PROJECT MANUAL

PARK ELEMENTARY SCHOOL EXPANSION PHASES 1 AND 2

Casper, Wyoming

Project: 2047
Date: November 27, 2019

GSG Architecture
Design
Architecture/Planning
The following list represents those individuals who shall be their company’s representative during the bidding and construction phase of this Project.

**OWNER:**
Natrona County School District #1
970 North Glenn Road
Casper, Wyoming 82601
307.253.5371

Doug Tunison, Project Manager  
abright@bgccw.org

**DESIGN-BUILD TEAM**

**General Contractor:**
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Casper, Wyoming 82601
307.235.5690

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whayden@casparbuildingsystems.com

**Architecture and Structural:**

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**Civil Engineering:**

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**Mechanical and Electrical Engineering:**

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Casper, WY 82601
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John Huntley, P.E., Mechanical  
john.huntley@WestPlainsEngineering.com

Pedro Uztariz, P.E., Mechanical  
pedro.uztariz@WestPlainsEngineering.com

Andrew Maxwell, P.E., Electrical  
andrew.maxwell@WestPlainsEngineering.com
Note: Sections added and/or modified from the Phase 1 specification are designated by XX XXXX - MM.

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DIVISION 32 - EXTERIOR IMPROVEMENTS – See Civil Drawings

DIVISION 33 - UTILITIES – See Civil Drawings

Appendix
Geotechnical Engineering Evaluation (Dated 08/22/2019)
The 1974 Geotechnical Evaluation is available at the office of the Architect.

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PART 1 GENERAL

1.01 PROJECT

A. **Project Name:** Park Elementary School Addition and Renovation
B. **Owner:** Natrona County School District #1
C. **Design-Build Team**
   1. General Contractor: Caspar Building Systems, Inc.
   2. Architect: GSG Architecture
   3. MEP Engineers: West Plains Engineering
   4. Civil Engineer: ECS
D. **Project Description:**
   Park Elementary School consists of two buildings that were constructed at different times and has been utilized as an educational facility and has remained, with small alterations, largely in its original configuration since that time.
  
   The original gymnasium and library were constructed in 1956. The gym is a unique design utilizing a glulam arch system with tongue and groove wood decking to support the shingled, barrel roof. The library and original entry/lobby area to the gym are shorter and incorporate low-slope roofs. The gym includes a raised stage/platform area, along with other minor support spaces (approximately 5,847 total SF).

   The construction of the classroom portion of the facility was completed in 1974 and is a two-story, load-bearing, reinforced masonry structure with steel joists and concrete deck at the second level, and slab-on-grade concrete floors on the ground level (approximately 20,669 total SF). The roof is constructed with steel joists and metal deck and supports a low-slope roofing system. The basic structural layout consists of load-bearing exterior and interior walls that define the classrooms and major circulation areas of the building.

   The total footprint of the entire school, including the original gymnasium and library, is approximately 26,516 SF.

E. **Existing Building Envelope**
   The building envelope of the classroom portion is constructed with two wythes of masonry, consisting of exterior brick and load-bearing CMU. The exterior masonry work is of high original quality. There are signs of weathering (erosion of some mortar joints, and stress relief cracking), consistent with the construction and age of the structure. There are several locations where the mortar joins have been compromised by water and need to be re-pointed prior to repairing the water-related issues. This work will occur during Phase 2 of the work.

   The windows consist of insulated, double pane, aluminum-framed units with sliding operable panels. These windows will be replaced during Phase 2 of the work.

   All low-slope roofs consist of a JP Stevens single-ply, Hypalon membrane system that was installed in 1999. This system has functioned well, although it is now beginning to leak in several areas and will be replaced/coated during Phase 2 of the work.

   The gymnasium’s vaulted roof consists of an architectural shingle system installed in 1993 and is currently leaking and will need to be replaced during Phase 2 of the work.

F. **Environmental Analysis**
   The District has completed an Environmental analysis and will address the abatement under a separate contract, prior to work commencing in the existing facility.

G. **Scope of Work**
   The site will be modified to improve drainage and provide new surfaces in the playground area. Parking will be modified to increase the number of spaces available through re-purposing the current parking lot and adjacent streets. This work will occur in Phase 2 of the project.
H. Project Phasing
   a. Phase 1 – North Classroom Addition – Fall 2019 thru Spring 2020
      1. Project consists of concrete foundation, steel frame and stud infill with GWB on the inside and insulation and brick veneer on the exterior with horizontal metal panel accents aligning with the original building. Slab on grade at the 1st floor, steel joists and deck with concrete slab for the 2nd floor, and steel joists and deck with rigid insulation and low slope membrane roof.

   b. Phase 2a – Summer 2020
      1. Link Addition (similar construction to CR addition – metal panels in lieu of brick veneer).
      2. Administration and Secured Entry Remodel (steel studs and GWB).
      3. “Above Ceiling” Renovation including but not limited to the following items:
         a. Individual CR HVAC allowing individual control of heating and AC
         b. Fire Sprinkler
         c. Lighting
         d. Fire Alarm
         e. Audio / Video updates
         f. Security Improvements – cameras, door monitoring
         g. Improve ventilation in RR’s
      4. Ceiling Replacement
      5. Begin Site Work
      6. Existing Roof Coating

   c. Phase 2b – Summer 2021 – “Below ceiling” Renovation including but not limited to the following items:
      1. Replace windows
      2. Casework / cabinet upgrades
      3. Replace Movable partitions
      4. Paint walls
      5. New tack surfaces
      6. New flooring
      7. Replace existing doors
      8. Refinish Gym and Stage Wood Floors
      9. Exterior Upgrades
      10. Replace existing plumbing fixtures

1.02 OWNER OCCUPANCY
   A. Owner intends to occupy the current Building and Site during the construction period following the District’s normal school schedule.

1.03 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. Work by Others (Utility Companies).
   C. Provide access to and from site as required by law and by Owner:
      1. Emergency Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
      2. Do not obstruct roadways, sidewalks, or other public ways without permit.
   D. Time Restrictions:
      1. Coordination will be required between the Owner and Contractor as to requirements for workdays and hours of the day.
   E. Utility Outages and Shutdown:
      1. Limit shutdown of utility services to 4 hours at a time, arranged at least 48 hours in advance with Owner and local utility providers.
      2. Prevent accidental disruption of utility services to other facilities.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION
SECTION 01 2000
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement, but not more than once per month.

B. Form to be used: AIA G702 and G703.

C. Execute certification by signature of authorized officer.

D. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored Products.

E. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.

F. Submit three copies of each Application for Payment.

1.02 MODIFICATION PROCEDURES

A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to the Contract Documents.

B. For minor changes not involving an adjustment to the Contract Price or Contract Time, Architect will issue instructions directly to Contractor.

C. 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.

D. Execution of Change Orders: Owner will issue Change Orders for signatures of parties as provided in the Conditions of the Contract on Architect's Change Order Document.

E. After execution of Change Order, promptly the CMAR will revise the Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

1.03 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.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

1. Electronic document submittal service.
2. Progress meetings.
3. Construction progress schedule.
4. Submittals for review.
5. Submittals for information.
7. Number of copies of submittals.
8. Submittal procedure.

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 (excluding those which contain items to be selected based on aesthetic qualities such as color texture and / or pattern) are to be in electronic (PDF) format 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 information (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. Contractor and Architect are required to use this service.

3. It is Contractor's responsibility to submit documents in PDF format.

4. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.

5. 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.

6. Paper document transmittals will not be reviewed; emailed PDF documents will not be reviewed.

7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Cost: The cost of the service is to be paid by Owner.

C. Submittal Service: The selected service is: Submittal Exchange

D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.

E. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

F. Submittals which contain items to be selected based on aesthetic qualities such as color texture and / or pattern shall be provided as physical samples to the architect.

3.02 PROGRESS MEETINGS

A. Contractor shall schedule and administer meetings throughout progress of the Work at maximum weekly intervals or as requested by the Owner or Architect.

B. Contractor shall make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
C. Attendance Required:
   1. Contractor.
   2. Owner.
   3. Architect.
   4. Contractor's Superintendent.
   5. Major Subcontractors.
D. Contractor shall 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 CONSTRUCTION PROGRESS SCHEDULE
A. Within 7 days after date of the final GMP Proposal, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
D. Within 10 days after joint review, submit complete schedule.
E. Submit updated schedule with each Application for Payment.

3.04 SUBMITTALS FOR REVIEW
A. For B1 and B2 below, Architect review by electronic means per item 3.01 above. Architect shall receive the specified physical samples for all items and systems requiring judgement of color, texture or other physical qualities not accurately portrayed in electronic media.
B. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.
C. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
D. Samples will be reviewed only for aesthetic, color, or finish selection.
E. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

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

3.06 SUBMITTALS FOR PROJECT CLOSEOUT
A. Submit Correction Punch List for Substantial Completion.
B. Submit Final Correction Punch List for Final Completion.
C. When the following are specified in individual sections, submit them at project closeout:
   1. Project record documents.
2. Operation and maintenance data.
3. Warranties.
5. Other types as indicated.
D. Submit for Owner's benefit during and after project completion.

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.
B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

3.08 SUBMITTAL PROCEDURES
A. Shop Drawing Procedures:
   1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related Work.
   2. Generic, non-project specific information submitted as shop drawings do not meet the requirements for shop drawings.
B. Submittals for review shall be numbered using the Specification Section number from this project manual with a suffix identifying the number of the submittal within the section. (Example: Section 03 3000 may have several components to be submitted such as concrete mix design and rebar shops, Submittals would then be numbered 30 3000 - 01 03 3000 - 02 etc). Revised or resubmitted submittals should be original number and suffix with an additional identifier indicating revision and revision number (Example: 03 3000 01 R1).
C. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.
D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
E. Submittals which require physical samples shall be delivered to the the address provided by the Architect. Contractor shall allow adequate delivery and return delivery time for such physical submittals in the project schedule.
F. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
G. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.
H. Provide space for Contractor and Architect review stamps.
I. When revised for resubmission, identify all changes made since previous submission.
J. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
K. Submittals not requested will not be recognized or processed.

END OF SECTION
PART 1 GENERAL

1.01 SUBMITTALS

A. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
   1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
   2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.

B. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

C. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
   1. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have Work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

A. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Accepted mock-ups shall be a comparison standard for the remaining Work.

D. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not conforming to specified requirements.

END OF SECTION
SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 TEMPORARY UTILITIES
   A. Existing utility infrastructure facilities may be used to activate temporary services.
   B. New permanent facilities may be used once installed with the express written permission of the Owner.

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

1.03 TEMPORARY SANITARY FACILITIES
   A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

1.04 BARRIERS
   A. Provide barriers to prevent unauthorized entry to construction areas and to protect adjacent properties from damage from construction operations.
   B. Provide protection for plants designated to remain (if any). Replace damaged plants.

1.05 FENCING
   A. Temporary security fencing construction: Commercial grade chain link fence or welded wire fencing minimum 6’ high with vehicular gates and locks.

1.06 EXTERIOR ENCLOSURES
   A. During the construction process as necessary to facilitate work and protect installed products and/or systems, provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.07 SECURITY
   A. Provide security and facilities to protect Work, and operations from unauthorized entry, vandalism, or theft by way of perimeter construction fence and eventually locked facility.

1.08 VEHICULAR ACCESS AND PARKING
   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.

1.09 WASTE REMOVAL
   A. Refer to See Section 01 7419 - Waste Management, for additional requirements.

1.10 PROJECT IDENTIFICATION
   A. Provide project identification sign of design and construction indicated on Drawings.
   B. Erect on site at location indicated, and if not indicated as directed by the Architect.

1.11 FIELD OFFICES
   A. Office: Provide a weathertight field office with lighting, electrical, telephone and data 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 a minimum of 6 persons.

PART 2 PRODUCTS - NOT USED
PART 3 EXECUTION - NOT USED

END OF SECTION
SECTION 01 5713
TEMP. EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SUBMITTALS

A. Erosion and Sedimentation Control Plan:
   1. Submit within 2 weeks after Notice to Proceed.
   2. Obtain the approval of the Plan by authorities having jurisdiction.
   3. Obtain the approval of the Plan by Owner.

PART 2 PRODUCTS

2.01 MATERIALS

A. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
   1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
   2. Permittivity: 0.05 sec, minimum, when tested in accordance with ASTM D4491.
   3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355 after 500 hours exposure.
   4. Tensile Strength: 100 lb-f, minimum, in cross-machine direction; 124 lb-f, minimum, in machine direction; when tested in accordance with ASTM D4632.
   5. Tear Strength: 55 lb-f, minimum, when tested in accordance with ASTM D4533.

B. Silt Fence Posts: One of the following, minimum 5 feet long:
   1. Steel 'U' or 'T' section, with minimum mass of 1.33 lb per linear foot.
   2. Softwood, 4 by 4 inches in cross section.
   3. Hardwood, 2 by 2 inches in cross section.

PART 3 EXECUTION

3.01 SCOPE OF PREVENTIVE MEASURES

A. In all cases, if permanent erosion resistant measures have been installed, temporary preventive measures are not required.

B. Construction Entrances: Traffic-bearing aggregate surface.
   1. Width: As required; 20 feet, minimum.
   2. Length: 50 feet, minimum.
   3. Provide at each construction entrance from public right-of-way.
   4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.

C. Linear Sediment Barriers: Made of silt fences.
   1. Provide linear sediment barriers:
      a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
      b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
      c. Along the toe of cut slopes and fill slopes.
      d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart.
      e. Across the entrances to culverts that receive runoff from disturbed areas.
2. Space sediment barriers with the following maximum slope length upslope from barrier:
   a. Slope of Less Than 2 Percent: 100 feet.
   b. Slope Between 2 and 5 Percent: 75 feet.
   c. Slope Between 5 and 10 Percent: 50 feet.
   d. Slope Between 10 and 20 Percent: 25 feet.
   e. Slope Over 20 Percent: 15 feet.

D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
   1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
   2. Straw bale row blocking entire inlet face area; anchor into pavement.

E. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.

3.02 MAINTENANCE

3.03 CLEAN UP
   A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
   B. Clean out temporary sediment control structures that are to remain as permanent measures.
   C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION
SECTION 01 5721
INDOOR AIR QUALITY CONTROLS

PART 1  GENERAL

1.01  PROJECT GOALS
A. Ventilation: Refer to mechanical specifications and commissioning reports to confirm all ventilation requirements.

1.02  SUBMITTALS
A. Indoor Air Quality Management Plan: Describe in detail measures to be taken to promote adequate indoor air quality upon completion; use SMACNA (OCC) as a guide.
B. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.
C. Duct and Terminal Unit Inspection Report.

PART 2  PRODUCTS

2.01  MATERIALS
A. Low VOC Materials: See other sections for specific requirements for materials with low VOC content.
B. Auxiliary Air Filters: MERV of 8, minimum, when tested in accordance with ASHRAE 52.2.

PART 3  EXECUTION

3.01  CONSTRUCTION PROCEDURES
A. Begin construction ventilation when building is substantially enclosed.
B. New HVAC equipment and ductwork shall NOT be used for ventilation during construction. If it is deemed that such use is required to maintain project schedule, budget or safety protocols provide the following:

3.02  BUILDING FLUSH-OUT
A. Contractor's Option AND EXPENSE: Either full continuous flush-out OR satisfactory air contaminant testing is required, not both.
B. Perform building flush-out after TCO and Owner furniture and before Substantial Completion.
C. Building Flush-Out: Operate all ventilation systems at normal flow rates with 100 percent outside air until a total air volume of 14,000 cubic feet per square foot of floor area has been supplied.
D. Install new HVAC filtration media after completion of flush-out and before occupancy or further testing.

3.03  AIR CONTAMINANT TESTING
A. Contractor's Option AND EXPENSE: Either full continuous flush-out OR satisfactory air contaminant testing is required, not both.

END OF SECTION
SECTION 01 6000
PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
   B. Related Requirements:
      1. Division 01 Section "References" for applicable industry standards for products specified.

1.03 DEFINITIONS
   A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
      1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
      2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
      3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
   B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.04 ACTION SUBMITTALS
   A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
      1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
      2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor through Construction Manager of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
         a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
         b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
   B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.05 QUALITY ASSURANCE
   A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING
   A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
   B. Delivery and Handling:
      1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
      2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
      3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
      4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
   C. Storage:
      1. Store products to allow for inspection and measurement of quantity or counting of units.
      2. Store materials in a manner that will not endanger Project structure.
      3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
      4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
      5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
      6. Protect stored products from damage and liquids from freezing.
      7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.07 PRODUCT WARRANTIES
   A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
      1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
      2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
   B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
      1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
      2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
      3. See Divisions 02 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.
   C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 PRODUCTS

2.01 PRODUCT SELECTION PROCEDURES
   A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
      1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

4. Where products are accompanied by the term "as selected," Architect will make selection.


6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

3. Products:
   a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
   b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:
   a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
   b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
2.02 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

3. Evidence that proposed product provides specified warranty.

4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.

5. Samples, if requested.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
   2. Field engineering and surveying.
   3. Installation of the Work.
   4. Cutting and patching.
   5. Coordination of Owner-installed products.
   6. Progress cleaning.
   7. Starting and adjusting.
   8. Protection of installed construction.
B. Related Requirements:
   1. Division 01 Section "Summary" for limits on use of Project site.
   2. Division 01 Section "Submittal Procedures" for submitting surveys.
   3. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.03 DEFINITIONS
A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.04 INFORMATIONAL SUBMITTALS
A. Qualification Data: For land surveyor.
B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.05 QUALITY ASSURANCE
A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
   1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
   a. Primary operational systems and equipment.
   b. Fire separation assemblies.
   c. Air or smoke barriers.
   d. Fire-suppression systems.
   e. Mechanical systems piping and ducts.
   f. Control systems.
   g. Communication systems.
   h. Fire-detection and alarm systems.
   i. Conveying systems.
   j. Electrical wiring systems.
   k. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
   a. Water, moisture, or vapor barriers.
   b. Membranes and flashings.
   c. Exterior curtain-wall construction.
   d. Sprayed fire-resistive material.
   e. Equipment supports.
   f. Piping, ductwork, vessels, and equipment.
   g. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 – PRODUCTS

2.01 MATERIALS
   A. General: Comply with requirements specified in other Sections.
      1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with requirements in Division 01 sustainable design requirements Section.

   B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
      1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.01 EXAMINATION
   A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the
existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.

2. List of detrimental conditions, including substrates.

3. List of unacceptable installation tolerances.

4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

3.03 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.

2. Establish limits on use of Project site.

3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.04 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
   1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Construction Manager before proceeding.
   2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
   1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
   2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
   3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.05 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
   2. Allow for building movement, including thermal expansion and contraction.

I. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

J. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

K. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.06 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond core drill.
   4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
   5. Proceed with patching after construction operations requiring cutting are complete.

F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
   1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.

3. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

G. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.07 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
   1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
   2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.08 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
   2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
      a. Use containers intended for holding waste materials of type to be stored.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Construction Waste Management and Disposal."
H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.09 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 01 Section "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

3.010 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION
PART 1 – GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
B. Related Requirements:
   1. Section 013100 “Project Management and Coordination.”
   2. Section 015000 “Temporary Facilities and Controls.”
   4. Section 042010 "Unit Masonry" for disposal requirements for masonry waste.
   5. Section 044301 "Anchored Stone Masonry Veneer“ for disposal requirements for excess stone and stone waste.
   6. Section 312000 “Earth Moving.”

1.02 SUMMARY
A. Section includes administrative and procedural requirements for the following:
   1. Salvaging nonhazardous demolition and construction waste.
   2. Recycling nonhazardous demolition and construction waste.
   3. Disposing of nonhazardous demolition and construction waste.

1.03 DEFINITIONS
A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.04 PERFORMANCE REQUIREMENTS
A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent minimum, with a goal of 75 percent, by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of all applicable materials, including but not limited to the following:
   1. Demolition Waste:
      a. Asphalt paving.
      b. Concrete.
      c. Concrete reinforcing steel.
      d. Brick.
      e. Concrete masonry units.
      f. Wood studs.
      g. Wood joists.
      h. Plywood and oriented strand board.
i. Wood paneling.
j. Wood trim.
k. Structural and miscellaneous steel.
l. Rough hardware.
m. Roofing.
n. Insulation.
o. Doors and frames.
p. Door hardware.
q. Windows.
r. Glazing.
s. Metal studs.
t. Gypsum board.
u. Acoustical tile and panels.
v. Carpet.
w. Carpet pad.
x. Demountable partitions.
y. Equipment.
z. Cabinets.
aa. Plumbing fixtures.
bb. Piping.
cc. Supports and hangers.
dd. Valves.
e. Sprinklers.
ff. Mechanical equipment.
gg. Refrigerants.
hh. Electrical conduit.
ii. Copper wiring.
jj. Lighting fixtures.
k. Lamps.
l. Ballasts.
mm. Electrical devices.
nn. Switchgear and panelboards.
oo. Transformers.

2. Construction Waste:
a. Masonry and CMU.
b. Lumber.
c. Wood sheet materials.
d. Wood trim.
e. Metals.
f. Roofing.
g. Insulation.
h. Carpet and pad.
i. Gypsum board.

j. Piping.

k. Electrical conduit.

l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
   1) Paper.
   2) Cardboard.
   3) Boxes.
   4) Plastic sheet and film.
   5) Polystyrene packaging.
   7) Plastic pails.

B. Waste that cannot be recycled or diverted from landfill or incinerator (i.e. general waste/dust, food items) shall be documented in the same manner as all other waste removed from the Project site. NO MATERIAL SHALL LEAVE PROJECT SITE WITHOUT DOCUMENTATION.

1.05 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan no later than 10 days of date established for commencement of the Work. Plan shall indicate how Contractor proposes to collect, segregate, and dispose of all construction wastes and debris produced by the work of the Contract, including all costs associated with this plan. The plan must include all materials listed as well as those deemed cost-effective to recycle. Contractor to provide documentation to justify decision not to recycle any items specified herein. Show compliance with regulations specified under “Quality Assurance” article below. Include a list of recycling facilities to which indicated recyclable materials will be distributed for disposal. Identify materials that are not recyclable or otherwise conservable that must be disposed of in a landfill or other means acceptable under governing State and local regulations. List permitted landfills and/or disposal means to be employed. Indicate any instances where compliance with requirements of this specification does not appear to be possible and request resolution form the Architect.

1.06 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit the following information:
   1. Material category.
   2. Generation of point of waste.
   3. Total quantity of waste in tons.
   4. Quantity of waste salvaged, both estimated and actual in tons.
   5. Quantity of waste recycled, both estimated and actual in tons.
   6. Total quantity of waste recovered (salvaged plus recycled) in tons.
   7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Hauler Tickets shall contain the following information on each load ticket:
   1. General description of each type of waste.
   2. Location and type of receiving agent (recycles, landfill, incinerator, clean fill, salvage operation).
   3. Quantity of waste in tons.
      a. For mixed loads which are sorted at an off-site location, provide weight and individual disposal information for each separated material.

C. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

F. Records of Reutilization: Provide complete information on where material was reutilized including address.

G. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

H. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

I. Waste reused on the Project: Materials such as rubblized concrete and asphalt which are reutilized on the project site as engineered fill, aggregate, or other material shall be documented.
   1. General Description of each type of waste.
   2. Location where reused on the project.
   3. Quantity of material.

J. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.07 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements.

B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Waste Management Conference: Prior to beginning work at the site, schedule and conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
   1. Review and discuss waste management plan including responsibilities of waste management coordinator.
   2. Review requirements for documenting quantities of each type of waste and its disposition.
   3. Discuss coordination and interface between the Contractor and other construction activities.
   4. Identify and resolve problems with compliance with requirements.
   5. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
   6. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
   7. Review waste management requirements for each trade.
   8. Record minutes of the meeting, identifying all conclusions reached and matters requiring further resolution.
   9. Attendees: The Contractor and related Contractor personnel associated with the work of this section, including the waste management coordinator; the Construction Quality Manager; the Architect; and such additional Owner personnel as the Architect deems appropriate.
   10. Plan Revisions: Make any revisions to the Construction Waste Management Plan agreed upon during the meeting and incorporate resolutions agreed to be made subsequent to the meeting. Submit the revised plan of the Architect for approval.

E. Implementation: Designate an on-site party responsible for instructing workers and implementing the Construction Waste Management Plan. Distribute copies of the Construction Waste Management Plan to the job site foreman and each subcontractor. Include waste management and recycling in worker orientation. Provide on-site instruction on appropriate separation, handling, recycling, and salvaging methods to be used by all parties at the appropriate stages of the work at the site. The Contractor must separate recyclable waste from non-recyclable waste prior to removal off-site. Include waste management and recycling discussion in pre-fabrication meetings with subcontractors and fabricators. Also include discussion of waste management and recycling in regular job meetings and job safety meetings conducted
during the course of work at the site.

1.08 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.


C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Contractor’s standard forms. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
   1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
   2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
   3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
   4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
   5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
   6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
   1. Comply with operation, termination, and removal requirements in Section 015000 “Temporary Facilities and Controls.”

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
   1. Distribute waste management plan to everyone concerned within three days of submittal return.
   2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
   2. Comply with Section 015000 “Temporary Facilities and Controls” for controlling dust and dirt, environmental protection, and noise control.
3.02 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
   3. Store items in a secure area until installation.
   4. Protect items from damage during transport and storage.
   5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Permitted on Project site.

C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area off-site and designated by Owner.
   5. Protect items from damage during transport and storage.

D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

F. Plumbing Fixtures: Separate by type and size.

G. Lighting Fixtures: Separate lamps by type and protect from breakage.

H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.03 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Grind asphalt to maximum size accepted by asphalt-recycling facility.
   1. Crush asphaltic concrete paving and screen to comply with requirements in Section 312000 "Earth Moving" for use as general fill.

B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
   1. Crush concrete and screen to comply with requirements in Section 312000 "Earth Moving" for use as satisfactory soil for fill or subbase.

D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
   1. Crush masonry and screen to comply with requirements in Section 312000 “Earth Moving” for use as general fill or satisfactory soil for fill or subbase.
   2. Clean and stack undamaged, whole masonry units on wood pallets.

E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

F. Metals: Separate metals by type.
   1. Structural Steel: Stack members according to size, type of member, and length.
   2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

G. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
H. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

I. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

J. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.

K. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
   1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

L. Carpet Tile: Remove debris, trash, and adhesive.
   1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

M. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

N. Conduit: Reduce conduit to straight lengths and store by type and size.

3.04 RECYCLING CONSTRUCTION WASTE

A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
   4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:
   1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.

C. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

D. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
   1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.05 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Glass: Remove waste glass products (sheet, bottles, etc.) daily from the work area and deposit in designated containers. Where glass containers are marked for separation by color or type, segregate glass accordingly. Glass containing imbedded wire (typical in some fire rated doors having glazed lights) is usually not reprocessed; verify with the Construction Quality Manager that wireglass is not recyclable.
   1. Verify with Owner how glass should be recycled or discarded. There is currently no local facility for recycling glass in the city of Laramie.

C. Burning: Do not burn waste materials.

D. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION
SECTION 01 7700
CLOSEOUT PROCEDURES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Substantial Completion procedures.
   2. Final completion procedures.
   3. Warranties.
   4. Final cleaning.
   5. Repair of the Work.
B. Related Requirements:
   1. Division 01 Section "Execution" for progress cleaning of Project site.
   2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   3. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
   4. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
   5. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.03 ACTION SUBMITTALS
A. Product Data: For cleaning agents.
B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.04 CLOSEOUT SUBMITTALS
A. Certificates of Release: From authorities having jurisdiction.
B. Certificate of Insurance: For continuing coverage.
C. Field Report: For pest control inspection.

