the specified equipment for a minimum of ten (10) years.
- B. The contractor shall be the factory authorized and factory certified distributor and installer of the equipment to be provided for this specification section. The installation contractor's factory certification shall be submitted to the Architect / Engineer as part of the contractor's subcontractor and materials list at the time of the bid as well as with the shop drawing submittal.
- C. The contract for the systems described herein shall be assigned to the general contractor for the building construction. The intercommunication system contractor shall coordinate all work and work sequencing with the general contractor.
- D. Owner and Architect / Engineer Inspections: The Owners technology staff and Architect / Engineer shall provide advice as requested. The Owners' technology staff shall inspect the project as the work progresses. Prior to final acceptance of the work, the Contractor shall decide with the appropriate authorized Owner personal to inspect the construction areas, both to ensure satisfactory completion of the work and to ensure complete cleanup and restoration of areas affected by the work. Temporary protection, coverings, and structures shall be removed at or before the time of inspection.

1.08 CIRCUITING GUIDELINES

- A. All wiring shall be Cat. 6/6a for connections to speakers, call switches, etc... for future migration to a complete IP (Internet Protocol) based intercom paging system. Cabling from the MDF or IDF to each classroom enclosure shall be provided by others. A patch cable, providing connectivity from the work outlet faceplate to the MS-500 shall be provided by others to the AV contractor for connection to the network.
- B. Each classroom / education space to have a dedicated network connection to the intercom paging system head-end to provide 2-way communications from the integrated paging system console as well as the district IP based phone system.
- C. Each office / administrative space to have 1-way communications from the paging system and is capable to being addressed from the building telephone system handset.
- D. Each corridor / common space / exterior space including library, cafeteria and gymnasium to have 1-way communications from the paging system and be capable of being addressed from the building telephone system handset.
- E. All wiring shall be in accordance with the manufacturer's specifications and certified for performance.

1.09 SEQUENCE OF OPERATIONS

- A. The ability to be distributed via a fiber 10/100/1000Mb switched, VLAN enabled network or 10/100/1000Mb switched stand-alone intercom network. It shall be possible to eliminate the need for copper feeder cables between the Main and Intermediate distribution frames using fiber optic cabling.

- B. Shall have SIP (Session Initiation Protocol) Integration to connect all talk-paths to the VoIP phone system of choice. This shall support registering as an extension on the system or through the use of a SIP Trunk.
- C. The system shall provide the ability to support a SIP tunnel from the building's VoIP phone system to provide two-way communication from all administrative telephones to any location equipped with a talkback speaker or audio system with room microphone.
- D. System shall interface with any VoIP telephone system using SIP type integration thus allowing the school(s) to upgrade or replace their telephone system without suffering a requirement to replace, or lose any feature of, their internal communications (intercom) system. Any system that limits system features based upon any selected telephone system and is not SIP based shall not be acceptable.
- E. The system shall have the ability to call 911 or any other programmed number/extension from the classroom as a part of the intercom communication system giving opportunity of messages to identified individuals or groups.
- F. System alerts must be able to be self configured and triggered from both classroom and headend. Alerts for example are medical, lockdown, evacuation, hold in place, disturbance, etc.
- G. Automatically sound a tone or play a pre-page WAV file over any loudspeaker connected for two-way communication to alert the classroom teacher that this 2-way call has been established. This is intended to prevent unauthorized monitoring.
- H. Distribution of emergency announcement(s) from any authorized telephone to all areas furnished with a loudspeaker. Emergency announcements shall have the highest system priority
- I. Distribution of general announcements from any administrative telephone, staff telephone, or classroom telephone. The system shall be capable of providing all-call, group call, or multiple group call.
- J. Classroom speakers or audio systems with room microphone shall be software assignable to unlimited paging groups.
- K. Provide the ability to define and archive unlimited schedules with up to three hundred (300) events per schedule. Each scheduled event shall be capable of activating included tones or playing custom audio/voice phrases or controlling any I/O port on a system network interface for building control and scheduled along with a bell. Schedule administration, modification and creation functions shall be available through web access on remote computers and mobile devices.
- L. The system shall automatically make audible messages display on scrolling LED displays as needed with no additional programming.
- M. The system shall support a strobe light to be used in conjunction with audible messages for loud areas.
- N. The system shall support room reporting features during emergency events and an opportunity to advise they are secure in place.
- O. The system shall support CAP and allow for API interoperability such as gunshot detection, weapon detection, vape detection, and other 3rd party hardware.
- P. The system shall provide an administrative console for the front office, consisting of a touch screen interface no less than 22" diagonal interface.
- Q. The User Interface shall be map based and support full touch operation. The manufacturer shall provide the ability to take a map in any format, including paper copy, PDF, Visio, etc. and create from that the map used for the primary user interface. Non map-based User Interfaces will not be considered.
- R. The system must allow 3rd party IP Cameras integrations into the system map to display during emergency events.
- S. The system shall be capable of dynamic room/zone paging.
- T. The WAV or MP3 files shall be activated via the administration software, telephone and / or telephone system and / or pushbuttons.
- U. The WAV or MP3 files shall be programmable as to what level of priority they can be broadcast. They shall be programmable to override any class change tones, normal all call, music, and intercom in the event of an emergency.
- V. The WAV or MP3 files shall also have the ability to be broadcast into any one or all of the zones with the system. Simultaneous playback of different audio to different zones must be possible.
- W. The WAV or MP3 files shall have the ability to be broadcast via a schedule for any day of the week or time of the day. They shall also have the ability to be broadcast for any duration of time and repeat number of plays with the ability to select how long the duration is between each repeated broadcast.

- X. The WAV or MP3 files shall also have the ability to be a part of the classroom change tones within the system. These files shall be able to replace any tone within the class change schedules as to offer the flexibility of customizable tones and or phrases in this class change mode.
- Y. The system shall be capable of automatically listening into a classroom in the event of an alert or lockdown.
- Z. It shall be possible without the cost of additional hardware/software to incorporate a LAN / WAN district wide paging system by means of the built in VoIP district Paging Adapter or district software. This adapter shall give the district the ability to page each school independently, as a group of schools, or all schools.
- AA. The system shall allow for the integration of changeable message signs to support bells and notifications. These signs shall be multi-color, multi segment LED scrolling displays and powered and controlled via a network PoE (Power over Ethernet) connection.
- BB. The system shall also allow for the integration of third-party system through the use of contact closure, TCP (Transmission Control Protocol) communication, RS-232 communications and HTTP (HyperText Transfer Protocol) communications.
- CC. The system shall support and allow for devices to be managed within the system itself including device discovery, automated programming and automated assignment to rooms and zones.
- DD. System must support device programming templates per device per site and support making individual adjustments to those templates on a per device basis and that setting would supersede the template for that device only.
- EE. System shall support monitoring and upgrading firmware of supported devices.
- FF. The system shall support door status monitoring with alerts and warning based on defined times. There must be the ability to bypass reporting based on bell schedules and special events.
- GG. The system shall support desktop announcer in which teacher and student windows and mac OS computers can display critical emergency alerts through a post message delivered through the headend application.
- HH. System shall support management of IP based PoE visual message displays and automate the programming of devices through the interface including automatically applying visual messages for bells and notifications without the use of a secondary application or software.
- II. The system shall support an automated commissioning function that allows the system to be placed into a test mode and monitors and reports the commissioning status of the devices.
- JJ. System shall support a district server that will allow for management and monitoring of all schools in the district. Server must support physical and virtualized server deployments. The district central server will allow for centralized paging to entire district, groups of schools or individual schools. Server will support the ability to record and preview the page before it sends to the sever. Server will also support sending notifications to a school, group of schools or entire district. Server will support defining associated campuses for schools to automate events and notifications at those sites. Shall support centralized reporting of alerts and allow to directly interact with alert. Server interface shall be map based and support nested maps allowing for closer detail on an area or grouping of schools. District server shall support monitoring servers and devices at campus and alert via UI on any degraded or offline devices. Server shall support direct access of campus servers through single pane of glass and will not require authenticating into individual sites.

1.10 WARRANTY

- A. The manufacturer and installation contractor shall guarantee the system, equipment and all its components for a minimum of one (1) year from date of final acceptance of the system as documented by the Architect / Engineer. This guarantee shall cover the replacement of all parts and labor to replace the same made necessary by normal usage and wear.
- B. Upon completion of the installation of the system, the contractor shall provide to the Architect / Engineer and Owner a signed written statement, on company letterhead, substantially in form as follows: “The undersigned, have engaged as the Intercom paging system contractor for the _____ building project confirms that the system was installed in accordance with the wiring diagrams, instructions and directions provided by the manufacturer.”

- C. Contractor shall repair, adjust, and / or replace, whichever the Owner and / or Architect / Engineer determines to be in its best interests, any defective equipment, materials, or workmanship, as well as such parts of the work damaged or destroyed by such defect, during warranty period, at the contractor's sole cost and expense.
- D. In the event that any of the equipment specified, supplied, and / or installed as part of the work should fail to produce capacities or meet design specification as published or warranted by the manufacturer of the equipment involved or as specified in this document, the contractor shall, in conjunction with the equipment manufacturer, remove and replace such equipment with equipment that will meet requirements without additional cost to the Owner.

1.11 TRAINING AND INSTRUCTION FOR OWNER MAINTENANCE

- A. A training program including a minimum of four (4) hours on the use of the system shall be provided to the Owner to use at their discretion. A full and complete overview of the system shall be included in this training as well as any literature required by the Owner to allow complete and total use of the system by the Owner's designated staff. System maintenance requirements for the equipment will also be documented and turned over the Owner. User and help videos shall also be made available to the customer via USB thumb drive or via an online fashion.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The following manufacturers are approved to submit proposals for this project:
 1. Audio Enhancement – EPIC (Education Paging & Intercom Communications) System™

2.02 EQUIPMENT

- A. INTERCOM PAGING SYSTEM:
 1. The system shall be a software-controlled system, whose primary interface is a web-based portal, accessible from any authorized computer. The system shall support being deployed on physical server hardware or through virtualization on the customer's hardware. For the physical server, the system shall utilize a 1U rack server, operating as an appliance, dedicated to the operation of the IPB (Intercom Paging and Bells) & SAFE (Signal Alert For Education) System™ only. The rack server shall have industry standard redundancy, including RAID1, Dual Power Supplies, and hot swappable hard drives. The entire system shall be Linux based. If virtualized the system shall support VMWare ESXI version 6.5 or later.
 2. The system shall be based on standards compliant SIP and RTP communications across the network and shall allow direct Trunk Integration to the VoIP telephone system.
 3. The system shall provide a simple calendar-based scheduling system for bells. It shall provide the ability to have an unlimited number of bell schedules.
 4. The system shall provide a map-based User Interface. All major functions, including Intercom, Paging, Notifications and Alerts shall be done using the map as the foundation for those actions. Paging shall clearly show on the map where the page audio will be transmitted to.
 5. Bell Schedules shall be easily assigned to days and changed simply with authenticated access to the system through any browser-based device. Bell schedules shall be able to be changed even if a current schedule is active in the system same day and apply immediately.
 6. The system shall support utilizing a shared data network and support (VLAN [Virtual Local Area Network] enabled) or dedicated network as means of distribution for all voice overhead paging, emergency paging, emergency tones, intercom, and class change tones. System shall support routing of traffic across multiple subnets and network segments.

7. The system shall be capable of accessing remote classrooms (trailers, temporary classrooms etc.) via IP interface or room audio system with room microphone. This shall provide intercom, class change tones, emergency tones, and normal / emergency paging via a wired network to these remote locations.
8. Exterior speakers shall be capable of being on separate zones and programmed separately.
9. The system shall have the ability to synchronize to the same NTP server utilized for the Master Clock system.
10. The system shall have the ability to produce user defined tone signals for time tones or emergency tones.
11. The system shall have SIP Integration to connect all talk-paths to the VoIP phone system of choice.
12. The system shall provide the ability to support a SIP trunk from the building's VoIP phone system to provide two-way communication from all administrative telephones to any location equipped with a talkback speaker or audio system with room microphone.
13. The system shall interface with any VoIP telephone system using SIP type integration thus allowing the school (s) to upgrade or replace their telephone system without suffering a requirement to replace, or lose any feature of, their internal communications (intercom) system. Any system that limits system features based upon any selected telephone system and is not SIP based shall not be acceptable.
14. The system shall provide its own SIP environment, and in the case of a failure of the schools VoIP telephone system, be capable of operating completely independently for all functions, save access from the handsets connected to the schools VoIP system.
15. The system shall not be reliant on WAN or internet connectivity for operation.
16. The system shall provide web access, which will give ability to monitor operations and functions of the system.
17. The system monitors the status of all connected devices for health, SIP connectivity and connected devices including the XD receiver. If a device becomes in a degraded or offline state, the system will monitor a technical contact via email and or SMS as well as show status on the map of the console.
18. The system shall provide web-based off-site programming and diagnostics of the system. It shall also be capable of determining basic circuit faults.
19. The system shall have a Web based administration programming tool which allows the administrative personnel to easily manage Audio Sources, Class Change schedules, paging groups, time updates, holiday schedules and day/night mode operation from an internet browser. System shall support HTML5.
20. The system shall provide calendar-based scheduling up to four years in advance. The system shall be capable of displaying a fully year calendar and differentiating which bell program is scheduled to run on each day. The calendar shall be based on a standard school year and provide a selectable start month for example, it can be configured to run from August to July.
21. The system shall be capable of being fully integrated with the school's existing LDAP (Lightweight Directory Access Protocol) or Active Directory system. Systems that do not provide LDAP or Active Directory integration shall not be considered.
22. The system shall provide discreet control over roles for the system. Roles shall be definable down to the individual feature level and provide the district with the ability to restrict or grant access to any roll individual features or groups of features.
23. The system shall provide web browser access to the system specifically for a teacher. Teacher access shall be assigned through LDAP or Active Directory. The Teacher screen shall provide information specific to the room that the teacher is assigned to. That information shall consist of, but not limited to, the next scheduled event for the room (Bell, Announcement, etc.), Audio/Visual Controls for their classroom technology, Teacher Name, Room Number, an Intercom Call button, and an Emergency call button.
24. The system shall have the ability to carry IP Communications to the edge of the classroom Audio/visual Systems. It shall be able to control connected A/V Devices, provided that those devices are controllable by RS-232

25. The system shall be based on a database structure, utilizing a robust commercially available database such as SQL (Structured Query Language).
26. The system shall provide 2-way handsfree communication in each classroom.
27. System Classroom and Common Zone network interfaces shall be capable of utilizing standard Cat 6/6a infrastructure for installation from the Telecommunications Closets only to the classroom and/or zone, thus allowing for only one type of wiring infrastructure within the school. Distribution of all voice signaling shall utilize a shared or dedicated network. Systems that require homerun, dedicated, 18 gauge shielded wiring shall not be acceptable.
28. The system shall provide a flexible and robust event engine. In addition to pre-programmed events and actions, the event engine shall be capable of accepting Java-based programming to accomplish advanced integrations and functions.
29. The system shall automatically broadcast page emergency instructions throughout an entire school when an alarm (e.g. lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions shall be preprogrammed and require no user intervention. The system shall provide redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.
30. The system shall provide the ability for the school to upload their own recorded files for both Bell Tones, and Notifications
31. The system shall provide the ability to initiate school safety paging announcements, evacuation tones and take cover tones from any telephone within the facility or outside the facility to any other location within the facility or district.
32. IP-enabled two-way voice communication shall be available from any provided telephone or administrative console through any speaker in the system. This shall allow handsfree communication to any classroom or any individual loudspeaker unit. A pre-announce tone shall sound immediately before the intercom path is opened.
33. The system shall provide a complete personal alert function for each teacher. The alert functionality shall be an integrated part of the administrative head end software and shall not require any separate application or hardware to support this functionality.
34. The teacher personal alert functionality shall be integrated into the classroom microphones and the teacher web screen.
35. The system shall be capable of displaying on the map the location of the alert in the case of a microphone that is within range of its paired receiver, or from the teacher's web access screen. The system shall also be capable of approximately locating the location of the alert in the case of a microphone that is not in range of its paired receiver. A system, either the microphone system, or the administrative system that is not capable of receiving an alert from a microphone that is not within range of its paired receiver shall not be considered.
36. Upon alert, the system shall have the ability to provide notification on the dedicated console at the front office, or on any other computer which is currently logged into the administrative interface and has the appropriate credentials. The system shall provide both an audible tone, and a change on the screen that clearly indicates that an emergency alert has been received.
37. Upon alert, the system shall also be capable of sending e-mail and SMS Text messages to the designated school personnel. These alerts shall include a web link to the administrative console.
38. If cameras are installed in the classrooms, the system shall be capable of showing a live video from the classroom that received an alert. This shall only be shown in the case of an alert where the microphone is within range of its paired receiver.
39. The system shall have the ability to acknowledge the receipt of the alert by changing the indicators on the classroom microphone receiver in the room where the alert was received from. In the case of an alert received from a microphone not in range of its paired receiver, no acknowledgement shall be sent.
40. The system shall have the capability of maintaining a record of all alerts that are received and provide appropriate school personnel with the capability to enter information about the alert, which shall be maintained in the systems database. That information shall also be made available to appropriate school personnel in the form of a report that shows all alerts that have occurred, their date, time, and the end alert information.

41. The system shall contain a rules-based integration engine that allows for input of TCP, HTTP, or Serial Data and allows for the parsing of data for actions or triggering other systems via TCP, HTTP or Serial.
42. The system shall support digital message displays that provide visual feedback in the form of scrolling messages via an LCD or LED display all controlled from the network.
43. The system shall allow for integration into the classroom audio system including teacher microphone as required by design. This includes integration to ensure that system notifications, pages and intercom calls take priority over classroom audio sources.
44. The system must include perpetual licensing and include all in version software upgrades at no additional cost.
45. The base functionality of the system including the map interface, intercom, paging, bells, classroom audio control, SAFE System and Event engine must be part of the base licensing of the product and not require additional licensing.
46. The system shall have the ability to control signage displays for display of clocks, messages, digital signage, countdown timers as well as allow for automated messages to be displayed automatically for notifications.
47. The system will allow for the building of clock signs, message signs as and notifications signs using the HTML EPIC interface allowing for using predefined templates and assets.
48. Clocks and emergency signs shall be a onetime perpetual license.
49. Server software shall require end user to create complex unique passwords for each system on first use. Systems that allow for generic or repeated passwords will not be acceptable.
50. System shall utilize a visual based event editor to define custom actions, inputs and outputs.
51. System shall support connection to District View Server for centralized management and licensing and services must be included as part of the system to support that connection, integration and programming.

B. INTERCOM PAGING SYSTEM NETWORK INTERCOM INTERFACE:

1. Shall allow users to install intercom paging systems spanning multiple building or facilities connected through a VLAN.
2. Network Requirements:
 - a. 100/1000 Ethernet switch port configured on a dedicated VLAN.
 - b. Systems requiring a specific network or subnet size are not allowable.

C. INTERCOM PAGING SYSTEM POWER:

1. All Network interfaces used in the classroom and for the common zones shall be powered via PoE from the district provided network switches.
 - a. PoE switches and network cabling from MDF (Main Distribution Frame) and IDF (Intermediate Distribution Frame) to devices provided by others.
2. All network switches shall include an uninterruptable power source to provide adequate runtime. In the event the school has a generator the UPS systems shall hold the switches long enough until generator power can be provided. Customer to provide all necessary UPS for network switches.