1.05 MAINTENANCE MATERIAL SUBMITTALS
A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.06 SUBSTANTIAL COMPLETION PROCEDURES
A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
   3. Submit closeout submittals specified in individual Divisions 02 through 33 Sections, including specific
warranties, workmanship bonds, maintenance service agreements, final certifications, and similar
documents.
4. Submit maintenance material submittals specified in individual Divisions 02 through 33 Sections,
including tools, spare parts, extra materials, and similar items, and deliver to location designated by
Architect. Label with manufacturer's name and model number where applicable.
   a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material
   submittal items, including name and quantity of each item and name and number of related
5. Submit test/adjust/balance records.
6. Submit sustainable design submittals required in Section 013515 – LEED Requirements and in
   individual Division 02 through 33 Sections.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to
requesting inspection for determining date of Substantial Completion. List items below that are incomplete
at time of request.
   1. Advise Owner of pending insurance changeover requirements.
   2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of
      changeover in security provisions.
   3. Complete startup, commissioning functional testing, and resolve all issues in the Commissioning
      Issues Log.
   4. Perform preventive maintenance on equipment used prior to Substantial Completion.
   5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and
      systems. Submit demonstration and training video recordings specified in Division 01 Section
      "Demonstration and Training."
   6. Advise Owner of changeover in heat and other utilities.
   7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
   8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools,
      and similar elements.
   9. Complete final cleaning requirements, including touchup painting.
   10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10
days prior to date the work will be completed and ready for final inspection and tests. On receipt of request,
Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will
prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on
Contractor's list or additional items identified by Architect, that must be completed or corrected before
certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is
      completed or corrected.
   2. Results of completed inspection will form the basis of requirements for final completion.
1.07 FINAL COMPLETION PROCEDURES
A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion,
   complete the following:
   1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
   2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion
      inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect.
      Certified copy of the list shall state that each item has been completed or otherwise resolved for
      acceptance.
   3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with
      insurance requirements.
B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.08 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Name of Architect.
   d. Name of Contractor.
   e. Page number.
4. Submit list of incomplete items in the following format:

1.09 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

1. Obtain warranties and bonds, executed by responsible Subcontractors, suppliers, vendors and manufacturers prior to final completion of work. The date of commencement of warranty coverage shall be the date of Substantial Completion as determined by the Owner.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.01 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
   a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   d. Remove tools, construction equipment, machinery, and surplus material from Project site.
   e. Remove snow and ice to provide safe access to building.
   f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   h. Sweep concrete floors broom clean in unoccupied spaces.
   i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
   j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
   k. Remove labels that are not permanent.
   l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
   m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
   n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
   o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
   p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
   q. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Construction Waste Management and Disposal."

3.02 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.

2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
   a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION
SECTION 01 7823
OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Operation and maintenance documentation directory.
   2. Emergency manuals.
   3. Operation manuals for systems, subsystems, and equipment.
   4. Product maintenance manuals.
   5. Systems and equipment maintenance manuals.
B. Related Requirements:
   1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
   2. Division 01 Section "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.
   3. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.03 DEFINITIONS
A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
B. Subsystem: A portion of a system with characteristics similar to a system.

1.04 CLOSEOUT SUBMITTALS
A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
   1. Architect and Commissioning Authority will comment on whether content of operations and maintenance submittals are acceptable.
   2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
B. Format: Submit operations and maintenance manuals in the following format:
   1. Three paper copies and/or electronic copy in .PDF format. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.
C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.
D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
   1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 7 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.01 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY
A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, “Preparation of Operating and Maintenance Documentation for Building Systems.”

2.02 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
2. Table of contents.

B. Title Page: Include the following information:
1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
   a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
   b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.


5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.03 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:
   1. Type of emergency.
   2. Emergency instructions.
   3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
   1. Fire.
   2. Flood.
   5. Power failure.
   7. System, subsystem, or equipment failure.
   8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:
   1. Instructions on stopping.
   2. Shutdown instructions for each type of emergency.
   3. Operating instructions for conditions outside normal operating limits.
   4. Required sequences for electric or electronic systems.
   5. Special operating instructions and procedures.

2.04 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
   2. Performance and design criteria if Contractor has delegated design responsibility.
   3. Operating standards.
   4. Operating procedures.
   5. Operating logs.
   6. Wiring diagrams.
   7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.05 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:
1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
F. **Warranties and Bonds:** Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

### 2.06 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

**A. Content:** For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers’ maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

**B. Source Information:** List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual’s table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

**C. Manufacturers' Maintenance Documentation:** Manufacturers’ maintenance documentation including the following information for each component part or piece of equipment:
   1. Standard maintenance instructions and bulletins.
   2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   3. Identification and nomenclature of parts and components.
   4. List of items recommended to be stocked as spare parts.

**D. Maintenance Procedures:** Include the following information and items that detail essential maintenance procedures:
   1. Test and inspection instructions.
   2. Troubleshooting guide.
   3. Precautions against improper maintenance.
   4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   5. Aligning, adjusting, and checking instructions.
   6. Demonstration and training video recording, if available.

**E. Maintenance and Service Schedules:** Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
   1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
   2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

**F. Spare Parts List and Source Information:** Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers’ maintenance documentation and local sources of maintenance materials and related services.

**G. Maintenance Service Contracts:** Include copies of maintenance agreements with name and telephone number of service agent.

**H. Warranties and Bonds:** Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

### PART 3 – EXECUTION

#### 3.01 MANUAL PREPARATION

**A. Operation and Maintenance Documentation Directory:** Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

**B. Emergency Manual:** Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

**C. Product Maintenance Manual:** Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
   1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
   2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
   1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
   1. Do not use original project record documents as part of operation and maintenance manuals.
   2. Comply with requirements of newly prepared record Drawings in Division 01 Section "Project Record Documents."

G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION
PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.
   4. Miscellaneous record submittals.

B. Related Requirements:

   1. Division 01 Section "Execution" for final property survey.
   2. Division 01 Section "Closeout Procedures" for general closeout procedures.
   3. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   4. Divisions 02 through 33 Sections for specific requirements for project record documents of the Work in those Sections.

1.03 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

   1. Number of Copies: Submit copies of record Drawings as follows:

      a. Initial Submittal:
         1) Submit PDF electronic files of scanned record prints and one of file prints.
         2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

      b. Final Submittal:
         1) Submit PDF electronic files of scanned record prints and three sets of prints.
         2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy of each submittal.

   1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy of each submittal.

PART 2 - PRODUCTS

2.01 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

   1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an acceptable drawing technique.

c. Record data as soon as possible after obtaining it.

d. Record and check the markup before enclosing concealed installations.

e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.

b. Revisions to details shown on Drawings.

c. Depths of foundations below first floor.

d. Locations and depths of underground utilities.

e. Revisions to routing of piping and conduits.

f. Revisions to electrical circuitry.

g. Actual equipment locations.

h. Duct size and routing.

i. Locations of concealed internal utilities.

j. Changes made by Change Order or Construction Change Directive.

k. Changes made following Architect's written orders.

l. Details not on the original Contract Drawings.

m. Field records for variable and concealed conditions.

n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.

4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file with comment function enabled.

2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.

3. Refer instances of uncertainty to Architect for resolution.


   a. See Division 01 Section "Submittal Procedures" for requirements related to use of Architect's digital data files.

   b. Architect will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2. Format: Annotated PDF electronic file with comment function enabled.

3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Architect.
   e. Name of Contractor.

2.02 RECORD SPECIFICATIONS
   A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
      1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
      2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
      3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
      4. Note related Change Orders and record Drawings where applicable.
   B. Format: Submit record Specifications as paper copy.

2.03 RECORD PRODUCT DATA
   A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
      1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
      2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
      3. Note related Change Orders and record Drawings where applicable.
   B. Format: Submit record Product Data as paper copy.
      1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.04 MISCELLANEOUS RECORD SUBMITTALS
   A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
   B. Format: Submit miscellaneous record submittals as paper copy.
      1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.01 RECORDING AND MAINTENANCE
   A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
   B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION
PART 1 – GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.
   3. Demonstration and training video recordings.
B. Related Requirements:
   1. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.03 INFORMATIONAL SUBMITTALS
A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
   1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
B. Qualification Data: For facilitator, instructor, videographer.
C. Attendance Record: For each training module, submit list of participants and length of instruction time.
D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.04 CLOSEOUT SUBMITTALS
A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
   1. Identification: On each copy, provide an applied label with the following information:
      a. Name of Project.
      b. Name and address of videographer.
      c. Name of Architect.
      d. Name of Construction Manager.
      e. Name of Contractor.
      f. Date of video recording.
   2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
   3. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals.

1.05 QUALITY ASSURANCE
A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section “Quality Requirements,” experienced in operation and maintenance procedures and training.
C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section “Project Management and Coordination.” Review methods and procedures related to demonstration and training including, but not limited to, the following:
   1. Inspect and discuss locations and other facilities required for instruction.
   2. Review and finalize instruction schedule and verify availability of educational materials, instructors’ personnel, audiovisual equipment, and facilities needed to avoid delays.
   3. Review required content of instruction.

E. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.06 COORDINATION

A. Coordinate instruction schedule with Owner’s operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.01 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
   1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
      a. System, subsystem, and equipment descriptions.
      b. Performance and design criteria if Contractor is delegated design responsibility.
      c. Operating standards.
      d. Regulatory requirements.
      e. Equipment function.
      f. Operating characteristics.
      g. Limiting conditions.
      h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project record documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable: Instructions on meaning of warnings, trouble indications, and error messages.
   a. Instructions on stopping.
   b. Shutdown instructions for each type of emergency.
   c. Operating instructions for conditions outside of normal operating limits.
d. Sequences for electric or electronic systems.
e. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.
5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.
8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION
3.01 PREPARATION
   A. Assemble educational materials necessary for instruction, including documentation and training module.
      Assemble training modules into a training manual organized in coordination with requirements in Division
      01 Section "Operations and Maintenance Data."
   B. Set up instructional equipment at instruction location.
3.02 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner with at least 15 days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.03 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
   1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.
   1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
   2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
   3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
   4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
      a. Name of Contractor/Installer.
      b. Business address.
      c. Business phone number.
      d. Point of contact.
      e. E-mail address.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
   1. Film training session(s) in segments not to exceed 15 minutes.
      a. Produce segments to present a single significant piece of equipment per segment.
      b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
      c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
   1. Furnish additional portable lighting as required.

E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded or by dubbing audio narration off-site after recording is made. Include description of items being viewed.

F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION
SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Footings
   2. Foundation Walls
   3. Slabs-on-grade
   4. Slabs-on-deck.

1.03 DEFINITIONS
A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.04 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.
B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.05 INFORMATIONAL SUBMITTALS
A. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
B. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
C. Placement Notification: Submit notification to Architect at least 24 hours in advance of placement.
D. Proposed location of saw cut joints not indicated on Drawings.

1.06 QUALITY ASSURANCE
A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

1.07 DELIVERY, STORAGE, AND HANDLING
A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement if present.

PART 2 - PRODUCTS

2.01 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Plywood, metal, or other approved panel materials.
   2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
      a. High-density overlay, Class 1 or better.
      b. Medium-density overlay, Class 1 or better; mill-release agent treated and edgesealed.
      c. Structural 1, B-B or better; mill oiled and edge sealed.
      d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that will leave no corrodible metal closer than 1 1/2" inch to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.02 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.03 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
   1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.04 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150, Type II. Supplement with the following:
      a. Fly Ash: ASTM C 618, Class F or C.
   B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded.
      1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
      2. Fine Aggregate: Free of materials with deleterious reactivity to alkali cement.
   C. Water: ASTM C 94 and potable.
2.05 ADMIXTURES
B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
  7. Mid-Range Water Reducing Admixture: ASTM C 494/C 494M, Type A.

2.06 CURING MATERIALS
A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. BASF Construction Chemicals - Building Systems; Confilm.
      b. ChemMasters; SprayFilm.
      c. Conspec by Dayton Superior; Aquafilm.
      d. Dayton Superior Corporation; Sure Film (J-74).
      e. Edoco by Dayton Superior; BurkeFilm.
      f. Euclid Chemical Company (The), an RPM company; Eucobar.
      g. L&M Construction Chemicals, Inc.; E-CON.
      h. Meadows, W. R., Inc.; EVAPRE.
      i. Sika Corporation; SikaFilm.
   B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
   C. Moisture-Retaining Cover: ASTM C 171, white burlap-polyethylene sheet; required at all exposed slabs.
   D. Water: Potable.
   E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating. Film must chemically break down in a four to six week period. Provide data from independent laboratory indicating maximum moisture less than 0.30 kg/m2 at 72 hours when tested in accordance with ASTM C 156.

2.07 RELATED MATERIALS
A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosicfiber
B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.08 REPAIR MATERIALS
A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.

4. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.09 CONCRETE MIXTURES, GENERAL
   A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
      1. Use a qualified testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
   B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
      1. Fly Ash: 25 percent.
   C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06, 0.30 for other reinforced concrete, and 1.00 for reinforced concrete that will be dry and protected from moisture in service, percent by weight of cement.
   D. Admixtures: Use admixtures according to manufacturer's written instructions.
      1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
      2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
      3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS
   A. Footings, foundation walls, exterior slabs-on-grade, and other building elements not otherwise specified: Proportion normal-weight concrete mixture as follows:
      1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
      2. Maximum Water-Cementitious Materials Ratio: 0.45.
      3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
      4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery.
   B. Interior Slabs-on-Grade and Slabs-on-Deck: Proportion normal-weight concrete mixture as follows:
      1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
      2. Maximum Water-Cementitious Materials Ratio: 0.45.
      3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
      4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.11 FABRICATING REINFORCEMENT
   A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.12 CONCRETE MIXING
   A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116 and furnish batch ticket information.

PART 3 - EXECUTION
3.01 FORMWORK
A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
   1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
   2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.
D. Construct forms tight enough to prevent loss of concrete mortar.
E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
H. Chamfer exterior corners and edges of permanently exposed concrete.
I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
L. Coat contact surfaces of forms with form-release agent, according to manufacturer’s written instructions, before placing reinforcement.

3.02 EMBEDDED ITEMS
A. Specify embedded items and anchorage devices for other work attached to or supported by cast-in-place concrete. Insert specific requirements for installing embedded items, if any, that are part of the Work.
B. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303 "Code of Standard Practice for Steel Buildings and Bridges."

3.03 REMOVING AND REUSING FORMS
A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.04 STEEL REINFORCEMENT
A. General: Comply with CRSI’s "Manual of Standard Practice" for placing reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Size, length, number and placement of supports shall be sufficient as to maintain reinforcing position within specified tolerances during construction traffic and concrete placement.

E. On vertical formwork, use approved bar chairs or spacers as required to maintain concrete cover and bar position.

F. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

G. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize contraction cracks.

3.05 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.

2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.

3. Locate vertical joints beside pilasters integral with walls, near corners, and in concealed locations where possible.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

3. Locate control joints where shown on Drawings. If not shown, provide control joints at column centerlines and at intervals not more than 12 feet each way.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.06 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:
   1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor’s option.
   2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.07 FINISHING FORMED SURFACES
   A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
      1. Apply to concrete surfaces not exposed to public view.
   B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
      1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete.
   C. Related Uniform Surfaces: At tops of walls, horizontal offsets, and similar uniformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.08 FINISHING FLOORS AND SLABS
   A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces not exposed in the final condition. Comply with ACI 302.2R, Class 5 floor recommendations for hard-steel troweling and finishing operations for concrete surfaces exposed in final condition.
   B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat
float passes and re-straightening until surface is left with a uniform, smooth, granular texture.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated and exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

2. Finish and measure surface so gap at any point between concrete surface and an unlevel surface, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 3/16 inch (4.8 mm).

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fibristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.9 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.10 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and edges lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Moisture-retaining-cover shall be inspected each day by Contractor. Any areas which do not show condensation on underside of cover or any slab areas which are not wet shall be immediately rewetted and cover replaced to prevent moisture loss.
   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.11 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning and that are unacceptable to Architect. Allow Architect and Structural Engineer to observe concrete surfaces upon removal of forms and prior to repair of surface defects. Defects in structural concrete shall be brought to the attention of the Architect and Structural Engineer.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template. Submit proposed repair to Architect for review prior to commencement of work.

1. Repair finished surfaces containing defects that are unacceptable to Architect. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in
diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner shall engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31/C 31M.
   a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
   b. Cast and field cure two sets of two standard cylinder specimens for each composite sample to verify adequacy of curing and protection of concrete, as directed by Architect.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION
SECTION 03 3513
CONCRETE FLOOR SEALER

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section Includes:
   1. Penetrating liquid floor treatment for horizontal concrete surfaces.
   B. Refer to Division 01 sustainable & energy efficiency project requirements affecting work of this section.

1.03 SUBMITTALS
A. Product Data: Provide data on sealer, including information on compatibility of different products and limitations.
B. Maintenance Data: Provide data on maintenance renewal of applied coatings.

1.04 QUALITY ASSURANCE
A. Qualification Data: For Installer.
B. Perform Work in accordance with ACI 301.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage, mixing with other components, and application.
B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.06 FIELD CONDITIONS
A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting penetrating liquid floor treatment for concrete performance.
   1. Do not install penetrating liquid floor treatment for horizontal concrete surfaces when air temperature or concrete surface temperature is less than 40 degrees F.
   2. Maintain concrete floor surface temperature above freezing during and after installation of concrete liquid floor treatment until liquid floor treatment is cured.
B. Maintain light level equivalent to minimum 200 W light source, placed 8 feet above the floor surface, for each 425 sq ft of floor being finished.
C. Close areas to traffic during penetrating liquid floor treatment application and, after application, for time period recommended in writing by liquid floor treatment manufacturer.

PART 2 - PRODUCTS

2.01 LIQUID FLOOR TREATMENTS
A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
   1. Manufacturers: Available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Bone Dry Products.
      b. Curecrete Distribution Inc.
      c. Euclid Chemical Company (The); an RPM company.
      d. L&M Construction Chemicals, Inc.
      e. PROSOCO, Inc; Consolideck LS.
      f. Vexcon Chemicals Inc.
      g. W. R. Meadows, Inc.
PART 3 - EXECUTION

3.01 FLOOR SURFACE PREPARATION

A. Make all applications of sealer per Manufacturer's recommendations and requirements, at a minimum and if not contraindicated by the Manufacturer prepare the floor for sealer application as follows:

1. Verify that concrete was steel troweled and its free of fins, ridges or voids.
2. Assure that curing agents used are compatible with coating system or completely removed.
3. Concrete must be cured for minimum of 28 days, with moisture content not exceeding 8 percent.
4. Remove surface contamination by cleaning or if necessary, by sandblasting.
5. Patch holes or voids.
6. Rout out cracks exceeding 1/16 inch wide and caulk.
7. Calk non-moving joints up to 1 inch wide with suitable backer and sealant.
8. Do not caulk or overcoat joints where movement exceeds 25% or joints are 1 inch wide. These joints must receive other joint treatment to assure watertightness.
9. Install test patch according to Manufacturer's recommendation in an inconspicuous location. Wait for Architect's review and approval before proceeding with remainder of work.
10. If test patch indicates lack of adhesion, install primer.

3.02 INSTALLATION

A. Penetrating Liquid Floor Treatment for Uncured and Cured Horizontal Concrete Surfaces:

1. Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions included but not the limited to the following:
   a. DO NOT apply to surfaces scheduled to subsequently receive cementitious coatings or toppings, such as concrete, terrazzo, polyester or epoxy coatings.
   b. Do not apply to uncured concrete horizontal surfaces that is less than 14 days' old.
   c. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
2. Complete second application of concrete sealer just before Substantial Completion, and before Owner occupancy and before equipment is installed on floor.

3.03 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
B. Allow no traffic on sealed surface for 72 hours after application.

3.04 PATCHING AND CLEANING

A. Patch areas which fail to match adjacent work.
B. Clean surface "broom clean" after completion of work.
C. Remove debris resulting from these operations.

END OF SECTION
SECTION 04 0900
MASONRY ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES
A. Masonry accessories including the following:
   1. Open mesh to collect and suspend mortar droppings in commercial masonry cavity walls, with insect barrier.
   2. Flexible flashing drainage plane system.
   3. Thru-wall flashing.
B. Refer to Division 01 sustainable & energy efficiency project requirements affecting work of this section.

1.03 SUBMITTALS
A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage, handling requirements and recommendations.
B. Verification Samples: For each specified, two samples representing actual product, color, and configuration.

1.04 QUALITY ASSURANCE
A. Installer Qualifications: Minimum 2 years' experience with similar masonry installations.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Store products in manufacturer's unopened packaging until ready for installation.
B. Protect products from exposure to direct sunlight.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Mortar Net Solutions or comparable product.

2.02 MATERIALS
A. Open mesh to collect and suspend mortar droppings in commercial masonry cavity walls:
   1. Description: 90 percent open weave mesh in trapezoidal configuration connected by continuous bottom strip 3 inches high. The insect barrier fabric is attached to one face of the trapezoidal material.
      a. Provide trapezoidal mesh material in thickness not more than 1/4 inch less than the cavity detailed.
B. Flexible Flashing Drainage Plane System:
   1. Engineered system, with high resistant to damage, composite with a stainless steel with non-asphalt adhesive polymer fabric laminated to one stainless steel and non-woven drainage fabric laminated to opposing face with non-asphalt adhesive:
      a. Basis-of-Design Product: Subject to compliance with requirements, provide York Manufacturing, Inc.; York Flash-Vent SS or comparable product by one of the following:
         1) STS Coatings, Inc.; Wall Guardian Venting Stainless Steel TWF.
         2) Building Materials West Company, Inc.; Evacu-Flash SS.
      b. Accessories:
         1) Sealant: Type as recommended by flashing manufacturer.
         2) Outside Corner and Inside Corner: Stainless steel: 26-gauge stainless steel.
         3) End Dam: Product may be folded in line with the flashing material or utilize preformed end dams by manufacturer using: Stainless steel: 26-gauge stainless steel.
         4) Splice Material: Self-adhered metal material; material matching system material and sealant as a splice.
3. Termination Bar: Rigid PVC or stainless-steel termination bar with sealant catch lip.


7. Repair and other Materials/Accessories: Manufacturer's standard.

8. Fasteners: Fastener types and sizes recommended by flashing manufacturer for intended use.

C. Thru Wall Flashing: Type 304 stainless steel core with one uncoated (bare) stainless steel face (outward facing) with a butyl block co-polymer adhesive (inward facing).

1. Basis-of-Design Product: Subject to compliance with requirements, provide York Manufacturing, Inc.; York 304 SS or comparable product by one of the following:
   a. Illinois Products, Inc.; IPCO Self-Adhesive Stainless Steel
   b. STS Coatings, Inc.; Wall Guardian Self Adhering Stainless Steel Flashing
   c. TK Products, Inc.; TK Self-Adhering Stainless Steel TWF
   d. Vapro Shield, Inc.; VaproThru-Wall Flashing SA.

2. Accessories:
   a. Sealant: Type as recommended by flashing manufacturer.
   b. Corner and End Dams: Stainless steel flashing in the field or use 26-gauge stainless steel pre-manufactured corners.
   c. Mortar Deflection: Polyester strands that will not degrade and will keep weep vents from clogging with mortar.
   d. Termination Bar: Rigid PVC or stainless-steel termination bar with sealant catch lip.

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 owner’s agent and architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION

A. Open mesh to collect and suspend mortar droppings in commercial masonry cavity walls: multilayer with insect barrier. Install in strict accordance with manufacturer's instructions and as follows:

1. Verify installation of flashing and completion of first two courses of masonry.
2. Extend flashing from the bottom of the open mesh to at least 6 inches above the top of the open mesh to prevent mortar bridging between the outer wythe and inner wall.
3. Remove mortar droppings and debris from flashing and weep vents.
4. Install one continuous row of open mesh at base of wall in cavity and over all wall openings directly on flashing, with dovetail profile facing upward. For wall cavities that exceed 11 feet in height, place an additional continuous trapezoidal strip on wall reinforcing anchors/ties at every 9 feet to 11 feet of wall height.
5. Butt ends together. Compress slightly if necessary.
6. Face Insect Barrier toward the outside of the building.

B. Flexible Flashing Drainage Plane System

1. Install where indicated, specified, or required in accord with flashing manufacturer's written instructions and as follows:
   a. Prohibited practice: Tucking the flashing into the backer wall.
   b. Prohibited practice: Bonding or splicing to non-woven drainage fabric.

2. Extend flashing 6 inches minimum, beyond opening, each side without stretching flashing material. Fold flashing ends at end of openings or horizontal flashing terminations to form end dam or use preformed end dams from manufacturer.
3. Flashing Width: Width required starting 1.5 inch to the exterior of the outside face of exterior wythe, extending through cavity, rising height required to extend above lintel steel at least 2 inches. After inspection by the agreed upon parties the flashing should be cut flush with the leading edge of the brick.
4. Splice end joints by butting ends together over 4-inch-wide piece of self-adhering stainless steel flashing. The self-adhering stainless-steel flashing should be sealed metal face down on to the substrate with the mastic. Remove the release linear and butt the two piece of flashing together and embed them into the splice sealant. Then seal the butt seam with sealant.
5. Masonry back up:
a. Surface mount flashing after damp proofing installation in accordance with manufacturer’s installation instructions.
b. Apply flashing with drainage surface to outside.
c. Fasten to masonry back-up surface at top by embedding in layer of sealant and use a termination bar to fasten to the backer wall and seal the top of the termination bar with sealant.

6. Stud back up with sheathing:
   a. Surface mount flashing after certified compatible damp proofing installation specified in Damp Proofing Section in accord with manufacturer’s installation instructions
   b. Apply flashing with drainage surface to the outside.
   c. Fasten to stud back-up surface at top by embedding in layer of sealant and use a termination bar to fasten to the backer wall and seal the top of the termination bar with sealant.

7. Confirm compatibility with manufacturer’s mutual letters for all lapping components, Air barrier installation lapping over flashing top in the Air Barrier Section.

8. Lay flashing in continuous bead of sealant on masonry supporting steel.

9. Fold ends of flashing at end of opening to form dam; seal with sealant or utilize preformed end dams from manufacturer.

10. Inside corners: Make in manufacturers accepted manner using corner and splice material or utilize preformed corners from manufacturer.

11. Outside corners: Make in manufacturers accepted manner using corner and splice material or utilize preformed corners from manufacturer.

12. Do not coat the entire drainage fabric with air barrier. Leave the drainage fabric exposed at least an inch over the top of the mortar droppings.

13. Weep vent protection use the geotextile drainage and install it on the third-row height of standard bricks to have the fabric reach the base of the flashing and covering the weep vents.

14. Cover flashing within a few days of installation to protect it from damage from the different trades, the environment and falling debris. If flashing is left unprotected and it is punctured, torn, or has loose scrim you should contact the manufacturer for repair instructions.

C. Thru-Wall Flashing:

1. Install where indicated, specified, or required in accordance with flashing manufacturer’s written instructions and as follows.
   a. Extend flashing 6 inches minimum beyond opening. Fold flashing ends at end of openings or horizontal flashing terminations to form end dam or use pre-manufactured units made of 26 gauge stainless steel.
   b. Flashing Width: Width required starting flush with outside face of exterior wythe, extending through cavity, rising height required to extend above lintel steel at least 2”.
   c. Splice end joints by overlapping them a minimum of 2” and seal with a compatible sealant or metal splice tape.
   d. Masonry back up:
      1) Surface apply after dampproofing installation in accordance with manufacturer’s installation instructions.
      2) Fasten to masonry back-up surface at top by embedding in layer of sealant or use a non-corrosive termination bar and fasten it to the backer wall at the top edge of the flashing and seal the top edge with compatible sealant or use a termination clamp, which is embedded in the block back up wall.
   e. Stud back up with sheathing:
      1) Fasten to stud back-up at top by embedding in layer of sealant or use a non-corrosive termination bar and fasten it to the backer wall at the top edge of the flashing and seal the top edge with a compatible sealant.
   f. Leave ready for certified compatible building felt or air barrier installation lapping flashing top installed in another Section.
   g. Fold ends of flashing at end of opening to form dam; seal with polyether sealant or use purchased manufacturers preformed end dams.
   h. Inside and outside corners: Make in industry accepted manner using corner and splice material or purchase manufactured corners from manufacturer.
   i. Use stainless steel or copper drip edge any location that the underside of the flashing will be exposed and/or deemed necessary by the design professional or AHJ on the project.
j. Cover flashing within a few days of installation to protect it from damage from the different trades, the environment and falling debris. If flashing is left unprotected and it is punctured, torn, or has loose scrim you should contact the manufacturer for repair instructions.

3.03 PROTECTION

A. Protect installed products from damage until completion of project.
B. Repair or replace damaged products before covering with construction.