D. APC BACK-UPS, 6 OUTLETS, 425VA, 120V

1. Output
 - a. Output power capacity - 255 Watts / 425VA
 - b. Max Configurable Power (Watts) 255 Watts / 425VA
 - c. Nominal Output Voltage 120V
 - d. Output Frequency (sync to mains) 50/60 Hz +/- 3 Hz Sync to mains
 - e. Topology Standby
 - f. Waveform type Square wave
 - g. Output Connections (4) NEMA 5-15R (2) NEMA 5-15R
 - h. Transfer Time 6 ms typical : 10 ms maximum
2. Input
 - a. Nominal Input Voltage 120V

- b. Input frequency 50/60 Hz +/- 3 Hz
 - c. Auto-sensing Input
 - d. Connections NEMA 5-15P
 - e. Cord Length 4.99ft (1.5meters)
 - f. Input voltage range for main operations 88 - 139V
 - g. Number of Power Cords 1
 - h. Maximum Input Current 5.0A
3. Batteries & Runtime
- a. Battery type Lead-acid battery
 - b. Typical recharge time 8hour(s)

E. APC SMART-UPS 1000VA, RACK MOUNT, LCD 120V WITH SMARTCONNECT PORT

1. Output
- a. Output power capacity - 700 Watts / 1.0kVA
 - b. Max Configurable Power (Watts) - 700 Watts / 1.0kVA
 - c. Nominal Output Voltage - 120V
 - d. Output Voltage - Distortion Less than 5 %
 - e. Output Frequency - (sync to mains) 50/60 Hz +/- 3 Hz Sync to mains Other
 - f. Output Voltages - 110, 125 Load Crest Factor 3 : 1
 - g. Topology Line - interactive
 - h. Waveform type - Sine wave
 - i. Output Connections - (6) NEMA 5-15R
 - j. Transfer Time- 6 ms typical : 10 ms maximum
2. Input
- a. Nominal Input Voltage 120V
 - b. Input frequency 50/60 Hz +/- 3 Hz
 - c. Auto-sensing Input
 - d. Connections NEMA 5-15P
 - e. Cord Length 8.01ft (2.4meters)
 - f. Input voltage range for main operations 75 - 154 Adjustable, 82 - 144V
 - g. Number of Power Cords 1
 - h. Other Input Voltages 110, 125
3. Batteries & Runtime
- a. Battery type Lead-acid battery
 - b. Typical recharge time 3hour(s)
 - c. Replacement Battery APCRBC157
 - d. Expected Battery Life (years) 4 - 6
 - e. RBC Quantity 1
 - f. Battery Charge Power (Watts) 112 Watts
 - g. Runtime
 - i. View Runtime Graph (Available in Technical Tab on site)
 - ii. View Runtime Chart (Available in Technical Tab on site)
 - h. Efficiency View Efficiency Graph (Available in Technical Tab on site)
4. Communications & Management
- a. Interface Port(s) RJ-45 Serial, SmartSlot, USB
 - b. Control panel Multifunction LCD status and control console
 - c. Audible Alarm when on battery : distinctive low battery alarm : configurable delays
 - d. Available SmartSlot™ Interface Quantity 1
5. Surge Protection and Filtering
- a. Surge energy rating 680Joules
 - b. Filtering Full time multi-pole noise filtering : 0.3% IEEE surge let-through : zero clamping response time : meets UL 1449
6. Physical
- a. Maximum Height 3.39inches (86MM, 8.6CM)

- b. Maximum Width 17.01inches (432MM, 43.2CM)
- c. Maximum Depth 18.78inches (477MM, 47.7CM)
- d. Rack Height 2U

F. EPIC Common Zone Amp CZA-1300

1. LED Information
 - a. AC Power
 - b. Green – Powered On
 - c. Orange – Standby Status
 - d. Red – Booting
 - e. Green – Ready
 - f. GPIO (General Purpose I/O)
 - g. Yellow – Input Active
 - h. Blue – Output Active
 - i. White – Input & Output Active
2. 1 x 300W output
2. Built-in 70V
3. Space-saving 1 RU design
4. Control Port:
 - a. (1) RS-232 Communication port to facilitate SAFE System Communications or 3rd party device control such as a projector
 - b. (1) Remote Control Port: Integration with LCD Wall Plate
 - c. (1) XD Port, RJ45
5. Ethernet I/F: 10/100 Mbs
6. Line Inputs
 - a. For PC, DVD audio, MP3, auxiliary mic, or other multimedia sources
 - b. (1) Unbalanced input (3.5mm)
 - c. (2) Balanced inputs RJ45 connector
 - d. Internal Network Audio
7. Line outputs
 - a. (1) Unbalanced (3.5mm) output
 - b. (1) Balanced line output (RJ45 connector)
8. Signal-to-Noise Ratio >89dB @ 20Hz – 20kHz at Maximum Output
9. Input Sensitivity 780mV
10. Output Power: (3) 24v RJ45
11. 5 Band Equalizer
12. USB: Control and configuration via software. BLE Dongle for easy setup
13. Power Supply
 - a. 100V – 120V/240V – 240V @ 300W power amplifiers
 - b. PoE (PoE 802.11 af) Powers all electronics except for the 70v Speaker out Amplifier
 - c. Both AC Power and PoE Power must be connected for unit to operate
14. Operating Temperature/Humidity -32 – 122 F (0- +50C) / 10-90%
15. Storage Temperature -40°C to 70°C/10-90% non-condensing

G. INTERCOM PAGING SYSTEM ADMINISTRATIVE KIOSK:

1. The administrative Kiosk shall be customizable, flexible and provide full access to the intercom paging system.
2. Kiosk shall be embed Android OS into the touch screen and only display the intercom interface.
3. The supplier is required to provide a dedicated touch screen Kiosk for the front office, with a minimum size of 22” Diagonally. The Kiosk shall not require the district to provide any additional hardware, software or licensing. The Kiosk shall also provide a boom microphone attached to the screen that wires directly to the Kiosk.
4. Administrative access to the system shall be browser based and shall also be capable of being any administrative computer.

5. Functionality to provide full access to all features such as all call, paging groups, emergency tones, control music, WAV file distribution, test rooms, crisis mode, schedules, etc...

H. NETWORK INTERFACE

1. Provide a Network Interface with performance as follows:
 - a. Full-Duplex, Hands Free communications on Intercom Call
 - b. Amplifier powered only by the PoE power source for emergency paging applications
 - c. Mounting Bracket as required
 - d. Connections – The following connections shall be available:
 - i. Line Output for connecting to auxiliary amplifiers
 - ii. 2 External I/O Connections – Terminal Block
 1. Ability to support relay output for interface into other systems.
 - iii. RJ45 for PoE Network Connection
 - iv. Serial interface for connecting to other equipment or SAFE Compatible equipment.
 - e. 1 speaker connection
 - i. The system shall provide a speaker connection which is powered exclusively by the PoE power from the network
 - ii. Can power up to 2 speakers per device.
 - f. Network Connection
 - i. The system shall have a network connection with PoE power.
 - ii. PoE shall be present on the system to provide power for the amplifier during a power emergency.
 - iii. Shall support LLDP-MED for two level 802.3 power negotiation and device information.
 - g. Integrated Network Based Communications
 - i. The System shall support the following protocols:
 1. Directed UDP (User Datagram Protocol)
 2. Unicast Audio
 3. Multicast Audio
 4. SIP
 5. TCP Control
 - a. Integrated Serial Tunnel over TCP
 - b. The system shall have integrated SIP communications and be able to communication bi-directionally with any VoIP communications system that follows the standard SIP protocols.
 - c. The system shall also have the ability to operate with multi-cast IP messages as well.
 6. Serial Gateway for Control via the network

I. NETWORK INTERFACE FOR 2-WAY INTERCOM

1. Line Input - Internal Network Audio Line
2. Outputs - 1 Unbalanced (3.5 mm) output
3. Minimum Load Impedance - 4 Ohms
4. Amplifier Type - 92% Efficient Class D for network audio only
5. Continuous Power @ 1% THD - 25 Watts powered by PoE†
6. S/N - >89 dB @ 20 Hz to 20 kHz at maximum output
7. Protection Circuits - Thermal and short circuit protected
8. PA Connector - Connects to public address system and mutes amplifier during announcements
9. Input Voltage - 4.0 Volts RMS to 74 Volts RMS
 - a. Control Port - RS-232, 3-pin screw terminal block header, RJ45 remote control port
10. RS-232 communication port
11. Intercom call, emergency alert, room microphone wall plate port (WPA-50x)
12. Input/output (I/O) aux port for sense, strobe, etc.
13. Power Supply - PoE + 802.3af/at†

14. Temperature/Humidity
 - a. Storage: -40 to 1580F (-400 to +700C) 10-90% non-condensing
 - b. Operating: -32-1220F (0 to +500C) / 10-90%
15. Enclosure Type - Metal
16. Ethernet I/F - 10/100 Mbps
17. Power Input (Network) - PoE 802.3af/at†
18. Operating Temperature - 14 F to 1220F (-100C to 500C)
19. Protocols
 - a. SIP RFC 3261 compatible
 - b. UDP Directed Broadcast
 - c. Multi-cast and VoIP enabled
20. Lineout Output Signal Amplitudes - 2.0 VPP maximum
21. Output Level - +2 dBm nominal
22. Total Harmonic Distortion - 0.5% maximum
23. Weight 1.3 lbs (589.67 g)
24. Dimensions 1.125 (H) x 9.19(W) x 3.56 (D) in. (28.57 x 233.43 x 90.42 mm)

J. NETWORK INTERFACE SAFE ALERT EXTENDER AND 2-WAY INTERCOM

1. Line Input - Internal Network Audio
2. Line Outputs - 1 Unbalanced (3.5 mm) output
3. Minimum Load Impedance - 4 Ohms
4. Amplifier Type - 92% Efficient Class D for network audio only
5. Continuous Power @ 1% THD - 25 Watts powered by PoE†
6. S/N - >89 dB @ 20 Hz to 20 kHz at maximum output
7. Protection Circuits - Thermal and short circuit protected
8. PA Connector - Connects to public address system and mutes amplifier during announcements
9. Input Voltage: 4.0 Volts RMS to 74 Volts RMS
10. Control Port - RS-232, 3-pin screw terminal block header, RJ45 remote control port
 - a. RS-232 communication port
 - b. Intercom call, emergency alert, room microphone wall plate port (WPA-50x)
 - c. Input/output (I/O) aux port for sense, strobe, etc.
11. Power Supply - PoE + 802.3af/at†
12. Temperature/Humidity
 - a. Storage: -40 to 1580F (-400 to +700C) 10-90% non-condensing
 - b. Operating: -32-1220F (0 to +500C) / 10-90%
13. Enclosure Type - Metal
14. Ethernet I/F - 10/100 Mbps
15. Power Input (Network) - PoE 802.3af/at†
16. Operating Temperature - 14 F to 1220F (-100C to 500C)
17. Protocols
 - a. SIP RFC 3261 compatible
 - b. UDP Directed Broadcast
 - c. Multi-cast and VoIP enabled
18. Lineout: Output Signal Amplitudes 2.0 VPP maximum
19. Output Level +2 dBm nominal
20. Total Harmonic Distortion 0.5% maximum
21. Weight 1.3 lbs (589.67 g)
22. Dimensions 1.125 (H) x 9.19(W) x 3.56 (D) in. (28.57 x 233.43 x 90.42 mm) MS-375 Specifications*
23. Integrated XD Receiver Specifications
 - a. System Frequency - XD Technology 1.9 GHz
 - b. Coverage - Adjustable for optimal coverage from small classrooms to cafes, gyms, and other large spaces
 - c. Microphone Type - Unidirectional electret condenser microphone

- d. Auxiliary Input Line level 35 stereo mini jack (monaural mix)
- e. Power Requirement - 24 VDC @ 130 mA Temperature Range 32 F - 104 F (0 C - 40 C)

K. CLAUDIA (Classroom Link Advanced Unit for Delivery of Instruction and Audio) Interface for Front Office

- 1. The program distribution panel shall provide inputs for audio signals from radios, MP3 players, CD players, etc....
- 2. The program distribution panel shall permit adjusting the volume of each source and monitoring of the source at the panel.
- 3. The program distribution panel shall be equipped with a 7" capacitive touch screen interface that provides control of the sources, and streaming functions into the paging system. 800X480 Resolution
- 4. The program distribution panel shall provide Bluetooth® connectivity from a source device
- 5. Two Line Level 3.5mm inputs
- 6. Two Line Level 3.5mm outputs
- 7. Powered via USB C
- 8. Gigabit Ethernet Connectivity
- 9. Delivers audio on demand or on schedule to MS-300/MS-500 Devices on Network from inputs within the unit including line level, preloaded, and Bluetooth.
- 10. Can be scheduled and controlled as part of bell schedule within the EPIC system.

L. ANALOG INTERCOM SYSTEM CABLING:

- 1. West Penn
- 2. Belden
- 3. General Cable
- 4. Mohawk
- 5. Accepted substitute

M. INTERCOM PAGING SYSTEM VOLUME CONTROL:

- 1. Volume control shall be capable of controlling the volume of up to one hundred-fifty (150) 1-way speakers.
- 2. Volume control shall be mounted on a brushed stainless-steel single gang wall plate with the plate being embossed with a dial scale of "0 through 10."
- 3. Volume control shall be equipped with a skirted black knob with white position indicator.
- 4. Volume control shall include a stainless-steel mounting box and hardware.

N. INTERCOM PAGING SYSTEM CEILING SPEAKER:

- 1. Ceiling Speaker Specifications
 - a. Lay-in ceiling speaker shall consist of a white 13.5" grill, a speaker and integral back box or equivalent ceiling speaker with appropriate backbox, grille and tile bridge.
 - b. Integrated 25/70/100V Transformer with tap settings accessible without disassembling speaker from 1.25W to 15W or 8Ohm bypass.
 - c. The speaker shall be capable of handling minimum 50 watts continuous power.
 - d. Sound pressure level at 1 meter on axis with a 1 Watt input shall be 96 dB.
 - e. The frequency response shall be 86 Hz to 16 kHz.
 - f. The baffle shall be constructed with a single piece of perforated steel with a white baked on acrylic enamel finish.
 - g. Shall support seismic cabling from 3 points.
 - h. The back box shall meet or exceeds UL 2043 for installation in a plenum space
 - i. Approximate weight shall be 7.1 lbs. (2.49 kg).
 - j. Basis of Design Audio Enhancement SP-0300.

O. INTERIOR INTERCOM PAGING SYSTEM SURFACE WALL SPEAKER:

- 1. Wall speaker shall consist of a speaker and matched surface mount enclosure.

2. The speaker, housing and hardware shall be electrically and acoustically matched for a frequency response of 65 Hz to 17 kHz.
3. The speaker shall be 8" (20.32 cm) in diameter. and have a ceramic magnet weighing 4.8 ounces.
4. Average sensitivity 92dB SPL, 1W/1M.
5. Maximum output shall be 99dB.
6. The baffle shall be constructed of 22 gauge steel with white baked hybrid epoxy.
7. Maximum dimensions of the housing shall be 11 5/8" square and 4 1/8" deep.

P. INTERCOM PAGING SYSTEM PAGING HORN:

1. The paging horn shall be a weather-resistant, high efficiency reentrant type horn speaker.
2. The paging horn shall be equipped with an amplifier and externally accessible volume control.
3. The paging horn shall include an adjustable swivel base.
4. The frequency response shall be 275 Hz to 14 kHz.
5. Dispersion shall be 90° horizontal and 90° vertical.
6. Sound pressure level shall be 121 dB measured at 4 feet (1.22 m) on axis with an input to the amplifier module being -10 dBm at 1 kHz.
7. Distortion shall be less than 2.0% at rated output of 15 watts RMS.
8. Input impedance shall be 600 ohms nominal.
9. The amplifier shall operate on a -24 Vdc nominal, positive ground power supply.
10. Operating current shall be 900 mA at -24Vdc
11. Operating temperature shall be -20 to 55 °C (-4 to 131 °F).
12. Operating humidity shall be 0-95% noncondensing.
13. Dimension of the horn shall be 8" (20.3 cm) W x 8" (20.3 cm) H x 9:" (22.9 cm) D.
14. Approximate weight shall be 4.0 lbs (1.8 kg).

Q. INTERCOM PAGING SYSTEM VOLUME CONTROL

1. The volume control must support a rotary selector switch with 11 positions.
2. Volume control shall be white in color and be sized to fit a decora style plate.
3. Inputs on control shall support incoming 25/70V signal on both the + and – with outgoing signal on + and -. Support for up to 12 AWG Wire.
4. 25W RMS
5. Basis of Design EPIC-V70v

R. CLASSROOM SOUND AMPLIFICATION SYSTEM (CSAS) EQUIPMENT: OPTIMUM AMPLIFIER WITH INTEGRATED XD RECEIVER:

1. Provide a fully PoE Powered Receiver/Amplifier with ability to provide functions described above with performance as follows:
 - a. Audio Power: 30 watts RMS mains powered amplifier
 - b. 92% Efficient Class D Amplifier
 - c. 1% percent THD across full frequency range of amplifier
 - d. Frequency Response: 20 Hz to 20 kHz
 - e. Power Requirements: PoE 802.3af/at 25.5W Maximum
 - f. Shall support LLDP-MED for two level 802.3 power negotiation and device information.
 - g. Signal-to-noise: >89dB
 - h. Integrated mounting tabs
 - i. Thermal and short circuited protected
 - j. Integrated 3 channel DECT RF Receiver
2. Controls:
 - a. The primary control of the system shall be done through the teacher microphone.
 - b. The following functions shall be available via USB connection for setup during installation:
 - i. Input Control for multi-media sources and mixed XD source
 - ii. Equalizer Controls
 - a. 5 Band Digital Equalizer
 - iii. Discreet Output volume controls for each input

- c. RS-232 Control
 - i. Provide 4 RS-232 ports which provide pass-through control of a downstream device like a projector, etc.
 - ii. RS-232 processor shall be capable of differentiating between commands destined for the amplifier, and responding to those commands, and commands intended for the downstream and passing those commands through to the alternative RS-232 ports
 - iii. Command pass through shall be bi-directional
 - d. Connections – The following connections shall be available:
 - i. Four (5) Multi-Media inputs
 - ii. Dedicated Line output – for Assistive Listening Device Connection
 - iii. Color Coded Connection
 - iv. Ethernet Connection (8P8C RJ45 with PoE Power)
 - v. 8P8C RJ45 Connection for Intercom Paging Wall plate
 - vi. Support for Touch Based Wall Controller on Remote Port
 - vii. General Purpose I/O Output on 8P8C RJ45
3. Integrated DECT Technology RF Receiver The Receiver shall utilize DECT technology. DECT is a radio technology for voice applications. DECT is ideal for the classroom because the use of both frequency and time domain is ideally suited to smaller areas with a large number of users. In each classroom, it will be an independent system, with all necessary electronics to support the receiving & pairing functionality mounted on the wall near the amplifier or in the ceiling. The receiver will be connected to the amplifier through a universal twisted pair cable, using balanced audio connections. Power for the receiver shall be provided through the same cable as the balanced audio connections.
- a. The receiver shall provide the following functionality. These features shall be included on board the receiver, and not require any external support to perform these functions.
 - i. Three Channel DECT based reception
 - ii. Pairing Button for Linking microphone to the receiver
 - iii. Remote control of all three microphone channels
 - iv. Advanced Feedback Blocker
 - a. The system shall have the ability to actively control feedback. This shall be done via an analog circuit that provides up to five active filters to control specific frequencies,
 - b. The Feedback Blocker shall also have the ability to lower the overall of the system by up to 6dB, during a user error situation where the overall system gain is manually turned up too high
 - c. The Feedback Blocker system shall automatically remove the filtering upon resolution of the user-initiated error condition
 - 1. The Feedback Blocker shall be of an analog design – in order to avoid the detrimental effects of digital sampling, only analog systems shall be considered in order to implement this feature.
 - v. Emergency Alert Function
 - a. The system shall provide a trigger signal when the teacher presses and holds a button on her transmitter for more than two (2) seconds.
 - b. The system shall be capable of providing a visual indication of three (3) red LED's when the teacher initiates a trigger signal
 - c. The system shall also be capable of receiving a trigger acknowledgement signal back from an external source, and altering the visual indicator from three (3) red LED's to two (2) Green and one (1) red LED
 - vi. Recording Function
 - a. The system shall provide for a secondary notification that can be used for future applications such as signaling an NDVR (Network Digital Video Recorder) to start a recording
 - vii. Control System Integration
 - a. The system shall have on board the capability of being controlled via RS-232

- protocol.
- viii. The system shall also have the capability of broadcasting RS-232 commands when the teacher presses the up/down volume controls on their microphone
- b. Power Requirements: Integrated power from PoE, receivers requiring secondary power not allowable.
- c. Operating Frequency – 1.9 GHz Band
- d. Receiver Type: DECT
 - i. Controls: System shall have available the following controls
 - a. Channel 1 Volume Control – Fully controllable from the teacher microphone remotely through the DECT system
 - b. Channel 2 Volume Control – Fully controllable from the teacher microphone remotely through the DECT system
 - c. Auxiliary Input Volume Control – Fully controllable from the teacher microphone remotely through the DECT system
 - d. Alert Controls on Teacher Microphone – Two (2) buttons on the sides of the microphone
 - e. Recording Control on Teacher Microphone – One (1) button on the front of the microphone

S. TEACHER BODY PACK TRANSMITTER AUDIO ENHANCEMENT STM-24

1. Provide a body pack transmitter with performance as follows:
 - a. Operating frequency – 1.9 GHz - DECT
 - b. Audio distortion: <1.0% (± 40 kHz deviation @ 1kHz)
 - c. Integrated microphone
 - d. Internal charger circuit
 - e. USB-C Charging Port – shall be capable of being charged from a standard USB port – including a port on a computer
 - f. Power button functionality
 - g. Power on – turns the microphone on when microphone is off and button is pressed
 - h. Mute – mutes the microphone when pressed and released once microphone is turned on
 - i. Power Off – push and hold to turn power off
2. Additional Function (F) Button Features
 - a. SAFE Alert Functionality – Provides security alert when the two (2) buttons on the sides of the microphone are pressed and held for more than two (2) seconds
 - b. Recording Functionality – Provides simple logic signal when the REC button is pressed on the face of the microphone which activates terminals on the receiver
 - c. Secure Room-Identifies when associated with SAFE that a room is secure.
 - d. Intercom-Initiates classroom intercom call to EPIC
 - e. Intercom Call Button– Initiates a 2-way intercom call across the network
 - f. Confirm Room Response Button – allows the teacher to indicate to the front office that they have completed their assigned procedures for the classroom during a lockdown emergency.
3. External Inputs
 - a. Provide an input for an external microphone
 - b. Provide an input for a stereo auxiliary input (Mixed to Mono in microphone)
4. Microphone Element – The teacher microphone shall utilize a 10mm microphone element to insure optimum frequency response and maximum pickup of teacher's voice.
5. Power 1 - LiON Long Life Battery (Systems using two (2) batteries will not be considered)
 - a. Battery style shall be common between handheld microphone and teacher transmitter. Systems that use different batteries in the handheld vs teacher microphone shall not be considered.
6. Provide remote volume control for the system from the teacher's transmitter
 - a. Volume control via the wireless microphone system to allow the teachers to remotely adjust their own volume level.
 - b. Volume control for the other channel from the teacher's microphone
 - c. Volume control for the auxiliary inputs from the teacher's microphone

- d. Side Alert Buttons – Provide remote control functionality that allows for enabling additional multi-use functions from the teacher microphone.
- e. REC Button – Provide a button on the face of the microphone that can be used for multiple purposes.

T. STUDENT HANDHELD TRANSMITTER SSH-24

- 1. Operating frequency – 1.9 GHz - DECT
- 2. Integrated microphone
- 3. Internal charger circuit.
- 4. USB-C Charging Port – must be capable of being charged from a standard USB port – including a port on a computer
- 5. 1/8” (3.5mm) auxiliary input connection - Provide an input for a stereo auxiliary input (Mixed to Mono in microphone)
- 6. Power 1 - LiON Long Life Battery (Systems using two (2) batteries will not be considered)
- 7. Battery style must be common between handheld microphone and teacher transmitter. Systems that use different batteries in the handheld vs teacher microphone will not be considered.
- 8. Operational Modes – the handheld microphone must be equipped with two operational modes
 - a. Push-to-Talk Mode – the user simply depressed the power button to talk, and when released the microphone automatically turns off – this provides for a number of separate microphones to be used consecutively and greatly reduces the chance of channel interference
 - b. Power-On Mode – The user depresses the power button, and slide is vertically into the on position – this holds the microphone in the on state for continuous operation
 - c. Microphone Element – The Handheld microphone shall utilize a 10mm microphone element to insure optimum frequency response and maximum pickup of teacher’s voice.

U. CLASSROOM SPEAKER PERFORMANCE SPECIFICATIONS

- 1. CS-12
 - i. 7” Tile Cut in Speaker
 - ii. Spring loaded mounting tabs
 - iii. Vented Enclosure
 - iv. 8 Ohm Nominal, 50W Continuous Pink Noise
 - v. Sensitivity - 88 dB (1W/1M)
 - vi. Frequency Response 70 Hz - 15 kHz (-10 dB) 100 Hz - 14 kHz +/-2 dB)
 - vii. Speaker back can meets UL2043 criteria for plenum installation.
 - viii. Depth not to exceed 5.8”

V. CLASSROOM INTERCOM WALL PLATES

- 1. Wall plates expand the communication between classrooms and the office.
 - b. WPA-702
 - i. Microphone
 - ii. Green Button for Intercom Call
 - iii. Red button to Initiate an Emergency Alert
- 2. Reference technology floor plans for device locations
- 3. Single gang decora style wall plate
- 4. 8P8C (RJ45) connection
- 5. Matching white decora style face plate

W. AMP INTEGRATED CLASSROOM INTERCOM CALL BUTTON

- 1. Reference technology floor plans for device locations
- 2. Single gang decora style call button white in color
- 3. Green button for intercom call
- 4. 8P8C (RJ45) connection
- 5. Matching white decora style face plate
- 6. WBA-702 includes red emergency button for alerting

- X. CLASSROOM INTERCOM, EMERGENCY ALERT & A/V TOUCH PANEL CONTROL – AUDIO ENHANCEMENT – CAPACITIVE TOUCH CONTROL MODULE (ITC2-M) (OPTIONAL)
1. For all locations where an MS-x00 Classroom Amplifier/Network Interface is specified.
 2. Coordinate with electrical contractor to make sure a double gang electrical box is available – or use an acceptable double gang mounting ring
 3. Provide a simple, standardized control interface for projectors, monitors, display devices, or other AV devices in a compact double-gang form factor. A CUSTOMIZABLE INTERFACE which will allow for a variety of configurations including full color graphical representations of equipment and buttons as well as multi-page capability.
 4. Multiple School Based Configurations for Emergencies
 5. SAFE Room lockdown, secure in place and reporting.
 6. Package Type: Double-Gang Back Lit Capacitive Touch Screen
 7. Dimensions: 4.5” (L) x 4.5” (W) x 1.25” (D)

PART 3 – EXECUTION

3.01 INSTALLATION

- A. The entire system shall be installed in a workmanlike manner, in accordance with approved manufacturers wiring diagrams and these specifications. The contractor shall furnish all conduits, cable tray, surface raceway, wiring, outlet boxes, junction boxes, cabinets etc... as well as all required miscellaneous materials and labor necessary for the complete installation of the cable support / pathway system.
- B. Wiring may be opened wired in cable tray or "J" hooks above accessible suspended lay-in ceilings. Wiring in walls or exposed on walls shall be enclosed in EMT conduit. Cable shall be supported at a minimum of every 5’.
- C. A nylon pull string shall be installed in each conduit / surface raceway run.
- D. Any locations where flexible metal conduit has to be used, it shall terminate to a junction box on both ends and be securely anchored for proper support.
- E. Conduit indications in the drawings are a minimum standard.
- F. All equipment shall be mounted with sufficient clearance for observation, servicing, testing and accessible from either the floor or ladder. If any device is installed in a location that is deemed inaccessible by the Owner and or Architect / Engineer, it will be moved to an accessible location by the contractor at no additional cost to the Owner.
- G. The contractor shall supply access panels where required and as defined by the Architect / Engineer. Contractor to notify the Architect / Engineer immediately if this issue arises during construction.
- H. All penetration of floor slabs and firewalls shall be fire stopped in accordance with all Federal, State and local codes.
- I. All wiring shall be color coded per National Electrical Code requirements and standards.
- J. All conduit ends shall have plastic grommets to protect cable from damage due to sharp edges on the conduit.
- K. Mounting heights and mounting requirements shall be as shown on the drawings.
- L. All junction boxes shall be clearly marked and labeled for easy identification. Flexible connectors shall be used for all devices mounted in suspended lay-in ceiling panels. All conduits, outlet boxes, junction boxes and panels shall be securely installed and anchored with appropriate fittings and connectors to insure positive grounding throughout the entire system.
- M. No wiring except that of this system shall be installed in this systems cable support / pathway system.
- N. Wiring splices shall be made only in designated junction boxes and tagged on both sides of the junction. The junction shall be made on clearly labeled, insulated terminal strip. Transposing or changing the color-coding of the cable is not permitted. Wire nut connectors are not acceptable. System cable and the 120vac power cable shall be in separate conduits.

- O. It shall be the responsibility of the contractor to wire and connect ancillary devices to this system as listed in this specification section.
- P. Any circuits leaving the building to the outside shall be protected by the appropriate transient protection devices as required by the manufacturer to avoid damage to the system if transient surges are inducted on to these circuits (i.e., lighting strikes).
- Q. Contractor to provide in-wall bracing support for all devices that are to be wall mounted to walls that are not masonry block walls.
- R. All devices shall be protected throughout the entire project. All devices shall be kept free of construction dirt and debris during the entire project. The contractor shall be responsible for replacing at no additional cost to the Owner any devices that are deemed dirty or unsuitable for use by the Owner and or Architect / Engineer throughout the entire project.
- S. All cabling and devices shall be labeled with type written labels. Device labels and cable labels shall match the labeling information that is documented on the as-built drawings. Contractor to coordinate labeling schemes and labeling requirements with A/E prior to commencing with final labeling. Labeling system shall be by Brady or Panduit.

3.02 INSTALLER QUALIFICATION

- A. Installer shall have a BICSI RCDD (Registered Communication Distribution Designer) on staff.
- B. Installer shall have an Avixa CTS (Certified Technology Specialist) on staff.
- C. Installer shall be an Authorized Audio Enhancement reseller and be certified in EPIC System, level 1 and level 2.
- D. Installer shall hold an appropriate State Contracting or Electrical License as required.

3.03 FIELD QUALITY CONTROL

- A. The system shall be installed and fully tested as listed in these specifications. The system shall be demonstrated to perform all features and functions as listed in these specifications at a minimum.

3.04 TESTING

- A. Reports of any field-testing during the system installation shall be forwarded to the Owner and Architect / Engineer for review and comment.
- B. Each individual system operation on a circuit-by-circuit basis shall be tested for its complete operation. Any devices that are to be connected to the system shall be tested as specified. Device locations and address / circuit numbers shall be documented on the as-built drawings as well as the wiring configuration of the device circuits. Device locations shall be field verified by the contractor and shall include any costs in the bid that is relating to all devices being connected to the system. The procedure for testing the entire system shall be set forth in these specifications and with the consent and approval of the Architect / Engineer, Owner and equipment manufacturer. Confirm testing requirements with the Owner and Architect / Engineer prior to commencing with system testing.
- C. Perform the tests and adjustments necessary to assure the satisfactory quality and level of performance of the system under normal operating conditions.
- D. Establish the normal settings for all controls and devices for all system operational and functional features and record the same for future reference. All levels shall be set and recorded in the as-built documentation for optimum system performance.
- E. The installation technician from the installer / manufacturer shall perform all system tests as specified. Perform all tests in the presence of the Owner, Architect / Engineer and any designated personnel as deemed necessary by the Owner or Architect / Engineer. This test shall be performed with the devices at their operational location and under normal operational conditions. Bench or default settings for devices are not acceptable. All test and test report costs shall be included in the contractors bid. A checkout report shall be generated by the installation technician and submitted to the Owner and Architect. The report shall include but not be limited to the following:
 - 1. A complete list of all equipment installed with corresponding serial numbers.

2. Indication that all equipment is properly installed, functions and conforms to the specifications.
 3. Serial numbers, locations by device and model number for each installed device.
 4. Technicians name, specified certification credentials and date of system test.
 5. Any additional information as deemed necessary by the Owner and or Architect / Engineer.
- F. A substantial completion test shall be performed before the final test and acceptance of the system by the Owner and Architect / Engineer. At the time of the substantial completion system test, provide to the Owner or his representative an oral explanation of the operation and maintenance of the system. Before starting the tests and adjustments listed above, the contractor shall submit the following to the Owner and the Architect / Engineer for review during the substantial completion test:
1. Preliminary as-built wiring diagrams of the entire system.
 2. Preliminary copy of the operation and maintenance manuals.
 3. Preliminary copy of the system test report form.
- G. If no system performance issues arise during the substantial completion test that need to be repaired by the installation contractor, this can be approved as the final system test by the Owner and or Architect / Engineer. If there are performance issues that arise that do need to be repaired, another complete and comprehensive system test shall be scheduled and performed to show that the necessary repairs have been properly addressed. These tests shall be performed at no cost to the Owner until a time that the system is shown to be in complete operating condition as approved by the Owner and Architect / Engineer.
- H. A commissioning report of all the tested functionality of the system shall be provided by a certified L2 technician by the manufacture or by the manufacture themselves.

3.05 DOCUMENTATION AND TRAINING

- A. After the final system test and the Owner and Architect / Engineer has accepted the system to be in the proper operating condition, the contractor shall compile and provide to the Owner three (3) complete operation and maintenance manuals and three (3) sets of as-built drawings on the completed system to include but not be limited to the following:
1. Operating and maintenance instruction sheets for each piece of equipment showing the proper operation and maintenance of the system component.
 2. Individual factory issued operation and maintenance catalog brochures of all equipment and components that were installed as part of the system. Advertising brochures, submittal data sheets and operational materials shall also be included but shall not be used in lieu of the required technical manuals.
 3. Complete as-built wiring diagrams and floor plan drawings of the complete system installation showing how the system was installed. These drawings shall include any devices that are connected to the system with their address / circuit number documented as well as the wiring configuration of all device circuits. The as-built drawings shall be an updated and revised copy of the submittal drawings showing all modifications made during the installation of the system. A copy of the as-built drawings in electronic format in AutoCAD Release 2014 or higher will be forwarded on to the Owner and Architect / Engineer for archiving in the operation and maintenance manuals.
 4. A statement of guarantee including the date of the termination of the warranty as well as the phone number of the person to be called in the event of equipment failure.
 5. A cover letter, for the above mentioned tests, certifying the entire system and its components, application and installation meets or exceeds the recommendations of the manufacturer, all applicable code requirements and test specifications.
- B. The final and installed version of the system software shall be provided to the Owner on a via electronic means the operation and maintenance manuals. These manuals shall be used for final check out of the system.

END OF SECTION

SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceways and cables.
2. Sleeve seals.
3. Grout.
4. Common electronic safety and security installation requirements.

1.2 SUBMITTALS

- A. Product Data: For sleeve seals.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY 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 electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

- A. Electronic safety and security penetrations occur when raceways, pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 280500

SECTION 280513 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. UTP cabling.
2. Coaxial cabling.
3. RS-232 cabling.
4. RS-485 cabling.
5. Low-voltage control cabling.
6. Control-circuit conductors.
7. Fire alarm wire and cable.
8. Identification products.

1.2 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
- E. RCDD: Registered Communications Distribution Designer.

1.3 PERFORMANCE REQUIREMENTS

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each pair of UTP cable for open and short circuits.

1.7 PROJECT CONDITIONS

- A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.
 - 1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.
- B. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. Support of Open Cabling: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
- B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
 - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry".

2.3 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ADC.
 2. AMP Netconnect; a brand of Tyco Electronics Corporation.
 3. Belden CDT Networking Division/NORDX.
 4. Belden Inc.
 5. Berk-Tek; a Nexans company.
 6. CommScope, Inc.
 7. Draka Cableteq USA.
 8. Genesis Cable Products; Honeywell International, Inc.
 9. Mohawk; a division of Belden.
 10. Superior Essex Inc.
 11. SYSTIMAX Solutions; a CommScope, Inc. brand.
 12. 3M; Communication Markets Division.
- B. Description: 100-ohm, 4-pair UTP, covered with a blue thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 3. Comply with TIA/EIA-568-B.2, Category 6.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 - b. Communications, Riser Rated: Type CMR[; or MPP, CMP, or MPR], complying with UL 1666.
 - c. Communications, Limited Purpose: Type CMX.
 - d. Multipurpose: Type MP or MPG.
 - e. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
 - f. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.4 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ADC.
 2. American Technology Systems Industries, Inc.
 3. AMP Netconnect; a brand of Tyco Electronics Corporation.

4. Belden CDT Networking Division/NORDX.
5. Dynacom Corporation.
6. Hubbell Incorporated; Hubbell Premise Wiring.
7. Leviton Voice & Data Division.
8. Molex Premise Networks; a division of Molex, Inc.
9. PANDUIT CORP.
10. Siemon.

- B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.
- C. Connecting Blocks: 110-style for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.5 RS-232 CABLE

- A. Standard Cable: NFPA 70, Type CM.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with UL 1581.

- B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.6 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CM.

1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

- B. Plenum-Rated Cable: NFPA 70, Type CMP.
 - 1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 - 2. Fluorinated ethylene propylene insulation.
 - 3. Unshielded.
 - 4. Fluorinated ethylene propylene jacket.
 - 5. Flame Resistance: NFPA 262, Flame Test.

2.7 LOW-VOLTAGE CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMG.
 - 1. 1 pair, twisted, No. 16 AWG, stranded (19x29) and No. 18 AWG, stranded (19x30) tinned copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1581.
- B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
 - 1. 1 pair, twisted, No. 16 AWG, stranded (19x29) No. 18 AWG, stranded (19x30) tinned copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with NFPA 262.

2.8 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in raceway.
- B. Class 2 Control Circuits: Stranded copper, power-limited cable, complying with UL 83, concealed in building finishes.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

2.9 FIRE ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Comtran Corporation.
 - 2. Draka Cableteq USA.
 - 3. Genesis Cable Products; Honeywell International, Inc.

Professional Design Engineers

4. Rockbestos-Suprenant Cable Corp.
 5. West Penn Wire; a brand of Belden Inc.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
1. Low-Voltage Circuits: No. 16 AWG, minimum.
 2. Line-Voltage Circuits: No. 12 AWG, minimum.

2.10 IDENTIFICATION PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation.
 2. HellermannTyton.
 3. Kroy LLC.
 4. PANDUIT CORP.
- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP cables according to TIA/EIA-568-B.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA-569-B.
- B. Comply with TIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- E. Pathway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 3 inches (75 mm) above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Division 26 Section "Hangers and Supports for Electrical Systems." for installation of supports for pathways, conductors and cables.

3.3 WIRING METHOD

- A. Install wiring in metal raceways and wireways. Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be [3/4 inch (21 mm)] <Insert size>. Control and data transmission wiring shall not share conduit with other building wiring systems.
- B. Install wiring in raceways except in accessible indoor ceiling spaces where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be [1/2 inch]. Control and data transmission wiring shall not share conduit with other building wiring systems.
- C. Install cable, concealed in accessible ceilings, walls, and floors when possible.

- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.4 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.
- C. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- D. UTP Cable Installation: Install using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.
 - 1. Comply with TIA/EIA-568-B.2.
 - 2. Install 110-style IDC termination hardware unless otherwise indicated.
 - 3. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- E. Open-Cable Installation:
 - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRE ALARM WIRING INSTALLATION

- A. Comply with NECA 1 and NFPA 72.

- B. Wiring Method:
 - 1. Cables may be installed above accessible ceiling spaces without raceway. Cables shall be installed in concealed raceways in walls and finished areas. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
 - 2. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- F. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.6 POWER AND CONTROL-CIRCUIT CONDUCTORS

- A. 120-V Power Wiring: Install according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
- B. Minimum Conductor Sizes:
 - 1. Class 1 remote-control and signal circuits, No. 14 AWG.
 - 2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
 - 3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.7 CONNECTIONS

- A. Comply with requirements in Division 28 Section "Digital Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.8 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA-569-B, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.9 GROUNDING

- A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.10 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.11 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. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

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- D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 280513

SECTION 283111 – FIRE ALARM AND DETECTION SYSTEM – SPEAKER/STROBE (AUDIO
EVACUATION FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract apply to this section.
- B. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:
Division 01 General Requirements
Division 08 Openings, Section 087100 Door Hardware
Division 15 Fire Suppression
Division 15 Heating Ventilating and Air Conditioning
Division 16 Electrical, Section 16 Common Work Results for Electrical

1.2. SUMMARY - FIRE

- A. Provide all permits, labor, equipment, materials and services to furnish and install a fully tested functional, UL Listed, code compliant, intelligent addressable networked fire alarm, emergency communications and active smoke control system including but not limited to all initiation and notification appliances, all raceways and wiring, connection to a central monitoring station.
- B. The 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. 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.
- C. Also included are system wiring, raceways, pull boxes, terminal cabinets, mounting boxes, and any accessories and miscellaneous items required for a code compliant system.
- D. The system drawings show the intended of coverage and suggested device locations. Final device quantity, location, and AHJ approval are the responsibility of the contractor.
- E. The final system shall be complete, tested, and ready for operation as described elsewhere in this specification, before owner acceptance.
- F. 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.

1.3 SUMMARY RELATED WORK - FIRE

- A. The Contractor shall coordinate work in this Section with all related trades. Work and/or

equipment provided in other Sections and related to the fire alarm system shall include, but not be limited to:

1. Sprinkler waterflow and supervisory switches shall be furnished and installed by the fire protection contractor, but wired and connected by the electrical contractor.
2. Duct smoke detectors shall be furnished, wired and connected by the electrical contractor. The HVAC contractor shall furnish necessary duct opening to install the duct smoke detectors.
3. New air handling and smoke exhaust system fan control circuits and status contacts to be furnished by the HVAC control equipment.

1.4 GENERAL CODES

- A. 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.
- B. The bidder shall not attempt to resolve conflicts directly with the local authorities unless specifically authorized by the engineer.

1.8 Fire Alarm - General Requirements

- A. Comply with the provisions of NFPA 72 and the operational requirements of this specification.
- B. The system shall identify all off normal conditions and log each condition into the system as an event.
 1. The system shall automatically display on the control panel Liquid Crystal Display (LCD) the first (oldest) event of the highest priority by type and the most recent event. The event priority shall be alarm, supervisory, trouble, and monitor.
 2. The system shall utilize four sequential event queues.
 3. For each event, the display shall include the event number, the type of event, a 40 character custom user description, and acknowledgement status.
 4. The user shall be able to review the event queue using the rotary controller.
 5. New alarm, supervisory, or trouble events shall sound a distinct, silenceable audible signal at the control panel.
 6. The LCD shall show the system time and the number of active and disabled points in the system, and the number of events in the alarm, supervisory, trouble and monitor queues.
 7. Specific input/output devices shall operate in accordance with the alarm, supervisory, trouble, monitor sections that follow and the input/output matrix.
- C. All critical systems, sub-systems and circuits shall be monitored for integrity. System faults shall be annunciated.
- D. Batteries shall be sized to support the system for 24 Hrs. of standby operation followed by 5 minutes of alarm operation at the end of the 24 Hour period.
- E. 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.

- F. The system shall provide configurable service groups to facilitate “one man” testing of the system based on the physical layout of the building.

1.9 ALARM OPERATION

- A. Upon the alarm activation of any area smoke detector, heat detector, manual pull station, sprinkler water flow, duct smoke detector, the following functions shall automatically occur:
 - 1. 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.
 - 2. The internal audible device shall sound at the control panel or command center.
 - 3. Display the alarm event on the graphical workstation.
 - 4. The LCD Display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location and time/date.
 - 5. All system activity/events shall be documented on the system printer and logged into system history.
 - 6. Any remote or local annunciator LCD/LED's associated with the alarm zone shall be illuminated.
- B. The following audio messages and actions shall occur simultaneously:
 - 1. An evacuation message shall be sounded on all floors (zones) - 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.
- C. Activate visual strobes - general alarm evacuation>. The visual strobe shall continue to flash until the system has been reset.
- D. Transmit signal to the central monitoring station with point identification.
- E. All self-closing fire/smoke doors held open shall be released.