END OF SECTION
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar and grout, and accessories.
C. Shop Drawings: Indicate bar sizes, spacings, reinforcement quantities, bending and cutting schedules, reinforcement supporting and spacing devices, and accessories.
D. Design Data: Indicate required mortar strength, unit assembly strength in each plane, and supporting test data.
E. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

1.05 QUALITY ASSURANCE
A. Comply with provisions of ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents.
    1. Maintain one copy of each document on project site.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

1.07 ENVIRONMENTAL REQUIREMENTS
A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.
B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

1.08 EXTRA MATERIALS
A. See Section 01 6000 - Product Requirements, for additional provisions.
B. Provide 50 of each size, color, and type of units for Owner's use in maintenance of project.

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 x 8 inches and nominal depths as indicated on the drawings for specific locations.
    2. Special Shapes: Provide non-standard blocks configured for corners.
    3. Load-Bearing Units: ASTM C 90, lightweight.
        a. Hollow block, as indicated.
        b. Exposed faces: Manufacturer's standard color and texture where indicated.
    4. Pre-Faced Units: ASTM C 90, hollow block, with smooth resinous facing complying with ASTM C 744.
    5. Colors and styles: As selected from Manufacturer's standard colors.

2.02 MORTAR AND GROUT MATERIALS
A. Provide "Epoxy Grout" as topping grout (rake out 1/2") in all wet areas, see the drawings.
B. Portland Cement: ASTM C 150, Type I; color as required to produce approved color sample.
    1. Hydrated Lime: ASTM C 207, Type S.
C. Pigments for Colored Mortar: Iron or chromium oxides with demonstrated stability and colorfastness.
    1. Colors: As required to match Architect's color samples.
D. Water: Clean and potable.

2.03 REINFORCEMENT AND ANCHORAGE
A. Manufacturers of Joint Reinforcement and Anchors:
    4. Substitutions: See Section 01 6000 - Product Requirements.
B. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420).
   1. Deformed billet-steel bars.
   2. Unfinished.
C. Single Wythe Joint Reinforcement: Truss type; ASTM A 82 steel wire, hot dip galvanized after fabrication to ASTM A 153/A 153M, Class B; 0.1875 inch side rods with 0.1875 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.

2.04 FLASHINGS
A. Plastic Flashings: Sheet polyvinyl chloride; 10 mil thick.
B. Lap Sealant: Butyl type as specified in Section 07 9005.

2.05 ACCESSORIES
A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
   1. Manufacturers:
      d. Substitutions: See Section 01600 - Product Requirements.
B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; 1/2 inch wide x by maximum lengths available.
   1. Manufacturers:
      d. Substitutions: See Section 01600 - Product Requirements.
C. Weep/Cavity vents: Cotton rope.
D. Cavity Mortar Diverter: Semi-rigid polyethylene or polyester mesh blocks, sized to fill bottom of wall cavity and suspend mortar droppings above weep/cavity vents to allow cavity drainage.
E. Building Paper: ASTM D 226, Type I ("No. 15") asphalt felt.
F. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.06 MORTAR MIXES
A. Ready Mixed Mortar: ASTM C 1142, Type RM.
B. Mortar for Unit Masonry: ASTM C 270, using the Proportion Specification.
   1. Engineered masonry: Type S.
   2. Masonry below grade and in contact with earth: Type S.
   3. Exterior, loadbearing masonry: Type S.
   4. Interior, loadbearing masonry: Type S.
C. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

2.07 MORTAR MIXING
A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C 270 and in quantities needed for immediate use.
B. Maintain sand uniformly damp immediately before the mixing process.
C. Add mortar color in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.
D. Do not use anti-freeze compounds to lower the freezing point of mortar.
E. If water is lost by evaporation, re-temper only within two hours of mixing.
F. Use mortar within two hours after mixing at temperatures of 90 degrees F, or two-and-one-half hours at temperatures under 40 degrees F.

2.08 GROUT MIXES
A. Bond Beams andLintels: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
1. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
2. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

B. Engineered Masonry: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C 94/C 94M.
1. Fine grout for spaces with smallest horizontal dimension of 2 inches or less.
2. Coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

2.09 GROUT MIXING
A. Mix grout in accordance with ASTM C 94/C94M.
B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C 476 for fine and coarse grout.
C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
D. Do not use anti-freeze compounds to lower the freezing point of grout.

2.10 PRECONSTRUCTION TESTING
A. Testing will be conducted by an independent test agency, in accordance with provisions of Section 01 4000.
B. Concrete Masonry: Test each type, class, and grade of concrete masonry unit in accordance with ASTM C 140 for conformance to requirements of this specification.
C. Mortar Mixes: Test mortars prebatched by weight in accordance with ASTM C 780 recommendations for preconstruction testing.
D. Grout Mixes: Test grout batches in accordance with ASTM C 1019 procedures.
E. Compressive Strength: Where indicated, test masonry prisms in accordance with ASTM C 1314.
   1. Prepare two sets of prisms; test one set at 7 days and the other at 28 days.
   2. Concrete masonry prisms: Height-to-thickness ratio of not less than 1.33 and not more than 5.0; apply correction factor per ACI 530.1/ASCE 6/TMS 602 for ratio other than 2.0. Required Compressive Strength of Masonry \( F_m = 2,000 \) psi.
F. Flexural Bond Strength: Where indicated, test masonry prisms in accordance with ASTM E 518, with tooled joints downward.

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. Clean reinforcement of loose rust.
C. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.
D. Only low lift grouting will be employed, maximum lift height of 48”.

3.03 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.

3.04 PLACING AND BONDING
A. Lay hollow masonry units with face shell bedding on head and bed joints.
B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
C. Remove excess mortar as work progresses.
D. Interlock intersections and external corners.
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. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

3.05 REINFORCEMENT AND ANCHORAGE
A. Reinforcement Bars: Secure at locations indicated and to avoid displacement during grouting. Minimum spacing between bars or to masonry surfaces shall be one bar diameter.
   1. Welding of splices is not permitted.
B. Joint Reinforcement: Install horizontal joint reinforcement 8 inches on center.
   1. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
   2. Place continuous joint reinforcement in first and second joint below top of walls.
   3. Lap joint reinforcement ends minimum 6 inches.
C. Anchors: Reinforce joint corners and intersections with strap anchors 16 inches on center.
D. Anchors: Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.
E. Wall Ties: Install wall ties at locations indicated, spaced at not more than 24 inches on center horizontally and 16 inches on center vertically, unless otherwise indicated on drawings.
F. Reinforced Hollow Unit Masonry: Keep vertical cores to be grouted clear of mortar, including bed area of first course.
   1. Bond Beams: At bond beams or other locations for horizontally reinforced masonry, provide special masonry units or saw to accommodate reinforcement.

3.06 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.
   1. Extend flashings full width at such interruptions and at least 4 inches into adjacent masonry or turn up at least 4 inches to form watertight pan at non-masonry construction.
   2. Remove or cover protrusions or sharp edges that could puncture flashings.
   3. Seal lapped ends and penetrations of flashing before covering with mortar.
B. Extend plastic flashings to within 1/4 inch of exterior face of masonry.
C. Lap end joints of flashings at least 4 inches and seal watertight with mastic or elastic sealant.

3.07 GROUTING
A. Use only low-lift grouting techniques, maximum lift height of 48”.
   1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
   2. Clean out masonry cells and other cavities to be grouted by vacuum methods or compressed air.
      Remove debris, allow to dry, and inspect before grouting.
   3. Hollow Masonry: Limit lifts and pours to maximum height of 4 feet.
   4. Place grout for spanning elements in single, continuous pour.

3.08 CONTROL AND EXPANSION JOINTS
A. Do not continue horizontal joint reinforcement through control and expansion joints.
B. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.
C. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
D. Size control joint in accordance with Section 079000 for sealant performance.

3.09 BUILT-IN WORK
A. As work progresses, install built-in metal door 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.
   1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
D. Do not build into masonry construction organic materials that are subject to deterioration.

3.10 TOLERANCES
A. Maximum Variation from Alignment of Columns: 1/4 inch.
B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
F. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.
G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.11 CUTTING AND FITTING
A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.
B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 FIELD QUALITY CONTROL
A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000.
B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C 140 for conformance to requirements of this specification.
C. Mortar Tests: Test each type of mortar in accordance with recommended procedures in ASTM C 780, testing with same frequency as masonry samples.
D. Test and evaluate grout in accordance with ASTM C 1019 procedures.
   1. Test with same frequency as specified for masonry units.
E. Prism Tests: Test masonry and mortar panels for compressive strength in accordance with ASTM C 1314 and for flexural bond strength in accordance with ASTM C 1072 or ASTM E 518; perform tests and evaluate results.

3.13 CLEANING
A. Remove excess mortar and mortar smears as work progresses.
B. Replace defective mortar. Match adjacent work.
C. Clean soiled surfaces with cleaning solution.
D. Use non-metallic tools in cleaning operations.

3.14 PROTECTION OF FINISHED WORK
A. Without damaging completed work, provide protective boards at exposed external corners which are subject to damage by construction activities.

END OF SECTION
SECTION 04 2001
MASSONRY VENEER

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Clay Facing Brick.
B. Mortar.
C. Reinforcement and Anchorage.
D. Flashings.
E. Installation of Lintels.
F. Accessories.

1.02 RELATED REQUIREMENTS
A. Section 04 2000 Reinforced Unit Masonry Assemblies: Concrete masonry unit backup for masonry veneer.
B. Section 05 5000 - Metal Fabrications: Loose steel lintels.
C. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.
D. Section 07 9005 - Joint Sealers: Backing rod and sealant at control and expansion joints.

1.03 REFERENCE STANDARDS
A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; American Concrete Institute International; 2011.
F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
I. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2014.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Convene two weeks before starting work of this section.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for masonry units and mortar.
C. Samples: Submit four 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.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

1.07 FIELD CONDITIONS
A. Cold and Hot Weather Requirements: Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.
PART 2 PRODUCTS

2.01 BRICK UNITS
A. Manufacturers:
   1. General Shale.
   2. Interstate Brick Co.
   3. Hebron Brick Co.
   4. Substitutions: See Section 01 6000 - Product Requirements.
B. Facing Brick: ASTM C216, Type FBS, Grade SW.
   1. Color and Texture: To match existing red brick.

2.02 MORTAR MATERIALS
A. Mortar: As specified in Section 04 2000.

2.03 REINFORCEMENT AND ANCHORAGE
A. Joint Reinforcement: Truss type; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
B. 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 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 thick.
   3. Vertical adjustment: Not less than 3-1/2 inches.
   4. Manufacturers:

2.04 FLASHINGS
A. Flashing: As specified in Section 04 0900, Masonry Accessories.
B. Weeps: Cotton rope.
C. 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.
D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.05 MORTAR MIXES
   1. Exterior, non-loadbearing masonry; Type N.
B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
C. 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 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. Brick Units:
   1. Bond: Running.
2. Coursing: Three units and three mortar joints to equal 8 inches.

3.03 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. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
D. Remove excess mortar as work progresses.
E. Interlock intersections and external corners, except for units laid in stack bond.
F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
H. Isolate top joint of masonry veneer from horizontal structural framing members or support angles with compressible jointfiller.

3.04 WEEPS/CAVITY VENTS
A. Install weeps in veneer walls at 32 inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.

3.05 CAVITY MORTAR CONTROL
A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
C. 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.

3.06 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER
A. Install horizontal joint reinforcement 16 inches on center.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
C. Place continuous joint reinforcement in first and second joint below top of walls.
D. Masonry Back-Up: Embed anchors in masonry back-up to bond veneer at maximum 1.77 sq ft of wall surface per anchor. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches oncenter.

3.07 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.
   1. Extend flashings full width at such interruptions and at least 8 inches into adjacent masonry or turn up at least 8 inches to form watertight pan at non-masonry construction.
   2. Remove or cover protrusions or sharp edges that could puncture flashings.
   3. Seal lapped ends and penetrations of flashing before covering with mortar.
B. Extend metal flashings to within 1/4 inch of exterior face of masonry.
C. Extend flexible flashings to within 1/4 inch of exterior face of masonry.
D. Lap end joints of flashings at least 4 inches and seal watertight with flashing sealant/adhesive.

3.08 LINTELS
A. Install loose steel lintels over openings.

3.09 CONTROL AND EXPANSION JOINTS
A. Do not continue horizontal joint reinforcement through control or expansion joints.
B. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.
C. Size control joints as indicated on drawings; if not shown, 3/4 inch wide and deep.
3.10 TOLERANCES
   A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
   B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
   C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
   D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
   E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

3.11 CUTTING AND FITTING
   A. Cut and fit for pipes and conduit. Coordinate with other sections of work to provide correct size, shape, and location.
   B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 CLEANING
   A. Remove excess mortar and mortar smears as work progresses.
   B. Replace defective mortar. Match adjacent work.
   C. Clean soiled surfaces with cleaning solution.
   D. Use non-metallic tools in cleaning operations.

3.13 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 05 1200
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section Includes:
   1. Structural steel.
   2. Grout.

1.03 DEFINITIONS
A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.04 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop and Erection Drawings: Show location, fabrication, and assembly of structural-steel components.
   1. Location of each piece or detail within the structure.
   2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   3. Include embedment piece and setting drawings.
   4. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
   5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

1.05 INFORMATIONAL SUBMITTALS
A. Welding certificates.

1.06 QUALITY ASSURANCE
A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
C. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303 as amended below:
      a. Section 3.2: Replace entire section with the following: "Requirements for structural steel including quantities, sizes, locations, arrangement, and details shall be shown or noted in the overall Contract Drawing package. Fabricator is responsible for incorporating all such information from structural, architectural, mechanical, and electrical drawings, as well as those of other disciplines."
      b. Section 3.5: Remove all text after first sentence.
      c. Section 4.4: Revise second sentence to read the following: "The shop and erection drawings shall be returned in accordance with the schedule defined in Division 1 of the project Specification. In the absence of such schedule, the Owner’s Designated Representative for Design shall return submittals within 14 calendar days of receipt from the Owner’s Designated Representative for Construction."
   2. AISC 360
   3. RCSC’s "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
1.07 DELIVERY, STORAGE, AND HANDLING
   A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
      1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
   B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1.08 COORDINATION
   A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
   B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS
   A. W-Shapes: ASTM A 992 unless indicated otherwise on Drawings.
   B. Channels, Angles Shapes: ASTM A 36 unless indicated otherwise on Drawings.
   C. Plate and Bar: ASTM A 36 unless indicated otherwise on Drawings.
   D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade C, structural tubing.
   E. Welding Electrodes: Comply with AWS requirements, 70 Series

2.02 BOLTS, CONNECTORS, AND ANCHORS
   A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
   B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
      1. Finish: Plain.
   C. Steel Headed Stud Anchors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
   D. Unheaded Anchor Rods: ASTM F 1554, Grade 55, weldable.
      4. Washers: ASTM F 436 (ASTM F 436M)
      5. Finish: Plain
   E. Headed Anchor Rods: ASTM F 1554, Grade 55, weldable, straight.
      3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
      4. Finish: Plain
   F. Threaded Rods: ASTM A 36/A 36M.
      3. Finish: Plain
   G. Expansion Anchors, Screw Anchors, and Adhesive Anchors: Size and Manufacturer as indicated on Drawings. Complete assemblies with required rods, nuts, washers, and adhesive system as applicable.
Installed in accordance with Manufacturer’s installation instructions. Current ICC approval and published ICC Research Report required.

1. Finish for use in conditioned environments free from potential moisture (interior): Plain or in accordance with Manufacturer’s standard.
2. Finish for use in exposed or potentially wet environments and for attachment of exterior cladding materials: Galvanized in conformance with ASTM A 153 or stainless steel, Series 300.

2.03 PRIMER
A. Primer: Where steel is to be field painted, provide fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
B. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.04 GROUT
A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time. Minimum compressive strength = 8000 psi. Required where grout is exposed to view or weathering.

2.05 FABRICATION
A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
   1. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
   2. Mark and match-mark materials for field assembly.
   3. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations, if applicable.
B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces. Do not enlarge bolt holes by burning.
D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning" or SSPC-SP 3, "Power Tool Cleaning."
F. Steel Headed Stud Anchors and Deformed Anchor Studs / Deformed Bar Anchors: Prepare steel surfaces as recommended by manufacturer of anchors. Use automatic end welding of anchors according to AWS D1.1 and manufacturer's written instructions.
G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
   1. Cut, drill, thermal cut, or punch holes perpendicular to steel surfaces.
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
H. Splices: Splicing of members to obtain required lengths is not permitted without prior approval of Structural Engineer-of-Record unless indicated on the Drawings.
I. Substitutions: Where exact sizes and weights indicated on Drawings are not readily available, secure approval of alternate sizes from Structural Engineer-of-Record in time to prevent project delay.

2.06 SHOP CONNECTIONS
A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: As indicated on Drawings.
B. Weld Connections: Comply with AWS D1.1/D1.1M[ and AWS D1.8/D1.8M] for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.07 SHOP PRIMING
A. Shop prime steel surfaces except the following:
   1. Retain, revise, or delete five subparagraphs below to suit Project.
2. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
3. Surfaces to be field welded, including top flange of beams to receive steel headed stud anchors.
5. Surfaces not otherwise indicated to be painted that are not exposed to view or weather in the final condition.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to either of the following specifications and standards:
   1. SSPC-SP 2, "Hand Tool Cleaning."
   2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer’s written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection.

2.08 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
   1. Fill vent and drain holes in closed sections (HSS or Pipe) that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
   2. Galvanize lintels, shelf angles and steel supporting the stone veneer located in exterior walls.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.03 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate where indicated on Drawings.
   3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Clean and moisten surfaces to receive grout. Immediately remove any remaining free water. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
E. Do not use thermal cutting during erection unless approved by Structural Engineer-of-Record. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

F. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

G. Steel Headed Stud Anchors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.04 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: As indicated on Drawings.

B. Weld Connections: Comply with AWS D1.1/D1.1M [and AWS D1.8/D1.8M] for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.05 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections.
   1. Verify structural steel materials and inspect steel frame joint details.
   2. Verify weld materials and visually inspect field welds according to AWS D1.1/D1.1M.
   3. Verify connection materials and inspect high-strength bolted connections.

3.06 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION
SECTION 05 2100
STEEL JOIST FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and
     Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. Section Includes:
      2. Joist accessories.

1.03 DEFINITIONS
   A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for
      Steel Joists and Joist Girders."
   B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform,
      unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.04 ACTION SUBmittALS
   A. Product Data: For each type of joist, accessory, and product.
   B. Shop Drawings:
      1. Include layout, designation, number, type, location, and spacing of joists.
      2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection
         locations and details; and attachments to other construction.
      3. Indicate locations and details of bearing plates to be embedded in other construction.

1.05 INFORMATIONAL SUBmittALS
   A. Welding certificates.

1.06 QUALITY ASSURANCE
   A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with
      applicable standard specifications and load tables in SJI's "Specifications."
      1. Manufacturer's responsibilities include providing professional engineering services for designing
         special joists to comply with performance requirements.
   B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M,
      "Structural Welding Code - Steel."

1.07 DELIVERY, STORAGE, AND HANDLING
   A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
   B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS
   A. Structural Performance: Provide special joists and connections capable of withstanding design loads
      indicated.
      1. Use ASD; data are given at service-load level.
      2. Design special joists to withstand design loads with live-load deflections no greater than the
         following:
            a. Floor Joists: Vertical deflection of 1/360 of the span.

2.02 K-SERIES STEEL JOISTS
   A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel
      Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung
      ends, and parallel top chord.
   B. Provide holes in chord members for connecting and securing other construction to joists.
C. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."
D. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."
E. Camber joists according to SJI's "Specifications."

2.03 PRIMERS
A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.04 JOIST ACCESSORIES
A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
B. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch (13 mm) of finished wall surface unless otherwise indicated.
C. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
D. Welding Electrodes: Comply with AWS standards.
E. Furnish miscellaneous accessories required by joist manufacturer to complete joist assembly.

2.05 CLEANING AND SHOP PAINTING
A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
B. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil (0.025 mm) thick.

PART 3 - EXECUTION
3.01 EXAMINATION
A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
A. Do not install joists until supporting construction is in place and secured.
B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
   1. Space, adjust, and align joists accurately in location before permanently fastening.
   2. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
D. Bolt joists to supporting steel framework using carbon-steel bolts.
E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.03 FIELD QUALITY CONTROL
A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and to perform field tests and inspections and prepare test and inspection reports.
B. Visually inspect field welds according to AWS D1.1/D1.1M.
   1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, as applicable:
      a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709.

C. Visually inspect bolted connections.

D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

E. Perform additional testing to determine compliance of corrected Work with specified requirements.

3.04 PROTECTION

A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories.
   1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
   2. Apply a compatible primer of same type as primer used on adjacent surfaces.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. Section Includes:
      1. Roof deck.
      2. Composite floor deck.

1.03 ACTION SUBMITTALS
   A. Product Data: For each type of deck, accessory, and product indicated.
   B. Shop Drawings:
      1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.04 QUALITY ASSURANCE

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
   B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS
   A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.02 ROOF DECK
   A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
      1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), grade, thickness and profile as indicated, shop primed with manufacturer's standard baked-on, rust-inhibitive primer. Use at interior locations.
      2. Color: Manufacturer's standard.
      3. Deck Profile: Type WR, wide rib.
      4. Profile Depth: 1-1/2 inches (38 mm).
      5. Design Uncoated-Steel Thickness: 0.0358 inch (0.91 mm).

2.03 COMPOSITE FLOOR DECK
   A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
      1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), grade, thickness and profile as indicated, G60 zinc coating.
      2. Profile Depth: 1-1/2 inches (38 mm).
      3. Design Uncoated-Steel Thickness: 0.0474 (1.2 mm).
2.04 NONCOMPOSITE FORM DECK
   A. Noncomposite Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
   1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), grade, thickness and profile as indicated, G90 zinc coating typical.
   2. Profile Depth: 9/16 inch (14 mm).
   3. Design Uncoated-Steel Thickness: 0.0239 (0.61 mm).
   4. Side Laps: Overlapped

2.05 ACCESSORIES
   A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
   B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
   C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.
   D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
   E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile indicated but not less than recommended by SDI Publication No. 31 for overhang and slab depth.
   F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
   G. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.

PART 3 - EXECUTION
3.01 EXAMINATION
   A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL
   A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
   B. Locate deck bundles to prevent overloading of supporting members.
   C. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
   D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
   E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
   F. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
   G. Mechanical fasteners may be used in lieu of welding to fasten deck with prior written approval of Structural Engineer-of-Record. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.03 ROOF-DECK INSTALLATION
   A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:
   1. Weld Diameter: 5/8 inch (16 mm), nominal.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 12 inches (305 mm) apart in the field of roof and 6 inches (150 mm) apart at end laps, end supports and at the perimeter edge of the roof.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches (914 mm), and as follows:
   1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing length of 1-1/2 inches (38 mm) minimum or as indicated on Drawings with end joints as follows:
   1. End Joints: Lapped.

D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

3.04 FLOOR-DECK INSTALLATION
A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
   1. Weld Diameter: As indicated
   2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart.
   3. Weld Washers: Install weld washers at each weld location when the minimum uncoated steel thickness is less than 0.028 inches (0.7 mm).

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches (914 mm), and as follows unless otherwise indicated:
   1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
   2. Mechanically clinch or button punch.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm) or as indicated.
   1. End Joints: Lapped.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.05 FIELD QUALITY CONTROL
A. Testing and Inspection: Owner will engage a qualified testing agency to perform tests and inspections.
B. Field welds will be subject to inspection.

3.06 PROTECTION
A. Galvanizing Repairs: Where deck is exposed to weather or moisture, prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation and apply repair paint.
C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.
   1. Do not use deck units for storage or as a working platform until permanently secured in position.
   2. Contractor shall assure that completed deck is not damaged by use as a runaway, storage of materials or subsequent work.
   3. Contractor shall assure that construction loads are not allowed which exceed the safe carrying capacity of the deck.

END OF SECTION
SECTION 05 4000
COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section Includes:
   1. Load-bearing wall framing.
   2. Exterior non-load-bearing wall framing.
   3. Roof joist framing.
B. Related Requirements:
   1. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of cold-formed steel framing product and accessory.
B. Shop Drawings:
   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.04 INFORMATIONAL SUBMITTALS
A. Welding certificates.

1.05 QUALITY ASSURANCE
A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.06 DELIVERY, STORAGE, AND HANDLING
A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS
A. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

2.02 LOAD-BEARING WALL FRAMING
A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   2. Coating: G60 (Z180), A60 (ZF180), or equivalent.
B. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch.
C. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch.
D. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0538 inch or 0.0677 inch as indicated on drawings.
   2. Flange Width: 1-5/8 inches (41 mm).

2.03 EXTERIOR NON-LOAD-BEARING WALL FRAMING
A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   2. Coating: G60 (Z180), A60 (ZF180), or equivalent
B. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with
   1. Minimum Base-Metal Thickness: 0.0428 inch.
C. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: Matching steel studs unless indicated otherwise on drawings.
   2. Flange Width: 1-1/4 inches and as indicated on drawings.
D. Vertical Deflection Clips: Manufacturer's standard bypass and head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
E. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch (1.09mm) and as indicated on drawings.
   2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures, or as indicated on drawings.
F. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
   1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
      a. Minimum Base-Metal Thickness: 0.0428 inch (1.09mm) and as indicated on drawings.
      b. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures, or as indicated on drawings.
   2. Inner Track: Of web depth indicated, and as follows:
      a. Minimum Base-Metal Thickness: 0.0428 inch (1.09mm) and as indicated on drawings.
      b. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures, or as indicated on drawings.
G. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.04 ROOF JOIST FRAMING
A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   2. Coating: G60 (Z180), A60 (ZF180), or equivalent.
B. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, unpunched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0538 inch.
   2. Flange Width: 2 inches.
2.05 FRAMING ACCESSORIES
A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Web stiffeners.
   4. Anchor clips.
   5. End clips.
   6. Foundation clips.
   7. Gusset plates.

2.06 ANCHORS, CLIPS, AND FASTENERS
A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
B. Anchor Bolts: ASTM F 1554, Grade 36.
C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
F. Welding Electrodes: Comply with AWS standards.

2.07 MISCELLANEOUS MATERIALS
A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.
B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.
C. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.08 FABRICATION
A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.01 EXAMINATION
   A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION
   A. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.
   B. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.03 INSTALLATION, GENERAL
   A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
   B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
   C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
      1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).
   D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
      1. Cut framing members by sawing or shearing; do not torch cut.
      2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
         a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
         b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
   E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
   F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
   G. Install insulation, specified in Section 072100 “Thermal Insulation,” in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
   H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
I. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.04 LOAD-BEARING WALL INSTALLATION
   A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
      1. Anchor Spacing: 12 inches.
   B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch (3 mm) between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as indicated.
   C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
   D. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
   E. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
   F. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
      1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
   G. Install horizontal bridging in stud system, spaced vertically 48 inches. Fasten at each stud intersection.
      1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches (150 mm) deep.
      2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
      3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
   H. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.05 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION
   A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
   B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as indicated.
   C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
   D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
      1. Install single or double deep-leg deflection tracks and anchor to building structure.
   E. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
      1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
      2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
   F. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, casework, stone veneer and similar work requiring attachment to framing.
1. If type of supplementary support is not indicated, comply with stud manufacturers written recommendations and industry standards in each case, considering weight or load resulting from item supported.

G. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
   a. Install solid blocking as indicated on Drawing.

2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

H. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.06 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.07 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section Includes but not limited to:
   1. Steel fabricated items including:
      a. Loose lintels.
      b. Ledge angles, shelf angles, channels, and plates.
      c. Miscellaneous steel items specifically detailed or required to complete assembly on drawings.

1.03 SUBMITTALS
A. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
B. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
C. Qualification Data:
   1. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.
   2. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.04 QUALITY ASSURANCE
A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel (AC172).

1.05 FIELD CONDITIONS
A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS
A. Delegated Design: Engage a qualified professional engineer to design ladders.
B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 MATERIALS - STEEL
A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
B. Steel Sections: ASTM A36/A36M.
C. Steel Tubing: ASTM A500, Grade B cold-formed structural tubing.
D. Plates: ASTM A283.
E. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish unless specifically noted otherwise.
2.03 FASTENERS
A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563; and, where indicated, flat washers.
C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
  1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
D. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
E. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
F. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
  1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.04 MISCELLANEOUS MATERIALS
A. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
B. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
C. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
D. Concrete: Comply with requirements in Section 033000 “Cast-in-Place Concrete” for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.05 FABRICATION
A. Fit and shop assemble items in largest practical sections, for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.06 FABRICATED ITEMS
A. Lintels:
  1. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
  2. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches unless otherwise indicated.
B. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing:
  1. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.
     a. For support of metal decking.
b. Prime paint finish.