1.10 SUPERVISORY OPERATION

- A. Upon supervisory activation of any sprinkler valve supervisory switch, water flow, duct smoke detector, clean agent fire suppression system trouble, the following functions shall automatically occur:
 - 1. The internal supervisory event audible device shall sound at the control panel.
 - 2. Display the event on the graphical workstation and display a pictorial image.
 - 3. The LCD display shall indicate all applicable information associated with the supervisory condition including; zone, device type, device location and time/date.
 - 4. All system activity/events shall be documented on the system printer and logged to system history.
 - 5. Any remote or local annunciator LCD/LED's associated with the supervisory zone shall be illuminated.
 - 6. Transmit signal to the central monitoring station with point identification.

1.11 TROUBLE OPERATION

- A. 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:
 - 1. The internal panel audible device shall sound at the control panel.
 - 2. Display the event on the graphical workstation and display a pictorial image.
 - 3. The LCD keypad display shall indicate all applicable information associated with the trouble condition including; zone, device type, device location and time/date.
- B. 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.
 - 1. All system activity/events shall be logged to system history.
 - 2. Any remote or local annunciator LCD/LED's associated with the trouble zone shall be illuminated.
- C. Transmit a trouble signal to the central monitoring station with point identification.

1.14 PRODUCT DATA

- A. 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.
- B. For each product submitted provide the following information:
 - 1. Manufacturer's catalog data, to include material description, agency approvals, operating characteristics, electrical characteristics, dimensions, mounting requirements and accessories.
 - 2. Manufacturer's product installation sheets: A copy of the documentation that is required to be shipped with all listed products by UL.

1.16 DESIGN CALCULATIONS

- A. 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.
- B. 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.

1.17 TESTING

- A. Before proceeding with any testing, all persons, facilities and building occupants whom receive alarms or trouble signals shall be notified by the contractor to prevent unnecessary response or building occupant distress. At the conclusion of testing, those previously notified shall be notified that testing has been concluded.

- B. The manufacturer's authorized representative shall provide on-site supervision of installation of the complete fire alarm system installation, perform a complete functional test of the system, and submit a written report to the Contractor attesting to the proper operation of the completed system prior to final inspection.
- C. Contractor shall pre-test each and every device in the system before the system is considered ready for final inspection.
- D. Upon the completion of a successful test, and prior to the final request for payment the Contractor shall:
 - 1. Certify the system to the Owner in writing
 - 2. Complete the NFPA 72 record of completion form
 - 3. Provide as built and O&M manuals.
 - 4. Provide a signed statement that the Owner had received the specified system operation and maintenance training
- E. The final payment will not be processed unless these documents are complete and are on hand.

1.18 WARRANTY

- A. The Contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of two (1) years from the date of substantial completion of the project.
- B. At the end of the project, the Contractor shall post the warranty period along with the company's name and telephone number inside the fire alarm panel.
- C. Warranty service for the equipment shall be provided by the system supplier's factory trained representative. Further, Warranty shall include all parts, labor and necessary travel.

1.19 TRAINING

- A. The Contractor through his/her supplier shall provide, as part of this contract, a minimum of (2) hours system operation training for owner, the Architect/Engineer, and fire department personnel.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Edwards Systems Technology
- B. Siemens
- C. Notifier

2.2 FIRE ALARM PANEL - OVERVIEW

- A. 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.
- B. The fire alarm control panel(s) shall be a multi-processor based networked system designed specifically for fire, one-way emergency audio communications application. The control panel shall be listed and approved for the application standard(s) as listed in the References section of this specification.
- C. 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.

2.3 FIRE ALARM PANEL - SYSTEM FEATURES

- A. Each control panel shall include the following capabilities:
 1. Supervision of the system electronics, wiring, detection devices and software
 2. Up to 1000 analog/addressable input/output points.
 3. Support multiple dialers (DACTs) and modems
 4. User configurable switches and LED indicators to support auxiliary functions
 5. Log up to 500 chronological events
 6. The ability to download all applications and firmware from the configuration computer at a single location on the fire network
 7. A real-time clock for time stamps and timed event control
 8. Electronic addressing of intelligent addressable devices
 9. Provide an independent hardware watchdog to supervise software and CPU operation
 10. "Dry" alarm, trouble and supervisory relay contacts
 11. An optional 10/100 Base-T Ethernet port for network programming, diagnostics and monitoring.
 12. Control panel modules shall plug in to a chassis assembly for ease of maintenance
 13. Field wiring shall connect to the panel using removable connectors

2.4 FIRE ALARM PANEL - PROGRAMMABILITY

- A. 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.
- B. 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.

- C. The fire alarm control panel shall be an Edwards EST3X or iO series panel.

2.5 FIRE ALARM PANEL - POWER SUPPLY

- A. System power supply(s) shall be a high efficiency switched mode design providing four (4) 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.
- B. 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. When powered from batteries, the power supply shall employ "Voltage Boost" technology to insure that output voltage never drops below 22.5 VDC regardless of battery voltage.
- C. 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.
- D. Batteries shall utilize sealed lead acid chemistry

2.6 FIRE ALARM PANEL - AUDIO ANNUNCIATION AND CONTROL

- A. 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.
- B. All audio messages and live pages shall originate at the one-way audio control unit. The one-way audio control unit shall store up to two (2) 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.
- C. The system shall automatically deliver a preannounce tone of 1000 Hz for three seconds when the emergency operator presses the microphone PTT key.
- D. The master one-way emergency audio control unit shall be an Edwards 3X-PMI.

2.7 FIRE ALARM PANEL - REMOTE MICROPHONE

- A. Remote microphones shall be included in the remote annunciator(s) as indicated on the fire alarm drawings.
- B. The remote microphone shall feature a Push-to-Talk switch; local and remote page active LEDs, and a trouble LED.

- C. The remote microphone shall operate on filtered-regulated 24 VDC power derived from the panel power supply. Power shall be supplied directly from the ACU/FACP or listed auxiliary power supply, ensuring a reliable and monitored power source.

2.8 FIRE ALARM PANEL - SIGNALING LINE CIRCUITS

- A. The signaling line circuit connecting panels/nodes to intelligent addressable devices including, detectors, monitor modules, control modules, isolation modules, intrusion detection modules and notification circuit modules shall be Class B (style 4). All signaling line circuits shall be supervised and power limited.
- B. Each SLC shall support 125 addressable detector addresses and 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.
- C. T-taps (branching) shall be permitted on Class B circuits. Where possible, the devices installed at the end of each branch should be easily accessible for troubleshooting, e.g. a pull station at normal mounting height.
- D. The SLC module shall allow replacement of “same type” devices without the need to address and reload the “location” parameters on replacement device.

2.9 FIRE ALARM PANEL - NOTIFICATION APPLIANCE CIRCUITS

- A. General
 - 1. 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").
 - 2. Initial circuit loading shall not exceed 80% in order to allow for future system expansion.
- B. 24 VDC Notification Appliance circuits
 - 1. 24VDC NACs shall be polarized and provide both strobe synchronization and a horn silence signals on a single pair of wires.
- C. Audio Notification Appliance Circuits

Audio notification appliance circuits shall be polarized and have a minimum circuit output rating of 50 watts @ 25V audio, and 35 watts @ 70V audio.

2.10 FIRE ALARM PANEL - AUDIO AMPLIFIERS

- A. 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.

- B. 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.
- C. Audio amplifiers shall be Edwards SIGA, ZA, or ANS series devices.

2.11 OFF PREMISES COMMUNICATIONS - DACT

- A. 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.

2.12 REMOTE BOOSTER POWER SUPPLY

- A. Install Remote NAC Power Supplies (boosters) at the locations shown on the drawings, 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.
- B. 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 10 amps.
- C. The remote NAC power supplies shall be Edwards model BPS/APS series devices.

2.13 ANNUNCIATORS

- A. Provide a UL864 listed remote annunciator at the location(s) shown on the drawings. The annunciators shall be semi-flush mounted. The annunciator shall display the same text information on the 80 character back-lit LCD as the FACP to which it is connected.
- B. The following common indicators shall be provided on the annunciator.
 - 1. Annunciator Power, Fire Alarm, Supervisory, Ground Fault, Trouble, Controls Enabled and Ack/Silence LEDs; and an internal buzzer.
- C. Common controls shall be provided on the annunciator:
- D. The fire alarm remote annunciator shall be Edwards R-Series annunciator.

2.15 PERIPHERAL COMPONENTS - PHOTOELECTRIC

- A. Provide analog/addressable photoelectric smoke detectors at the locations shown on the drawings.
- B. The photoelectric smoke detector shall be an Edwards SIGA-PD.

2.16 PERIPHERAL COMPONENTS - DUCT SMOKE

- A. Provide intelligent low profile photoelectric duct smoke detectors / remote test switches at the locations shown on the drawings.
- B. The Intelligent Photoelectric Duct Smoke Detector shall be an Edwards model SIGA-SD.
- C. The remote key operated test switch / LED shall be a Edwards model SD-TRK.

2.17 PERIPHERAL COMPONENTS - FIXED HEAT

- A. Provide intelligent fixed temperature heat detectors at the locations shown on the drawings.
- B. 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. The Intelligent fixed temperature detector shall be an Edwards SIGA-HFS.

2.18 PERIPHERAL COMPONENTS - RATE OF RISE

- A. Provide intelligent combination fixed temperature / rate-of-rise heat detectors at the locations shown on the drawings.
- B. The heat detector shall be rated for ceiling installation at a minimum of 70 ft centers and also be suitable for wall mount applications. The Intelligent combination fixed temperature / rate-of-rise heat detector shall an Edwards SIGA-HRS.

2.19 PERIPHERAL COMPONENTS - STANDARD BASE

- A. 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.
- B. Removal of the respective detector shall not affect communications with other detectors.
- C. The standard addressable detector base shall be an Edwards SIGA-SB or SB4.

2.20 PERIPHERAL COMPONENTS - DOUBLE ACTION SINGLE STAGE

- A. Provide addressable double action, single stage fire alarm stations at the locations shown on the drawings.
- B. 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.

- C. The addressable double action, single stage manual fire alarm station shall be an Edwards SIGA-278.

2.21 MODULES - GENERAL

- A. 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.
- B. The addressable multifunction modules shall Edwards Signature Series devices.

2.22 MODULES

- A. Provide addressable single or dual input multifunction modules at the locations shown on the drawings.
- B. 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.
- C. Each module shall identify and report by device address, ground faults and opens associated with its initiating device circuit, to the control panel. Single function modules or without individual ground fault detection identification capability shall not be considered as equal.
- D. The Intelligent Single Input Module shall be an Edwards SIGA-CT1, or SIGA-CT2.

2.24 MODULES - RELAY

- A. Provide addressable control relay modules at the locations shown on the drawings.
- B. The module shall be suitable for mounting on a North American 2 ½" (64mm) deep 1-gang box or 1 ½" (38mm) deep 4" square box with 1-gang covers.
- C. The addressable control relay module shall be an Edwards SIGA-CR

2.25 NOTIFICATION APPLIANCES - GENERAL

- A. 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.
- B. All strobes shall be provided with lens markings oriented for wall mounting. Exterior mounted

devices shall be provided with a weatherproof back box.

- C. All visual appliances shall be synchronized. Light and audible output levels shall be designed to meet ADA and NFPA requirements
- D. All notification appliances shall be white unless noted otherwise on the drawings.

2.27 NOTIFICATION APPLIANCES - SPEAKER-CEILING

- A. Provide low profile ceiling mounted speaker at the locations shown on the drawings.
- B. Speakers 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.
- C. 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.
- D. The speaker shall provide in and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.
- E. The low profile ceiling mounted speaker shall be an Edwards Genesis GC series.

2.28 NOTIFICATION APPLIANCES - SPEAKER-STROBE-WALL

- A. Provide low profile wall mounted speaker-strobes at the locations shown on the drawings.
- B. 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.
- C. 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.
- D. The strobe output shall be switch selectable as required by its application from the following available settings: 15cd, 30cd, 75cd & 110cd.
- E. The low profile wall mounted speaker-strobes shall be an Edwards G4 series.

2.29 NOTIFICATION APPLIANCES - SPEAKER-STROBE-CEILING

- A. Provide low profile ceiling mounted speaker-strobes at the locations shown on the drawings.

- B. 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.
- C. 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.
- D. 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
- E. The low profile ceiling mounted speaker-strobes shall be an Edwards Genesis GC series.

2.30 NOTIFICATION APPLIANCES - SPEAKER-STROBE-WEATHERPROOF

- A. Provide low profile weatherproof speaker-strobes at the locations shown on the drawings.
- B. The weatherproof speaker-strobes shall mount in a North American 4" square 1 1/2" deep electrical box for indoor applications without a trim skirt 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 weatherproof speaker-strobes shall be Edwards Genesis WG4 Series.

2.31 MAGNETIC DOOR HOLDERS

- A. Provide fail safe electromagnetic door holders as shown on the drawings.
- B. The electromagnetic door holders shall be Edwards 1500 series.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. The entire system shall be installed in a skillful manner in accordance with approved manufacturer's installation manuals, shop drawings and wiring diagrams.
- B. All work shall be performed in accordance with the requirements of NFPA 70 and NFPA 72.
- C. Coordinate locations of all devices with all other divisions' drawings and specifications.
- D. 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.
- E. Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces.
- F. All systems and system components listed to UL864 Control Units for Fire Protective Signaling Systems maybe 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.
- G. No wiring except life safety system circuits and system power supply circuits shall be permitted

in the control panel enclosures.

- H. 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.
- I. 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.

3.2 ELECTRICAL INSTALLATION

A. BOXES, ENCLOSURES AND WIRING DEVICES

- 1. Boxes shall be installed plumb and firmly in position.
- 2. Extension rings with blank covers shall be installed on junction boxes where required.
- 3. Junction boxes served by concealed conduit shall be flush mounted.
- 4. Fire alarm system junction box covers shall be painted red.

B. CONDUCTORS

- 1. Each conductor shall be identified as shown on the drawings 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.
- 2. Maintain a consistent color code for fire alarm system conductor functions throughout the installation.
- 3. All wiring shall be installed in compliance with the National Electric Code, NFPA 70, and the equipment manufacturer's requirements.
- 4. Wiring for Signaling Line Circuit and Initiating Device Circuit field wiring shall be solid copper, No. 16 AWG pair conductors at a minimum. Speaker circuits; 16 AWG twisted 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.
- 5. All wiring shall be checked and tested to insure that there are no grounds, opens or shorts.

C. DEVICES

- 1. All devices and appliances shall be mounted to or in an approved electrical box.

D. RACEWAYS

- 1. Conduits shall be sized according to the conductors contained therein. Cross sectional area percentage fill for system conduits shall not exceed 40%.
- 2. Install all conductors in rigid metal conduit or electro-metallic tubing (EMT), utilizing set screw and/or 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.
- 3. 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.
- 4. Run conduit or tubing concealed in finished areas unless specifically shown otherwise on the drawings. Conduit may be exposed in unfinished mechanical/electrical rooms, and basement levels.

5. 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.
 6. Wiremold on existing walls may be used where approved by School facility department.
- E. Open cable will not be allowed where exposed. Open cable may be used where concealed above an accessible ceiling.

3.3 FA COMPONENTS

- 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.
- C. Fire Alarm Control Panels
1. Mount the enclosure with the top of the cabinet 72" above the finished floor or center the cabinet at 63", whichever is lower.
 2. Grounds shall comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- D. Remote power supplies and auxiliary fire alarm panels
1. 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.
 2. Do not locate these panels above ceilings or where inaccessible by a person standing on the finished floor of the space.
 3. Label the power supplies and auxiliary FACPs with the room number, electrical panel number and circuit breaker number feeding them.
 4. Paint the handles of the dedicated circuit breakers feeding fire alarm panels red, and install handle locks.
 5. Within the panel, all non-power limited wiring must be properly separated from power limited circuits.
- E. Manual Pull Stations
1. Mount stations so that their operating handles are between 42" and 48" above the finished floor.
- F. Notification Appliances: Mount assemblies as follows:
1. 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.
 2. Each speaker's (horn) output shall be set to the wattage value indicated for its specific location as shown on the drawings.
 3. Each strobe's output shall be set to the candela value indicated for its specific location as shown on the drawings.
 4. Each speaker (horn)-strobe's outputs shall be set to the wattage/candela value indicated for its specific location as shown on the drawings.

5. Where ceiling height exceeds 30 feet, appliances shall be suspended from the ceiling to a height of 30 feet maximum above the finished floor.
 6. Appliances installed outdoors shall be UL listed for outdoor use.
- G. Smoke Detectors:
1. 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.
 2. Detectors located on the wall shall have the top of the detector at least 4" below the ceiling.
 3. On smooth ceilings, detectors shall not be installed over 30 ft. apart in any direction.
 4. Install smoke detectors no closer than 3 ft. from air handling supply air diffusers or return air openings.
 5. Locate detectors no closer than 12" from any part of a lighting fixture.
- H. Duct Smoke Detectors:
1. Install sampling tubes so they extend the full width of ducts exceeding 36".
 2. Detectors shall be located to facilitate ease of maintenance.
 3. All penetrations near detectors located on/in return ducts shall be sealed to prevent air entry.
- I. End-of-Line Resistors
1. Devices containing end-of-line resistors shall be appropriately labeled.
- J. Remote Status and Alarm Indicators:
1. Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- K. Heat Detectors
1. Heat detectors shall be installed in strict accordance with their UL listing and the requirements of NFPA 72.
 2. 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.
- L. Addressable Control (relay) Modules
1. Install the module less than 3 feet from the device controlled.
 2. Orient the device mounting for best maintenance access.
 3. Label all addressable control modules as to their function.
 4. 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.

3.4 FIRE STOPPING

- A. Provide fire stopping for holes at conduit penetrations through floor slabs, fire rated walls, partitions with fire rated doors, corridor walls, and vertical service shafts in accordance with the

fire stopping provisions of this contract.

SECTION 31 23 00 EXCAVATION AND FILL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements, if attached, apply to the work specified in this section.
- B. Related Work Specified Elsewhere:
 - 1. Watering for Embankments - Section 31 23 11

1.02 DESCRIPTION OF WORK

- A. The Work covered by this section of the specifications shall consist of furnishing all plant, labor, and equipment, appurtenances and material, and of performing all operations in connection with the excavation, embankment, compaction, topsoiling, and grading required for the reconstruction of the City streets in accordance with these specifications and in conformity with the dimensions and typical sections shown on the plans and with the lines and grades established by the Engineer.
- B. The Owner's representative will provide the initial and final grade stakes as discussed in Section 01 32 23. The Contractor shall be responsible for providing all interim slope and grade staking and other staking as may be necessary to complete construction.

1.03 CLASSIFICATION OF EXCAVATION

- A. "Unclassified Excavation" shall include all excavation performed under this section regardless of the material encountered.

1.04 QUALITY ASSURANCE

- A. During the construction of the subgrade, a representative of the Owner shall be on site to allow for the examination of the exposed subgrade.
- B. In-place density tests will be taken, by the Owner's representative, on each layer of the subgrade as directed by the Geotechnical report.
- C. The Contractor will conduct additional soil tests and quality control testing as desired for his own information and use. The Contractor shall have submitted directly to the Engineer with copies to the Owner, three (3) copies of all field and laboratory tests and reports of inspections performed by him or his agents.
- D. All grades shall be finished to within 0.10 feet of the final elevations as staked by the Owner's authorized representative.

PART 2 PRODUCTS

2.01 CONTRACTOR FURNISHED BORROW (if required)

*A. Borrow Material furnished by the Contractor shall be clean earthen fill material free from sticks, roots, stones larger than 3 inches and other deleterious material. **Prior to any hauling the Contractor shall furnish laboratory test results showing the classification of the borrow material by the Unified Soil Classification System (USCS), Liquid Limit, Plasticity Index and Standard Proctor w/ Max Density at Optimum Moisture.** The Borrow material shall meet the USCS requirements for the following soil classifications: (SC) Clayey Sands and (CL) Sandy Clays.*

PART 3 EXECUTION

3.01 GENERAL

- A. The excavation shall be carried to the elevations or depths required to obtain the specified depths as shown on the plans. Should the Contractor, through negligence or other fault, excavate below the designated lines or elevations, he shall replace the excavation with suitable materials and properly compact and control the moisture content in a manner as specified herein under "Formation of Embankments". All replacement work shall be at the Contractor's expense.
- B. The Contractor shall inform and satisfy himself as to the character, quantity, and distribution of all material to be excavated. No payment will be made for any excavated material which is used for purposes other than those designated. All spoil areas shall be leveled to a uniform line and section and shall present a neat appearance before project acceptance.
- C. Those areas outside of the embankment areas in which the top layer of soil material becomes compacted due to hauling or to any other activity of the Contractor shall be scarified and disced to a depth of 4 inches as directed to loosen and pulverize the soil.
- D. If it is necessary to interrupt existing surface drainage, sewers, or under drainage, conduits, utilities, or similar underground structures, or parts thereof, the Contractor shall be responsible for and shall take all necessary precautions to protect and preserve or provide temporary service. When such facilities are encountered, the Contractor shall notify the Engineer. The Contractor, at his own expense, shall satisfactorily repair all damage to such facilities or structures which may result from any of his operations during the period of the contract.
- E. The Contractor shall supervise the excavation, moving, placing, and deposition of all material and shall, with the assistance of the Engineer and/or his representative, determine the suitability of materials to be placed in embankments. All material determined to be unsuitable and all excess shall be disposed of in the appropriate areas as shown on plans, or in the outer portions of the embankments.
- F. Topsoil shall not be used directly below any areas to receive surfacing.