C. Miscellaneous steel as detailed or required: Pipes, Tubes, ‘C’ Sections, ‘L’ Sections

2.07 FINISHES - STEEL

A. Prime paint all steel items.
   1. Exceptions: Galvanize items specifically noted to receive that finish.
B. Prepare surfaces to be primed in accordance with SSPC-SP3.
C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
D. Prime Painting: One coat.

2.08 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.
B. Maximum Offset Between Faces: 1/16 inch.
C. Maximum Misalignment of Adjacent Members: 1/16 inch.
D. Maximum Bow: 1/8 inch in 48 inches.
E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.
B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
C. Field Welding: Comply with the following requirements:
D. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
E. Obtain fusion without undercut or overlap.
F. Remove welding flux immediately.
G. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
H. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
I. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
J. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
K. Obtain Architect approval prior to site cutting or making adjustments not scheduled.

3.04 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers’ written instructions and requirements indicated on Shop Drawings.
B. Anchor supports for overhead doors securely to, and rigidly brace from, building structure.
C. manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
3.05 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION
SECTION 06 1053
MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. Section Includes:
      1. Rooftop equipment bases and support curbs.
      2. Wood blocking and nailers.
      3. Plywood backing panels.
   B. Refer to Division 01 sustainable & energy efficiency project requirements affecting work of this section.

1.03 SUBMITTALS
   A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
      1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and amount of preservative retained.
      2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
      3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
      4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
   B. Evaluation Reports: For the following, from ICC-ES:
      1. Preservative-treated wood.
      2. Fire-retardant-treated wood.
      4. Post-installed anchors.
      5. Metal framing anchors.

1.04 QUALITY ASSURANCE
   A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL
   A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
      1. Factory mark each piece of lumber with grade stamp of grading agency.
   B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.
2.02 WOOD-PRESERVATIVE-TREATED MATERIALS
A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
D. Application: Treat items indicated on Drawings, and the following:
   1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
   3. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.

2.03 FIRE-RETARDANT-TREATED MATERIALS
A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
   1. Treatment shall not promote corrosion of metal fasteners.
   2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
   3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
E. Application: Treat items indicated on Drawings, and the following:
   1. Concealed blocking.
   2. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
   3. Plywood backing panels.

2.04 MISCELLANEOUS LUMBER
A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.
   3. Rooftop equipment bases and support curbs.
B. Dimension Lumber Items: Standard, Stud, or No. 3 grade lumber of any species.
C. Concealed Boards: 19 percent maximum moisture content of any of the following species and grades:
   1. Mixed southern pine or southern pine, No. 3 grade; SPIB.
   2. Hem-fir or hem-fir (north), Standard or No. 3 Common grade; NLGA, WCLIB, or WWPA.
   3. Spruce-pine-fir (south) or spruce-pine-fir, Standard or No. 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
   4. Eastern softwoods, No. 3 Common grade; NELMA.
   5. Northern species, No. 3 Common grade; NLGA.
D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.05 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.06 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.


PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities where indicated.

H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

K. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:


2. ICC-ES evaluation report for fastener.

L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
3.02 WOOD BLOCKING AND NAILER INSTALLATION
   A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
   B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.03 PROTECTION
   A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION
SECTION 06 1600
SHEATHING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section Includes:
   1. Wall sheathing.
   2. Parapet sheathing.
B. Refer to Division 01 sustainable & energy efficiency project requirements affecting work of this section.

1.03 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at Project site.
   1. Review air-barrier and water-resistant glass-mat gypsum sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier and water-resistant glass-mat gypsum sheathing.

1.04 SUBMITTALS
A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
B. Qualification Data: For Installer.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS
A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.02 WALL AND PARAPET SHEATHING
A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. CertainTeed Corporation.
      b. Georgia-Pacific Gypsum LLC.
      c. National Gypsum Company.
      d. USG Corporation.
   2. Type and Thickness: As indicated on the drawings.

2.03 FASTENERS
A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. For parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
C. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
   1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C1002.
2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

2.04 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS
A. Sealant for Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 07 9200 "Joint Sealants."
B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with MISCELLANEOUS MATERIALS

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL
A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
C. Securely attach to substrate by fastening as indicated, complying with the following:
   1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
   2. ICC-ES evaluation report for fastener.
D. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
E. Coordinate wall and parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.02 WOOD STRUCTURAL PANEL INSTALLATION
B. Fastening Methods: Fasten panels as indicated below:
   1. Wall and Roof Sheathing:
      a. Screw to cold-formed metal framing.
      b. Space panels 1/8 inch apart at edges and ends.

3.03 GYPSUM SHEATHING INSTALLATION
A. Comply with GA-253 and with manufacturer's written instructions.
   1. Fasten gypsum sheathing to wood framing with nails or screws.
   2. Fasten gypsum sheathing to cold-formed metal framing with screws.
   4. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
   1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
   1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES
   A. Specially fabricated cabinet units.
   B. Plastic Laminates.
   C. Solid Surface Countertops.
   D. Solid Surface Window Sills.
   E. Cabinet hardware.
   F. Preparation for installing utilities.

1.2 RELATED REQUIREMENTS
   A. Section 06 1000 - Rough Carpentry: Support framing for solid surface countertops, grounds, and concealed blocking.

1.3 REFERENCE STANDARDS
   A. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.
   D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
   F. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.9).
   H. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.

1.4 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.
   C. Product Data: Provide data for hardware accessories.
   D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.
   E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.5 QUALITY ASSURANCE
   A. Perform work in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Premium quality.
   B. Perform cabinet construction in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Premium quality, unless other quality is indicated for specific items.
   C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
   D. Manufacturer Qualifications: Member in good standing of the Architectural Woodwork Institute (AWI) or the Architectural Woodwork Manufacturers Association of Canada (AWMAC) and familiar with the AWI/AWMAC QSI.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Protect units from moisture damage.
1.7 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

2.1 MANUFACTURERS
A. JBD, Inc.
B. Eggli Brothers Millwork.
C. Woodwise Cabinets, Inc.
D. Johnson Brothers Planing Mill.
E. Sidney Millwork.
F. LSI.
G. Substitutions: See Section 01 6000 - Product Requirements.

2.2 CABINETS
A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI (AWS) for Premium Grade.

2.3 WOOD-BASED COMPONENTS
A. Wood fabricated from old growth timber is not permitted.

2.4 PANEL MATERIALS
A. Particleboard: ANSI A208.1; medium density industrial type as specified in AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, composed of wood chips bonded with interior grade adhesive under heat and pressure; sanded faces; thickness as required; use for components indicated on drawings.
B. Medium Density Fiberboard (MDF): ANSI A208.2; type as specified in AWI/AWMAC Architectural Woodwork Quality Standards Illustrated; composed of wood fibers pressure bonded with moisture resistant adhesive to suit application; sanded faces; thickness as required.
C. Hardboard: AHA A135.4; Pressed wood fiber with resin binder, Class 1 - Tempered, 1/4 inch thick, smooth two sides (S2S); use for drawer bottoms, dust panels, and other components indicated on drawings.

2.5 LAMINATE MATERIALS
A. Manufacturers:
   3. Chemetal: www.chemetalco.com
   4. Substitutions: See Section 01 6000 - Product Requirements.
B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
C. Provide specific types as indicated on the drawings.
   1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, color to be selected.
   2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, color to be selected.
   3. Cabinet Liner: CLS, 0.020 inch nominal thickness, color to be selected.
   4. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.6 SOLID POLYMER MATERIALS (SOLID SURFACE)
A. Manufacturers:
   1. Avonite:www.avonitesurfaces.com
   2. Trespa North AmericaLtd.: www.trespanorthamerica.com
   3. DuPont: www.corian.com
   4. Formica Corp.: www.formica.com
   6. LG Hausys Hi-Macs:www.lghimacsusa.com
   7. Substitutions: See Section 016000 - Product Requirements.
2.7 COUNTERTOPS

A. Solid Surface, Solid Polymer Countertop: Refer to Room Interior Elevations for specific locations.
   1. 1/2" solid surface slab. Color to be selected from manufacturer full line. Provide 1 1/2" Bullnose at all exposed edges.
   2. Backsplash height shall be according to detail provided.
   3. Back splashes shall be field installed, with tight, sealed joints.
   4. Cutouts for sinks furnished by others shall be smooth and uniform without saw marks. The top and bottom of sink openings shall be finished smooth. Corners of sink cutouts must be a minimum of 1/4" (6mm) radius.
   5. Surfaces shall be fabricated to field measurements. Seams shall be located where shown on approved shop drawings. Provide seam blocks under all seams where necessary in accordance with manufacturer's recommendations.
   6. Joint Adhesive: Type recommended by manufacturer, in color to match surfaces.
   7. Silicone Sealant: Type recommended by manufacturer.
   8. Warranty: Ten year warranty against defective materials and workmanship.
   9. Installation: In locations indicated, conforming to manufacturer's recommended installation procedures. Set tops on supports, and anchors using fasteners shown on approval submittals.

2.8 WINDOW SILLS

A. Solid Polymer Window Sills:
   1. 1/2" thick solid surface with 3" roundover edge. Color to be selected from manufacturer's standards.
   2. General: Shall be non-porous, homogeneous blend of polyester or acrylic alloys and fillers to create a material that cuts like wood. The color and pattern shall extend throughout the material.
   3. Joint Adhesive: Type recommended by manufacturer, in color to match surfaces.
   4. Silicone Sealant: Type recommended by manufacturer.
   5. Installation: In locations indicated, conforming to manufacturer's recommended installation procedures.

2.9 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.
B. Plastic Edge Banding: 3mm extruded PVC, flat shaped; smooth finish; of width to match component thickness, color as selected from manufacturer's standards.
   1. Use at all exposed shelf edges, doors and drawers.
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 stainless steel or chrome-plated finish in exposed locations.
E. Concealed Joint Fasteners: Threadedsteel
F. Grommets: Basis of Design: Doug Mockett & Company or approved equal.
   1. Type 1: Maxia.
   2. Type 2: Standard 3 1/2" inches diameter aluminum grommets for cut-outs, finish satin aluminum; Model # ABG3
   3. Type 3: Max 1/B- "The Max" medium size.
G. Keyboard Drawer: Universal all metal under desk drawer by Rightangle; Model # RA328SDMRG.
2.10 HARDWARE
A. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.
B. Cabinet Drawer and Door Pulls:  
   1. Product: DP3B- 4" Tab Drawer Pull manufactured by Doug Mockett & Co.
C. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with satin finish.  
   1. Provide one lock per individual active cabinet door, and drawer as indicated on drawings. Spring catches on inactive cabinet door will not be accepted.  
   2. Product: CL920R manufactured by Schlage or approved equal.
D. Catches: Magnetic.
E. Drawer Slides:  
   1. Type: Full extension. Galvanized steel construction, ball bearing separating tracks.  
   2. Static Load Capacity: Commercial grade.  
   4. Stops: Integral type.
F. Hinges: European style concealed self-closing type, steel with satin finish.  
   1. Products: 

2.11 FABRICATION  
A. Cabinet Style: Flush overlay.  
B. Cabinet Doors and Drawer Fronts: Flush style. 3/4" inch thick.  
C. Drawer Construction Technique: Dovetail joints.  
D. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.  
E. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.  
F. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.  
G. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises.  
   1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.  
   2. Cap exposed plastic laminate finish edges with material of same finish and pattern.  
H. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION
3.1 EXAMINATION  
A. Verify adequacy of backing and support framing.  
B. Verify location and sizes of utility rough-in associated with work of this section.

3.2 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. Do not use additional overlay trim for this purpose.  
D. Secure cabinets to floor using appropriate angles and anchorages.  
E. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.  
F. Solid Polymer Countertop installation: The installation shall be performed by trained personnel.  
   1. The runner method uses 1"x4" supports that run parallel to the length of the top. They are at the front, center and rear edge of the counter top, adhered with dabs of silicone every 18"-24". The cabinets must have cross supports for the runners every 18"-24".
2. Leave 1/8" between the edge of the substrate and the back of the build up. Leave a minimum 1/16" between the countertop and the back wall. For wall to wall installations, allow clearance on each end for expansion.
3. Dabs of silicone are placed in the front, center and rear every 18"-24" for all substrates. A dab of silicone should be size of thumb nail.
4. Attach substrate to the solid polymer countertop and then fasten it to the cabinets.
5. Set tops on pre-leveled cabinets.
6. Put screws from all corner blocks on cabinets into substrate. Make sure screws do not go all the way through substrate and into countertop.
7. Use Dow or GE 100% silicone for bonding to wooden substrates. Do not use liquid nails or other rigid adhesive which does not allow for expansion and contraction of the top.

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

3.4 CLEANING
A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Board insulation at perimeter foundation wall, and over roof deck.
   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
   A. Section 03 3000 - Cast-in-Place Concrete.
   B. Section 06 1053 – Miscellaneous Rough Carpentry.
   C. Section 07 2119 - Sprayed Insulation: Sprayed-on, adhered insulation.
   D. Section 07 2500 - Weather Barriers: Separate air barrier and vapor retarder materials.
   E. Section 09 2216 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01 3000 - 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.
   D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

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 at Perimeter of Foundation: Extruded polystyrene board.
   B. Insulation in Metal Framed Walls: Batt insulation with integral vapor retarder.
   C. Insulation Over Roof Deck: Polyisocyanurate board faced with oriented strandboard.

2.02 FOAM BOARD INSULATION MATERIALS
   A. Extruded Polystyrene Board Insulation: Perimeter foundation walls, at masonry cavity walls and metal panel walls. ASTM C 578, Type IV; Extruded polystyrene board with either natural skin or cut cell surfaces; with the following characteristics:
      1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
      2. Smoke Developed Index: 450 or 450 or less, when tested in accordance with ASTM E84.
      4. Board Thickness: 2 inches.
      6. Thermal Conductivity (k factor) at 25 degrees F: 0.20.
8. Board Density: 1.6 lb/cu ft.
9. 5 year aged R-Value: 5.0 per inch.
10. Water Absorption, maximum: 0.1 percent, volume.
11. Manufacturers:
   d. Foam-Control Plus+250 25 psi (approved for below grade use only)
12. Substitutions: See Section 01 6000 - Product Requirements.

2.03 BATT INSULATION MATERIALS
A. Glass or Mineral Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C 665; friction fit.
   1. Flame Spread Index: 25 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.
   7. Manufacturers:
      c. Knauf Insulation GmbH: www.knaufinsulation.us.
8. Substitutions: See Section 01 6000 - Product Requirements.

2.04 ACCESSORIES
A. Sheet Vapor Retarder: Clear polyethylene film for above grade application, 10 mil thick.
B. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.
C. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
D. Nails or Staples: Steel wire; electroplated or galvanized; type and size to suit application.
E. Adhesive: Type recommended by insulation manufacturer for application.
1. Provide Dow Mastic No. 7 or No. 11 or for extruded polystyrene insulation.

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 and adhesive.
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. Adhere a 6 inch wide strip of polyethylene sheet over construction, control, and expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints.
   2. Extend sheet full height of joint.
B. Apply adhesive to back of boards:
   1. Three continuous beads per board length.
2. Install boards horizontally on foundation perimeter.
3. Place boards to maximize adhesive contact.
4. Install in running bond pattern.
5. Butt edges and ends tightly to adjacent boards and protrusions.
C. Extend boards over expansion joints, unbonded to foundation on one side of joint.
D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
E. Apply to interior face of exterior foundation walls from finish floor line (bottom of slab) to top of footing.

3.03 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.
E. Install with factory applied vapor retarder membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members.
F. Retain insulation batts in place with spindle fasteners at 12 inches on center.
G. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.
H. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.
I. Tape seal tears or cuts in vapor retarder.
J. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.
K. Coordinate work of this section with construction of weather barrier seal specified in Section 07 2500.

3.04 PROTECTION

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

END OF SECTION
SECTION 07 2119
FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section Includes:
   1. Closed-cell spray polyurethane foam.
B. Refer to Division 01 sustainable & energy efficiency project requirements affecting work of this section.

1.03 SUBMITTALS
A. Product Data: For each type of product.
B. Qualification Data: For Installer.
C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
D. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from ICC-ES.

1.04 QUALITY ASSURANCE
A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.01 CLOSED-CELL SPRAY POLYURETHANE FOAM
A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, Type II, minimum density of 1.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. BASF Corporation.
      b. Gaco Western LLC.
      c. Icynene-Lapolla.
      d. Johns Manville; a Berkshire Hathaway company.
   2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.

2.02 MISCELLANEOUS MATERIALS
A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

PART 3 - EXECUTION

3.01 PREPARATION
A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.02 INSTALLATION
A. Comply with insulation manufacturer's written instructions applicable to products and applications.
B. Spray insulation to envelop entire area to be insulated and fill voids.
C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.
D. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.
E. Miscellaneous Voids: Apply according to manufacturer's written instructions.

3.03 PROTECTION
A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Weather barrier membrane.
B. Seam Tape.
C. Flashing.
D. Fasteners.

1.02 RELATED REQUIREMENTS
A. Section 04 2001 - Masonry Veneer.
B. Section 06 1053 – Miscellaneous Rough Carpentry.
C. Section 07 6200 - Sheet Metal Flashing and Trim.
D. Section 08 1113 - Hollow Metal Doors and Frames.
E. Section 08 4313 - Aluminum Framed Storefronts.

1.03 REFERENCES
A. ASTM International:
   5. ASTM E 84; Test Method for Surface Burning Characteristics of Building Materials.
   7. ASTM E 1677; Specification for Air Retarder Material or System for Framed Building Walls.
B. AATCC – American Association of Textile Chemists & Colorists:

1.04 SUBMITTALS
A. Product Data: Submit manufacturer current technical literature for each component.
B. Samples: Weather Barrier Membrane, minimum 8-1/2 inches by 11 inch.
C. Quality Assurance Submittals:
   1. Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with indicated requirements.
   2. Manufacturer Instructions: Provide manufacturer’s written installation instructions.
D. Closeout Submittals:
   1. Refer to Section 01 7800 Closeout Submittals.

1.05 QUALITY ASSURANCE
A. Qualifications:
   1. Installer shall have experience with installation of weather barrier assemblies under similar conditions.
   2. Installation shall be in accordance with weather barrier manufacturer’s installation guidelines and recommendations.
B. Mock-up:
   1. Install mock-up using approved weather barrier assembly including fasteners, flashing, tape and related accessories per manufacturer’s current printed instructions and recommendations.
      a. Mock-up size: 10 feet by 10 feet
b. Mock-up Substrate: Match wall assembly construction, including window opening.

c. Mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 01 6000 Product Requirements.

B. Deliver weather barrier materials and components in manufacturer’s original, unopened, undamaged containers with identification labels intact.

C. Store weather barrier materials as recommended by weather barrier manufacturer.

1.07 SCHEDULING

A. Review requirements for sequencing of installation of weather barrier assembly with installation of windows, doors, louvers and flashings to provide a weather-tight barrier assembly.

B. Schedule installation of weather barrier materials and exterior cladding within nine months of weather barrier assembly installation.

PART 2 PRODUCTS

2.01 MANUFACTURER


C. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Commercial Grade materials only.

1. Performance Characteristics:

   a. Air Penetration: Type 1 when tested in accordance with ASTM E 1677.

   b. Water Vapor Transmission: 30 perms, when tested in accordance with ASTM E 96, Method B.

   c. Water Penetration Resistance: 235 cm when tested in accordance with AATCC Test Method 127.

   d. Basis Weight: 2.4 oz/yd2, when tested in accordance with TAPPI Test Method T-410.

   e. Air Infiltration Resistance: Air infiltration at >750 seconds, when tested in accordance with TAPPI Test Method T-460.

   f. Tensile Strength: 33/41 lbs/in., when tested in accordance with ASTM D 822 , Method A.

   g. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E 84 . Flame Spread: 15, Smoke Developed: 25.

2.03 ACCESSORIES

A. Seam Tape: Tape as manufactured by weather barrier manufacturer and compatible with all other products in this installation.

B. Fasteners:

   1. #4 nails with large 1-inch plastic cap fasteners or 1-inch minimum plastic cap staple with a 7/8” minimum staple length.

C. Sealants:

   1. Refer to Section 07 9005 Joint Sealants.

   2. Provide Sealants recommended by the weather barrier manufacturer.

D. Adhesives:

   1. Provide adhesive recommended by weather barrier manufacturer.

E. Primers:

   1. Provide flashing manufacturer recommended primer to assist in adhesion between substrate and flashing.

   2. Products:

      a. Primers recommended by the flashing manufacturer

F. Flashing:
1. Flexible membrane flashing materials for window openings and penetrations.

**PART 3 EXECUTION**

**3.01 EXAMINATION**
A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

**3.02 INSTALLATION - WEATHER BARRIER**
A. Install weather barrier over exterior face of exterior wall substrate in accordance with manufacturer recommendations.
B. Install weather barrier prior to installation of windows and doors.
C. Start weather barrier installation at a building corner, leaving 6-12 inches of weather barrier extended beyond corner to overlap.
D. Install weather barrier in a horizontal manner starting at the lower portion of the wall surface with subsequent layers installed in a shingling manner to overlap lower layers. Maintain weather barrier plumb and level.
E. Sill Plate Interface: Extend lower edge of weather barrier over sill plate interface 3-6 inches. Secure to foundation with elastomeric sealant as recommended by weather barrier manufacturer.
F. Window and Door Openings: Extend weather barrier completely over openings.
G. Overlap weather barrier:
   1. Exterior corners: minimum 12 inches.
   2. Seams: minimum 6 inches.
H. Weather Barrier Attachment:
   1. Attach weather barrier to studs through exterior sheathing. Secure using weather barrier manufacturer recommend fasteners, space 6 -18 inches vertically on center along stud line, and 24 inch on center, maximum horizontally.

**3.03 SEAMING**
A. Seal seams of weather barrier with seam tape at all vertical and horizontal overlapping seams.
B. Seal any tears or cuts as recommended by weather barrier manufacturer.

**3.04 OPENING PREPARATION (AT ALUMINUM STOREFRONT OPENINGS AND OTHER NON FLANGED INSTALLATIONS)**
A. Flush cut weather barrier at edge of sheathing around full perimeter of opening.
B. Cut a head flap at 45-degree angle in the weather barrier at window head to expose 8 inches of sheathing. Temporarily secure weather barrier flap away from sheathing with tape.

**3.05 FLASHING (AT ALUMINUM STOREFRONT OPENINGS AND OTHER NON FLANGED INSTALLATIONS)**
A. Cut flexible flashing a minimum of 12 inches longer than width of sill rough opening.
B. Cover horizontal sill by aligning flexible flashing edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
C. Fan flexible flashing at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges.
D. Apply 9-inch wide strips of flexible flashing at jambs. Align flashing with interior edge of jamb framing. Start flexible flashing at head of opening and lap sill flashing down to the sill.
E. Spray-apply primer to top 6 inches of jambs and exposed sheathing.
F. Install flexible flashing at opening head using same installation procedures used at sill. Overlap jamb flashing a minimum of 2 inches.
G. Coordinate flashing with window installation.
H. On exterior, install backer-rod in joint between window frame and flashed rough framing. Apply sealant at jambs and head, leaving sill unsealed. Apply sealants in accordance with sealant manufacturer’s instructions and ASTM C 1193.
I. Position weather barrier head flap across head flashing. Adhere using 4-inch wide flexible flashing over the 45-degree seams.
J. Tape top of window in accordance with manufacturer recommendations.
K. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealant in accordance with sealant manufacturer’s instructions and ASTM C 1193.

3.06 OPENING PREPARATION (FOR USE WITH FLANGED WINDOWS)
A. Cut weather barrier in a modified “I-cut” pattern.
   1. Cut weather barrier horizontally along the bottom of the header.
   2. Cut weather barrier vertically 2/3 of the way down from top center of window opening.
   3. Cut weather barrier diagonally from bottom of center vertical cut to the left and right corners of the opening.
   4. Fold side and bottom weather barrier flaps into window opening and fasten.
B. Cut a head flap at 45-degree angle in the weather barrier at window head to expose 8 inches of sheathing. Temporarily secure weather barrier flap away from sheathing with tape.

3.07 FLASHING (FOR USE WITH FLANGED WINDOWS)
A. Cut flexible flashing a minimum of 12 inches longer than width of sill rough opening.
B. Cover horizontal sill by aligning flexible flashing edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6 inches. Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
C. Fan flexible flashing at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges.
D. On exterior, apply continuous bead of sealant to wall or backside of window mounting flange across jambs and head. Do not apply sealant across sill.
E. Install window according to manufacturer’s instructions.
F. Apply 4-inch wide strips of flexible flashing at jambs overlapping entire mounting flange. Extend jamb flashing 1-inch above top of rough opening and below bottom edge of sill flashing.
G. Apply 4-inch wide strip of flexible flashing as head flashing overlapping the mounting flange. Head flashing should extend beyond outside edges of both jamb flashings.
H. Position weather barrier head flap across head flashing. Adhere using 4-inch wide flexible flashing over the 45-degree seams.
I. Tape head flap in accordance with manufacturer recommendations
J. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealant in accordance with sealant manufacturer’s instructions and ASTM C 1193.

3.08 PROTECTION
A. Protect installed weather barrier from damage.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY
B. This Section includes
   1. Factory-formed: exposed-fastener, metal wall panels.
   2. Finish must conform to the "Metal Construction Association Certified Premium Painted designation.

1.03 RELATED SECTIONS
A. Division 5 Section "Cold Formed Metal Framing"
B. Division 6 Section "Rough Carpentry"
C. Division 7 Section "Sheet Metal Flashing and Trim"
D. Division 7 Section "Gutters and Downspouts"
E. Division 7 Section "Manufactured Copings"

1.04 PERFORMANCE REQUIREMENTS
A. General: Provide metal wall panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.
B. System shall meet performance criteria as installed. Either test data or signed and sealed engineering calculations shall document the performance of the panel system to meet design loads required.
C. Wind Loading: Design and size components to withstand dead and live loads caused by wind pressures as follows:
   1. Positive pressure: 27 psf normal to panel.
   2. Negative pressure: 45 psf normal to panel.
D. Maximum Deflection under Design Loads:
   1. 1/240 of span.
E. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of wall area when tested according to ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sq. ft.
F. Water Penetration: No water penetration when tested according to ASTM E 331 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. and not more than 12 lbf/sq. ft.

1.05 SUBMITTALS
A. Product Data: Manufacturer's current product specifications and installation instructions.
B. Shop Drawings: Include small-scale elevations, as required. Show details of trim and flashing conditions, fastening and anchorage methods, weatherproofing techniques, terminations, and penetrations.
C. Samples:
   1. Selection Samples: Submit actual metal chips with full range of colors available for Architect's selection.
   2. Verification Samples: Submit two samples of each type of metal panel required, not less than 12 inches (305 mm), and illustrating finished panel profile.
D. Product Test Reports: Submit copies of test reports or load tables verifying performance capability of panel system:
   2. Fastener test and pull-out calculations.
   3. Load tables.

1.06 QUALITY ASSURANCE
A. Installer: Company specializing in the type of work required for this project, with not less than 5 years of documented experience.
B. Pre-Installation meeting: Convene meeting not less than one week prior to beginning installation between general contractor, installing contractor, owner's representative and manufacturer.

1.07 DELIVERY, STORAGE & HANDLING
A. Do not deliver materials of this section to project site until suitable facilities for storage and protection are available.
B. Protect materials from damage during transit and at project site. Store under cover, but sloped to provide...
positive drainage. Do not expose materials with strippable protective film to direct sunlight or extreme heat.

C. Do not allow storage of other materials or allow staging of other work on installed metal panel system.

D. Upon receipt of delivery of metal panel system, and prior to signing the delivery ticket, the installer is to examine each shipment for damage and for completion of the consignment.

1.08 WARRANTY
A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal roofing that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer Finish Warranty Period: 30 years from date of Substantial Completion.
B. Special Installer's Warranty: Specified form in which Wall Installer agrees to repair or replace components of custom-fabricated sheet metal wall that fail in materials or workmanship within 5 years from date of Substantial Completion.

PART 2 – PRODUCTS
2.01 MANUFACTURERS
A. Basis-of Design Product: ATAS International, Inc.; Belvedere™ BWK360
B. Other Acceptable Manufacturers (providing proof of matching the Basis of Design can be achieved):
   c. Sheffield Metals International: www.sheffieldmetals.com
   d. Substitutions: See Section 01 6000 – Product Requirements.

C. Manufacturer's Qualifications: All panels are to be factory formed and packaged per job requirements.
   1. Manufacturer shall have a minimum of ten (10) years' experience in the factory fabrication of metal wall panels.
   2. Manufacturer must be certified to ISO 9001:2008 with design.

D. Coordinate with insulation requirements as noted by Architect.

E. Secondary framing members as required for load criteria and wind requirements.

2.02 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS
A. Exposed-fastener, Lap seam Metal Wall Panels: Provide Factory-formed, designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weather tight installation.
B. Ribbed-Profile, Exposed-Fastener Metal Wall Panels
      a. Texture: Smooth.
      b. Finish: KYNAR 5000® PDVF or HYLAR 5000® Finish.
      c. Color: Standard or Premium color to be chosen later.
   2. Panel Coverage: 36".
   3. Panel Height: 1-1/2".
   4. Panel Application Orientation: Horizontal and Diagonal matching the roof slope of 1:12.
   5. Major Rib Spacing: 6".

2.03 FABRICATION
A. Panels:
   1. Panels to be Factory fabricated in a controlled environment.
   2. Panels to be tension leveled during roll forming process.
   3. Panels to be produced in longest lengths possible, except when modular units are utilized.
B. Form all components true to shape, accurate in size, square and free from distortion or defects. Cut panels to precise lengths indicated on approved shop drawings or as required by field conditions.
C. Accessories: Factory fabricates trim and flashing components in standard 12-foot lengths.
   1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
   2. Fabricate wall panels as required to maintain fabrication tolerances and to withstand design loads.
D. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.
E. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
F. Panels, fabrication, and installation shall meet the requirements of the Metal Construction Association Preformed Metal Wall Guidelines.
PART 3 - EXECUTION

3.01 PREPARATION
   A. Field Measurements
      1. Field measurements should be taken by the installer for verification of dimensional correctness in relationship to original plans, prior to providing manufacturer with a bill of material.
   B. Delivery, Storage, and Handling
      1. Do not deliver materials of this section to project site until suitable facilities for storage and protection are available.
      2. Protect materials from damage during transit and at project site. Store under cover, but sloped to provide positive drainage. Do not expose materials with strippable protective film to direct sunlight or extreme heat.
      3. Do not allow storage of other materials or allow staging of other work on installed metal panel system.
      4. Upon receipt of delivery of metal panel system, and prior to signing the delivery ticket, the installer is to examine each shipment or damage and for completion of the consignment.
   C. Sequencing and Scheduling
      1. Installer shall coordinate with general contractor as to scheduled delivery time after receipt of field verified bill of material by manufacturer as it relates to actual project scheduling.

3.02 METAL WALL PANEL INSTALLATION, GENERAL
   A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
      1. Field cutting of metal wall panels by torch is not permitted.
      2. Rigidly fasten metal wall panels and allow for thermal expansion and contraction as required by the panel manufacturer. Pre-drill panels as required.
      3. Install screw fasteners.
      4. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
      5. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing and material compatibility.
      6. Provide weatherproof seals for pipe and conduit penetrating exterior walls.
   B. Fasteners: Use fasteners of size and length as required for compatibility with substrate.
      1. Steel Wall Panels: Use stainless-steel fasteners or metallic coated fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.
      2. Exposed fasteners shall have a high performance factory applied coating to match paint color.
      3. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal wall panel manufacturer.
   C. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies.
   D. Provide water and air infiltration retarder / barriers as noted within project documents.

3.03 ACCESSORY INSTALLATION
   A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
      1. Install components required for a complete sheet metal roofing assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
      2. Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual" and NRCA Waterproofing Manual. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
      3. Panels, fabrication and installation shall meet the requirements of the Metal Construction Association Preformed Metal Wall Guidelines.

3.04 CLEANING AND PROTECTION
   A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed. Maintain in a clean condition during construction.
   B. Protection:
      1. Provide as required, completed work of this section will be without damage or deterioration at date of substantial completion.
   C. Touch up minor abrasions with matching paint provided by panel manufacturer. Remove and replace panels that cannot be satisfactorily touched up. See Metal Construction Association Technical Bulletin
D. Sweep and remove chips, shavings and dust from roof on a daily basis during installation period. Leave installed work clean, free from grease, finger marks and stains. Remove all protective masking from material immediately after installation of product.

E. Upon completion of installation, remove scraps and debris from project site.

F. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt and sealant.

END OF SECTION
SECTION 07 4243
COMPOSITE WALL PANELS

PART 1 - GENERAL

1.01 SUMMARY
A. Section Includes:
   1. Wall panel assembly consisting of:
      a. Metal Composite Material (MCM)
      b. Installation System
      c. Accessories
   2. The extent of the wall panel assembly as indicated in these specifications and in the drawings.
B. Related Sections:
   1. Section 05 1200 Structural Steel Framing
   2. Section 06 1053 Miscellaneous Rough Carpentry
   3. Section 07 2100 Thermal Insulation
   4. Section 07 6200 Sheet Metal Flashing And Trim
   5. Section 07 9005 Joint Sealers
   6. Section 08 4113 Aluminum Frames, Entrances, and Storefronts

1.02 REFERENCES
A. American Society For Testing And Materials (ASTM)
   1. ASTM B117 Standard Practice For Operating Salt Spray (Fog) Apparatus
   2. ASTM B137 Standard Test Method For Measurement Of Coating Mass Per Unit Area On Anodically Coated Aluminum
   3. ASTM B211 Standard Specification For Aluminum And Aluminum-Alloy Rolled Or Cold Finished Bar, Rod, And Wire
   4. ASTM B680 Standard Test Method For Seal Quality Of Anodic Coatings On Aluminum By Acid Dissolution
   5. ASTM C267 Standard Test Methods For Chemical Resistance Of Mortars, Grouts, And Monolithic Surfacing And Polymer Concretes
   6. ASTM C297 Standard Test Method For Flatwise Tensile Strength Of Sandwich Construction
   8. ASTM D523 Standard Test Method For Specular Gloss
   9. ASTM D635 Standard Test Method For Rate Of Burning And/Or Extent And Time Of Burning Of Plastics In A Horizontal Position
   10. ASTM D714 Standard Test Method For Evaluating Degree Of Blistering Of Paints
   13. ASTM D1781 Standard Test Method For Climbing Drum Peel For Adhesives
   14. ASTM D1929 Standard Test Method For Determining Ignition Temperature Of Plastics
   15. ASTM D2244 Standard Practice For Calculation Of Color Tolerances And Color Differences From Instrumentally Measured Color Coordinates
   16. ASTM D2247 Standard Practice For Testing Water Resistance Of Coatings In 100% Relative Humidity
   17. ASTM D2248 Standard Practice For Detergent Resistance Of Organic Finishes
19. ASTM D3359 Standard Test Methods For Measuring Adhesion By Tape Test
20. ASTM D3363 Standard Test Method For Film Hardness By Pencil Test
21. ASTM D4145 Standard Test Method For Coating Flexibility Of Prepainted Sheet
22. ASTM D4214 Standard Test Methods For Evaluating The Degree Of Chalking Of Exterior Paint Films
23. ASTM D5420 Standard Test Method For Impact Resistance Of Flat, Rigid Plastic Specimen By Means Of A Striker Impacted By A Falling Weight (Gardner Impact)
25. ASTM E283 Standard Test Method For Determining Rate Of Air Leakage Through Exterior Windows, Curtain Walls, And Doors Under Specified Pressure Differences Across The Specimen
27. ASTM E331 Standard Test Method For Water Penetration Of Exterior Windows, Skylights, Doors, And Curtain Walls By Uniform Static Air Pressure Difference

B. American Architectural Manufacturers Association (AAMA)

1. AAMA 2605 Voluntary Specification, Performance Requirements And Test Procedures For Superior Performing Organic Coatings On Aluminum Extrusions And Panels

1.03 DEFINITIONS
A. Metal Composite Material (MCM): A factory manufactured panel consisting of metal skins bonded to a plastic core, as defined by the International Building Code (IBC) Section 1402.
B. ISO 9001:2008: A set of guidelines set forth by the International Organization For Standardization (ISO) to provide guidance and tools for companies and organizations who want to ensure that their products and services consistently meet customer’s requirements, and that quality is consistently improved.

1.04 SYSTEM DESCRIPTION
A. Design Requirements:
1. Barrier System: Wall panel assembly shall be designed in accordance with manufacturer's guidelines to be sealed at all panel joints, intersections, dissimilar material abutments, and cutouts, thus providing a weathertight barrier system.
2. Expansion and Contraction: Wall panel assembly shall be designed with provisions for thermal expansion and contraction of the component parts to prevent buckling, failure of joint seals, undue stress on fasteners or other detrimental effects due to accumulation of dead loads and various live loads.
3. Windload: Wall panel assembly shall be designed to withstand a positive and negative windload pressure acting inward and outward normal to the plane of the wall to meet the requirements of the latest adopted Local Building Code.

B. General Performance: Wall panel assembly shall comply with performance requirements, as determined by the following testing performed by a qualified agency.

1.05 SUBMITTALS
A. Product Data:
1. Submit manufacturer's datasheet for specified product.
2. Submit manufacturer's installation guidelines for specified product.
B. Shop Drawings: Submit shop drawings indicating project layout and elevations, fastening and anchoring methods, dimensions of individual components and profiles, detail and location of joints, sealants and gaskets, flashing and accessories.
C. Samples:
1. Submit two (2) samples 3” x 5” of each product specified.
2. Submit two (2) samples 3” x 5” of each finish specified.
D. Test Reports: Submit test reports indicating compliance of products with specified performance requirements from an independent testing agency.
E. Warranty: Submit manufacturer’s warranty meeting the requirements of this section.

1.06 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Manufacturer shall have a minimum of ten (10) years’ experience in the manufacture of this product, shall be an ISO 9001:2008 Registered Company, and shall be located within the United States of America.
   2. Installer: Installer shall be experienced in performing work of this section and in work of similar scope required by this project.

B. Pre-Installation Meeting:
   1. Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer’s installation instructions, and manufacturer’s warranty requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site:
   1. Materials to be packaged to protect against transportation damage. Examine materials upon receipt to ensure that no damage has occurred during shipment.

B. Storage And Protection:
   1. Storage: Materials should be stored horizontally on pallets or platforms, covered with a suitable ventilated and weathertight covering. Do not store materials where accumulation of moisture may occur or in contact with materials that might cause staining, denting, or other damage.
   2. Material Handling: Use care in unloading, storing, and erecting the materials to prevent bending, warping, and twisting. Protect finish and edges from damage. The protective film on the panel surface is to remain in place until installation and shall be removed immediately upon completion.

1.08 PROJECT CONDITIONS

A. Field Measurements: Verify location and dimension of all elements related to the installation of the wall panel assembly. Indicate those measurements on the shop drawings.

B. Limitations: Proceed with installation of the wall panel assembly only when existing site conditions comply with manufacturer’s recommendations.

1.09 WARRANTY

A. Metal Composite Material (MCM):
   1. Panel: The integrity of the panel bond will remain intact for a minimum of five (5) years from the Date of Substantial Completion.
   2. Finish:
      a. Polyvinylidene Fluoride (PVDF):
         1) The finish will not have a Fade Differential of greater than 5E units. Testing shall be in accordance with ASTM D2244.
         2) The finish will not have a Chalk Rating of less than 8. Testing shall be in accordance with ASTM D4214.
         3) The finish will not check, peel, lose adhesion or fracture (other than minute fractures which may develop due to fabrication and which are acceptable by industry standards on the Date Of Substantial Completion).
         4) Warranty period shall be thirty (30) years from the Date Of Substantial Completion.
      b. Anodized:
         1) The finish will not check, peel, lose adhesion or fracture.
         2) Warranty period shall be twenty (20) years from the Date Of Substantial Completion.

B. Installation System:
   1. Fabricator and/or installer standard form in which they agree to repair or replace components of metal-faced composite wall panel assemblies that fail in materials or workmanship within specified warranty period.
   2. Weathertight warranties or other such guarantees regarding installation shall be the responsibility of the installing contractor.
C. Accessories: Warranties or other such guarantees regarding accessories used during installation shall be the responsibility of the installing contractor.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Citadel Architectural Products, Inc.; 3131-A North Franklin Road; Indianapolis, IN 46226 ph: (800) 446-8828; fax: (800) 247-2635; www.citadelap.com; info@citadelap.com

B. Substitutions:
   1. Not permitted without approval of the architect 10 days prior to bid.
   2. Items being submitted for consideration must be of the same function and meet the performance requirements set forth in this section.

C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.
   1. Product Data: Submit product data including testing performed by a qualified agency indicating compliance with performance requirements specified in this section.
   2. Samples: Submit two (2) samples 3" x 5" of each proposed product substitution.

2.02 WALL PANEL ASSEMBLY

A. Metal Composite Material (MCM):
      a. Composition: Face: .024" (min) prefinished smooth aluminum Core: .105" thermoset phenolic resin Back: .010" primed smooth aluminum
      b. Thickness: 4mm (nominal)
      c. Weight: 1.25 lbs/ft²
      d. Tolerance: Thickness: ±1/32" Length / Width: +0, -1/8" Squareness: 1/64" per lineal ft.
      e. Performance:
         1) Surface Burning Characteristics: Panel shall have a Class A rating with a Flame Spread Index less than 25, and a Smoke Developed Index less than 450. Testing shall be in accordance with ASTM E84.
         2) Bond Integrity: Panel shall have a minimum peel strength of 34.5 lb-in/lb. Testing shall be in accordance with ASTM D1781.
         3) Ignition Temperature: Panel shall have a minimum self-ignition temperature of 900° F. Testing shall be in accordance with ASTM D1929.
         4) Impact Resistance: Panel shall not have a deformation measuring larger than 0.186" in diameter or 0.007" in depth after being struck by a falling ball at 24 in-lb. Testing shall be in accordance with ASTM D5420.
         5) Rate Of Burning: Panel shall have a CC1 Classification indicating a burning extent of 1" (25.4mm) or less when tested at a nominal thickness of .060" (1.5mm) or thickness of intended use. Testing shall be in accordance with ASTM D635.
         6) Tensile Strength: Panel shall have a mean value of 1650 lbs. Testing shall be in accordance with ASTM C297.

2. Finish:
   a. Polyvinylidene Fluoride (PVDF):
      1) Type: Kynar 500® coating using 70% resin. Finish shall be in conformance with AAMA 2605.
      2) Color:
         a) As selected by Architect from manufacturer's color guide.
      3) Composition:
         a) Three-Coat Colors: 0.2-mil primer coat, 0.8-mil color coat, 0.7-mil clear coat.
      4) Performance:
         a) Gloss: Finish shall have a gloss value of 20-35 at 60°. Testing shall be in accordance with ASTM D523.
b) Solar Reflectance: Finish shall have a value of >25% initial, >15% after 3 years for Steep Slope and a value of >65% initial, >50% after 3 years for Low Slope. Testing shall be in accordance with ASTM E903.

c) Emissivity: Finish shall have a value of 0.80 (80%) min. Testing shall be in accordance with ASTM C1371.

d) Pencil Hardness: Finish shall have a value of F-2H. Testing shall be in accordance with ASTM D3363.

e) Flexibility: Finish shall have a value of 0-2 T-bend, no pick off. Testing shall be in accordance with ASTM D4145.

f) Adhesion: Finish shall have a value of No Adhesion Loss. Testing shall be in accordance with ASTM D3359.

g) Reverse Impact: Finish shall have a value of No Cracking Or Adhesion Loss. Testing shall be in accordance with ASTM D2794.

h) Abrasion: Finish shall have a value of 65-85 l/mil. Testing shall be in accordance with ASTM D968.

i) Mortar Resistance: Finish shall have a value of No Effect. Testing shall be in accordance with ASTM C267.

j) Detergent Resistance: Finish shall have a value of No Effect using 3% detergent @ 100 F° (72 hrs). Testing shall be in accordance with ASTM D2248.

k) Acid Resistance: Finish shall have a value of No Effect using 10% muriatic acid (24 hrs) and No Effect using 20% sulfuric acid (18 hrs). Testing shall be in accordance with ASTM D1308.

l) Acid Rain: Finish shall have a value of No Objectionable Color Change after 15 cycle min. Testing shall be in accordance with Kesternich SO2, DIN 50018.

m) Alkali Resistance: Finish shall have a value of No Effect using 10%, 25% NaOH (1 hr). Testing shall be in accordance with ASTM D1308.

n) Salt Spray Resistance: Finish shall have a value of No Face Blistering; Max average 1/16” scribe creep, passes 4000 hrs using 5% salt fog @ 95°F. Testing shall be in accordance with ASTM B117.

o) Humidity Resistance: Finish shall have a value of Passes 4000 hrs, No #8 blisters using 100% relative humidity @ 95°F. Testing shall be in accordance with ASTM D714, ASTM D2247.

p) Exterior Exposure: Finish shall have a value of Max 5 fade and Max 8 chalk at 10 yrs @ 45°, south Florida. Testing shall be in accordance with ASTM D2244, ASTM D4214.

b. Anodized:
   1) Type: AA-C22-A21 (clear) AA-C22-A23 (colored)
   2) Color: As selected by Architect from manufacturer's color guide.
   3) Composition:
      a) Anodized (clear): barrier, aluminum oxide, nickel/hydrate seal
      b) Anodized (colored): barrier, aluminum oxide, colorant, nickel/hydrate seal
   4) Performance:
      a) Salt Spray Resistance: Testing shall be in accordance with ASTM B117.
      b) Acid Dissolution: Testing shall be in accordance with ASTM B680.
      c) Gloss: Testing shall be in accordance with ASTM D523.
      d) Coating Mass: Testing shall be in accordance with ASTM B137.

B. Installation System:
   1. Reveal (RV) System:
      a. Description: Field-assembled installation system consisting of metal composite material (MCM), trim moldings, silicone sealant, and accessories to provide a barrier system.
      b. Performance:
1) Air Infiltration: Installation system shall not allow air infiltration in excess of 0.06 cfm/ft² at 1.57 psf. Testing shall be in accordance with ASTM E283.

2) Structural Performance: Installation system shall have a design load of 35.0 psf applied in the positive and negative direction. There shall be no deflection in excess of L/175 of the span of any support member nor shall there be any failure of the system. At a structural test load equal to 1.5 times the specified design load, no support member shall have permanent deformation in excess of 1/1000 of its span nor shall there be any failure of the system. Testing shall be in accordance with ASTM E330.

3) Water Penetration: Installation system shall not have uncontrolled water penetration to the room side at a static air pressure differential of 15.0 psf. Testing shall be in accordance with ASTM E331.

c. Trim Moldings:
   1) CRAX-1 Horizontal / Vertical (Reveal)
   2) CRAX-2 Perimeter J (Reveal)
   3) CRAX-3 Perimeter J
   4) CRAX-4 Inside Corner
   5) CRAX-5 Outside Corner
   6) CRAX-6 Horizontal / Vertical (3" Reveal)
   7) CRAX-7 Horizontal / Vertical
   8) CRAX-8 Outside Corner (Adjustable)
   9) CRAX-9 Inside Corner (Adjustable)

C. Accessories:
   1. Extrusions:
      a. Shall conform with ASTM B211 and the manufacturer's recommendations.
      b. Shall be applied in accordance with the panel manufacturer's installation guidelines.
   2. Sealants:
      a. Selected from the panel manufacturer's approved list of sealants.
      b. Shall be applied in accordance with both the panel manufacturer's installation guidelines and the sealant manufacturer's recommendations.
   3. Fasteners:
      a. Selected by contractor to suit project requirements.
      b. Shall be applied using the recommended fastener schedule in accordance with panel manufacturer's installation guidelines.
      c. Shall be coated to prevent corrosion and/or reaction with other materials.
      d. Shall be concealed except where unavoidable. Exposed fasteners shall be finished to match adjoining metal.
   4. Flashing:
      a. Selected by contractor to suit project requirements.
      b. Shall be installed in such a manner to maintain the integrity of the wall system against moisture intrusion.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrate to receive the work of this section to verify that the conditions are acceptable for installation.
   1. Substrate to receive panels shall be even, smooth, sound, clean, dry, and free from defects detrimental to work. Notify contractor in writing of conditions detrimental to proper and timely completion of the work.
   2. Substrate to receive panels shall be in vertical and horizontal alignment with no more deviation than 1/4" in 20'.
B. Proceed with installation only after all unsatisfactory conditions have been corrected in a manner acceptable to installer. Starting work within a particular area will be construed as installer's acceptance of surface conditions.

3.02 PREPARATION
A. Verify dimensions as required.
B. Protect adjacent work areas and finished surfaces to prevent damage that otherwise might occur during the work of this section.

3.03 INSTALLATION
A. Wall panel assembly shall be installed in accordance with the manufacturer's written installation guidelines and the approved set of shop drawings.
B. Erect wall panel assembly level and true to the intended plane.
C. Maximum deviation from vertical and horizontal alignment of erected wall panel assembly shall be no more than 1/4" in 20'-0".
D. Maximum deviation in panel flatness shall be 0.6% of the assembled units.
E. Seal all joints as required using methods and materials as recommended by the panel manufacturer.

3.04 CLEANING
A. Remove panel masking immediately after installation. Delay will result in difficulty with removal and possibly residue on the panel surface.
B. Remove temporary coverings and protection to adjacent work areas.
C. Remove and legally dispose of construction debris from project site.

END OF SECTION
SECTION 07 5416
KETONE ETHYLENE ESTER (KEE) ROOFING WITH A SIMULATED METAL ROOFING PROFILE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 PREINSTALLATION MEETINGS
A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.
   1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
   3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
   5. Review structural loading limitations of roof deck during and after roofing.
   6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
   7. Review governing regulations and requirements for insurance and certificates if applicable.
   8. Review temporary protection requirements for roofing system during and after installation.
   9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference at Project site.
   1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
   3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
   5. Review structural loading limitations of roof deck during and after roofing.
   6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
   7. Review governing regulations and requirements for insurance and certificates if applicable.
   8. Review temporary protection requirements for roofing system during and after installation.
   9. Review roof observation and repair procedures after roofing installation.

1.03 SUMMARY
A. Section Includes:
   1. Fully adhered membrane roofing over substrate system including cover board.
   2. Roof insulation and taper system.

1.04 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.
   1. Base flashings and membrane terminations.
   2. Membrane Layout and Fastening Pattern (Corners, Perimeters and Field).
   3. Cover Board fastening patterns.
C. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
   1. Installer shall provide business address showing a location no more than four hours distant from project site.
D. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article and roof system, as indicated in the construction documents, meets requirements for roof system warranty specified in "Warranty" Article.

E. Maintenance Data: For roofing system to include in maintenance manuals.

F. Warranties: Special warranties specified in this Section.

G. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm with 5-years (minimum) documented experience installing thermoplastic membrane systems that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty. Submit the following qualification data:
   1. Project Foreman or Superintendent shall have supervised a minimum of five (5) project of similar size and scope as this Project. Contractor shall provide Name and address of these five (5) project of similar size and scope as this Project. Include contact name and phone number for reference.

B. Manufacturer Qualifications: A qualified manufacturer with twenty (20) year's experience manufacturing the same membrane without formulation changes. The roofing membrane and system shall be identical to that used for this Project and which can show evidence of these materials being satisfactorily used on at least Ten (10) projects of similar size, scope and type within such a period. At least three (3) projects in Wyoming shall have been in successful use for 10 years or longer. Obtain components for membrane roofing system from or approved by roofing membrane manufacturer.
   1. Manufacturer's with less than the stipulated years of experience under a single name may be included with documentation of production of membrane material under of the same formula under another corporate identity.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
   1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.08 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
   1. Special warranty includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, cover boards, walkway products and other components of membrane roofing system.
   2. Warranty Period: 20 years from date of Substantial Completion.
   3. Warranty shall include 1 1/2" hail warranty and shall not include exclusions for ponding water.
   4. Warranty Shall Include 115 MPH wind damage clause to repair damage by winds up to 115 MPH as substantiated by the nearest certified weather station.
   5. Installed membrane shall carry FM field of roof rating of 1-75 against uplift.
B. Installer Warranty: Installer shall provide additional 2 year warranty against defects in workmanship and installation.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

C. Roofing System Design: Provide a membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE 7.
1. Typical Roof area (outward): 40 PSF
2. Typical Roof Special Zone 1 (Eaves, Rakes and Ridges - Outward): 67 PSF.
3. Roof Special Zone 2 (Corners - Outward): 100 PSF.
4. Typical Parapet (Inward or Outward): 86 PSF.
5. Parapet Corners (Inward or Outward): 118 PSF.

D. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

E. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.

F. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.02 KETONE ETHYLENE ESTER (KEE) ROOFING

A. KEE Sheet: ASTM D6754/D6754M, Keytone Ethylene Ester (KEE) Sheet Roofing and system dependent accessories:
1. Basis-of-Design Product: Subject to compliance with requirements, provide products specified by Seaman Corporation; FiberTite 50 mil XT FB or comparable product.
2. Physical Material Properties:
   a. Thickness: Per ASTM D-751; .050 Minimum.
   b. Tensile Strength: Per ASTM D-882 and ASTM D-751; 9500 psi.
   c. Breaking Strength: Per Grab Method; 400 lbs.
   d. Tear Strength (8" x 10" sample): Per ASTM D-751; 125 lbs.
   e. Puncture Resistance: Per Fed. Std. 101B, Method 2031; 23 joules
   f. Dimensional Stability ASTM D-12040.5%.
   g. Low Temperature: ASTM D-2136; -40F.
   h. Accelerated Weathering: Per Carbon Arc with water Spray; 5,000 hours - no cracking, blistering, or crazing.
   i. Oil Resistance: Per Mil-20696C; No swelling, cracking or leaking.
   j. Hydrocarbon Resistance: Per Mil-C-20696C; No swelling, cracking or leaking.
   k. Seam Strength: Per ASTM D-751; 100% of Fabric.
   l. Coating Adhesion: Per ASTM D-751; Cannot initiate coating peel.
   m. Color: White.
   n. Maximum Sheet width 78"

2.03 AUXILIARY ROOFING MATERIALS

A. Auxiliary Materials: In general, Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
1. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as sheet membrane.
3. Metal Termination Bars: Manufacturer’s standard predrilled aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
4. Metal Battens: Manufacturer’s standard aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, pre-punched.
5. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
7. Wood Nailers: As required by roofing manufacturer.
8. Simulated Metal Roofing Profile (Rib)
   a. The simulated metal roofing profile shall be an ornamental co-extrusion with a heat-activated KEE adhesive strip provided by Seaman Corporation.
   b. Extruded profile shall be provided in 100 feet continuous lengths and match fleece back membrane color.

2.04 COVER BOARD
A. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board, or ASTM C1278/C1278M fiber-reinforced gypsum board.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dens Deck prime.
      b. Securock Gypsum Fiber.
      c. Or approved equal.
   2. Thickness: 1/2 inch.

2.05 INSULATION
A. General: Preformed roof insulation boards manufactured or approved by KEE roof membrane manufacturer.
B. 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:
   3. Or approved equal.
C. Base Insulation System:
   1. Polysiocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C 1289, Type II, Class 1 with the following characteristics:
      a. Premanufactured tapering system.
      b. Compressive Strength: 20 psi.
      c. Board Size: 48 x 96 inch, base size, trimmed and tapered as necessary to achieve drainage patterns indicated on drawings.
      d. Board Thickness: Layer boards as necessary to achieve final base thickness, stagger joints by a minimum of 6”. Provide 2 layers minimum to achieve 5.25 inch total overall thickness.
         1) Add additional thickness as necessary to achieve slope.
      e. Board Edges: Square
      g. In general, provide preformed roof insulation boards that comply with requirements and referenced standards.

PART 3 - EXECUTION
3.01 EXAMINATION
A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
   1. Verify that roof openings and penetrations are in place and set and braced.
   2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.
3.02 PREPARATION
A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
B. Prevent materials from spilling or migrating onto surfaces of other construction.
C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
D. Where indicated, install preformed sound absorbing glass fiber insulation strips supplied with decking material in acoustic deck flutes. Install in accordance with manufacturer's instructions.