3.02 STRIPPING

- A. All vegetation such as brush, heavy sods, heavy growth of grass, decayed vegetation, rubbish, roots, and any other unsuitable material within the area to which excavation is to occur, or upon which embankment is to be placed, shall be cleared, stripped, grubbed, and disposed of, before the excavation of suitable materials or a formation of embankment is started.
- B. In no case shall such objectionable material be allowed in or under the subgrades for any areas to receive surfacing.
- C. All depressions or holes below the ground surface, whether caused by grubbing or otherwise, shall be backfilled with suitable material and compacted to the ground surface elevation or up to twelve (12) inches below the proposed final subgrade elevation before the construction of the embankment will be permitted to start.

3.03 EXCAVATION OF SUITABLE MATERIAL

- A. Excavation shall be performed to the lines, grades, and elevations as indicated in the plans or as directed by the Engineer and shall be made so that the requirements for formation of embankments and floor can be followed. No excavation or stripping shall be started until the Engineer has taken cross sectional elevations and measurements of the existing ground surface and has provided control stakes for the proposed work. During the process of excavation, the grade shall be maintained so that it will be properly drained at all times. Temporary drains and drainage ditches shall be installed to intercept or divert all surface water which may affect the work.
- B. The suitable excavation material shall be handled in such a manner as to allow the material to be properly placed and compacted in the fill areas.
- C. The Contractor shall make the distribution of the excavated material as indicated in the plans. Widening or narrowing of the section and raising or lowering of the grade to avoid haul will not be permitted. The right is reserved by the Engineer to make minor adjustments or revisions in lines or grades if found necessary as the work progresses to obtain satisfactory construction.
- D. Stones or rock fragments larger than 4 inches in their greatest dimension will not be permitted in the top eight (8) inches of the subgrade or embankment.
- E. All cut-and-fill slopes shall be uniformly dressed to the slope, cross section, and alignment as shown in the plans.
- F. No payment or measurement for payment will be made for suitable materials removed, manipulated, and replaced in order to obtain required density. Any removal, manipulation, aeration, replacement, and recompaction of suitable materials necessary to obtain the required density shall be considered as incidental to the excavation and embankment operations and shall be performed by the Contractor at no additional compensation.

3.04 STOCKPILING

- A. If at the time of excavation it is not possible to place any material in its proper section of the permanent construction, it shall be stockpiled in approved areas for later use at no extra cost to the Owner.
- B. The stockpiled material shall be handled and placed as specified in the section of these

specifications covering excavation, embankment, and topsoil.

- C. Stockpiles of topsoil or any other material shall be located within the project limits as near the final placement site as practicable. When stockpiling within the project limits is not possible, it shall be the Contractor's obligation to arrange for and maintain stockpile sites at his own expense. Stockpiles of topsoil shall not be placed within 50 feet of embankment areas and shall not be placed on areas which subsequently will require any excavation or embankment.
- D. Prior to Completion of the Work, the Contractor shall obtain and furnish to the Owner a lien waiver or a letter of satisfaction written by the owner of the stockpile area property and addressed to the Contractor.

3.05 EXCESS EXCAVATION

- A. When the volume of excavation exceeds that required to construct the embankments to the grades indicated, the excess shall be used to grade the areas of ultimate development or wasted in areas secured by the Contractor, subject to the approval of the Engineer and the Owner. In general, suitable excess excavation will be used in the widening of embankments, flattening of slopes, etc.
- B. If it is necessary to dispose of any material, it shall be disposed of in such a manner as to present a neat appearance and to not obstruct proper drainage or cause damage to abutting property.

3.06 PREPARATION OF EMBANKMENT AREA

- A. Prior to the placement of any fill material beneath the proposed trail, the entire layer of topsoil upon which the embankment is to be placed, except where limited by solid rock, shall be removed for its entire depth to the bottom of the natural existing topsoil.
- B. A minimum of six (6) inches of material below the bottom of the natural existing topsoil or to the depth as previously described shall be scarified for the entire width of the subgrade embankment. The area shall be scarified in furrows uniformly spaced so that at least 50% of the surface will be broken to the required depth. All roots, debris, large stones, or objectionable material that would cause interference with the compaction of the foundation for fill shall be removed from the area and disposed of as specified.
- C. After removal and scarifying of the topsoil and other material under the embankment areas, the area should be examined by the Contractor for the existence of unsuitable materials. The Contractor shall notify the Engineer if he feels that unsuitable materials exist. The volume of unsuitable material shall be determined by cross sectioning the area before and after removal. The area of unsuitable material shall be removed to a depth as shown in the plans or as directed by the Owner's representative. The area shall be filled and compacted in accordance with "Formation of Embankments".
- D. A thin layer (approximately 3 inches) of the fill material shall then be uniformly spread over the scarified foundation and the whole area compacted to ##% (see Geotechnical report) of maximum density as determined by standard proctor ASTM Test Designation D698 at a moisture content between 3% under and 3% over optimum.
- E. Except for the undercut of unsuitable materials which lie at a depth greater than six (6) inches below finished grade elevation in areas previously described, no direct payment shall be

made for work performed under this section.

3.07 FORMATION OF EMBANKMENTS

- A. Embankments shall be formed of satisfactory materials placed in successive horizontal layers of not more than 8 inches loose depth for the full width of the cross section.
- B. The grading operations shall be conducted and the various soil strata shall be placed to produce a soil structure as shown in the typical cross section or as directed. All materials entering the embankment shall be reasonably free of organic matter such as leaves, grass, roots, and other objectionable material. Soil, granular material, shale, and any other material permitted for use in embankment shall be spread in successive layers as specified.
- C. The subgrade embankments shall be constructed from the in-place non-organic soils.
- D. Operations on earthwork shall be suspended at any time when satisfactory results cannot be obtained because of rain, freezing weather, or other unsatisfactory conditions of the field. The Contractor shall drag, blade, or slope the embankment to provide proper surface drainage. Frozen material shall not be placed in the embankment nor shall embankments be placed over frozen material.
- E. The material in the layers shall be of the proper moisture content before rolling to obtain the prescribed compaction. Wetting or drying of the material and manipulation when necessary to secure a uniform moisture content throughout the layer shall be required. Should the material be too wet to permit proper compaction or rolling, all work on all portions of the embankment thus affected shall be delayed until the material has dried to the required moisture content. Sprinkling shall be done in accordance with the requirements of Section 31 23 11. Samples of embankment materials for testing, both before and after placement and compaction, will be taken. From these tests, corrections, adjustments, and modifications of methods, materials, and moisture content will be made to construct the embankment.
- F. Where a large portion of the materials excavated consist of rock, the rock may be used in the construction of the embankment as hereinafter specified:
 - 1. The maximum dimension of any rock used shall not exceed 12" maximum.
 - 2. Rocks shall be carefully distributed throughout the embankment and imbedded with earth or other fine material so that the interstices between the large particles are filled and a dense, compact, uniform embankment is secured.
 - 3. No rock larger than 4" in any direction will be allowed in the upper eight (8) inches of any embankment as this portion of the embankment shall be composed solely of earth or other suitable material.
- G. The Contractor shall be responsible for the stability of all embankments made under the contract and shall replace any portion which in the opinion of the Engineer has become displaced due to carelessness or negligence on the part of the Contractor. The Contractor shall plan his work so that the necessary compaction tests on each lift can be completed prior to placing additional lifts of material.

3.08 DIVERSION DITCHES AND DRAINAGE PROVISIONS

- A. If it is necessary, in the prosecution of the work, to interrupt the natural drainage of the surface, or the flow of artificial drain, the Contractor shall provide temporary drainage

facilities that will prevent damage to public or private interests and shall restore the original drains as soon as the work will permit. The Contractor shall, at his own expense, take all measures necessary to properly drain the work site. The Contractor shall be held liable for all damages which may result from neglect to provide for either natural or artificial drainage which his work may have interrupted. All temporary diversion ditches shall be of adequate size to handle any anticipated flow.

B. Diversion ditches which are to be permanent shall conform to the shape required in the plans.

3.09 TOPSOIL

A. The topsoil shall be stripped and stockpiled from the regular grading areas and placed on all disturbed areas, at the conclusion of the project, as shown on plans.

B. All topsoil removed from the excavation areas shall be salvaged (on areas to be grass, topsoil shall be replaced at conclusion of the project).

C. The stockpiling of topsoil shall be in accordance with the requirements of paragraph 3.04.

3.10 TOLERANCES

A. The subgrade and all other graded surfaces shall be of such smoothness that it will not vary more than 0.10 of a foot from true grade as established by grade hubs. Any deviation in excess of this amount shall be corrected by loosening, adding, or removing materials, reshaping, and compacting.

3.11 WATERING FOR EMBANKMENTS

A. Refer to Section 31 23 11 - Watering for Embankments.

3.12 EQUIPMENT

A. The Contractor may use any type of earthmoving, compaction, and watering equipment he may desire or has at his disposal, provided the equipment is in a satisfactory condition and is of such capacity that the construction schedule can be maintained as planned by the Contractor and as approved by the Owner in accordance with the completion schedule specified for the construction. The Contractor shall furnish, operate, and maintain such equipment as is necessary to control uniform density, layers, section, and smoothness of grade.

3.13 HAUL

A. No payment will be made separately or directly for haul on any part of the Work. All hauling will be considered a necessary and incidental part of the Work, and its cost shall be considered by the Contractor and included in the contract price for the work involved.

PART 4 MEASUREMENT AND PAYMENT

4.01 METHOD OF MEASUREMENT

- A. In the event unsuitable material is encountered during subgrade construction, and the Contractor has requested in writing and received the Engineer's approval, measurement of the additional amount of excavation required, payment for excavation, removal and disposal of said unsuitable material shall be on a cubic yard basis at the contract unit price bid for unclassified excavation.

4.02 BASIS OF PAYMENT

- A. Payment for unsuitable material shall be on a cubic yard basis at the contract unit price bid for unclassified excavation.

* * * END OF SECTION * * *

SECTION 31 23 11 WATERING FOR EMBANKMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work of this section.
- B. Related Work Specified Elsewhere:
 - 1. Excavation and Fill - Section 31 23 00

1.02 DESCRIPTION OF WORK

- A. This item shall consist of furnishing and applying water required in the compaction of embankments and/or the clay cover, and for other purposes in accordance with the requirements of these specifications or as directed.

PART 2 PRODUCTS

2.01 WATER SOURCE

- A. The Contractor shall obtain a Temporary Water Rights Permit to use water for construction, testing, or drilling purposes from the SD Department of Agriculture and Natural Resources for all water sources. Contact DANR by phone at 605 773-3352 for more information.
- B. The Contractor shall be responsible to provide own source of water for construction. Contractor shall obtain all federal, state, and local permits necessary for sources provided by Contractor. Upon receipt of the permits the Contractor shall submit two copies to the Engineer for his review and approval prior to removal of any water.
- C. The Contractor shall be responsible for all measures necessary to protect the health and safety of all personnel with access to the site.

PART 3 EXECUTION

3.01 CONSTRUCTION METHODS

- A. Water, when required, shall be applied at the locations, in the amounts, and during the hours, including nights, as required. An adequate water supply shall be provided by the Contractor.
- B. The equipment used for watering shall be of ample capacity and of such design as to assure uniform application of water in the amounts required.
- C. Contractor shall provide information to Engineer on size or capacity of water vehicle used and shall provide daily load counts to the Resident Project Representative.

*** END OF SECTION ***

SECTION 31 23 14 SHEETING, SHORING, AND BRACING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Supplementary Conditions shall apply to work covered in this section.
- B. Related requirements specified elsewhere:
 - 1. Trenching, Backfilling and Compacting - Section 31 23 33
 - 2. Sanitary Sewer Piping and Fittings – Section 33 31 00

1.02 DESCRIPTION OF WORK

- A. Furnish and install all necessary sheeting, shoring, and bracing to adequately protect all new and existing structures, all existing piping as may be required during construction period, and all new piping.

PART 2 PRODUCTS

2.01 MATERIALS AND CONDITION

- A. All sheeting, shoring, and bracing shall be in good or new condition and shall conform to the requirements of current safety codes and guidelines.

PART 3 EXECUTION

3.01 METHODS

- A. All excavation shall be properly shored, sheeted, and braced to furnish safe working conditions conforming to the current codes, regulations, and guidelines; to prevent any shifting and movement of material which may endanger personnel; to prevent damage to structures, or other work; and to avoid delay to the work.
- B. Bracing shall be so arranged as not to place any strain on portions of completed work until the general construction has proceeded far enough to provide ample strength. If the Engineer is of the opinion that at any point the sheeting or supports furnished are inadequate or unsuited for the purpose, he may order additional sheeting or support to be installed. Whether so ordered by the Engineer or not, sufficient sheeting or support shall be installed to protect the work from any damage to new structures.
- C. Trench sheeting shall remain in place until pipe, etc., has been laid, tested for defects, and repaired if necessary, and the earth around it compacted to a depth of one foot over the top of the pipe. Timber sheeting if used shall not be removed below an elevation of two feet above the top of the pipe.
- D. No sheeting, shoring, and bracing which is within three feet of the surface of the finished grade may be left in place without the written permission of the Engineer.
- E. In general, the sheeting and bracing shall be removed as the excavation is refilled in such a

manner as to avoid the caving in of the bank or disturbance to adjacent areas or structures. The voids left by the withdrawal of the sheeting shall be carefully filled by ramming or otherwise as directed. Permission of the Engineer shall be obtained before the removal of any shoring, sheeting, or bracing.

- F. It shall be the duty and responsibility of the Contractor to be familiar with all local, state, and federal regulations relating to this type of work and to comply with those regulations.

* * * END OF SECTION * * *

SECTION 31 23 33 TRENCHING, BACKFILLING, AND COMPACTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions shall apply to the work covered in this Section.
- B. Related Requirements specified elsewhere:
 - 1. Sheeting, Shoring and Bracing - Section 31 23 14
 - 2. Curbs, Gutters, Sidewalks and Driveways - Section 32 16 00
 - 3. Existing Underground Utilities - Section 33 01 00
 - 4. Sanitary Sewer Piping and Fittings – Section 33 31 00

1.02 SCOPE

- A. This section covers the excavation of all necessary trenching for underground utilities and backfilling same after the pipe and related material has been properly laid, inspected and tested all in accordance with applicable federal, state and local laws and regulations.

1.03 QUALITY ASSURANCE

- A. The Contractor shall obtain qualified testing and inspection services and such other independent services as may be required to assure compliance with the requirements as specified hereinafter. Certified tests of all granular materials will be provided to the Engineer prior to delivery or installation on the job site.
- B. Moisture-density (Proctor) tests on the engineered fill materials and all in-place engineered fill field density tests shall be made as herein specified and in accordance with the General Conditions. Sufficient tests in number and location will be performed so as to assure that the engineered fill is in general compliance with the compaction requirements as specified herein.
- C. The Contractor may conduct additional soil testing and quality control testing as desired for his own information and use.
- D. When requested by the Engineer or Resident Project Representative, the Contractor shall excavate and expose the pipe previously laid at any point.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL EXCAVATION

- A. All material encountered shall be excavated to the lines and grades as shown on the plans, set by the Engineer or as specified herein.
- B. Unless otherwise shown on the plans, trenches for forcemain shall be of a depth that will provide the following minimum covers over the top of the pipe as measured from the original ground surface.
 - 1. Minimum cover for all watermain and forcemain shall be seventy-two (72) inches.
- C. Where pipe elevation is determined by minimum depth only, the excavation shall be sufficient at all points to grade the pipes on the tangents and vertical curves as dictated by the minimum bending radius of the pipe and fittings as recommended by the manufacturers.
- D. The trenches shall be sufficiently straight between designated angle points to permit the pipe to be laid true to line in the approximate center of the trench.
- E. Intersections with and crossings of other underground utilities shall be as shown on the plans and/or in accordance with applicable state and local laws and regulations. Refer to Section 33 01 00 for additional requirements.
- F. All excavated material suitable for backfilling shall be placed in an area away from the trench edges so as to avoid overloading, sliding, and cave-ins.
- G. The areas immediately adjacent to the trench shall be graded as required to prevent surface water from entering the trenches.

3.02 EXCAVATION FOR APPURTENANCES

- A. A minimum of twelve (12) inches shall be left between the trench wall and the outside surface of the appurtenance.

3.03 SHEETING, SHORING AND BRACING

- A. Refer to Section 31 23 14 of these specifications

3.04 ROAD, STREET, AND DRIVEWAY CROSSINGS

- A. At such road and all other crossings as may be designated by the Engineer, the trenches are to be mechanically tamped and filled in such a manner as to prevent any serious interruption of traffic upon the roadway or crossing.
- B. Not more than one street crossing may be obstructed by the same trench at any one time except by permission of the Engineer and Owner.

3.05 ROCK EXCAVATION

- A. Rock excavation shall be completed to a minimum of eight (8) inches below and on each side of all pipes, valves, fittings, and other appurtenances.
- B. Excess excavation shall be backfilled with compacted material conforming to the bedding material required for the material being used.

3.06 DEWATERING

- A. Where water is encountered in a trench, water shall be removed by pumping to lower the water level to such elevation that the pipe may be laid dry at the grade shown on the plans.
- B. All water pumped from the trench shall be disposed of in a manner so as not to cause any damage to adjacent property.
- C. When dewatering is paid for, it shall be considered as dewatering only when a manifold or pump and system of well points is installed to lower ground water such that excavation and construction can take place.
- D. The process of pumping water out of the trench with a suction hose and pump will not be considered as dewatering.
- E. Where seepage of water into the trench occurs that can be removed using standard pumping procedures, it shall not be deemed sufficient cause for installing a system of manifolds and well points and classified as dewatering in order to obtain remuneration under the Bid Item - Dewatering.
- F. A dewatering permit is required when the discharge from dewatering may reach the waters of the state. To obtain information on the General Dewatering Permit, the Contractor should contact the Department of Agriculture and Natural Resources at (605) 773-3351.

3.07 TRENCH BOTTOM PREPARATION

- A. The sides of all trenches shall be vertical from the bottom of the trench to a point one (1) foot above the top of the pipe.
- B. The width of the trench shall be a minimum of twelve (12) inches on each side of the pipe bell.
- C. The bottom of all trenches for underground piping shall be carefully and accurately formed to the lines and grades as shown on the plans, set by the Engineer or as specified herein.
- D. Rock, boulders, and large stones, or other manmade material shall be removed to provide a clearance of at least eight (8) inches below the outside barrel of the pipes, valves, fittings appurtenances. Adequate clearance for properly jointing pipe laid in rock trenches shall be provided at bell holes. The space between the rock at the bottom of the trench and the bottom of the pipe barrel shall be filled with compacted bedding material.
- E. If the trench bottom is inadvertently excavated deeper than necessary, it shall be backfilled to the proper grade with compacted bedding material.

3.08 UNSTABLE TRENCH BOTTOM

- A. Whenever wet, soft or unstable soils incapable of properly supporting the pipe, or other appurtenances are encountered in the trench, the Contractor shall be required to remove the unsuitable materials and backfill to the proper grade with concrete, granular material or other suitable approved material.
- B. Backfill material shall be compacted to provide a firm and level support for the piping system. Firm support is defined as no visual deformation in the surface when workers walk on the compacted material.

3.09 BACKFILLING AND COMPACTING

- A. Any trenches improperly backfilled or showing excessive settlement shall be reopened to a depth required for proper compaction.
- B. Backfill material shall be free of boulders, frozen clods, large roots, excessive sod or other vegetation, construction debris.
- C. No backfilling shall take place in freezing weather without written permission from the Engineer.
- D. Borrowed granular bedding material shall conform to the gradation indicated below.

<u>Sieve Opening</u>	<u>Bedding Material (Percent Passing)</u>
1"	95-100
No. 200	< 15

- E. Bedding material excavated from the job site shall be finely divided material free from organic material and clods, lumps of frozen material or stones larger than 1 1/2" in maximum diameter. Bedding material shall be of proper moisture content to form a firm bed for the pipe.
- F. The bedding material backfilling around the pipe shall be deposited in layers not to exceed eight inches (8") and carefully compacted to a degree of compaction at least equal to 90% maximum dry density as determined by Standard Proctor Test, ASTM Test Designation D698 throughout the entire depth of each layer. Where the pipe has a protective coating, care shall be taken not to damage the coating.
- G. The embedment material shall be finely divided material free from debris, organic material, and clods, lumps or stones larger than 1-1/2 inches maximum diameter. The material shall be borrowed material or job site excavated material. Embedment material shall be placed in uniform layers not more than twelve (12) inches thick and compacted to 90% maximum density as determined by ASTM D698 until the pipe has a cover of not less than one (1) foot.
- H. The remainder of the backfill shall consist of selected material from excavation or borrow, and shall be free from cinders, ashes, refuse, organic and frozen material, boulders or other materials that are unsuitable. Stones larger than 3 inches in diameter shall not be placed within two feet of the top of the pipe. This material shall be placed from 12 inches above the top of the pipe to 6 inches below the ground surface, unless otherwise specified, or to the subgrade elevation for streets or paved surfaces.
- I. After completing the bedding and embedment of the pipe as specified above, the remainder of the backfill material beneath unpaved areas shall be placed in uniform layers not exceeding one (1) foot and tamped. It shall be the Contractor's responsibility to compact each layer throughout its entire depth to a degree of compaction at least equal to that of the surrounding earth. The Contractor shall moisten or aerate the backfill material to obtain the required compaction. The Contractor shall provide a final cover of topsoil as specified herein. Any additional settlement of the trench shall be brought back to grade with additional topsoil. The trench shall be left in a condition so as to present a neat appearance.
- J. Open trenches under road surfacing, sidewalks, curb and gutter, and other adjacent improvements to a point eight (8) feet from the edge of the road surface and as otherwise

noted on the plans shall be backfilled with uniform layers not exceeding one (1) foot. Each layer, except the upper 6 inches of subgrade underlying the pavement, shall be spread uniformly and tamped with a hand tamper or other approved device until thoroughly compacted to at least 90% of the maximum density obtainable at optimum moisture content. The upper 6-inch layer, forming the subgrade for surfacing shall be compacted to at least 97% of the maximum density obtainable at optimum moisture content. Density of backfill shall be determined based on Standard Proctor Test, ASTM Test Designation D698.