3.03 INSTALLATION OF BASE AND TAPER SYSTEM
A. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.
B. Attachment of Insulation:
1. Loose lay first layer of insulation.
2. Mechanically fasten subsequent insulation layers to deck in accordance with insulation manufacturer's instructions and Factory Mutual requirements and the uplift resisting requirements of the structural engineer as noted in this document.
C. Lay subsequent layers of insulation with joints staggered minimum 12 inch from joints of preceding layer.
D. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions, maintain minimum 1/4” per foot slope for all taper systems.
E. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
F. Tape joints of insulation in accordance with insulation manufacturer's instructions.
G. Do not apply more insulation than can be covered with membrane in same day.
H. Coordinate installing membrane roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.
I. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.

3.04 INSTALLATION OF COVER BOARD
A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Stagger joints from joints in insulation below a minimum of 12 inches in each direction. Loosely butt cover boards together and fully adhere to underlying material with adhesive recommended by and compatible with the roof insulation manufacturer's products at the rate prescribed by the manufacturer to comply with the established wind resistance rating.

3.05 INSTALLATION OF FULLY ADHERED ROOFING MEMBRANE
A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
C. Accurately align roofing membranes and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
D. Shingle joints on sloped substrate in direction of drainage.
E. Apply adhesive to substrate at rate prescribed by the manufacturer and as necessary to meet wind and uplift warranty terms. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
F. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
G. At intersections with vertical surfaces:
1. Extend membrane as detailed up parapets and other vertical surfaces using manufacturer's recommended intermediate membrane clips as necessary.
2. Fully adhere flexible flashing over membrane and up to reglets.
3. Secure flashing to nailing strips at 4 inches on center.
4. Insert flashing into reglets and secure.
H. Fully Adhere roofing membrane securely at terminations, penetrations, and perimeter of roofing.
3.06 BASE FLASHING INSTALLATION
A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
B. Apply solvent-based bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
C. Flash penetrations and field-formed inside and outside corners with sheet flashing.
D. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.

3.07 INSTALLATION OF SIMULATED METAL ROOFING PROFILE
A. Preparation
1. The ornamental nature of the SMRP places a high value on the aesthetics of the finished roof system.
2. The surface of the FiberTite fleece back membrane shall be clean and dry for the proper installation of the SMRP.
3. The SMRP shall be installed in equidistant and parallel lengths – alignment errors will be visible at ground level.
4. Best spacing of the SMRP is determined by using incremental distances between fleece back membrane laps.
5. Installation of SMRP at overlaps will be nominally spaced at 69 inch intervals.
6. Cut and/or preassemble SMRP to desired lengths.
7. Segments of SMRP can be joined using a plastic dowel.
8. Using washable chalk, snap/mark lines at predetermined/specified intervals between the overlaps.

B. Number of Interval Segments

<table>
<thead>
<tr>
<th>Of SMRP’s Between Overlaps</th>
<th>Nominal “on center” Distance Between SMRP’s</th>
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<tr>
<td></td>
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<tr>
<td>1</td>
<td>34.50”</td>
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<td>2</td>
<td>23.00”</td>
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<tr>
<td>3</td>
<td>17.25”</td>
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C. Application
1. Unroll the FiberTite Rib Profile and place next to the chalk line/or membrane overlap edge.
2. Position SMRP so the bottom of the SMRP is lying flat and free to tension.
3. Once Aligned, adhere the beginning (2“ – 4”) of the SMRP to the fleece back roofing membrane.
4. Pull the SMRP taught, aligned to the chalk line to keep the profile straight for the welder.
5. Using a hot air apparatus, adhere the SMRP’s continuous, straight and parallel.
6. Do not overheat the fleece back membrane while adhering the heat activated adhesive strip on the SMRP.
7. Do not install the SMRP on or over welded overlaps.
8. Do not rush the heat activation process and take time necessary to ensure aesthetics are achieved.
9. SMRP splice joints and exposed ends can be detailed by using/welding small strips/pieces of the same colored membrane.

3.08 FIELD QUALITY CONTROL
A. Pre-Installation Conference: Contractor shall include in their bid, the cost for roofing system manufacturer's technical personnel to attend the Pre-Installation Conference.
B. Carry out all roof inspections required by manufacturer for warranty issue range for such inspections with the manufacturer in accordance with their requirements at a minimum provide for the following inspection schedules even if not required by the manufacturer.
1. Contractor shall include in their bid, the cost for roofing system manufacturer's technical personnel to inspect roofing installation prior to the contractor's completion of 50% of the project. Upon completion of this inspection, the roofing system manufacturer's technical personnel shall submit an in-progress report to the Owners representative.
2. Final Roof Inspection: Contractor shall include in their bid, the cost for the roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit final inspection report to the Owners representative.
3. Notify Owner's representative 48 hours in advance of date and time of inspection.
C. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.
D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. The Owner retains the right to hire a roofing specialist to inspect the work. This consultant may or may not attend the Manufacturer's inspection tour at the Owner's discretion.
   1. The Contractor shall provide access to the Owner's Independent Roofing Consultant with a minimum of 24 hours notice.
   2. The Owner's Independent Roofing Consultant is not empowered to direct or otherwise authorize changes to the work.

3.09 PROTECTING AND CLEANING

A. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

B. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Repair or replace defaced or damaged finishes caused by work of this section.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section Includes:
   1. Formed wall sheet metal fabrications.
   2. Formed equipment support flashing.
   3. Formed overhead-piping safety pans.

1.03 COORDINATION
A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.04 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at Project site.
   1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
   3. Review requirements for insurance and certificates if applicable.
   4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.05 SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
B. Shop Drawings: For sheet metal flashing and trim.
   1. Include plans, elevations, sections, and attachment details.
   2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
   3. Include identification of material, thickness, weight, and finish for each item and location in Project.
   4. Include details for forming, including profiles, shapes, seams, and dimensions.
   5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   6. Include details of termination points and assemblies.
   7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
   8. Include details of roof-penetration flashing.
   9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
   10. Include details of special conditions.
   11. Include details of connections to adjoining work.
   12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.
C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
D. Samples for Verification: For each type of exposed finish.
1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

E. Qualification Data: For fabricator.
F. Product Test Reports: For each product, for tests performed by a qualified testing agency.
G. Sample Warranty: For special warranty.

1.06 CLOSEOUT SUBMITTALS
A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.07 QUALITY ASSURANCE
A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.08 DELIVERY, STORAGE, AND HANDLING
A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.09 WARRANTY
A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS
A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 SHEET METALS
A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
   1. As-Milled Finish: One-side bright mill.
   2. Exposed Coil-Coated Finish:
a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers’ written instructions.

3. Color: As selected by Architect from manufacturer's full range.

4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; with smooth, flat surface.
   1. Finish: 2D (dull, cold rolled).

2.03 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

C. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
      b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
   2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
   3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

D. Solder:
   1. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

E. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

F. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

G. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.


2.04 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
   1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
   2. Obtain field measurements for accurate fit before shop fabrication.
   3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
   4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
   1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
   2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, non-expansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

G. Do not use graphite pencils to mark metal surfaces.

2.05 WALL SHEET METAL FABRICATIONS

A. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:
   1. Aluminum: 0.032 inch thick.
   2. Stainless Steel: 0.016 inch thick.

B. Wall Expansion-Joint Cover: Fabricate from the following materials:
   1. Aluminum: 0.040 inch thick.
   2. Stainless Steel: 0.019 inch thick.

2.06 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:
   1. Stainless Steel: 0.019 inch thick.

B. Overhead-Piping Safety Pans: Fabricate from the following materials:
   1. Stainless Steel: 0.025 inch thick.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

3.03 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
   2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torc cutting of sheet metal flashing and trim is not permitted.
6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
   1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
   1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
   2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.
   1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
   2. Prepare joints and apply sealants to comply with requirements in Section 07 9200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
   1. Do not solder aluminum sheet.
   2. Do not use torches for soldering.
   3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.04 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

C. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.
3.05 WALL FLASHING INSTALLATION
A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-open components such as windows, doors, and louvers.
B. Through-Wall Flashing: Installation of through-wall flashing is specified in Division 04.
C. Reglets: Installation of reglets is specified in Section 03 3000 "Cast-in-Place Concrete." and Division 04.
D. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.06 MISCELLANEOUS FLASHING INSTALLATION
A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.
B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.07 ERECTION TOLERANCES
A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.08 CLEANING AND PROTECTION
A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
B. Clean and neutralize flux materials. Clean off excess solder.
C. Clean off excess sealants.
D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION
SECTION 07 6526
SELF-ADHERING SHEET FLASHING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section Includes:
   1. Materials and installation methods for flexible rubberized asphalt, self-sealing flashing and flashing accessories.

1.03 SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, for each manufactured product and accessory.
B. Shop Drawings: For self-adhered flashing.
   1. Include plans, elevations, sections, and attachment details.
C. Samples of flashing.

1.04 DELIVERY, STORAGE, AND HANDLING
A. Comply with manufacturer’s recommendations for storage and handling of each product.

1.05 WARRANTY
A. Standard Product Warranty:
   1. Submit manufacturer’s warranty that flashing and accessories are free of defects at time of delivery, and are manufactured to meet manufacturer’s published physical properties and material specifications.
   2. Installer to warrant that flashing and accessories have been installed in accordance with manufacturer’s recommendations.

PART 2 - PRODUCTS

2.01 MATERIALS
A. Flashing Description: 35 mil of self-adhesive rubberized asphalt integrally bonded to 5 mil of aluminum film to provide a min. 40 mil thick membrane. Membrane shall be interleaved with disposable silicone-coated release paper until installed.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide products specified by Perm-A-Barrier Aluminum Flashing manufactured by Grace Construction Products or comparable product.
   2. Performance Requirements:
      a. UV Exposure Limit: Not more than 365 calendar days
      b. Water Absorption, ASTM D 570: max 0.1% by weight
      d. Lap Adhesion at 25°F, ASTM D 1876 Modified: 5.0 lbs./in. of width
      e. Low Temperature Flexibility, ASTM D 1970 Modified: Unaffected to -15°F.
      f. Tensile Strength, ASTM D 412, Die C Modified: min. 600 Psi.
      g. Elongation, Ultimate Failure of Rubberized Asphalt: ASTM D 412, Die C Modified: min. 200%.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install self-adhered flashing according to manufacturer's written instructions.
B. Refer to manufacturer's literature for recommendations on installation
C. Prime substrate to receive wall flashing as required per manufacturers written instructions.
   1. Precut pieces of flashing to easily handled lengths for each location.
   2. Remove silicone-coated release paper and position flashing carefully before placing it against the surface.
   3. When properly positioned, place against surface by pressing firmly into place by hand roller. Fully adhere flashing to substrate to prevent water from migrating under flashing.
   4. Overlap adjacent pieces 2 inch and roll all seams with a hand roller.
   5. Trim bottom edge 1/2 inch back from exposed face of the wall. Flashing shall not be permanently exposed to sunlight.
   6. At heads, sills and all flashing terminations, turn up ends a minimum of 2 inch and make careful folds to form an end dam, with the seams sealed.
   7. Seal top edge of flashing with termination mastic.
   8. Do not allow the rubberized asphalt surface of the flashing membrane to come in contact with polysulfide sealants, creosote, uncured coal tar products or EPDM.

END OF SECTION
SECTION 07 7200
ROOF ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section Includes:
   1. Copings.
B. Refer to Division 01 sustainable & energy efficiency project requirements affecting work of this section.

1.03 SUBMITTALS
A. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
B. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
C. Samples: Submit two appropriately sized samples of coping.
D. Qualification Data: For manufacturer.
E. Product Test Reports: For copings, for tests performed by a qualified testing agency.
F. Sample Warranty: For manufacturer’s special warranty

1.04 CLOSEOUT SUBMITTALS
A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.05 QUALITY ASSURANCE
A. Perform work in accordance with SMACNA (ASMM) details.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.07 FIELD CONDITIONS
A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.08 WARRANTY
A. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS
A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
B. SPRI Wind Design Standard: Manufacture and install copings tested according to SPRI ES-1 and capable of resisting the following design pressures:
   1. Design Pressure: As indicated on Drawings.
C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants,
failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.02 COPINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Architectural Products Company.
2. ATAS International, Inc.
4. Castle Metal Products.
5. Cheney Flashing Company.
8. Merchant & Evans Inc.
9. Metal-Era, Inc.
10. Perimeter Systems; a division of SAF.
11. SAF (Southern Aluminum Finishing Company, Inc.).

B. Copings: Fabricated to sizes required; mitered, welded corners; concealed fasteners.

1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness and finish as cap; concealed stainless steel fasteners.
2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 RE-3 to positive and negative design wind pressure as defined by applicable code but not less than the engineered values as follows:
   a. Typical Parapet (Inward of Outward): 86 PSF
   b. Parapet Corners (Inward or Outward): 118 PSF
3. Material: Formed aluminum sheet, 0.063 inch thick, minimum.
4. Surface: Smooth, flat finish.
5. Finish: Two-coat fluoropolymer.
6. Color: To be selected by Architect from manufacturer's full range.

C. Control and Expansion Joint Covers: Composite construction of 12 inch wide flexible EPDM flashing of white color with closed cell urethane foam backing, each edge seamed to aluminum sheet metal flanges, designed for nominal joint width of 1 inch. Include special formed corners, tees, intersections, and wall flashings, each sealed watertight.

2.03 MATERIALS

A. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

2.04 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

2.05 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.

B. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.06 FINISHES
A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
D. Aluminum Finishes:
   1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION
3.01 EXAMINATION
A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 UNDERLAYMENT INSTALLATION
A. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

3.03 INSTALLATION, GENERAL
A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
   1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
   2. Provide uniform, neat seams with minimum exposure of solder and sealant.
   3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
   4. Torch cutting of roof specialties is not permitted.
   5. Do not use graphite pencils to mark metal surfaces.
B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
   1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
   2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.
F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

3.04 COPING INSTALLATION
A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.
B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.
C. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.

3.05 CLEANING AND PROTECTION
A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
B. Clean and neutralize flux materials. Clean off excess solder and sealants.
C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.
D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Sealants and joint backing.
   B. Precompressed foam sealers.

1.02 RELATED REQUIREMENTS
   A. Section 07 6200 - Sheet Metal Flashing and Trim
   B. Section 08 4313 - Aluminum Framed Storefronts
   C. Section 08 8000 - Glazing: Glazing sealants and accessories.
   D. Section 09 2900 - Gypsum Board
   E. Section 09 9000 - Painting and coating

1.03 REFERENCE STANDARDS

1.04 ADMINISTRATIVE REQUIREMENTS
   A. Coordinate the work with other sections referencing this section.

1.05 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data indicating sealant chemical characteristics.
   C. Samples: Submit two sample cards, 4 x 8 inch in size illustrating sealant colors for selection.
   D. Manufacturer's Installation Instructions: Indicate special procedures.

1.06 QUALITY ASSURANCE
   A. Manufacturer and Applicator Qualifications: Companies specializing in manufacturing and installing the Products specified in this section with minimum five years documented experience.

1.07 MOCK-UP
   A. Provide mock-up of sealant joints in conjunction with wall under provisions of Section 01 4000.
   B. Construct mock-up with specific sealant types within walls and other components as requested by the Architect.
   C. Locate where directed.
   D. Mock-up may remain as part of the Work.

1.08 FIELD CONDITIONS
   A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.09 WARRANTY
   A. See Section 01 7700 - Closeout Procedures, 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:
  14. Substitutions:  See Section 01 6000 - Product Requirements.

2.02 SEALANTS

A. General Purpose Exterior Sealant:  Acrylic, solvent release curing; ASTM C920, Grade NS, Class 12-1/2, Uses M, G, and A; single or multi-component.
   1. Color:  color as selected.
   2. Applications:  Use for:
      a. Joints between concrete and other materials.
      b. Joints between metal frames and other materials.
      c. 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.
   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.
      b. Joints between kitchen and bath countertops and wall surfaces.

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.
F. 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: 85 after 7 days, when tested in accordance with ASTM D2240 Shore A.
   3. Color: Concrete gray.
   6. Applications: Use for:
      a. Control joints in concrete slabs and floors not filled with filler placed in form.
      b. Joints in concrete slabs and floors.

G. Rigid Polyurethane Crack and Joint Filler: Two part, low viscosity, fast setting, rigid sealant intended for cracks and control joints not subject to significant movement; used on cracks and joints prior to application of moisture control systems, underlayments, and toppings.
   1. Applications: Use for:
      a. Interior and exterior control joints in concrete slabs and floors.
      b. Saw cut joints.
      c. Cracks, spalls, and other repairs.

   1. Approved by manufacturer for wide joints up to 1-1/2 inches.
   2. Color: Match adjacent finished surfaces.
   3. Applications: Use for:
      a. Expansion joints in floors.

   2. Applications: Use for:
      a. Joints in sidewalks and vehicular paving.

J. Nonsag Polyurethane Sealant: ASTM C920, Grade NS, Class 25, Uses NT, I, M, A; single component, chemical curing, non-staining, non-bleeding, non-sagging type.
   1. Color: To be selected by Architect from manufacturer's standard range.
   3. Service Temperature Range: -40 to 180 degrees F.
   5. Applications: Use for:
      a. Vertical control between dissimilar exterior materials.

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.
E. Exposed Concrete Floor Joints: Test joint filler in inconspicuous area of floor slab. Verify specified product does not stain or discolor slab.

3.03 INSTALLATION
A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
B. Perform installation in accordance with ASTM C1193.
C. Perform acoustical sealant application work in accordance with ASTM C919.
D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
E. Install bond breaker where joint backing is not used.
F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
H. Tool joints concave.
I. 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
PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section Includes:
   1. Furnish Expansion Joint Systems in accordance with the drawings and general provisions of the Contract.
   2. Provide Expansion joint in areas where movement between existing and new construction is anticipated whether indicated on drawings or not, and other openings indicated.
   3. Furnish complete prefabricated joint systems of the following type from a single manufacturer
      a. Exterior wall expansion joint systems.
      b. Interior floor expansion joint assemblies
      c. Interior wall to wall expansion joint assemblies
      d. Interior ceiling expansion joint systems.
B. Refer to Division 01 sustainable & energy efficiency project requirements affecting work of this section.

1.03 SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.
B. Shop Drawings: For each expansion joint cover assembly.
   1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
   2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
C. Manufacturer's specifications, technical data, installation instructions, and detail drawings for each system.
D. Certificates or other documentation confirming UL approved compliance with fire resistance rating of fire barrier assemblies.
E. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
   1. Manufacturer and model number for each expansion joint cover assembly.
   2. Expansion joint cover assembly location cross-referenced to Drawings.
   3. Nominal, minimum, and maximum joint width.
   4. Movement direction.
   5. Materials, colors, and finishes.
   6. Product options.
F. Sample of specified systems where required.

1.04 QUALITY ASSURANCE
A. Manufacturer: Furnish assemblies from one (1) manufacturer with a minimum of five (5) years of experience in the design, engineering and fabrication of expansion joint systems.
B. Installer: Firm with not less than five (5) years of successful experience in the installation of systems similar to those required by this project and acceptable to the manufacturer of the system.

1.05 DELIVERY AND STORAGE
A. Provide temporary protective covers on anodized aluminum finished surfaces.
B. Deliver joint systems to jobsite in new, clean, unopened cartons or crates of sufficient size and strength to protect materials during transit.
C. Store components in original containers in a clean, dry location.
1.06 WARRANTY
   A. Manufacturer's Standard warranty against material and manufacturing defects for a period of not less than three (3) years when installed in accordance with manufacturer’s recommendations.

PART 2 - PRODUCTS
2.01 MANUFACTURER
   A. Basis-of-Design Product: Subject to compliance with requirements, provide products as specified or comparable product.
      1. Architectural Art Mfg., Inc.
      2. Construction Specialties, Inc.
      3. MM Systems Corp.

2.02 MATERIALS
   A. Manufacturer's Standard for the system detailed.
   B. Fasteners, accessories and other materials required for complete installation in accordance with the manufacturer's instructions.

2.03 EXTERIOR JOINT SYSTEMS
   A. Preformed, Foam Joint Seals: Manufacturer's standard joint seal manufactured from urethane or EVA (ethylene vinyl acetate) foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths based on design criteria indicated, with factory- or field-applied adhesive for bonding to substrates.
      1. Basis of design: CS Construction Specialties; HS Series or similar design by approved acceptable manufacturer.
         b. Joint Seal Color: As selected by Architect from Manufacturer's full range.

   B. Vertical Applications in Masonry:
      1. Basis of design Balco; a CSW Industrials Company; FCVS-2 or similar design by approved acceptable manufacturer.
      2. General Characteristics:
         a. Accordion type unit capable of multi directional movement and weather tight function.
         b. Continuous extruded aluminum frame secured to both sides of joint with mechanical attachment to masonry.
         c. Exterior Cover Plate: Continuous extruded flexible silicone face seal full length of joint capable of 100% expansion
            1) Color: As selected by Architect from Manufacturer's full range.
         d. Interior Baffle: Continuous santoprene material inserted into fill length of aluminum frame, capable of 100% expansion.
         e. Base closure unit: Self flashed assembly; component of complete expansion joint system for exterior enclosures.

   C. Roof to Wall Bellows:
      1. Basis of design Balco; a CSW Industrials Company; BRBS-1-2CSE or similar design by approved acceptable manufacturer.
      2. General Characteristics:
         a. EPDM Bellows with Closed Cell foam backing.
         b. Width: 4 inch wide.
         c. Movement Capability: +50 percent.
         d. Stainless steel flat flanges.

2.04 INTERIOR SYSTEMS
   A. Floor System: Embedded frame with aluminum cover plate Construction Specialties Model GFPS-200 and/or 200M width appropriate to joint detail or similar design by approved acceptable manufacturer.
      1. General Characteristics:
         a. Continuous extruded two part tongue and groove style aluminum cover plate with flexible gasketing
         b. Continuous extruded aluminum frame 1 1/2" in block out height with mechanical attachment to concrete deck. Inset frames shall be provided with primer when set in concrete.
c. Heavy Duty minimum 2000 pound point load.

B. Wall to Wall and Wall to Ceiling and Ceiling to Ceiling Systems: Single side attachment for flat to flat and corner conditions Construction Specialties model FWF-200 and FWFC (GWB), and FCF-200 and FCFC-200 (Lay-in tile) width appropriate to joint detail or similar design by approved acceptable manufacturer.
   1. General Characteristics:
      a. Continuous extruded cover plate secured to wall or ceiling component, and with no-mar gasketing in preformed channel material on underside of plate to eliminate marking of adjacent surface.
   C. Concealed wall to wall system: Closed cell ethylene vinyl acetate foam, Construction Specialties Model HS, width appropriate to joint detail or similar design by approved acceptable manufacturer.
      1. Density: ASTM D3575, 10lb/cu.ft
      2. Tensile Strength: ASTM D3575, 120 psi
      3. Tensile Elongation: ASTM D3575, 250%
      4. Tear Resistance: ASTM D624, 21.5 lbs/in

2.05 ACCESSORIES
A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.
   1. Provide where indicated on Drawings.
B. Manufacturer's stainless-steel attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.06 FABRICATION
A. Field assemble components provided in standard lengths with pre-packaged fasteners and accessories.
B. Fabricate special transitions and corner fittings as required. Miter and weld elastomeric seal as applicable.

2.07 FINISHES
A. For metallic elements of all expansion joints: mill finish aluminum.
B. All others: As selected by the Architect at the time of submittal.

PART 3 - EXECUTION
3.01 EXAMINATION
A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.
B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION
A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.
B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.03 INSTALLATION
A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.
B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
   1. Repair or grout block out as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
   2. Install frames in continuous contact with adjacent surfaces.
   3. Shimming is not permitted.
   4. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
   5. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
6. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
7. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.

C. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
   1. Provide in continuous lengths for straight sections.
   2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
   3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

F. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.
   1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

G. Moisture Barrier Drainage: If indicated, provide drainage fitting and connect to drains.

3.04 PROTECTION AND CLEANING

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion joint cover assemblies. Reinstall cover plates or seals prior to Substantial Completion.

END OF SECTION
SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section includes:
   1. Interior standard steel doors and frames.
   2. Exterior standard steel doors and frames.
B. Refer to Division 01 sustainable & energy efficiency project requirements affecting work of this section.

1.03 COORDINATION
A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.04 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at Project site.

1.05 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
B. Shop Drawings: Include the following:
   1. Elevations of each door type.
   2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
   4. Locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
   7. Details of anchorages, joints, field splices, and connections.
   8. Details of accessories.
   9. Details of moldings, removable stops, and glazing.
C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.06 INFORMATIONAL SUBMITTALS
A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
   1. Provide additional protection to prevent damage to factory-finished units.
B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.
PART 2 - PRODUCTS

2.01 MANUFACTURERS
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. Ceco Door; ASSA ABLOY.
      2. Curries Company; ASSA ABLOY.
      3. DE LA FONTAINE.
      4. Mesker Door Inc.
      5. Michbi Doors Inc.
      6. MPI Group, LLC (The).
      7. Pioneer Industries.
      8. Premier Products, Inc.
     10. Security Metal Products; a brand of ASSA ABLOY.
     11. Steelcraft; an Allegion brand.

2.02 PERFORMANCE REQUIREMENTS
   A. Thermally Rated Door Assemblies: Provide door assemblies with $U$-factor of not more than $0.40 \text{ deg Btu/F \times h \times sq. ft.}$ when tested according to ASTM C 518.

2.03 INTERIOR STANDARD STEEL DOORS AND FRAMES
   A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
   B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2; SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.
      1. Doors:
         a. Type: As indicated in the Door and Frame Schedule.
         c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch.
         d. Edge Construction: Model 1, Full Flush.
         e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
         f. Core: Manufacturer's standard.
      2. Frames:
         a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
         b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
         c. Construction: Full profile welded.

2.04 EXTERIOR STANDARD STEEL DOORS AND FRAMES
   A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
   B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.
      1. Doors:
         a. Type: As indicated in the Door and Frame Schedule.
         c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
         d. Edge Construction: Model 2, Seamless.
         e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
         f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
         g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
         h. Core: Manufacturer's standard insulated core.
         i. Profile: As indicated on the drawings.
2. Frames:
   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
   b. Construction: Full profile welded.

2.05 BORROWED LITES
A. Fabricate of metallic-coated steel sheet, minimum thickness of 0.042 inch.
B. Construction: Face welded.
C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.06 FRAME ANCHORS
A. Jamb Anchors:
   1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
   2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.
D. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M; hot-dip galvanized according to ASTM A 153/A 153M, Class B.

2.07 MATERIALS
A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
D. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
E. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
F. Glazing: Comply with requirements in Section 08 8000 “Glazing”.

2.08 FABRICATION
A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
   1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
   2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
   3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.09 STEEL FINISHES
   A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
      1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION
3.01 PREPARATION
   A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
   B. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.02 INSTALLATION
   A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
   B. Hollow-Metal Frames: Comply with SDI A250.11.
      1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
         a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
         b. Install frames with removable stops located on secure side of opening.
      2. Floor Anchors: Secure with post-installed expansion anchors.
         a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
      4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
      5. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
      6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
         a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
         b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8.

D. Glazing: Comply with installation requirements in Section 08 8000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.03 CLEANING AND TOUCHUP

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. Section Includes:
      1. Five-ply flush wood veneer-faced doors for transparent finish.

1.03 PREINSTALLATION MEETINGS
   A. Preinstallation Conference: Conduct conference at Project site.

1.04 SUBMITTALS
   A. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
   B. 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.
   C. Samples: Submit two samples of door construction, 12" x 12" in size cut from top corner of door.
   D. Samples: Submit two samples of door veneer, 6 x 6 inch in size illustrating wood grain, stain color, and sheen.
   E. Sample Warranty: For special warranty.

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Comply with requirements of referenced standard and manufacturer's written instructions.
   B. Package doors individually in plastic bags or cardboard cartons or cardboard cartons, and wrap bundles of doors in plastic sheeting.
   C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.06 FIELD CONDITIONS
   A. Environmental Limitations: Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.07 WARRANTY
   A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
      1. Failures include, but are not limited to, the following:
         a. Delamination of veneer.
         b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
         c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
      2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.01 FLUSH WOOD DOORS, GENERAL
   A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."
      1. Provide labels from AWI indicating that doors comply with requirements of grades specified.

2.02 FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH
   A. All Doors: See drawings for locations and additional requirements.
      2. Flush construction
      3. Wood Veneer Faced 5 ply, factory finished.
         a. Species: Sliced White Maple.
      4. 1 3/4" THICK.
      5. Solid core all locations.
B. Door and Panel Cores:
   1. Non-Rated Solid Core Doors: Type Agrifiber cores, plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

C. Door Facings:
      b. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.

2.03 LIGHT FRAMES
   A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard flush wood beads unless otherwise indicated.
      1. Wood Species: Same as door faces.
      2. Profile: Flush rectangular beads.

2.04 ACCESSORIES
   A. Glazing Stops: Rolled steel channel shape, mitered corners; prepared for countersink style tamper proof screws, field painted color as selected by Architect. Refer to Section 09 9000 Painting and coating. Sizes and configurations as indicated on drawings.
   B. Astragals for Non-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, field painted color as selected by Architect. Refer to Section 09 9000 Painting and coating.

2.05 DOOR CONSTRUCTION
   A. Fabricate doors in accordance with door quality standard specified.
   B. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
   C. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

2.06 FACTORY FINISHING - WOOD VENEER DOORS
   A. Finish work in accordance with, Section 5 - Finishing for grade specified and as follows:
      1. Transparent:
         a. System - 1, Lacquer, Nitrocellulose.
         b. Stain: As selected by Architect.
         c. Sheen: Satin.
   B. Seal door top edge with color sealer to match door facing.

PART 3 - EXECUTION

3.01 EXAMINATION
   A. Examine doors and installed door frames, with Installer present, before hanging doors.
      1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
      2. Reject doors with defects.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
   A. Hardware: For installation, see Section 08 7100 "Door Hardware."
   B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
   C. Install frames level, plumb, true, and straight.
      1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
      2. Anchor frames to anchors or blocking built in or directly attached to substrates.
         a. Secure with countersunk, concealed fasteners and blind nailing.
         b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
            1) For factory-finished items, use filler matching finish of items being installed.
D. Job-Fitted Doors:
   1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
      a. Do not trim stiles and rails in excess of limits set by manufacturer.
   3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
   4. Clearances:
      a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
      b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
      c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
   5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.03 ADJUSTING
   A. Operation: Rehang or replace doors that do not swing or operate freely.
   B. Adjust all closers to comply with ADA requirements.
   C. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION
SECTION 08 3100
ACCESS DOORS AND PANELS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section includes:
   1. Access doors and frames for walls and ceilings.
   2. Floor access doors.

1.03 SUBMITTALS
A. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.
C. Product Schedule: For access doors and frames. Use same designations indicated on Drawings.
D. Qualification Data: For testing and inspecting agency.

1.04 CLOSEOUT SUBMITTALS
A. Record Documents: List of applicable room name and number in which access door is located.

PART 2 - PRODUCTS

2.01 ACCESS DOORS AND FRAMES
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Acudor Products, Inc.
   2. Babcock-Davis.
   5. Larsen's Manufacturing Company.
   6. Milcor Inc.
   7. Nystrom, Inc.

2.02 ACCESS DOOR AND PANEL APPLICATIONS
A. Walls, Unless Otherwise Indicated:
   1. Material: Steel.
   2. Size: 12 by 12 inch, unless otherwise indicated.
   4. Tool-operated spring or cam lock; no handle.
   5. In All Wall Types: Surface mounted face frame and door surface flush with frame surface.
   6. Color: Paint to match adjacent wall color in exposed locations.
B. Walls in Wet Areas:
   1. Performance Requirements:
      a. Air Infiltration: Less than 0.01 cfm/sq foot in accordance with ASTM E 283.
      b. Water Penetration: No leakage at 15.05 psf in accordance with ASTM E 331.
   3. Size: 12 by 12 inch, unless otherwise indicated to suit conditions of installation.
   4. Door: Continuous exposed stainless steel hinged door.
   6. In All Wall Types: Flush access doors and frames, with extruded door gasket. Gasket to be continuous bulb trim seal.
   7. Color: Paint to match adjacent wall color in exposed locations.
C. Ceilings, Unless Otherwise Indicated: Same type as for walls.
   1. Material: Steel.
2. Size in Other Ceilings: 12 by 12 inch, unless otherwise indicated to suit conditions of installation.
4. Tool-operated spring or cam lock; no handle.
5. Color: Paint to match adjacent wall color in exposed locations

2.03 WALL AND CEILING UNITS
A. Access Doors: Factory fabricated door and frame units, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies that units are to be installed in.
   1. Door Style: Single thickness with rolled or turned in edges.
   2. Double-Skinned Hollow Steel Door Panels: 16 gage, 0.059 inch, minimum, on both sides and each edge.
   4. Primed and Factory Finish: Polyester powder coat; color as selected by Architect.
   5. Hardware:
      a. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.

2.04 FLOOR ACCESS DOORS
A. Basis-of-Design Product: Bilco, TER Floor Access.
B. Performance characteristics:
   1. Cover: Reinforced to support a minimum live load of 150 psf with a maximum deflection of 1/150th of the span.
   2. Operation: Smooth and easy with controlled operation throughout the entire arc of opening and closing.
   3. Operation of the cover not to be affected by temperature.
C. Cover: 1 inch fillable pan to receive concrete or a combination of concrete and flooring material as selected by Architect. All fill material to be furnished and installed by others in the field.
D. Frame: Extruded aluminum with full anchor flange around the perimeter.
E. Lifting Mechanisms: Include required number and size of compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. The upper tube prevents accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube interlocks with a flanged support shoe fastened to a formed 1/4 inch gusset support plate.
F. Handle: Removable exterior turn/lift handle with a spring loaded ball detent, provided to open the and the latch release protected by a flush, gasketed, removable screw plug.
G. Hardware:
   1. Hinges: Continuous heavy duty Type 316 stainless steel hinge.
   2. Cover:
      a. Equipped with an aluminum hold open arm that automatically locks the cover in the open position.
      b. Fitted with the required number and size of compression spring operators.
   3. Type 316 stainless steel snap lock with fixed handle mounted on the underside of the cover.
   4. Hardware: Compression spring tubes shall be an anti-corrosive composite, all fasteners shall be Type 316 stainless steel material, and all other hardware, zinc plated and chromate sealed.
H. Finishes: Factory mill aluminum finish with bituminous coating applied to the exterior of the frame.

2.05 FABRICATION
A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
   1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
   1. For recessed doors with plaster infill, provide self-furring expanded-metal lath attached to door panel.

E. Latch and Lock Hardware:
   1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.

PART 3 - EXECUTION

3.01 EXAMINATION
   A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.
   C. Provide where shown, specified, or required, for non-mechanical equipment access. See DIVISIONS 22, 23 and 26 for access doors provided in those divisions for access to mechanical and electrical equipment.

3.02 INSTALLATION
   A. Install units in accordance with manufacturer’s instructions.
   B. Install frames plumb and level in openings. Secure rigidly in place.

3.03 ADJUSTING
   A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION
SECTION 08 4313
ALUMINUM-FRAMED STOREFRONTS AND WINDOWS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Aluminum-framed storefront.
B. Aluminum-framed windows.
C. Infill panels of glass.
D. Aluminum doors and frames.
E. Weatherstripping.
F. Perimeter sealant.

1.02 RELATED REQUIREMENTS
A. Section 07 9005 - Joint Sealers: Perimeter sealant and back-up materials.
B. Section 08 8000 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS
A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2012.

1.04 PERFORMANCE REQUIREMENTS
A. Design and size components to withstand the following load requirements without damage or permanent set, when tested in accordance with ASTM E 330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   1. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
B. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
C. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at a reference differential pressure across assembly of 1.57 psf as measured in accordance with ASTM E 283.
D. Water Leakage: None, when measured in accordance with ASTM E 331 with a test pressure difference of 12.0 lbf/sq ft.
E. 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.
F. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
1.05 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Submit Storefront and Curtainwall in a single submittal.
   C. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details.
   D. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
   E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
   F. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
   G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE
   A. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum five 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 strippable coating. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 PROJECT CONDITIONS
   A. Coordinate the work with installation of other components or materials.

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

1.10 WARRANTY
   A. See Section 01 7700 - Closeout Procedures, 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 excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Basis of Design: See below under description of products.
   C. Interior Storefront System to be 450 for ¼” infill.
   D. Doors to be 500 Wide stile.
   E. Aluminum-Framed Storefront and Doors:
      5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COMPONENTS
   A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior (exterior wall applications only), drainage holes and internal weep drainage system.
      1. Framing members for interior applications need not be thermally broken.
      3. Cross-Section: 2 x 4 1/2 inch nominal dimension at exterior units; 1 3/4 x 4 1/2 inch at interior units.
4. Include sill receptor at all frames.

B. Swing Doors: Glazed aluminum.
   2. Top Rail: 5 inches wide.
   5. Glazing Stops: Square.

2.03 MATERIALS
   C. Fasteners: Stainless steel.
   D. Perimeter Sealant: As specified in Section 07 9005.
   E. Glass: As specified in Section 08 8000.
   F. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
   G. Glazing Accessories: As specified in Section 08 8000.

2.04 FINISHES
   A. Anodized Exterior Finish:

2.05 HARDWARE
   A. For each door, include weatherstripping, sill sweep strip, and threshold.
   B. Other Door Hardware: As specified in Section 08 7100.
   C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
   D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
   E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

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

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify dimensions, tolerances, and method of attachment with other work.
   B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.
3.02 INSTALLATION
A. Install wall system in accordance with manufacturer's instructions.
B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
C. Provide alignment attachments and shims to permanently fasten system to building structure.
D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
E. Set thresholds in bed of sealant and secure.
F. Install hardware using templates provided.
   1. See Section 08 7100 for hardware installation requirements.
G. Install glass and infill panels in accordance with Section 08 8000, using glazing method required to achieve performance criteria.
H. Install perimeter sealant in accordance with Section 07 9005.
I. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.
J. Provide batt insulation stuffed full, within all accessible voids of aluminum framing prior or as part of installation.

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

3.04 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. Take care to remove dirt from corners. Wipe surfaces clean.
C. Remove excess sealant by method acceptable to sealant manufacturer.

3.06 PROTECTION
A. Protect installed products from damage during subsequent construction.
B. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.
C. Protect finished work from damage.

END OF SECTION
SECTION 08 7100
DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes commercial door hardware for the following:
   1. Swinging doors.
   2. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:
   1. Mechanical door hardware.
   2. Electromechanical door hardware.

C. Related Sections:
   1. Division 08 Section "Hollow Metal Doors and Frames".
   2. Division 08 Section "Flush Wood Doors".
   3. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
   4. Division 08 Section "Access Control Hardware".

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
   6. NFPA 105 - Installation of Smoke Door Assemblies.
   7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:
   1. ANSI/BHMA Certified Product Standards - A156 Series
   2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS
A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
   1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
   2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
   3. Content: Include the following information:
      a. Type, style, function, size, label, hand, and finish of each door hardware item.
      b. Manufacturer of each item.
      c. Fastenings and other pertinent information.
      d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
      e. Explanation of abbreviations, symbols, and codes contained in schedule.
      f. Mounting locations for door hardware.
      g. Door and frame sizes and materials.
      h. Warranty information for each product.
   4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:
1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
   a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
   b. Complete (risers, point-to-point) access control system block wiring diagrams.
   c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturer with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical building hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

D. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

F. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

G. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.

2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.

3. Review sequence of operation narratives for each unique access controlled opening.

4. Review and finalize construction schedule and verify availability of materials.

5. Review the required inspecting, testing, commissioning, and demonstration procedures

H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.
1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the “Keying Conference”.

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Seven years for heavy duty cylindrical (bored) locks and latches.
2. Twenty five years for manual surface door closer bodies.
3. Three years for exit devices.
4. Two years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
1. Quantity: Provide the following hinge quantity:
   a. Two Hinges: For doors with heights up to 60 inches.
   b. Three Hinges: For doors with heights 61 to 90 inches.
   c. Four Hinges: For doors with heights 91 to 120 inches.
   d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
   a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
   b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
   a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
   b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:
   a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:
   a. Hager Companies (HA) - CB Series.
   b. Ives (IV).
   c. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - TA Series.

B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:
   a. Ives (IV).
   b. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.3 POWER TRANSFER DEVICES

A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:
   a. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE) – EL-CEPT Series.
   b. Securitron (SU) - EL-CEPT Series.
   c. Von Duprin (VD) - EPT-10 Series.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Manufacturers:
   a. Ives (IV).
   b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
   c. Trimco (TC).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
1. Manufacturers:
   a. Schlage (SC).
   b. No Substitution.

C. Cylinders: Original manufacturer cylinders complying with the following:
   1. Mortise Type: Threaded cylinders with rings and carns to suit hardware application.
   2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
   3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
   4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.

D. Permanent Cores: Manufacturer’s standard; finish face to match lockset; complying with the following:
   1. Removable Cores: Core insert, removable by use of a special key, and for use with only the core manufacturer’s cylinder and door hardware. Provide removable core (small or large format) as specified in Hardware Sets.

E. Security Cylinders: ANSI/BHMA A156.5, Grade 1, patterned security cylinders and keys able to be used together under the same facility master or grandmaster key system. Cylinders are to be factory keyed.
   1. Manufacturers:
      a. Schlage Lock (SC) - Primus Everest.
      b. No Substitution.

F. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified patented cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer’s United States patents. Cylinders are to be factory keyed with owner having the ability for on-site original key cutting.
   1. Manufacturers:
      a. Schlage Lock (SC) - Everest D Series.
      b. No Substitution.

G. Keying System: Each type of lock and cylinders to be factory keyed.
   1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
   2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
   3. Existing System: Key locks to Owner's existing system.

H. Key Quantity: Provide the following minimum number of keys:
   1. Change Keys per Cylinder: Three (3).
   2. Master Keys (per Master Key Level/Group): Five (5).
   4. Construction Control Keys (where required): Two (2).
   5. Permanent Control Keys (where required): Two (2).

I. Construction Keying: Provide temporary keyed construction cores.

J. Key Registration List (Bitting List):
   1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
   2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified.
   1. Furnish with solid cast levers, standard 2 3/4” backset, and 1/2” (3/4” at rated paired openings) throw brass or stainless steel latchbolt.
   2. Locks are to be non-handed and fully field reversible.
   3. Manufacturers:
      a. Schlage (SC) – ND Series.

2.7 LOCK AND LATCH STRIKES

A. Stripes: Provide manufacturer’s standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
   2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.8 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs thru-bolts.
   a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
   b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
6. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
9. Rail Sizing: Provide exit device rails factory sized for proper door width application.
10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
1. Manufacturers:
   a. Von Duprin (VD) - 35A/98 XP Series.

2.9 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
   1. Manufacturers:
      a. LCN Closers (LC) - 4040 Series.

2.10 PNEUMATIC DOOR OPERATORS
A. General: Provide low energy operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.
   1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.

B. Standard: Certified ANSI/BHMA A156.19.
C. Performance Requirements:
   1. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
   2. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.

D. Configuration: Surface mounted or in-ground as required. Door operators to control single swinging and pair of swinging doors.

E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.

F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.

G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.

H. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.

I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. LCN Closers (LC) - 4840 Series.

2.11 ARCHITECTURAL CLOSERS
A. Door Protective Trim
   1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
   2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2” less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1” less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
   3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
   4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
      a. Stainless Steel: 300 grade, 050-inch thick.
   5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
   6. Manufacturers:
      a. Ives (IV).
      b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
      c. Trimco (TC).

2.12 DOOR STOPS AND HOLDERS
A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:
   a. Ives (IV).
   b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
   c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handled design with mounting brackets as required for proper operation and function.

1. Manufacturers:
   a. Rixson Door Controls (RF).
   b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
   c. Sargent Manufacturing (SA).

2.13 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.


D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:
   1. National Guard Products (NG).
   2. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.14 ELECTRONIC ACCESSORIES

A. Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Manufacturers:
   a. Security Door Controls (SD) - 630 Series.
   b. Von Duprin (VD) - PS.

2.15 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.16 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer’s standards, but in no case less than specified by referenced standards for the applicable units of hardware.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION
A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

3.3 INSTALLATION
A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
   1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
   2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
   3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
   4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL
A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING
A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION
A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
B. Clean adjacent surfaces soiled by door hardware installation.
C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION
A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS
A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
B. The supplier is responsible for handing and sizing all products and providing the correct option for the appropriate door type and material where more than one is presented in the hardware sets. Quantities listed are for each pair of doors, or for each single door.

C. Manufacturer’s Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. RO - Rockwood
4. VD - Von Duprin
5. SC - Schlage
6. RF - Rixson
7. LC - LCN Closers
8. OT - OTHER
9. SU - Securitron
10. AL - Alarm Lock
11. AR - Adams Rite
12. RU - Corbin Russwin

### Hardware Sets

- Verify all existing frame conditions to receive new doors and hardware.
- Provide frame filler when new door receives exit hardware and existing frame prep is a 4-7/8 strike.
- Verify and match existing hinge size and prep.

**Set: 1.0**

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Model/Make/Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Continuous Hinge w/cutout</td>
<td>CFM__HD1 PT</td>
</tr>
<tr>
<td>1 Removable Keyed Mullion</td>
<td>KR4954</td>
</tr>
<tr>
<td>1 Mullion Stabilizer</td>
<td>154</td>
</tr>
<tr>
<td>1 Mullion Wall Mounting Kit</td>
<td>MT54</td>
</tr>
<tr>
<td>1 Rim Exit Dev (DT, LX, RX)</td>
<td>LX-RX-LC 98DT 990DT SNB</td>
</tr>
<tr>
<td>1 Rim Exit Dev (ELR, LX, RX)</td>
<td>LX-RX-LC QEL 98NL 990NL SNB</td>
</tr>
<tr>
<td>1 Rim Cylinder</td>
<td>20-057 ICX</td>
</tr>
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<td>1 Mortise Cylinder</td>
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<td>2 Primus Permanent Core</td>
<td>20-740 - verify &amp; match existing</td>
</tr>
<tr>
<td>1 Door Closer (STOP)</td>
<td>4040XP SCUSH</td>
</tr>
<tr>
<td>1 Door Closer Shoe</td>
<td>4040XP-30 as required</td>
</tr>
<tr>
<td>1 Door Closer Spacer</td>
<td>4040XP-61 as required</td>
</tr>
<tr>
<td>1 Closer Drop Plate</td>
<td>4040XP-18PA as required</td>
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<tr>
<td>1 Door Operator</td>
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<td>1 Shoe</td>
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<td>1 Spacer</td>
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<td>1 Weatherseal</td>
<td>Door manufacturer</td>
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<tr>
<td>2 Electric Power Transfer</td>
<td>EL-CEPT</td>
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<tr>
<td>1 Power Supply</td>
<td>PS900 as required</td>
</tr>
<tr>
<td>2 Door Position Switch</td>
<td>DPS</td>
</tr>
<tr>
<td>1 Card Reader</td>
<td>By security contractor</td>
</tr>
<tr>
<td>1 Wiring Diagram</td>
<td>As required</td>
</tr>
<tr>
<td>1 Tubing</td>
<td>925 (100 ft)</td>
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<tr>
<td>1 Control Box</td>
<td>7982SES</td>
</tr>
<tr>
<td>1 Weather Ring</td>
<td>8310-801</td>
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<tr>
<td>2 Actuator</td>
<td>8310-853T</td>
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<tr>
<td>2 Mounting Box</td>
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Notes: Outside low energy operator actuator enabled when lock is unlocked, disabled when locked. Inside actuator always enabled. Valid credential at reader retracts (unlocks) active leaf exit device latch for entry. Free egress at all times.

**Set: 2.0**

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<td>Model</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Mullion Stabilizer</td>
<td>154</td>
</tr>
<tr>
<td>Mullion Wall Mounting Kit</td>
<td>MT54</td>
</tr>
<tr>
<td>Rim Exit Dev (DT, LX, RX)</td>
<td>LX-RX-LC 98DT 990DT SNB</td>
</tr>
<tr>
<td>Rim Exit Dev (ELR, LX, RX)</td>
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</tr>
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<td>Rim Cylinder</td>
<td>20-057 ICX</td>
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<tr>
<td>Mortise Cylinder</td>
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<tr>
<td>Primus Permanent Core</td>
<td>20-740 - verify &amp; match existing</td>
</tr>
<tr>
<td>Door Closer (STOP)</td>
<td>4040XP SCUSH</td>
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<tr>
<td>Door Closer Shoe</td>
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<tr>
<td>Door Closer Spacer</td>
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<tr>
<td>Closer Drop Plate</td>
<td>4040XP-18PA as required</td>
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<tr>
<td>Door Operator</td>
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<td>Shoe</td>
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<td>Card Reader</td>
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<td>Wiring Diagram</td>
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<td>Control Box</td>
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<td>Actuator</td>
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<tr>
<td>Mounting Box</td>
<td>8310-867F</td>
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</table>

Notes: Outside low energy operator actuator enabled when lock is unlocked, disabled when locked. Inside actuator always enabled. Valid credential at reader retracts (unlocks) active leaf exit device latch for entry. Free egress at all times.

### Set 3.0
Doors: 120G

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<td>US32D</td>
<td>VD</td>
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<tr>
<td>Rim Cylinder</td>
<td>20-057 ICX</td>
<td>626</td>
<td>SC</td>
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<td>Primus Permanent Core</td>
<td>20-740 - verify &amp; match existing</td>
<td>626</td>
<td>SC</td>
</tr>
<tr>
<td>Door Closer (HO, STOP)</td>
<td>4040XP SHCUSH</td>
<td>AL</td>
<td>LC</td>
</tr>
<tr>
<td>Kick Plate</td>
<td>K1050 10&quot; CSK BEV</td>
<td>US32D</td>
<td>RO</td>
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<td>Threshold</td>
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<td>PS900 as required</td>
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<td>Door Position Switch</td>
<td>DPS</td>
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<tr>
<td>Card Reader</td>
<td>By security contractor</td>
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</tr>
<tr>
<td>Wiring Diagram</td>
<td>As required</td>
<td>VD</td>
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Notes: Valid credential at reader retracts (unlocks) active leaf exit device latch for entry. Free egress at all times.

### Set 4.0
Doors: V102

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<th>Notes</th>
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<tr>
<td>Continuous Hinge w/cutout</td>
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<td>PE</td>
<td></td>
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<tr>
<td>Removable Keyed Mullion</td>
<td>KR4954</td>
<td>SP28</td>
<td>VD</td>
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<td>Mullion Stabilizer</td>
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<td>SP28</td>
<td>VD</td>
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<td>VD</td>
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<tr>
<td>Rim Exit Dev (DT, LX, RX)</td>
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<td>SC</td>
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<td>Door Closer (STOP)</td>
<td>4040XP SCUSH</td>
<td>AL</td>
<td>LC</td>
</tr>
<tr>
<td>Door Closer Shoe</td>
<td>4040XP-30 as required</td>
<td>AL</td>
<td>LC</td>
</tr>
<tr>
<td>Door Closer Spacer</td>
<td>4040XP-61 as required</td>
<td>AL</td>
<td>LC</td>
</tr>
</tbody>
</table>

DOOR HARDWARE 2047 - MM 08 7100 - 11
2 Closer Drop Plate 4040XP-18PA as required AL LC
1 Threshold 252x3AFG PE
2 Sweep 345CNB PE
1 Mullion Seal 5110BL PE
1 Weatherseal Door manufacturer OT
2 Electric Power Transfer EL-CEPT SU
1 Power Supply PS900 as required VD
2 Door Position Switch DPS SU
1 Card Reader By security contractor OT

Notes: Valid credential at reader retracts (unlocks) active leaf exit device latch for entry. Free egress at all times.

**Set: 5.0**
Doors: 120F

3 Hinge (heavy weight) T4A3386 NRP US32D MK
1 Rim Exit Dev (EO) LD 98EO SNB US32D VD
1 Door Closer (STOP) 4040XP SCUSH AL LC
1 Kick Plate K1050 10” CSK BEV US32D RO
1 Threshold 273x3AFG PE
1 Sweep 216SNFG PE
1 Weatherseal (head) 2893AV PE
2 Weatherseal (jambs) 2903AV PE
1 Door Position Switch DPS SU

**Set: 6.0**
Doors: V100, V102A, V104

2 Continuous Hinge CFM__HD1 PE
1 Removable Keyed Mullion KR4954 SP28 VD
1 Mullion Stabilizer 154 SP28 VD
1 Mullion Wall Mounting Kit MT54 SP28 VD
2 Dummy Push Bar 350 US32D VD
2 Dummy Pull Trim 990DT US26D VD
1 Mortise Cylinder 20-061 ICX 626 SC
1 Primus Permanent Core 20-740 - verify & match existing 626 SC
2 Door Closer (STOP) 4040XP SCUSH AL LC
2 Door Closer Shoe 4040XP-30 as required AL LC
2 Door Closer Spacer 4040XP-61 as required AL LC
2 Closer Drop Plate 4040XP-18PA as required AL LC
2 Wall Stop 403 US26D RO
1 Mullion Seal 5110BL PE
1 Weatherseal Door manufacturer OT

**Set: 7.0**
Doors: V101B

1 Continuous Hinge CFM__HD1 PE
1 Electric Strike 7401 626 AR
1 Buzzer 2006M HS
1 Push Button Release TS-20 AL
1 Storeroom Lock ND80 T RHO 626 SC
1 Primus Permanent Core 20-740 - verify & match existing 626 SC
1 Concealed Overhead Stop 1-X36 630 RF
1 Door Closer 4040XP REG AL LC
1 Weatherseal Door manufacturer OT
1 Door Sweep 315CN PE
1 Power Supply PS900 as required VD
1 Card Reader By security contractor OT

Notes: Valid credential at reader or remote unlocking from push button in Main Office momentarily releases electric strike for entry. Free egress at all times.
### Set: 8.0
Doors: 101

<table>
<thead>
<tr>
<th>Set</th>
<th>Doors</th>
<th>Description</th>
<th>Model/Part</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>Hinge (heavy weight)</td>
<td>T4A3786 (NRP as required)</td>
<td>US26D MK</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Electric Strike</td>
<td>7401</td>
<td>626 HS</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Buzzer</td>
<td>2006M</td>
<td>HS</td>
</tr>
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<td>1</td>
<td>1</td>
<td>Push Button Release</td>
<td>TS-20</td>
<td>AL</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Security Vestibule Lock</td>
<td>ML2087 NSA LC</td>
<td>626 RU</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Mortise Cylinder</td>
<td>20-061 ICX</td>
<td>626 SC</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Primus Permanent Core</td>
<td>20-740 - verify &amp; match existing</td>
<td>626 SC</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Door Closer</td>
<td>4040XP REG</td>
<td>AL LC</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Kick Plate</td>
<td>K1050 10&quot; CSK BEV</td>
<td>US32D RO</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Wall Stop</td>
<td>403</td>
<td>US26D RO</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Gasketing</td>
<td>S44D</td>
<td>PE</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Power Supply</td>
<td>PS900 as required</td>
<td>VD</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Card Reader</td>
<td>By security contractor</td>
<td>OT</td>
</tr>
</tbody>
</table>

Notes: Valid credential at reader or remote unlocking from push button in Main Office momentarily releases electric strike for entry from Main Office side. Mechanical lock is a classroom function on Corridor C100 side and is locked/unlocked with an authorized key.