3.10 TESTING REQUIREMENTS

- A. Frequency of Testing: Minimum of one (1) test every 250 feet to 350 feet of trench per lift or as directed by Engineer. Frequency of testing may be altered by Engineer after adequate testing is completed to determine level of effort by Contractor is sufficient. When frequency is altered by the Engineer, random testing will be performed to verify compaction efforts. The Contractor may be required to excavate to depths required by Engineer for testing and backfill test holes to density specified.
- B. Retesting: In the event of failure to meet compaction criteria, the Contractor shall re-excavate and re-backfill at direction of Engineer. All retesting to be paid for by Contractor and to be performed by soils testing firm secured by the Contractor and approved by the Engineer.

3.11 EXCESS EXCAVATION

- A. The Contractor shall be responsible for securing and maintaining an adequate area where excess excavation can be stockpiled for future use or wasted.
- B. The Engineer's approval on the site selection shall be required.
- C. The Contractor shall be responsible for the final cleanup of the site chosen. The site shall be cleaned to the satisfaction of the property owner, and a lien waiver or a letter of satisfaction written by the property owner and addressed to the Contractor shall be obtained by the Contractor and furnished to the Owner.

3.12 TOPSOIL

- A. All lawns areas shall be left smooth with a minimum of 6" of compacted black dirt throughout the entire area disturbed by the trench.
- B. Prior to topsoiling and finish grading, all rough grades shall be corrected, adjusted, and brought to the required elevations.
- C. The subgrade surface shall be prepared for topsoiling by cross disking to a depth of two (2) inches or more to permit bonding of the topsoil to the subgrade.
- D. All stones and other debris greater than two (2) inches in any dimension shall be removed from the surface of the subgrade prior to the placement of the topsoil.
- E. Topsoil material shall not be placed when the topsoil or subgrade is frozen or wet enough to cause clodding.
- F. Topsoiling operations adjacent to lagoons and along piping routes shall be considered complete when the finished surface is:
 - 1. Free of sticks, stones and other material one (1) inch or more in any dimension.

2. Smooth and true to required grades with a maximum allowable deviation of 0.1 foot.
- G. All lawns shall be raked with a landscape rake, garden rake, or other approved equipment to remove all clods, stones, sticks, or other material greater than one (1) inch in any dimension. Trenches shall be slightly crowned and all disturbed areas smoothed to a maximum deviation of 0.1 foot and ready for seeding operations by Contractor prior to acceptance by the Engineer.

* * * END OF SECTION * * *

SECTION 32 11 23 AGGREGATE MATERIAL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Special Conditions shall apply to work covered in this section.
- B. Related requirements specified elsewhere:
 - 1. Asphalt Concrete Surfacing - Section 32 12 16

1.02 DESCRIPTION OF WORK

- A. Aggregates shall be hauled, spread, compacted, and laid to grade as staked by the Owner's representative and shown on plans.

1.03 QUALITY ASSURANCE

- A. The finished grade of the base course/gravel cushion shall be within 0.05 feet at any point, as staked and checked by the Owner's Representative.

PART 2 PRODUCTS

2.01 BASE COURSE/GRAVEL CUSHION

- A. The aggregates shall consist of sound durable particles of gravel and sand with which may be included limited amounts of fine soil particles. The physical characteristics and quality of the materials shall conform to the specifications for the particular material required by the contract as follows:

REQUIREMENT	Aggregate Base Course	Gravel Cushion
SIEVE	PERCENT PASSING	
2" (50 mm)		
1" (25.0 mm)	100	
3/4" (19.0 mm)	80-100	100
1/2" (12.5 mm)	68-91	
No. 4 (4.75 mm)	46-70	50-75
No. 8 (2.36 mm)	34-58	38-64
No. 40 (425 μm)	13-35	15-35
No. 200 (75 μm)	3.0-12.0	3.0-12.0
Liquid Limit Max	25	25

REQUIREMENT	Aggregate Base Course	Gravel Cushion
SIEVE	PERCENT PASSING	
Plasticity Index	0-6	0-6
L.A. Abra. Loss, max.	40	40
Foot Notes	1,2	
Processing Required	crushed	crushed

- ¹ The fraction passing the No. 200 (75 µm) sieve shall not be greater than 2/3 of the fraction passing the No. 40 (425 µm) sieve. In no case shall the upper limit specified for the No. 200 (75 µm) sieve be exceeded.
- ² Requirements include quarried ledge rock.

B. Granular material of which 30% of the particles retained on the No. 4 sieve shall contain one or more fractured faces. A crushed particle shall be defined to be a fragment of stone showing at least one freshly fractured face.

PART 3 EXECUTION

3.01 BASE COURSE

A. Base course material, meeting the requirements as set forth in Part 2 above, shall be furnished and installed to obtain the desired grades, as shown on the plans. The base course material shall then be compacted-see Geotechnical report for % and moisture levels.

3.02 GRAVEL CUSHION

A. Gravel cushion material, meeting the requirements as set forth in Part 2 above, shall be furnished and installed to obtain the desired grades, as shown on the plans. No density requirements are needed under the sidewalk but the material shall be approved by the Engineer prior to placement of the fiber/rebar reinforced concrete sidewalks.

3.03 UNSUITABLE MATERIAL

A. Unsuitable material shall be excavated and replaced with approved base course material as designated by the Owner or his Representative. No additional compensation shall be considered for this operation.

* * * END OF SECTION * * *

SECTION 32 12 16 ASPHALT CONCRETE SURFACING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Supplementary Conditions shall apply to work covered in this section.
- B. Related requirements specified elsewhere:
 - 1. Bituminous Tack Coat – Section 32 12 13.13

1.02 DESCRIPTION OF WORK

- A. The work covered under these specifications shall include the furnishing of all labor, materials, and equipment necessary to lay a compacted asphalt concrete mat (at a depth as indicated in the plans), complete in place, as specified herein.

1.03 SUBMITTALS

- A. The Contractor shall submit for review copies of all certificates from the manufacturer that the materials meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

- A. The contractor shall provide the required control tests of the mineral aggregate for the asphalt surfacing. The cost is considered incidental to the project.
- B. The contractor shall provide the required job mix, prepared by an independent testing laboratory approved by the Engineer for the Class E, Type 1 Asphalt concrete to the Engineer/Owner 14 days prior to start of production. The cost of the job mix designs shall be paid for by the Contractor and are considered incidental to the project.
- C. Following the Engineer's approval of the above-mentioned tests, all remaining tests shall be performed by the Owner's representative with results being given to both the Contractor and the Owner.

PART 2 PRODUCTS

2.01 GENERAL

- A. Specifications to be used for this section shall be the South Dakota Department of Transportation Standard Specifications for Roads and Bridges, 2015 Edition, Division III Materials Details with the following modifications, and/or special provisions.
 - 1. Where the term Engineer, Area Engineer, Department, etc., is used it shall be replaced with Helms and Associates, Owner etc. as applicable.

2. The shale content or other particles of low specific gravity (less than 1.95) passing the No. 4 sieve shall not exceed four (4) percent.

2.02 ASPHALT CONCRETE

- A. The construction requirements and material handling shall conform to the requirements of Section 320, Section 880, and Section 890 of the South Dakota Department of Transportation Standard Specifications for Roads and Bridges, 2015 edition.
- B. Mineral aggregate for asphalt concrete shall conform to the requirements of the standard specifications for Class E, Type I. The asphalt cement shall be PG 64-22 or PG 64-28. The Contractor shall provide a job mix formula with the supporting mix design data prior to production.
- C. A bituminous tack coat (SS-1H or CSS-1H) shall be applied between each lift at a rate of 0.10 to 0.15 gallon per square yard.

PART 3 EXECUTION

3.01 GENERAL

- A. The construction requirements and material handling shall conform to the requirements of Section 320, Section 880, and Section 890 of the South Dakota Department of Transportation Standard Specifications for Roads and Bridges, 2015 Edition, except as modified hereinafter.
 1. Where the term Engineer, Area Engineer, Department, etc. is used it shall be replaced Helms and Associates, Owner etc. as applicable.

3.02 ASPHALT CONCRETE SURFACE

- A. Asphalt concrete surfaces will be replaced in the areas as designated by the Owner and Engineer.
- B. Placement of asphalt concrete surfaces shall be on compacted granular base course as indicated on the plans. The compacted thickness of asphalt concrete shall be as shown on the plans or as directed by the Owner and Engineer.
- C. The contractor shall adjust and cover all manholes and valve boxes, prior to tack coat application, with material approved by the Engineer.

3.03 GENERAL

- A. The Asphalt Concrete Paving equipment, weather limitations, job mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the State Highway Specifications for the type of material specified.

3.04 MIXING ASPHALTIC CONCRETE MATERIALS

- A. Provide hot plant-mixed asphaltic concrete paving materials.
 1. Temperature leaving the plant: 143 degrees C (290 degrees F) minimum, 160 degrees C (320 degrees F) maximum.

2. Temperature at time of placing: 138 degrees C (280 degrees F) minimum.

3.05 SUBGRADE

- A. Shape to line and grade and compact with self-propelled rollers.
- B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with weighted dump truck as directed by Engineer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

3.06 BASE COURSES

- A. Base
 1. Spread and compact to the thickness shown on the drawings.
 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- B. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").
- C. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).
- D. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

3.07 PLACEMENT OF ASPHALTIC CONCRETE PAVING

- A. Remove all loose materials from the compacted base.
- B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.
- C. Receipt of asphaltic concrete materials:
 1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C (280 degrees F).
 2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.
- D. Spreading:
 1. Spread material in a manner that requires the least handling.
 2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.

E. Rolling:

1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the drawings.
2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
 - a. No depressions which will retain standing water.
 - b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

3.08 PROTECTION

- A. Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

3.09 FINAL CLEAN-UP

- A. Remove all debris, rubbish, and excess material from the work area.

* * * END OF SECTION * * *

SECTION 32 16 00 CURBS, GUTTERS, SIDEWALKS AND DRIVEWAYS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions shall apply to the Work covered in this Section.
- B. Related requirements specified elsewhere:
 - 1. Trenching, Backfilling and Compaction - Section 31 23 33
 - 2. Asphalt Concrete Surfacing – Section 32 12 16

1.02 SCOPE

- A. This section covers the labor, materials, equipment and related services necessary to install or repair pavement and related structures damaged during construction.

1.03 QUALITY ASSURANCE

- A. The Contractor shall be responsible for obtaining the services of a qualified testing firm as may be required to assure compliance with the requirements of these specifications.

1.04 SUBMITTALS

- A. A complete description of the materials to be used in the Work covered by this Section of the specifications shall be submitted to the Engineer for review.
- B. Three (3) copies of all reports and test results completed by the independent testing service shall be submitted directly to the Engineer.

PART 2 PRODUCTS

2.01 CONCRETE

- A. See Division 030000.

PART 3 EXECUTION

3.01 GENERAL

- A. After completing proper compaction of the backfill, the Contractor shall replace the disturbed surfaces to the original grade. Surfacing material, as specified herein shall be replaced to the same depths and limits with the same type of material as the surfacing material removed, unless otherwise shown on plans.
- B. A flush, smooth, adjoining surface transition shall be provided.
- C. Existing asphalt paved surface, sidewalks, curb and gutter, concrete or asphalt driveways and alley approaches shall be scored along a straight line by a concrete saw to a depth of two (2)

inches (or by a method previously approved by the Engineer) at a distance of two (2) feet beyond each edge of proposed ditch. The remaining thickness of surfaces shall be fractured to a true vertical face. All exposed faces shall be adequately cleaned to ensure bonding between new and existing surfaces and cut and fractured to a vertical face immediately prior to placement of the new surfacing.

- D. Placement of concrete or asphalt on frozen surfaces will not be permitted.
- E. Concrete surfaces shall be cured and protected for a sufficient period of time (not less than 3 days) to prevent damage to concrete and insure required compressive strength requirements.

3.02 CONCRETE SIDEWALK

- A. Concrete Sidewalk shall be replaced at locations as designated by the Engineer with nominal four (4) inch thick fiber reinforced concrete or six (6) inch rebar reinforced concrete sidewalk. Concrete sidewalk shall be poured on compacted gravel cushion, at a depth as indicated on the plans.
- B. Sidewalk to be replaced shall be removed to nearest expansion or scored joint from each edge of the trench.
- C. Expansion joints shall be provided where walks abut a structure, at changes in directions, and at intervals of not more than 50 feet. Expansion joints shall be filled to within one inch of the surface with bituminous expansion joint material, and then filled flush to the surface with joint sealing compound. The joint sealing compound shall be finished slightly concave, and shall not be allowed to overflow the joint.
- D. Concrete walks shall be edged and grooved, with the grooves dividing each walk into equal length sections approximately equal to the width of the walk. Walks shall be floated smooth and even, and given a light broom finish at right angles to the length of the walk.

3.03 CONCRETE PAVEMENT

- A. Concrete Pavement, including driveways and heavy concrete sidewalk sections, shall be replaced at locations designated by the Engineer with six (6) inch thick, rebar reinforced concrete placed on compacted base course, at a depth as indicated on the plans.
- B. If an expansion or scored joint is within six (6) feet of the edge of the trench, the existing concrete shall be removed and replaced to the joint.
- C. The alignment of the new surface shall match that of the existing surface unless otherwise directed.
- D. The alignment and grade of the new surface shall match that of the existing surface unless otherwise directed.
- E. Expansion joints shall be filled to within one (1) inch of the surface with bituminous expansion joint material. Dowels shall be placed across the expansion joint at maximum 24" spacings.
- F. Contraction joints shall be provided at intervals of not more than ten (10) feet. Contraction joints shall consist of a groove of at least one third (1/3) the depth of the pavement sawed in green concrete or a plane of weakness formed by inserting a removable metal template.
- G. All expansion and contraction joints shall be filled flush to the surface with joint sealing

compound. The joint sealing compound shall be finished slightly concave, and shall not be allowed to overflow the joint.

H. Reinforcement shall consist of #4 deformed rebar placed at 24" OC both directions.

3.04 CONCRETE CURB AND GUTTER OR STRAIGHT GUTTER

- A. Curb and gutter shall be replaced to the thickness, geometric design, and alignment of the existing section with non-reinforced concrete on a 6-inch compacted gravel base course.
- B. In the event a joint is encountered within 5 feet of a proposed edge of the trench, the concrete shall be removed to such joint.
- C. Expansion joints shall be placed at changes in direction and at intervals not greater than 50 feet. Expansion joints shall be 1/2 inch wide, filled to within one inch of the surface with bituminous expansion joint material cut to the shape of the curb section. Dowels shall be placed across expansion joints as shown on the drawings or as directed.
- D. Contraction joints shall be provided at intervals of not more than 10 feet. Contraction joints shall consist of a groove at least 1-1/4 inches deep sawed in the green concrete or a plane of weakness formed by inserting a removable metal template.
- E. All expansion and contraction joints shall be filled flush to the surface with joint sealing compound. The joint sealing compound shall be finished slightly concave, and shall not be allowed to overflow the joint.
- F. All exposed edges of curbs and gutters shall be rounded with a suitable edging tool. Exposed surfaces shall be finished smooth and even with a steel trowel, and then given a light broom finish.

3.05 CONTRACTOR'S RESPONSIBILITY

- A. Any repaired areas which will include surface material and/or seeding requiring further repair due to trench settlement shall be repaired by the Contractor at his expense for a period of one year after written final acceptance of the project by the Owner.

* * * END OF SECTION * * *

SECTION 33 01 00 EXISTING UNDERGROUND UTILITIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Supplementary Conditions shall apply to the Work covered in this Section.

1.02 SCOPE

- A. This Section describes, but is not limited to, the relationship of the Project to existing underground utilities and the Work associated with the location, adjustment, and repair of underground utilities.
- B. The information and data relative to existing underground utilities are provided to assist the Contractor with the preparation of his bid. This information should not be used by the Contractor for reference during construction of the Work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL

- A. Existing underground utilities, as shown on the drawings, are located in accordance with available data, but locations may vary and cannot be guaranteed. The exact locations shall be determined by each Contractor as the Work proceeds. Excavation work shall be done carefully so as to avoid damaging the existing utilities and Work.
- B. Each Contractor shall provide for protection, temporary removal and replacement or relocation of obstructions as required for the performance of this Work required in these contract documents.
- C. Other obstructions not shown on the plans and requiring relocation shall be exposed by the Contractor without injury; or if injured, shall be repaired by Contractor at his expense. Removal of such obstruction or its relocation shall be made by the Contractor according to the provisions of the General Conditions.

3.02 UTILITY CONTACT

- A. Prior to Work in a specific area affecting underground utilities, the following individuals shall be notified as appropriate:
- B. All above utilities, excepting water, may be located utilizing the South Dakota One Call Notification Center:

(Locate Phone Number) 1-800-781-7474

(Admin. Phone Number) 1-800-422-1242

- C. The failure of any utility to be present for any reason, at the Pre-Construction Conference, if held, shall not relieve the Contractor of any responsibility described herein.

3.03 UTILITY REPAIR:

- A. When an underground utility is exposed or damaged, the Contractor shall comply with the repair requirements of the affected utility.
- B. When an underground utility is exposed, the Contractor shall compact the backfill beneath the exposed utility before completion of the backfill operation.

3.04 SANITARY/STORM SEWER AND WATER MAIN SEPARATION:

- A. Horizontal Separation - Sewers shall be laid at least 10 feet (3.0 m) horizontally from any existing or proposed watermain. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 foot (3.0 m) separation, the Department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the sewer closer to a watermain, provided that the watermain is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so the bottom of the watermain is at least 18 inches above the top of the sewer.
- B. If it is impossible to obtain proper horizontal separation as described above, both the watermain and sewer shall be constructed of slip-on or mechanical joint pipe complying with public water supply design standards of the Department and be pressure tested in accordance with AWWA standards to assure water tightness before backfilling.
- C. Vertical Separation
 - 1. Sewers Crossing Under Watermains - The sewer shall be laid to provide a minimum of 18 inches from the top of the sewer to the bottom of the watermain. The crossing shall be arranged so the sewer joints will be equidistant and as far as possible from the watermain.
 - 2. Sewers Crossing Over Watermains - Either the watermain or the sewermain must be encased in a watertight carrier pipe that extends 10 feet (3.0 m) on both sides of the crossing, measured perpendicular to the watermain. The carrier pipe shall be PVC, ABS, or HDPE, and the ends sealed with a rubber gasket or boot.
 - 3. Special Conditions - When it is impossible to obtain the proper horizontal and vertical separation as stipulated above, one of the following methods shall be specified:
 - 4. Water Pipe - The sewer shall be designed and constructed equal to water pipe and shall be pressure tested in accordance with AWWA standards prior to backfilling to assure water tightness; or;
 - 5. Carrier Pipe - Either the watermain or the sewermain may be encased in a watertight carrier pipe that extends 10 feet (3.0 m) on both sides of the crossing, measured perpendicular to the watermain. The carrier pipe shall be PVC, ABS, or HDPE, and the ends sealed with a rubber gasket or boot.
- D. Storm Sewer Requirements:
 - 1. A reinforced concrete pipe (RCP) storm sewer may cross below a watermain with a separation of less than 18 inches or at any height above a watermain provided the joints

on the RCP within 10 feet of either side of the watermain are assembled with:

2. Prefomed butyl rubber sealant meeting federal specification #SS-S-210A and AASHTO M 198, and each of these joints are encased with a minimum 2-foot wide by 6-inch thick concrete collar centered over the joint and reinforced with the equivalent steel area as that in the RCP. Encasement of the watermain will not be required when the RCP joints are collared within the 20-foot section.
 3. An O-ring that conforms to ASTM C 443 specifications. O-rings are manufactured for concrete pipe with diameters up to 18 inches.
 4. A strip of impermeable material held in place with stainless steel bands and tested to 5 psi prior to the storm sewer being put into use.
- E. There shall be at least a 10-foot horizontal separation between watermains and sanitary sewer forcemains. There shall be an 18-inch vertical separation at crossings as required in paragraphs B and C.

PART 4 MEASUREMENT AND PAYMENT

4.01 METHOD OF MEASUREMENT

- A. The cost to repair any underground utilities or other obstructions damaged by the Contractor's activities shall be considered incidental Work with no separate measurement made.

4.02 BASIS OF PAYMENT

- A. The cost to repair any underground utilities or other obstructions damaged by the Contractor's activities shall be considered incidental Work with no separate and payment to be made.

* * * END OF SECTION * * *

SECTION 33 11 00 WATER UTILITY PIPING AND FITTINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions shall apply to the Work covered in this section.
- B. Related Work Specified Elsewhere:
 - 1. Trenching, Backfilling and Compacting - Section 31 23 33
 - 2. Standard Drawing 33 11 00-1

1.02 DESCRIPTION OF WORK

- A. The work covered under these specifications shall include the furnishing of all labor, material, tools, and equipment necessary to furnish and install, complete in place, all piping and fittings as shown on the drawings and as specified herein.

1.03 SUBMITTALS

- A. The Contractor shall submit for review copies of shop drawings for materials specified herein.
- B. Certificates from the manufacturer that the materials meet or exceed specified requirements.
- C. The manufacturer's installation recommendations, including types and amounts of gasket lubricant, where applicable, to be used.
- D. Certification shall be provided that all pipes, plumbing fittings, and fixtures are "Lead Free" in accordance with the January 4, 2011 modification to Section 1417 of the Safe Drinking Water Act.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All materials shall be packed, loaded, transported, unloaded, and handled in such a manner so as to prevent damage to the materials.
- B. All material shall be loaded and unloaded by lifting with slings or hoists or skidding so as to avoid shock or damage. Dropping or rolling will not be permitted. The use of end hooks to install or move piping will not be allowed.
- C. All materials shall be stored on the site in accordance with the manufacturer's recommendations. Do not store materials directly on the ground.
- D. All materials shall be kept clean and dry. The insides of all piping and fittings shall be kept free of dirt and debris.

PART 2 PRODUCTS

2.01 DUCTILE IRON FITTINGS

- A. Ductile iron fittings shall conform to the requirements of AWWA/ANSI Specifications C110/A21.10 & C153/A21.53.
- B. Ductile Iron Fittings to be installed underground shall be mechanical joint type conforming to the requirements of AWWA/ANSI Specifications C111/A21.11.
- C. Ductile Iron Fittings to be installed in "non-buried" locations shall be provided with flanged joints with rubber full-face gaskets. Flanged faces shall be drilled to standard 125-pound template unless otherwise noted.
- D. All Ductile Iron Fittings shall be lined with cement mortar in accordance with AWWA/ANSI Specifications C104/A21.4. The exterior finishes shall be an asphaltic varnish coating not less than 1-mil thick.
- E. When utilized for contaminated soils areas, the fittings will be furnished with Nitrile Butadiene gaskets.

2.02 PRESSURIZED POLYVINYL CHLORIDE (PVC) PIPE

- A. All Polyvinyl Chloride pipe shall be pressure class 150 AWWA C-900 rated pipe with rubber gasket sealed joints.
- B. The pipe shall be made from Type 1, Grade 1, Class 12454-B compounds conforming to ASTM D1784 with a hydrostatic design basis (HDB) of 4,000 psi as per ASTM 2837.
- C. All pipes shall be marked with the following: Nominal pipe size, material code designation, SDR, pressure rating, manufacturer's name or trademark, NSF seal and ASTM numbers.
- D. The PVC pipe shall be furnished in 20 foot laying lengths. Longer lengths will be allowed only if the Contractor certifies that he will provide equipment on the project to fully support the pipe while being transported and distributed over the project.
- E. All PVC pipe shall be furnished with gasket joints conforming to ASTM D3139. Rubber gaskets shall conform to the requirement of ASTM F477.
- F. Manufacturer's proof of design tests and joint dimensions shall be submitted to the Engineer for gasket joints, which do not maintain SDR throughout the joint.
- G. Gasket joint couplings used for plain end pipe shall have a pressure rating equal to the pipe on which used. Centering of pipe within the coupling will be assured by means of an integral positive stop in the coupling. All couplings must be of the double gasket type. Couplings requiring welds will not be allowed.
- H. All gasket joints shall have a seating depth equal to at least 50% of the nominal pipe diameter.
- I. The ends of the pipe to be inserted into couplings or joints shall be factory marked to allow field checking of the depth of setting of the pipe in the joint socket.

2.03 FITTINGS FOR PRESSURIZED PVC PIPE

- A. Repair couplers and gaskets will be pressure Class 150 PVC pressure fittings meeting the requirements of:

1. AWWA-C907 (also referred to as C900 fittings)
 2. ASTM D-1784, Materials
 3. ASTM D-3139, Joints
 4. ASTM F-477, Gaskets
 5. NSF Standard 61, Suitability for Potable Water
- B. All other fittings for use on PVC C-900 Class 150 pipe shall be ductile iron fittings conforming to the requirements of paragraph 2.02 above, with the exception of transition couplers as specified in paragraph 2.05 below.

2.04 TRANSITION COUPLERS

- A. The couplings used for transitions between piping of different materials, piping of different diameters, and existing piping to new piping (excluding repair couplers), shall be a wide-range flexible coupler with a sleeve type design meeting the requirements of AWWA C219.
1. The coupling body shall be a center sleeve fabricated of high strength carbon steel tubing equivalent to ANSI/AWWA C200. The transition couplers will be readily available in nominal diameter ranges from 1.5 to 24 inches on all pipe classes.
 2. Compression End Rings: One gasket compression end ring per coupling end. End rings to be of either one, two, or four bolt design, fabricated of carbon steel equivalent to ASTM A576.
 3. Hydraulic Wide Range Gasket: Chloramine Resistant NSF-61 approved EPDM gasket designed with a multi-layered wide range removable outer layer. Gasket hydraulically actuated with a pressure-equalizing dam, pressure cavity and sealing lip for working pressure of 260 psi (1.5 to 16 inches) and 232 psi (18 to 24 inch nominal diameter coupling).
 4. Fasteners shall be grade 304 (A2) or 316 (A4) stainless steel with yield strengths that conform to all nationally recognized standards. Bolts to be coated with an anti-seize type coating to prevent galling.
 5. The interior and exterior coatings shall NSF-61 approved fusion bonded epoxy coating conforming to AWWA C213.
 6. When properly installed the coupling will provide a minimum deflection of 8 degrees, up to 260 psi working pressure and 3/8 inch longitudinal pipe movement without leakage. (Flanged adapters will provide half the longitudinal movement and deflection.)
 7. All products will be proof tested to a minimum of 1.5 times working pressure.
- B. Flanged couplers shall consist of one compression end and gasket, coupling center sleeve, and AWWA Class "D" Flange (per AWWA C207).
- C. Pre-Approved transition couplers are: "Macro" extended range coupling by Romac Industries, Inc.; Omega Series Style CRCER by Cascade Waterworks Mfg. Co.; Maxi-Range Pipe Coupling by Mueller Co.; or Engineer approved equal.

2.05 FASTENERS

- A. All fasteners in buried locations shall be Grade 304 (A2) or Grade 316 (A4) stainless steel.

Anti-Seize shall be applied to all threads prior to installation.

2.06 LUBRICANT FOR PIPE GASKETS

- A. Lubricant shall be an emulsified polymer based product, specifically formulated to be water-soluble without causing turbidity. Lubricant shall not transfer taste and/or odor to new water main installations. Lubricant must not promote bacterial growth and be safe for use on all metal and plastic pipes. Lubricant shall be easily flushed from the line and be non-reactive to chlorinated water. Lubricant should work easily on both wet and dry surfaces.

2.07 POLYETHYLENE WRAP

- A. All ductile fittings shall be wrapped with polyethylene plastic film having a minimum thickness of 0.006 inches or with a cross woven polyethylene plastic film having a minimum thickness of 0.004 inches.

2.08 TRACER WIRE

- A. Tracer wire shall be 12-gauge solid copper or high strength stainless steel wire with a 45-mil polyethylene coating. Provide sufficient length to be continuous over each separate run of nonmetallic pipe.
- B. Corp Stop compression joints will be provided with an optional tracer wire hole that has a set screw for a positive connection. Curb Box lids will also be provided with a tracer wire screw that is tapped into the bottom of the lid for securing a quick connect eyelet terminal. Once tightened, the threaded end of the screw becomes accessible for attaching an alligator clip at the top of the lid.
- C. All tracer wires are to be connected to a combination cast iron & ABS/PVC tamper proof tracer wire access box. The cover is to be manufactured of cast iron and ABS/PVC components produced in the USA. Cast iron collar & cover is to be manufactured in accordance with ASTM A48 Class 25. The ABS is to be manufactured in accordance with ASTM D 1788. The cover shall be lettered "Water" and shall have a standard AWWA size cast-in pentagonal bolt. Box will be a minimum of 3 inches in diameter and adjustable from 18 to 24 inches.

2.09 BEDDING MATERIAL

- A. Borrowed granular bedding material shall conform to the gradation indicated below.

<u>Sieve Opening</u>	<u>Bedding Material (Percent Passing)</u>
1"	95-100
No. 200	< 15

- B. Bedding material excavated from the job site shall be finely divided material free from organic material and clods, lumps of frozen material or stones larger than 1 1/2" in maximum diameter. Bedding material shall be of proper moisture content to form a firm bed for the pipe.

PART 3 EXECUTION

3.01 GENERAL

- A. The areas to receive piping shall be examined for defects that may adversely affect the execution and quality of Work. Prior to the start of piping installation, all measurements shall be checked for deviations from allowable tolerances for piping.

3.02 BURIED PIPING INSTALLATION

- A. All piping and fittings shall be laid true to line and grade as shown on the plans. Each section of pipe shall be so laid and fitted together that when complete the piping will have a smooth uniform flow line. The inside of all pipes shall be cleaned before installation and kept thoroughly clean during and after the laying. Pipe ends shall be cleaned inside and outside.
- B. Apply lubricant liberally to the inside of the pipe bell and spigot. Make sure lubricated surfaces remain free of dirt, gravel or other debris. Assemble the pipe joint immediately after application of the lubricant.
- C. All pipe and fitting shall be examined for defects before being lowered into the trench. The interior and exterior protective coating shall be inspected and field repaired, if required, and possible accordance with applicable standards.
- D. The pipe shall be handled and installed in accordance with manufacturer's recommendations and the requirements of AWWA C600 for Ductile Iron pipe, ANSI/AWWA C605 and ASTM D2774 for PVC pipe.
- E. When pipe laying is not in progress, including the noon hours, the open ends of pipe shall be closed. No trench water, animals, or foreign material shall be permitted to enter the pipe.
- F. Granular Bedding shall be used as bedding material. After each pipe has been graded, aligned, and placed in final position on the bedding material and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe joining and embedment operations. Granular Bedding shall be placed as in Class C Bedding on Standard drawing 331100-1. Bedding material shall be as specified in Part 2.
- G. The pipe shall be laid upon properly placed bedding material so that the barrel of the pipe will have a bearing for its full length. Bell holes and depressions for joints shall be excavated after the trench bedding has been graded.
- H. The Contractor shall provide and maintain all necessary means and devices at all times to remove and dispose of all water entering the trench during the process of pipe laying. The trench shall be kept dry until the pipe laying and jointing are completed. Removal of water shall comply with Section 31 23 33.
- I. Thrust blocks or restraining fittings to restrain pressurized piping shall be provided at all abrupt changes in direction, tees, bends, dead ends and hydrants, and shall be in accordance with the pipe manufacturer's recommendations.

3.03 EXPOSED PIPING INSTALLATION

- A. Each item or system shall be furnished complete and installed as shown on the plans and in accordance with the manufacturer's recommendations, instructions, and directions. All installed equipment and systems shall be properly protected during subsequent construction operation.
- B. The Contractor shall inspect all material or equipment as it is received to determine damage and/or missing parts. It shall be his responsibility to repair or replace damaged items in accordance with the manufacturer's instructions.
- C. The Contractor shall provide all scaffolding required for the proper installation of this work in conformance with the standards of any local and state safety codes applying to scaffolding.
- D. All pipes shall be set such that the vertical and horizontal centerlines are properly aligned. Installation of piping by means of springing, forcing or stressing the pipe or adjacent fittings, valves or equipment will not be allowed.

3.04 MECHANICAL JOINTS AND COUPLINGS

- A. Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled or replaced. Over tightening bolts to compensate for poor installation practice will not be permitted.
- B. The holes in mechanical joints with tie rods shall be carefully aligned to permit installation of the tie rods. In flange and mechanical joint pieces, holes in the mechanical joint bells and the flanges shall straddle the top (or side for vertical piping) centerline. The top (or side) centerline shall be marked on each flange and mechanical joint piece at the foundry.

3.05 TRACER WIRE INSTALLATION

- A. Tracer wire shall be installed in the trench at the same time as the pipe or immediately prior to starting the backfill of the trench.
- B. Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.
- C. Splices will be allowed at pipeline intersections, manholes, bored crossings, and at other locations as agreed upon by the Resident Project Representative. Splices in tracer wire will be made with split bolt or compression-type connectors. Wire nuts may not be used. A waterproof connection is necessary to prevent corrosion. Splices shall be completed in accordance with the manufacturer's recommendations.
- D. Prior to final acceptance, all tracer wire shall be electrically tested for continuity from one exposed end to another.
- E. Tracer wire will be installed from Corporation Pack Joint to the Curb Stop. Attach wire to corporation stop compression nut and underside of curb stop box.
- F. Bring the wire to the ground surface at each fire hydrant and loop the wire in a tracer wire terminal box. These boxes shall be located between the hydrant and the hydrant valve with at least two feet of extra wire inside the box. The tracer wire terminal box must be installed

flush with the finished grade.

3.06 TESTING

- A. All piping shall be tested in accordance with Section 33 13 01.
- B. All piping shall be cleaned and flushed in accordance with the requirements of Section 33 13 00.

* * * END OF SECTION * * *

SECTION 33 12 16 WATER UTILITY DISTRIBUTION VALVES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions shall apply to the Work covered in this Section.
- B. Related requirements specified elsewhere:
 - 1. Watermain Piping and Fittings – Section 33 11 00
 - 2. Sanitary Sewer Piping and Fittings - Section 33 31 00

1.02 DESCRIPTION OF WORK

- A. This section covers the furnishing and installation of valves and appurtenances as specified herein and as shown on the plans.

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All valves and related appurtenances shall be shipped in accordance to the requirements of AWWA C509 or C515. Valve ends shall be sealed to prevent the entry of foreign matter into the valve body. The boxes and crates in which valves are shipped shall completely enclose and protect the valve and accessories from foreign matter.
- B. Valves and accessories shall be stored in a manner so as to be protected from weather, moisture, and other possible damage. Materials shall not be stored directly on the ground.
- C. All material shall be handled in a manner that will prevent damage to the interior and exterior surfaces.

1.04 SUBMITTALS

- A. The Contractor shall submit for review copies of shop drawings for materials specified herein.
- B. Certification of performance, leakage, and hydrostatic tests as described in Section 5 of AWWA C-504 (Butterfly Valves) and/or AWWA C-509/515 (Resilient Seated Gate Valves) shall be furnished when requested by the Engineer.
- C. Certifications for all fasteners shall be provided for valves, fittings, and all other appurtenances provided under this specification.

PART 2 PRODUCTS

2.01 GATE VALVES

- A. Gate valves shall be resilient wedge type manufactured to meet all applicable requirements of AWWA Standard for Resilient Seated Gate Valve C509 or C515.
- B. All valves shall have non-rising stems, opening by turning left and provided with standard 2”

square nut operator with arrow cast in metal to indicate direction of opening.

- C. Cast iron wedge shall have sealing surfaces of the wedge permanently bonded with resilient material to meet ASTM tests for rubber to metal bond ASTM D429. Each valve shall have a smooth unobstructed waterway free from any sediment pockets. Stuffing boxes shall be O Ring seal type with 2 rings located in stem above thrust collar. Low friction torque reduction thrust bearings shall be located both above and below the stem collar.
- D. Body and cover bolts and nuts shall be Grade 304 (A2) or 316 (A4) stainless steel. Anti-Seize shall be applied to all threads prior to installation.
- E. Exterior and interior coatings in accordance with ANSI/AWWA C550 for potable water.
- F. Non-rising stems shall be in full compliance with AWWA specification with cast integral stem collar and furnished of bronze conforming to ASTM B584 Alloy A. Stem nuts shall be independent of wedge and shall be made of solid bronze conforming to ASTM B 62.
- G. Valves shall have hydrostatic shell test of 400 psi and shut-off test of 200 psi. At the 200-psi shut-off test, valve must be bubble-tight with a zero (0) leakage allowance.
- H. Resilient wedge gate valves shall be the product of a manufacturer having a minimum of five (5) years experience in the manufacture of water works and distribution valves.
- I. Pre-Approved resilient wedge gate valves are as manufactured by: American Darling Valve Co., Birmingham, Alabama; Mueller Company, Decatur, Illinois; Clow Valve Division, Oskaloosa, Iowa; American AVK, Minden, NV; or Engineer approved equal.

2.02 VALVE BOXES

- A. Valve boxes shall be cast iron, 5-1/4" inside diameter, adjustable valve boxes of the screw type with sufficient length for the pipe bury as shown. Where the valve box is shown or required on control manholes, the length shall be sufficient to penetrate the valve marker and the Type II reinforced manhole cover. The cast iron cover of the valve box shall have an arrow indicating the direction of opening.
- B. Covers for water piping shall have the word "WATER" cast on the top.
- C. Pre-Approved valve boxes and covers are as manufactured by: Tyler Pipe Utilities Division, Tyler, Texas; Mueller Co., Decatur, Illinois; Clow Corporation, Oak Brook, Illinois; or Engineer approved equal.
- D. Each valve box shall be furnished with valve box centering adaptor compatible with the valve boxes furnished.
- E. The Contractor shall furnish one T-handled valve wrench to the owner that is compatible with the installed valves.

2.03 FLANGED AND MECHANICAL JOINT VALVES

- A. Valves located in non-bury locations shall be flanged style with 125 lb. ANSI flanged ends. Valves located in buried locations shall be mechanical joint type conforming to the requirements of ANSI Specification A21.11.

2.04 FASTENERS

- A. All fasteners in buried locations shall be Grade 304 (A2) or 316 (A4) stainless steel. Anti-

Seize shall be applied to all threads prior to installation.

2.05 POLYETHYLENE WRAP

- A. All ductile fittings shall be wrapped with polyethylene plastic film having a minimum thickness of 0.008 inches or with a cross woven polyethylene plastic film having a minimum thickness of 0.004 inches.

PART 3 EXECUTION

3.01 VALVE INSTALLATION

- A. All valves shall be installed in locations as shown on the plans or as directed by the Owner's Resident Project representative.
- B. The valve and joints shall be installed in accordance with the manufacturer's recommendations.
- C. All pipe bevels shall be removed prior to installation of any valve or ductile iron fitting.

3.02 VALVE BOX INSTALLATION

- A. All foreign material and debris shall be removed from the top of the valve operator prior to setting the valve box.
- B. Valve box centering device shall be installed to center valve box on valve.
- C. Valve boxes shall be centered and plumb over the operating nut of the valve and shall be set so that no shock or stress will be transmitted to the valve.
- D. Tops of the valve boxes shall be set flush with the valve identification collar or manhole cover unless otherwise directed.

* * * END OF SECTION * * *

SECTION 33 31 00 SANITARY SEWER PIPING AND FITTINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions shall apply to the Work covered in this section.
- B. Related Work Specified Elsewhere:
 - 1. Trenching, Backfilling and Compacting - Section 31 23 33
 - 2. Sanitary Sewer Gravity Pipe Cleaning - Section 33 01 30.12
 - 3. Standard Drawing: 33 31 00

1.02 DESCRIPTION OF WORK

- A. The work covered under these specifications shall include the furnishing of all labor, material, tools, and equipment necessary to furnish and install, complete in place, all piping and fittings as shown on the drawings and as specified herein.

1.03 SUBMITTALS

- A. The Contractor shall submit for review shop drawings for materials specified herein as hereinafter specified.
- B. Certificates from the manufacturer that the materials meet or exceed specified requirements.
- C. The manufacturer's installation recommendations, including types and amounts of gasket lubricant, where applicable, to be used.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be packed, loaded, transported, unloaded, and handled in such a manner so as to prevent damage to the materials.
- B. All material shall be loaded and unloaded by lifting with slings or hoists or skidding so as to avoid shock or damage. Dropping or rolling will not be permitted. The use of end hooks to install or move piping will not be allowed.
- C. All materials shall be stored on the site in accordance with the manufacturer's recommendations. Do not store materials directly on the ground.
- D. All materials shall be kept clean and dry. The insides of all piping and fittings shall be kept free of dirt and debris.

PART 2 PRODUCTS

2.01 DUCTILE IRON FITTINGS

- A. Ductile iron fittings shall conform to the requirements of ANSI/AWWA C110 &

C153/A21.10 & A21.53.

- B. Ductile Iron Fittings to be installed underground shall be mechanical joint or push-on joint type conforming to the requirements of ANSI/AWWA C 111/A 21.11.
- C. Ductile Iron Fittings to be installed in "non-buried" locations shall be provided with flanged joints with rubber full-face gaskets. Flanged faces shall be drilled to standard 125-pound template unless otherwise noted.
- D. All Ductile Iron Fittings shall be lined with cement mortar in accordance with ANSI/AWWA C104/A21.4 the exterior finishes shall be an asphaltic varnish coating not less than 1 mil thick.

2.02 GRAVITY PVC PIPE

- A. Polyvinyl Chloride (PVC) gravity pipe shall be Type I, Grade I, conforming to the requirements of ASTM Specification D 3034 for Rigid Poly (Vinyl Chloride) Sewer pipe.
- B. Solvent Cement for PVC pipe joints shall conform to ASTM Specification ASTM D 2564 and shall be applied in conformance with ASTM D 2855. Solvent weld joints will be allowed on PVC cleanout risers only.
- C. Gasket type joints shall be made with rubber gaskets conforming to the requirements of ASTM F-477.
- D. The pipe shall be capable of withstanding trench loads imposed on it.

2.03 GRAVITY PVC PIPE FITTINGS

- A. Repair couplers, tees, wyes, and bends for Polyvinyl Chloride (PVC) gravity pipe fittings shall be of PVC with material and dimensions conforming to the requirements of ASTM Specification D 3034.
- B. Gaskets for elastomeric joints shall conform to the requirements of ASTM F-477.
- C. Solvent Cement for solvent weld joints shall conform to the requirements of ASTM Specification D 2564 and shall be applied in conformance with ASTM D 2855. Solvent weld joints will be allowed on PVC cleanout risers only.
- D. Sewer "Wyes" for service connections shall be in-line sewer wyes. Saddle wyes will not be permitted for use without permission from Project Engineer.

2.04 TRANSITION COUPLINGS (PRESSURE PIPING)

- A. The couplings used for transitions between piping of different materials shall be a wide-range flexible coupler with a sleeve type design meeting the requirements of AWWA C219.
 - 1. The coupling body shall be a center sleeve fabricated of high strength carbon steel tubing equivalent to ANSI/AWWA C200. The transition couplers will be readily available in nominal diameter ranges from 1.5 to 24 inches on all pipe classes.
 - 2. Compression End Rings: One gasket compression end ring per coupling end. End rings to be of either one or two bolt design, fabricated of carbon steel equivalent to ASTM A576. (One bolt per end in Nominal Size ranges of 2 to 12 inches and two bolts per end on the 16 to 24 inch nominal diameter coupling.)

3. Hydraulic Wide Range Gasket: Chloramine Resistant NSF-61 approved EPDM gasket designed with a multi-layered wide range removable outer layer. Gasket hydraulically actuated with a pressure-equalizing dam, pressure cavity and sealing lip for working pressure of 260 psi (1.5 to 16 inches) and 232 psi (18 to 24 inch nominal diameter coupling).
 4. Fasteners shall be grade 304 (A2) or 316 (A4) stainless steel with yield strengths that conform to all nationally recognized standards. Bolts to be coated with an anti-seize type coating to prevent galling.
 5. The interior and exterior coatings shall NSF-61 approved fusion bonded epoxy coating conforming to AWWA C213.
 6. When properly installed the coupling will provide a minimum deflection of 8 degrees, up to 260 psi working pressure and 3/8 inch longitudinal pipe movement without leakage. (Flanged adapters will provide half the longitudinal movement and deflection.)
 7. All products will be proof tested to a minimum of 1.5 times working pressure.
- B. Flanged couplers shall consist of one compression end and gasket, coupling center sleeve, and AWWA Class "D" Flange (per AWWA C207).
- C. Pre-Approved transition couplers are: Hymax-2000 Series wide range coupling; Hymax-2100 Series wide range flanged coupling adapter; "Macro" extended range coupling by Romac Industries, Inc.; or Engineer approved equal.

2.05 TRANSITION COUPLINGS (GRAVITY PIPING)

A. GASKET

1. Manufactured to meet the material requirements of:
 - a. CSA B602 - mechanical couplings for drain, waste, vent pipe and sewer pipe
 - b. ASTM D 5926 - Standard Specification for Poly Vinyl Chloride (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
 - c. ASTM C 1173 - Standard Specification for Flexible Transition Couplings for Underground Piping Systems
 - d. Hardness, Shore "A", Inst. +5.....65
 - e. Tensile Strength, Min. psi1000
 - f. Elongation at Rupture, Min. %.....250
 - g. Tear Strength, Min..... 150 lb/in.
 - h. Brittleness Temperature..... -40°F

B. CLAMPS

1. Manufactured to the requirements of CSA B602
2. Clamp Housing- 301 Stainless Steel
3. Clamp Band - 301 Stainless Steel

4. Clamp Screw - 305 Stainless Steel

5. Installation torque 60" lbs

C. SHEAR RING

1. 0.012" Thick, 300 Series Stainless Steel

2. Width manufactured according to coupling width (1.50", 2.13", or 4")

3. Length manufactured according to coupling diameter

4. Clamps spot welded in place

D. COUPLING

1. Manufactured to conform to the performance requirements of:

a. ASTM C 1173 - standard specification for flexible transition couplings for underground piping systems

b. CSA B602 - mechanical couplings for drain, waste, vent pipe and sewer pipe

c. Maximum test pressure: 4.3 PSI (29.6KPA)

d. Maximum operating temperature: 140° F nonconsistent

E. Pre-Approved transition couplers are Strong Back RC Series Repair Couplings manufactured by Fernco Inc. or Engineer approved equal.

2.06 BEDDING MATERIAL

A. Borrowed granular bedding material shall conform to the gradation indicated below.

<u>Sieve Opening</u>	<u>Bedding Material (Percent Passing)</u>
1"	95-100
No. 200	< 15

B. Borrowed granular bedding material for unstable trench bottom shall conform to the gradation indicated of size 67 Course Aggregate, ASTM C33 which is indicated below.

<u>Sieve Opening</u>	<u>Bedding Material (Percent Passing)</u>
1-1/2"	100
3/4"	90-100
3/8"	20-55
No. 4	0-10
No. 8	0-5

C. Bedding material excavated from the job site shall be finely divided material free from organic material and clods, lumps of frozen material or stones larger than 1 1/2" in maximum diameter. Bedding material shall be of proper moisture content to form a firm bed for the pipe.

2.07 FASTENERS

A. All fasteners in buried locations shall be Grade 304 (A2) or Grade 316 (A4) stainless steel.

Anti-Seize shall be applied to all threads prior to installation.

2.08 LUBRICANT FOR GASKETED PIPE

- A. Lubricant shall be an emulsified polymer based product, specifically formulated to be water-soluble without causing turbidity. Lubricant shall not transfer taste and/or odor to new water main installations. Lubricant must not promote bacterial growth and be safe for use on all metal and plastic pipes. Lubricant shall be easily flushed from the line and be non-reactive to chlorinated water. Lubricant should work easily on both wet and dry surfaces.

2.09 POLYETHYLENE WRAP

- A. All ductile fittings shall be wrapped with polyethylene plastic film having a minimum thickness of 0.008 inches or with a cross woven polyethylene plastic film having a minimum thickness of 0.004 inches.

PART 3 EXECUTION

3.01 GENERAL

- A. The areas to receive piping shall be examined for defects that may adversely affect the execution and quality of Work. Prior to the start of piping installation, all measurements shall be checked for deviations from allowable tolerances for piping.

3.02 BURIED PIPING INSTALLATION

- A. All piping and fittings shall be laid true to line and grade as shown on the plans. Each section of pipe shall be so laid and fitted together that when complete the piping will have a smooth uniform flow line. The inside of all pipe shall be cleaned before installation and kept thoroughly clean during and after the laying. Pipe ends shall be cleaned inside and outside.
- B. Apply lubricant liberally to the inside of the pipe bell and spigot. Make sure lubricated surfaces remain free of dirt, gravel, or other debris. Assemble the pipe joint immediately after application of the lubricant.
- C. All pipe and fitting shall be examined for defects before being lowered into the trench. The interior and exterior protective coating shall be inspected and field repaired, if required.
- D. The pipe shall be handled and installed in accordance with manufacturer's recommendations and the requirements of AWWA C 600 for Ductile Iron pipe, ASTM D 2774 for PVC pressure piping and ASTM D 2321 for PVC gravity sewer piping.
- E. When pipe laying is not in progress, including the noon hours, the open ends of pipe shall be closed. No trench water, animals, or foreign material shall be permitted to enter the pipe.
- F. Class "C" Bedding shall be used with all piping. The bedding material shall conform to the requirements of Part 2 above. General requirements for placement are shown on Standard Drawing 333100-1. On all non-rigid piping, care will be taken to provide maximum support in the haunch area of the pipe. This area extends from the bedding material to the center of the pipe. If coarse materials with voids have been used for bedding materials, the same bedding materials will be used for haunching. When a trench box or similar device is used during excavation, the box will be raised sufficiently to recompact the haunch area in the natural trench to 97% maximum dry density as determined by ASTM D 698.

- G. After each pipe has been graded, aligned, and placed in final position on the bedding material and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe joining and embedment operations.
- H. The pipe shall be laid upon properly placed bedding material so that the barrel of the pipe will have a bearing for its full length. No blocking will be allowed to bring the piping up to grade. Bell holes and depressions for joints shall be excavated after the trench bedding has been graded to provide uniform support for the entire pipe.
- I. The Contractor shall provide and maintain all necessary means and devices at all times to remove and dispose of all water entering the trench during the process of pipe laying. The trench shall be kept dry until the pipe laying and jointing are completed. Removal of water shall comply with Section 31 23 33.
- J. Thrust blocks or restraining fittings to restrain pressurized piping shall be provided at all abrupt changes in direction, tees, bends, dead ends and hydrants, and shall be in accordance with the pipe manufacturer's recommendations.
- K. The Contractor shall place backfill material in lifts not exceeding 1-foot and compact to 97% Standard Proctor Density. Stones equal to or larger than 3-inches in diameter shall not be placed within 2-feet of the pipe.

3.03 EXPOSED PIPING INSTALLATION

- A. Each item or system shall be furnished complete and installed as shown on the plans and in accordance with the manufacturer's recommendations, instructions, and directions. All installed equipment and systems shall be properly protected during subsequent construction operation.
- B. The Contractor shall inspect all material or equipment as it is received to determine damage and/or missing parts. It shall be his responsibility to repair or replace damaged items in accordance with the manufacturer's instructions.
- C. The Contractor shall provide all scaffolding required for the proper installation of this work in conformance with the standards of any local and state safety codes applying to scaffolding.
- D. All pipe shall be set such that the vertical and horizontal centerlines are properly aligned. Installation of piping by means of springing, forcing or stressing the pipe or adjacent fittings, valves or equipment will not be allowed.

3.04 MECHANICAL JOINTS AND COUPLINGS

- A. Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled or replaced. Over tightening bolts to compensate for poor installation practice will not be permitted.
- B. The holes in mechanical joints with tie rods shall be carefully aligned to permit installation of the tie rods. In flange and mechanical joint pieces, holes in the mechanical joint bells and the flanges shall straddle the top (or side for vertical piping) centerline. The top (or side) centerline shall be marked on each flange and mechanical joint piece at the foundry.

3.05 TRACER WIRE INSTALLATION

- A. Tracer wire shall be installed in the trench at the same time as the pipe or immediately prior to starting the backfill of the trench.
- B. Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.
- C. Splices will be allowed at manholes, bored crossings, and at other locations as agreed upon by the Resident Project Representative. Splices in tracer wire will be made with split bolt or compression-type connectors. Wire nuts may not be used. A waterproof connection is necessary to prevent corrosion. Splices shall be completed in accordance with the manufacturer's recommendations.
- D. Prior to final acceptance, all tracer wire shall be electrically tested for continuity from one exposed end to another.
- E. Bring the wire to the ground surface at each manhole and boring ends and loop the wire in a tracer wire terminal box. These boxes shall be located adjacent to the manhole and/or bored crossing in the boulevard with at least two feet of extra wire inside the box. The tracer wire terminal box must be installed flush with the finished grade.

3.06 TESTING

- A. All piping shall be cleaned and flushed after completion of installation.

* * * END OF SECTION * * *

SECTION 33 41 00 STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions shall apply to the Work covered in this section.
- B. Related Work Specified Elsewhere:
 - 1. Trenching, Backfilling and Compacting - Section 31 23 33
 - 2. Standard Detail – 33 41 00-01

1.02 DESCRIPTION OF WORK

- A. The work covered under these specifications shall include the furnishing of all labor, material, tools, and equipment necessary to furnish and install, complete in place, all storm water drainage piping and related appurtenances as shown on the drawings and as specified herein.

1.03 SUBMITTALS

- A. The Contractor shall submit for review copies of shop drawings for materials specified herein.
- B. Certificates from the manufacturer that the materials meet or exceed specified requirements.
- C. The manufacturer's installation recommendations, including types and amounts of gasket lubricant, where applicable, to be used.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All materials shall be packed, loaded, transported, unloaded and handled in such a manner so as to prevent damage to the materials.
- B. All material shall be loaded, unloaded and placed in position by lifting with slings or hoists or skidding so as to avoid shock or damage. Dropping or rolling will not be permitted. The use of end hooks to install or move piping will not be allowed.
- C. All materials shall be stored on the site in accordance with the manufacturer's recommendations.

PART 2 PRODUCTS

2.01 PE STORM SEWER PIPE

- A. Storm sewer pipe will conform to the requirements of ASTM F2648 Standard Specification for 2 in. to 60 in. Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications or AASHTO M294 Type S.
- B. Pipe will be dual-walled with a smooth interior and corrugated exterior.

- C. All joints will be gasket style to provide a watertight connection capable of holding a 10.8-psi internal pressure for a minimum of 10 minutes, per ASTM D3212.
- D. Fittings for PE pipe will have gasket style joints, and conform to the requirements of ASTM F2306.
- E. Tapping saddle tees/In-serta Tees may be used for lateral connections.

2.02 PVC STORM DRAINAGE PIPING - SDR 35

- A. Polyvinyl Chloride (PVC) gravity pipe shall be Type I, Grade I, conforming to the requirements of ASTM Specification D 3034 for Rigid Poly (Vinyl Chloride) Sewer pipe.
- B. Solvent Cement for PVC pipe joints will not be allowed.
- C. Gasket type joints shall be made with rubber gaskets conforming to the requirements of ASTM F-477.
- D. Tapping saddle tees/In-serta Tees may be used for lateral connections.

2.03 POLYPROPYLENE (PP) PIPE

- A. Polypropylene Pipe will conform to the requirements of ASTM F2881 or AASHTO M330.
- B. Joints for Polypropylene pipe shall include dual gaskets and conform to the requirements of ASTM D3212.
- C. Fittings for polypropylene pipe shall conform to ASTM F2881.
- D. Tapping saddle tees/In-serta Tees may be used for lateral connections.

2.04 GRAVITY PVC PIPE FITTINGS

- A. Fittings for Polyvinyl Chloride (PVC) gravity pipe fittings shall be of PVC with material and dimensions conforming to the requirements of ASTM Specification D 3034.
- B. Gaskets for elastomeric joints shall conform to the requirements of ASTM F-477.
- C. Solvent Cement for solvent weld joints will not be allowed.

PART 3 EXECUTION

3.01 GENERAL

- A. Storm drainage piping shall be laid with the groove or bell end of the pipe upstream and the tongue end shall be inserted into the groove.
- B. Rubber gaskets at joints shall be installed according to the manufacturer's instructions.
- C. Proper equipment shall be provided by the Contractor for lowering the sections of pipe into place. Dropping the pipe into place will not be permitted.

3.02 EXCAVATION

- A. Trenches shall be excavated to a width sufficient to allow for proper jointing of the pipe and thorough compaction of the bedding and backfill material under and around the pipe. Where feasible, trench walls shall be vertical. The completed trench bottom shall be firm for its full length and width.

- B. The foundation for each type of bedding shall be adequate to furnish a uniform stable support.

3.03 BEDDING

- A. Bedding shall be used with all storm piping.

1. **Class E bedding material (as seen in the Standard Drawing 33 41 00 – 1), will be used with all PVC, PP and PE storm drainage piping and the bedding shall meet the follow requirement:**

- B. Bedding material shall consist of pit run gravel with a minimum amount of rock retained on the 1" sieve and no more than 15% passing the #200 sieve. The gravel for bedding shall be approved by the Engineer prior to its use.

3.04 DISPOSAL OF EXCESS MATERIAL

- A. Any excess material, or material determined as unsuitable for backfill, shall be wasted at an area designated by the Engineer.

3.05 TESTING OF GRAVITY STORM SEWERS

A. TEST SECTIONS

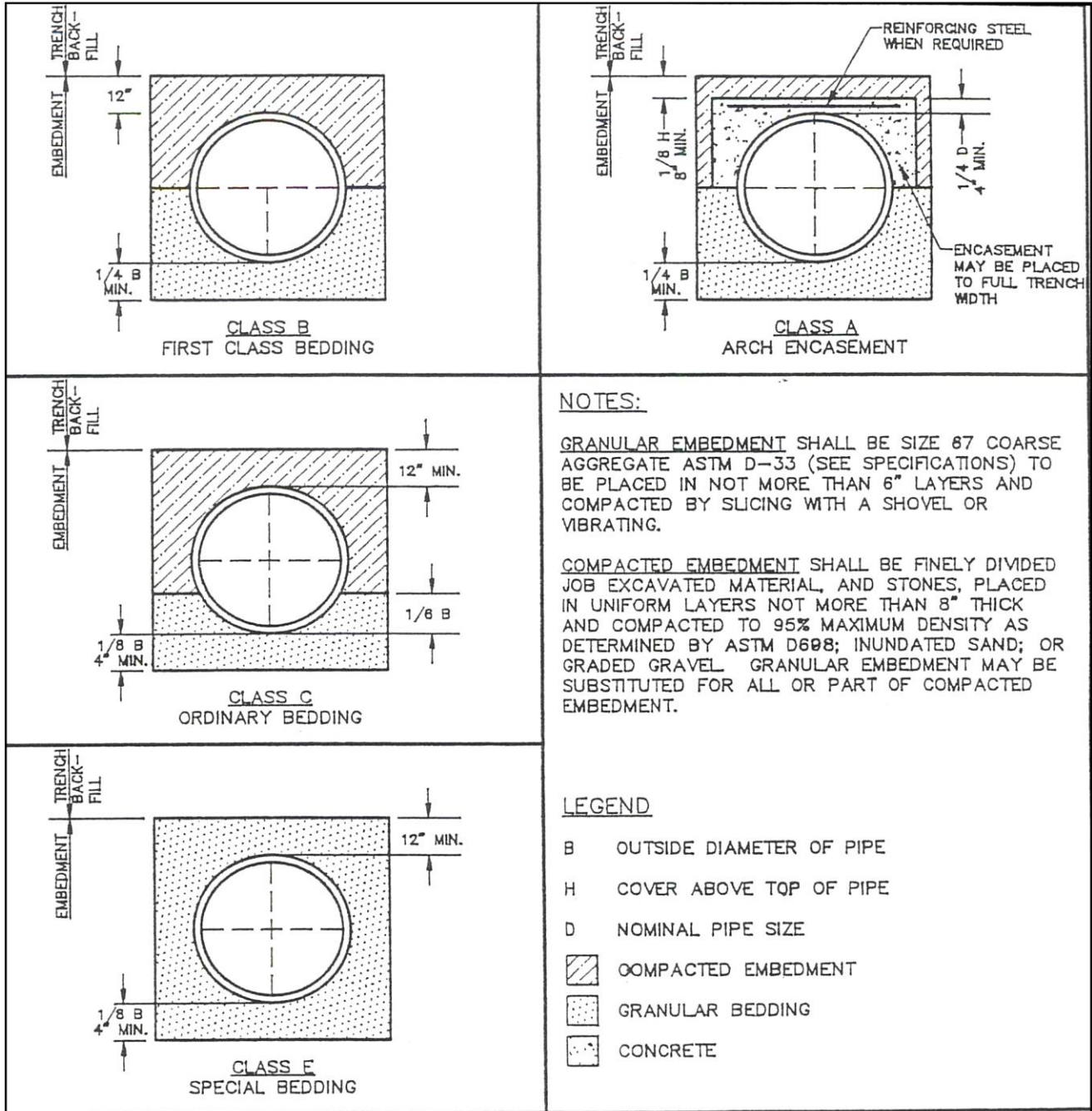
1. The alignment tests of all gravity sewer lines shall be carried out on sections of sewer line located between manholes and/or inlets.
2. The Contractor shall be solely responsible for any and all damage to the pipeline, and to public and private property, which may result from defective material or workmanship.
3. Concrete and corrugated metal pipe will not be tested for infiltration or exfiltration, unless specifically called out in the plans.

B. GRAVITY SEWER LINE DISPLACEMENT AND DEFLECTION

1. All tests for alignment and displacement of the gravity sewer lines will be made after the pipe has been laid and the trench backfilled and compacted as specified.
2. The Engineer's test procedure will be as follows: A light will be shined between manholes and/or inlets by means of a flashlight or by reflecting sunlight with mirrors.
3. The Engineer may require the Contractor to conduct random deflection tests between successive inlet in areas where unstable trench walls or bottoms, heavy rainfall, frozen soil, high ground water levels, deep lines or difficulty in achieving compaction is experienced.

3.06 CLEANING OF GRAVITY SEWER LINES

- A. All lines shall be thoroughly flushed and cleaned before acceptance until all traces of construction materials, soil or other foreign matter have been removed.
- B. The Contractor shall take all necessary measures to protect adjacent facilities and property. Damages caused by flushing water or water carried material shall be the responsibility of the Contractor.
- C. All flushing and cleaning shall be completed prior to the initiation of the testing process described in 3.05.



EMBEDMENTS FOR CONDUITS

HELMS AND ASSOCIATES
CONSULTING ENGINEERS
ABERDEEN, SOUTH DAKOTA

Standard Drawing
33 41 00 - 1

*** END OF SECTION ***