### Set: 9.0
Doors: 120A, 120B, 120C, 209B

<table>
<thead>
<tr>
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<th>Doors</th>
<th>Description</th>
<th>Model/Part</th>
<th>Function</th>
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<tbody>
<tr>
<td>6</td>
<td>1</td>
<td>Hinge (heavy weight)</td>
<td>T4A3786 (NRP as required)</td>
<td>US26D MK</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Manual Flush Bolt</td>
<td>555</td>
<td>US26D RO</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Dust Proof Strike</td>
<td>570</td>
<td>US26D RO</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Storeroom Lock 3/4&quot; latch</td>
<td>ND80 T RHO 14-042</td>
<td>626 SC</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>Standard Permanent Core</td>
<td>23-030 - verify &amp; match existing</td>
<td>626 SC</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Door Closer (HO)</td>
<td>4040XP SHCUSH</td>
<td>AL LC</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Armor Plate</td>
<td>K1050 34&quot; CSK BEV omit @ 209B</td>
<td>US32D RO</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Kick Plate</td>
<td>K1050 10&quot; CSK BEV @ 209B</td>
<td>US32D RO</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Silencer</td>
<td>608-RKW</td>
<td>RO</td>
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### Set: 10.0
Doors: 124B, 124C, 211

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<th>Model/Part</th>
<th>Function</th>
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<tr>
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<td>Hinge (heavy weight)</td>
<td>T4A3786</td>
<td>US26D MK</td>
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<tr>
<td>1</td>
<td>1</td>
<td>Indicator Privacy Lock</td>
<td>L9040 06A L283-722 (OCC/VAC)</td>
<td>626 SC</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Door Closer</td>
<td>4040XP EDA</td>
<td>AL LC</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Kick Plate</td>
<td>K1050 10&quot; CSK BEV</td>
<td>US32D RO</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Wall Stop</td>
<td>403</td>
<td>US26D RO</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Silencer</td>
<td>608-RKW</td>
<td>RO</td>
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### Set: 11.0
Doors: 111, 118, 119, 209

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<th>Doors</th>
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<th>Model/Part</th>
<th>Function</th>
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</thead>
<tbody>
<tr>
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<td>1</td>
<td>Hinge (heavy weight)</td>
<td>T4A3786 (NRP as required)</td>
<td>US26D MK</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Indicator Corridor Lock</td>
<td>L9456 06A L283-722 (OCC/VAC)</td>
<td>626 SC</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Standard Permanent Core</td>
<td>23-030 - verify &amp; match existing</td>
<td>626 SC</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Kick Plate</td>
<td>K1050 10&quot; CSK BEV</td>
<td>US32D RO</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Wall Stop</td>
<td>403</td>
<td>US26D RO</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>Silencer</td>
<td>608-RKW</td>
<td>RO</td>
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### Set: 12.0
Doors: 103, 104, 110, 112, 116, 120D, 123, 124, 203, 208, 210

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<th>Description</th>
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<th>Function</th>
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</thead>
<tbody>
<tr>
<td>3</td>
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<td>Hinge (heavy weight)</td>
<td>T4A3786 (NRP as required)</td>
<td>US26D MK</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Storeroom Lock</td>
<td>ND80 T RHO</td>
<td>626 SC</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Standard Permanent Core</td>
<td>23-030 - verify &amp; match existing</td>
<td>626 SC</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Door Closer (HO)</td>
<td>4040XP HEDA</td>
<td>AL LC</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Kick Plate</td>
<td>K1050 10&quot; CSK BEV</td>
<td>US32D RO</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Wall Stop</td>
<td>403</td>
<td>US26D RO</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Gasketing</td>
<td>S44D</td>
<td>PE</td>
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</table>
**Set: 13.0**
Doors: 101A, 116B

<table>
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<tr>
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<th>Model</th>
<th>Finish</th>
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<tbody>
<tr>
<td>3 Hinge (heavy weight)</td>
<td>T4A3786 (NRP as required)</td>
<td>US26D MK</td>
</tr>
<tr>
<td>1 Storeroom Lock</td>
<td>ND80 T RH0</td>
<td>626 SC</td>
</tr>
<tr>
<td>1 Standard Permanent Core</td>
<td>23-030 - verify &amp; match existing</td>
<td>626 SC</td>
</tr>
<tr>
<td>1 Kick Plate</td>
<td>K1050 10” CSK BEV</td>
<td>US32D RO</td>
</tr>
<tr>
<td>1 Wall Stop</td>
<td>403</td>
<td>US26D RO</td>
</tr>
<tr>
<td>1 Gasketing</td>
<td>S44D</td>
<td>PE</td>
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</table>

**Set: 14.0**
Doors: 101B, 105A, 117, 121, 121A, 124A, 203A

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
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<tbody>
<tr>
<td>3 Hinge (heavy weight)</td>
<td>T4A3786 (NRP as required)</td>
<td>US26D MK</td>
</tr>
<tr>
<td>1 Storeroom Lock</td>
<td>ND80 T RH0</td>
<td>626 SC</td>
</tr>
<tr>
<td>1 Standard Permanent Core</td>
<td>23-030 - verify &amp; match existing</td>
<td>626 SC</td>
</tr>
<tr>
<td>1 Door Closer</td>
<td>4040XP REG/EDA</td>
<td>AL LC</td>
</tr>
<tr>
<td>1 Kick Plate</td>
<td>K1050 10” CSK BEV</td>
<td>US32D RO</td>
</tr>
<tr>
<td>1 Wall Stop</td>
<td>403</td>
<td>US26D RO</td>
</tr>
<tr>
<td>1 Gasketing</td>
<td>S44D</td>
<td>PE</td>
</tr>
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</table>

**Set: 15.0**
Doors: V103A

<table>
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<tr>
<th>Item</th>
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<th>Finish</th>
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<tbody>
<tr>
<td>6 Hinge (heavy weight)</td>
<td>T4A3786 (NRP as required)</td>
<td>US26D MK</td>
</tr>
<tr>
<td>2 Manual Flush Bolt</td>
<td>555</td>
<td>US26D RO</td>
</tr>
<tr>
<td>1 Dust Proof Strike</td>
<td>570</td>
<td>US26D RO</td>
</tr>
<tr>
<td>1 Classroom Lock 3/4” latch</td>
<td>ND70 T RH0 14-042</td>
<td>626 SC</td>
</tr>
<tr>
<td>1 Standard Permanent Core</td>
<td>23-030 - verify &amp; match existing</td>
<td>626 SC</td>
</tr>
<tr>
<td>2 Door Closer (HO)</td>
<td>4040XP H/EDA</td>
<td>AL LC</td>
</tr>
<tr>
<td>2 Kick Plate</td>
<td>K1050 10” CSK BEV</td>
<td>US32D RO</td>
</tr>
<tr>
<td>2 Wall Stop</td>
<td>403</td>
<td>US26D RO</td>
</tr>
<tr>
<td>2 Silencer</td>
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**Set: 16.0**
Doors: V103B

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<thead>
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<th>Item</th>
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<tbody>
<tr>
<td>1 Continuous Hinge</td>
<td>CFM __ HD1</td>
<td>PE</td>
</tr>
<tr>
<td>1 Dummy Push Bar</td>
<td>350</td>
<td>US32D VD</td>
</tr>
<tr>
<td>1 Dummy Pull Trim</td>
<td>990DT</td>
<td>US26D VD</td>
</tr>
<tr>
<td>1 Door Operator</td>
<td>4841 SCUSH</td>
<td>AL LC</td>
</tr>
<tr>
<td>1 Shoe</td>
<td>4840-30</td>
<td>AL LC</td>
</tr>
<tr>
<td>1 Spacer</td>
<td>4840-61</td>
<td>AL LC</td>
</tr>
<tr>
<td>1 Wall Stop</td>
<td>415</td>
<td>US26D RO</td>
</tr>
<tr>
<td>1 Weatherseal</td>
<td>Door manufacturer</td>
<td>OT</td>
</tr>
<tr>
<td>1 Tubing</td>
<td>925 (100 ft)</td>
<td>LC</td>
</tr>
<tr>
<td>1 Control Box</td>
<td>7982SES</td>
<td>LC</td>
</tr>
<tr>
<td>2 Actuator</td>
<td>8310-853T</td>
<td>LC</td>
</tr>
<tr>
<td>2 Mounting Box</td>
<td>8310-867F</td>
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**Set: 17.0**
Doors: 110A, 116A, 208A

<table>
<thead>
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<th>Item</th>
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<tbody>
<tr>
<td>3 Hinge (heavy weight)</td>
<td>T4A3786</td>
<td>US26D MK</td>
</tr>
<tr>
<td>1 Passage Latch</td>
<td>ND10S RH0</td>
<td>626 SC</td>
</tr>
<tr>
<td>1 Kick Plate</td>
<td>K1050 10” CSK BEV</td>
<td>US32D RO</td>
</tr>
<tr>
<td>1 Wall Stop</td>
<td>403</td>
<td>US26D RO</td>
</tr>
<tr>
<td>3 Silencer</td>
<td>608-RKW</td>
<td>RO</td>
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**Set: 18.0**
Doors: 100, 102

<table>
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<th>Item</th>
<th>Model</th>
<th>Finish</th>
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<tbody>
<tr>
<td>3 Hinge (heavy weight)</td>
<td>T4A3786 (NRP as required)</td>
<td>US26D MK</td>
</tr>
<tr>
<td>1 Entrance/Office Lock</td>
<td>ND50/53 T RH0</td>
<td>626 SC</td>
</tr>
<tr>
<td>1 Standard Permanent Core</td>
<td>23-030 - verify &amp; match existing</td>
<td>626 SC</td>
</tr>
<tr>
<td>1 Kick Plate</td>
<td>K1050 10” CSK BEV</td>
<td>US32D RO</td>
</tr>
<tr>
<td>1 Wall Stop</td>
<td>403</td>
<td>US26D RO</td>
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DOOR HARDWARE 2047 - MM 08 7100 - 14
### Set: 19.0
**Doors:** 114A

<table>
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<th>Item Description</th>
<th>Part Number</th>
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<th>Notes</th>
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<tbody>
<tr>
<td>Hinge (heavy weight)</td>
<td>T4A3786</td>
<td>US26D</td>
<td>MK</td>
</tr>
<tr>
<td>Mullion Stabilizer</td>
<td>154</td>
<td>SP28</td>
<td>VD</td>
</tr>
<tr>
<td>Mullion Wall Mounting Kit</td>
<td>MT54</td>
<td>SP28</td>
<td>VD</td>
</tr>
<tr>
<td>Removable Keyed Mullion</td>
<td>KR9954</td>
<td>SP28</td>
<td>VD</td>
</tr>
<tr>
<td>Fire Rated Rim Exit (EO)</td>
<td>98EO-F SNB</td>
<td>US32D</td>
<td>VD</td>
</tr>
<tr>
<td>Fire Rated Rim Exit (PASSAGE)</td>
<td>98L-BE-F 996L-BE SNB</td>
<td>US32D</td>
<td>VD</td>
</tr>
<tr>
<td>Mortise Cylinder</td>
<td>20-061 ICX</td>
<td>626</td>
<td>SC</td>
</tr>
<tr>
<td>Standard Permanent Core</td>
<td>23-030 - verify &amp; match existing</td>
<td>626</td>
<td>SC</td>
</tr>
<tr>
<td>Door Closer</td>
<td>4040XP EDA</td>
<td>AL</td>
<td>LC</td>
</tr>
<tr>
<td>Wall Stop</td>
<td>403</td>
<td>US26D</td>
<td>RO</td>
</tr>
<tr>
<td>Mullion Seal</td>
<td>5110BL</td>
<td>PE</td>
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<td>Gasketing</td>
<td>S44D</td>
<td>PE</td>
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<tr>
<td>Meeting Stile Seal (edge)</td>
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### Set: 20.0
**Doors:** 105

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<tr>
<td>Hinge (heavy weight)</td>
<td>T4A3786 NRP</td>
<td>US26D</td>
<td>MK</td>
</tr>
<tr>
<td>Rim Exit Device (NL)</td>
<td>LD 98L-NL 996L-NL SNB</td>
<td>US32D</td>
<td>VD</td>
</tr>
<tr>
<td>Rim Cylinder</td>
<td>20-057 ICX</td>
<td>626</td>
<td>SC</td>
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<tr>
<td>Standard Permanent Core</td>
<td>23-030 - verify &amp; match existing</td>
<td>626</td>
<td>SC</td>
</tr>
<tr>
<td>Door Closer</td>
<td>4040XP EDA</td>
<td>AL</td>
<td>LC</td>
</tr>
<tr>
<td>Kick Plate</td>
<td>K1050 10&quot; CSK BEV</td>
<td>US32D</td>
<td>RO</td>
</tr>
<tr>
<td>Wall Stop</td>
<td>403</td>
<td>US26D</td>
<td>RO</td>
</tr>
<tr>
<td>Gasketing</td>
<td>S44D</td>
<td>PE</td>
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<tbody>
<tr>
<td>Hinge (heavy weight)</td>
<td>T4A3786 NRP</td>
<td>US26D</td>
<td>MK</td>
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### Set: 22.0
**Doors:** 114B

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### Set: 23.0
**Doors:** 106, 107, 204, 205

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<td>1 Tubing</td>
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<td>2 Actuator</td>
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<tr>
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<tr>
<td>1 Meeting Stile Seal (edge)</td>
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**Notes:** Doors are normally held open on wall magnets.

**Set: 25.0**

Doors: 120E

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<td>2 Door Sweep</td>
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<td>1 Mullion Seal</td>
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<td>1 Meeting Stile Seal (edge)</td>
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</table>

**END OF SECTION**
SECTION 08 8000
GLAZING

PART 1  GENERAL

1.01  SECTION INCLUDES
A. Glass.
B. Decorative glass film at Boiler Room 105 exterior windows.
C. Glazing compounds and accessories.

1.02  RELATED REQUIREMENTS
A. Section 07 9005 - Joint Sealers: Sealant and back-up material.
B. Section 08 1113 - Hollow Metal Doors and Frames: Glazed lites in doors.
C. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.
D. Section 08 4313 - Aluminum-Framed Storefronts.

1.03  REFERENCE STANDARDS
J. GANA (GM) - GANA Glazing Manual; 2009.

1.04  SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
C. Certificates: Certify that products meet or exceed specified requirements.

1.05  QUALITY ASSURANCE
B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

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

1.07  WARRANTY
A. See Section 01 7700 - Closeout Procedures, for additional warranty requirements.
B. Sealed Insulating Glass Units: Provide a five (5) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2  PRODUCTS

2.01  INSULATING GLASS UNITS
A. Sealed, Tempered, Insulating Glass Units: Vision glass, double glazed.
1. Application(s): Aluminum Framed Storefronts and Hollow Metal Doors as indicated on Window and / or Door schedules.

A. 2. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum, ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or as indicated, Quality-Q3.
   a. Tint: Clear.

B. 3. Inboard Lite: Fully tempered float glass, 1/4 inch thick, minimum, ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or as indicated, Quality-Q3.
   a. Tint: Clear.
   b. Coating: Low-E type, on #3 surface.

4. Total Thickness: 1 inch.

5. Glazing Method: Gasket glazing.

2.02 EXTERIOR GLAZING ASSEMBLIES

A. Air and Vapor 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.
   2. To maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.

2.03 GLASS MATERIALS

A. Float Glass Manufacturers:
   7. Substitutions: Refer to Section 01 6000 - Product Requirements.

B. Float Glass: All glazing is to be float glass unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
   3. Tinted Types: Color and performance characteristics as indicated.
   4. Thicknesses: As indicated; for exterior glazing comply with specified requirements for wind load design regardless of specified thickness.

2.04 WINDOW FILM

A. Window Film: Manufacturer, 3M; www.3m.com.
   1. Model and Color: SH2FNCR; Fine Crystal.
      a. Install on interior face of exterior windows in Boiler Room 105.

2.05 SEALED INSULATING GLASS UNITS

A. Manufacturers:
   1. Any of the manufacturers specified for float glass.
   2. Fabricator certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.
   4. Substitutions: Refer to Section 01 6000 - Product Requirements.

B. Sealed Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Edge Spacers: Aluminum, bent and soldered corners.
   3. Edge Seal: Glass to elastomer with supplementary silicone sealant.
4. Edge Seal Color: black.
5. Purge interpane space with dry hermetic air.

2.06 GLAZING COMPOUNDS

A. Manufacturers:
   5. Substitutions: Refer to Section 01 6000 - Product Requirements.

B. Glazing Putty: Polymer modified latex recommended by manufacturer for outdoor use, knife grade consistency; grey color.

C. Butyl Sealant: Single component; ASTM C920, Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.

D. Acrylic Sealant: Single component, solvent curing, non-bleeding; ASTM C920, Type S, Grade NS, Class 12-1/2, Uses M and A; cured Shore A hardness of 15 to 25; color as selected.

E. Polysulfide Sealant: Two component; chemical curing, non-sagging type; ASTM C920, Type M, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

F. Polyurethane Sealant: Single component, chemical curing, non-staining, non-bleeding; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 20 to 35; color as selected.

G. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

2.07 GLAZING ACCESSORIES

A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; hardness range of 5 to 30 cured Shore A durometer; coiled on release paper; black color.
   1. Manufacturers:
      c. Substitutions: Refer to Section 01 6000 - Product Requirements.

D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; black color.

E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings for glazing are correctly sized and within tolerance.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant.

D. Install sealants in accordance with ASTM C1193 and GANA Sealant Manual.

E. Install sealants in accordance with manufacturer's instructions.
3.03 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)
   A. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
   B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
   C. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

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

3.05 INSTALLATION - INTERIOR DRY METHOD (TAPE AND TAPE)
   A. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.
   B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
   C. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
   D. Place glazing tape on free perimeter of glazing in same manner described above.
   E. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
   F. Knife trim protruding tape.

3.06 FIELD QUALITY CONTROL
   A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
   B. Monitor and report installation procedures and unacceptable conditions.

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

3.08 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.

END OF SECTION
SECTION 09 0561
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. This section applies to all floors identified in the contract documents as to receive the following types of floor coverings:
      1. Resilient tile and sheet.
      2. Broadloom carpet.
      3. Carpet tile.
      4. Thin-set ceramic tile and stone tile.
   B. Preparation of new concrete floor slabs for installation of floor coverings.
   C. Testing of concrete floor slabs for moisture and alkalinity (pH).
   D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
      1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated as necessary by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued. Failure of project scheduling to allow for an average expected drying time based on concrete materials, weather conditions and temperatures does not constitute a condition not under Contractor's control.

1.02 RELATED REQUIREMENTS
   A. Section 03 3000 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.

1.03 REFERENCES
   A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.

1.04 ADMINISTRATIVE REQUIREMENTS
   A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.05 SUBMITTALS
   A. Floor Covering and Adhesive Manufacturers’ Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
      1. Moisture and alkalinity (pH) limits and test methods.
      2. Manufacturer's required bond/compatibility test procedure.
   B. Testing Agency's Report:
      1. Description of areas tested; include floor plans and photographs if helpful.
      2. Summary of conditions encountered.
      3. Moisture and alkalinity (pH) test reports.
      5. Recommendations for remediation of unsatisfactory surfaces.
      7. Submit report not more than two business days after conclusion of testing.
   C. Adhesive Bond and Compatibility Test Report.
   D. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
      1. Manufacturer's qualification statement.
      2. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
      3. Manufacturer's installation instructions.
      4. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.
1.06 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.

B. Testing Agency Qualifications: Contractor will employ independent testing agency experienced in the types of testing specified.
   1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

C. Contractor's Responsibility Relating to Independent Agency Testing:
   1. Provide access for and cooperate with testing agency.
   2. Confirm date of start of testing at least 10 days prior to actual start.
   3. Achieve and maintain specified ambient conditions.
   4. Notify Architect when specified ambient conditions have been achieved and when testing will start.

1.07 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
   1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
   2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
   3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Follow recommendations of testing agency.

B. Perform following operations in the order indicated:
   1. Preliminary cleaning.
   2. Moisture vapor emission tests; 3 tests in the first 1,000 square feet and one test in each additional 1,000 square feet, unless otherwise indicated or required by flooring manufacturer.
   3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   5. Specified remediation, if required.
   6. Patching, smoothing, and leveling, as required.
   7. Other preparation specified.
   9. Protection.

C. Remediations:
   1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
   2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating over entire suspect floor area. Should alternate adhesives be recommended due to excessive moisture or humidity and proper cure times have been expended and due to the project schedule, the Architect will review and consider recommendations to the Owner for additional costs.
   3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.
3.02 PRELIMINARY CLEANING
   A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
   B. Do not use solvents or other chemicals for cleaning.

3.03 MOISTURE VAPOR EMISSION TESTING
   A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
   B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
   C. Test in accordance with ASTM F1869 and as follows.
   D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
   E. Report: Report the information required by the test method.

3.04 INTERNAL RELATIVE HUMIDITY TESTING
   A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
   B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
   C. Test in accordance with ASTM F2170 Procedure A and as follows.
   D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
   E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated.
   F. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
   G. Report: Report the information required by the test method.

3.05 ALKALINITY TESTING
   A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
   B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
   C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
   D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
   E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated.
   F. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.06 PREPARATION
   A. See individual floor covering section(s) for additional requirements.
   B. Comply with requirements and recommendations of floor covering manufacturer.
   C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
   D. Do not fill expansion joints, isolation joints, or other moving joints.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING
   A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 APPLICATION OF REMEDIAL FLOOR COATING
   A. Comply with requirements and recommendations of coating manufacturer.

3.09 PROTECTION
   A. Cover prepared floors with building paper or other durable covering.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section Includes:
   1. Non-load-bearing steel framing systems for interior partitions.
   2. Suspension systems for interior ceilings and soffits.
   3. Grid suspension systems for gypsum board ceilings.
B. Refer to Division 01 sustainable & energy efficiency project requirements affecting work of this section.

1.03 SUBMITTALS
A. Product Data: For each type of product.
B. Product Certificates: For each type of code-compliance certification for studs and tracks.
C. Evaluation Reports: For firestop tracks, post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.04 QUALITY ASSURANCE
A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS
A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
C. Horizontal Deflection: For wall assemblies, limited to 1/360 of the wall height based on horizontal loading of 10 lbf/sq. ft.

2.02 FRAMING SYSTEMS
A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
   1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
B. Studs and Tracks: ASTM C 645.
   1. Steel Studs and Tracks:
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
         1) CEMCO; California Expanded Metal Products Co.
         2) Jaimes Industries.
         3) MarinoWARE.
         4) SCAFCO Steel Stud Company.
         5) Steel Construction Systems.
         6) Steel Network, Inc. (The).
         7) Telling Industries.
      b. Minimum Base-Metal Thickness: 0.0329 inch (20 gage).
      c. Depth: As indicated on Drawings.
C. Slip-Type Head Joints: Where indicated, provide the following:
   1. Single Long-Leg Track System: ASTM C 645 top track with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Double-Track System: ASTM C 645 top outer tracks, inside track with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.

3. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) CEMCO; California Expanded Metal Products Co.
      2) ClarkDietrich Building Systems.
      3) MarinoWARE.
      4) Steel Construction Systems.
      5) Telling Industries.

D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Blazeframe Industries.
      b. CEMCO; California Expanded Metal Products Co.
      c. ClarkDietrich Building Systems.
      d. Fire Trak Corp.
      e. MarinoWARE.
      f. Steel Network, Inc. (The).

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
   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:
      b. MarinoWARE.
      c. MRI Steel Framing, LLC.
      d. SCAFCO Steel Stud Company.
      e. Steel Construction Systems.
   2. Minimum Base-Metal Thickness: 0.0179 inch.

F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.
   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:
      b. MarinoWARE.
      c. MRI Steel Framing, LLC.
      d. SCAFCO Steel Stud Company.
      e. Steel Construction Systems.
   2. Depth: As indicated on Drawings.
   3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
c. MRI Steel Framing, LLC.
d. SCAFCO Steel Stud Company.
e. Steel Construction Systems.

2. Configuration: Asymmetrical or hat shaped.

I. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
   1. Depth: As indicated on Drawings.
   2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
   3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.
   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:
      b. MarinoWARE.
      c. MRI Steel Framing, LLC.
      d. SCAFCO Steel Stud Company.
      e. Steel Construction Systems.

2.03 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

B. Hanger Attachments to Concrete:
   1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58 or AC308 as appropriate for the substrate.
      a. Uses: Securing hangers to structure.
      b. Type: Torque-controlled, expansion anchor, torque-controlled, adhesive anchor or adhesive anchor.
      c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.

E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
   1. Depth: As indicated on Drawings.

F. Furring Channels (Furring Members):
   1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
   2. Steel Studs and Tracks: ASTM C 645.
      a. Minimum Base-Metal Thickness: 0.0179 inch.
      b. Depth: As indicated on Drawings.
      a. Minimum Base-Metal Thickness: 0.0179 inch.
   4. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.
      a. Configuration: Asymmetrical or hat shaped.

2.04 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
   1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:
   1. Asphalt-Saturated Organic Felt: ASTM D 228/D 228M, Type I (No. 15 asphalt felt), nonperforated.
   2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.
PART 3 - EXECUTION

3.01 EXAMINATION
A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION
A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
   1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
B. Coordination with Sprayed Fire-Resistive Materials:
   1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
   2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.03 INSTALLATION, GENERAL
A. Installation Standard: ASTM C 754.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
D. Install bracing at terminations in assemblies.
E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.04 INSTALLING FRAMED ASSEMBLIES
A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
   1. Single-Layer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
   2. Multilayer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
   3. Tile Backing Panels: As required by horizontal deflection performance requirements unless otherwise indicated.
B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
C. Install studs so flanges within framing system point in same direction.
D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
   1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
   2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
      a. Install two studs at each jamb unless otherwise indicated.
      b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
      c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
   a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring:
   1. Screw to wood framing.
   2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Z-Shaped Furring Members:
   1. Erect insulation, specified in Section 07 2100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
   2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
   3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.05 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
   1. Hangers: 48 inches o.c.
   2. Carrying Channels (Main Runners): 48 inches o.c.
   3. Furring Channels (Furring Members): 16 inches o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
      a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
      a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
   3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   5. Do not attach hangers to steel roof deck.
   6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
   7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
   8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.
B. Metal stud wall framing.
C. Metal channel ceiling framing.
D. Acoustic insulation.
E. Cementitious backing board.
F. Bullet/blast-resistant fiberglass panels.
G. Gypsum wallboard.
H. Joint treatment and accessories.
I. Textured finish system.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing
B. Section 06 1000 - Rough Carpentry: Blocking and Gypsum Sheathing.
C. Section 07 2100 - Thermal Insulation: Thermal insulation at perimeter walls
D. Section 07 8400 - Firestopping: Top-of-wall assemblies at fire rated walls.
E. Section 07 9005 - Joint Sealers: Acoustic sealant.
F. Section 09 9123 - Interior Painting
G. Section 09 3000 - Tiling: Tile backing board.

1.03 REFERENCE STANDARDS

A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
B. AISI SG-971 - Specification for the Design of Cold-Formed Steel Structural Members; 1996, with 2000 Supplement.
L. 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; 2014.
P. ASTM E413 - Classification for Rating Sound Insulation; 2010.
Q. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2013.

1.04 SYSTEM DESCRIPTION
A. Acoustic Attenuation for Interior Partitions: STC of 45-49 calculated in accordance with ASTM E 413, based on tests conducted in accordance with ASTM E 90.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
D. Samples: Submit two samples of gypsum board finished with proposed texture application, 12 by 12 inches in size, illustrating finish color and texture.

1.06 QUALITY ASSURANCE
A. Maintain one copy of all installation standards at project site.
B. Perform in accordance with ASTM C 840. Comply with requirements of GA-600 for fire-rated assemblies.
C. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum 10 years of documented experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES
A. Provide completed assemblies complying with ASTM C840 and GA-216.
B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

2.02 METAL FRAMING MATERIALS
A. Manufacturers - Metal Framing, Connectors, and Accessories:
   5. Scafo Steel Stud Manufacturing: www.scafco.com
   6. Substitutions: See Section 01 6000 - Product Requirements.
B. Metal Framing Connectors and Accessories:
   1. Same manufacturer as framing.
   2. Substitutions: See Section 01 6000 - Product Requirements.
C. Non-Loadbearing Framing System Components: ASTM C645; 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/240 at 5 psf.
   1. Studs: "C" shaped with flat or formed webs.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C - T shaped track.
   4. Furring: Hat-shaped sections, minimum depth of 7/8 inch; 1 5/8' studs, 4" Z-furring and other shapes and widths as indicated and as required to execute the construction as detailed.
   5. Exterior Non-Loadbearing Studs and Furring for Application of Gypsum Board
D. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05 4000.
E. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
F. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing 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 SG02-1.

3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.

4. Deflection and Firestop Track:
   a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   5. Substitutions: Not permitted.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board.
   3. Thickness:

C. Backing Board For Wet Areas: One of the following products:
   1. Application: Surfaces behind tile in wet areas including kitchen walls, shower ceilings and toilet room walls.
   2. 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.
   4. Edges: Square.

D. O.F. 300 Opaque Fiberglass:
   1. Application: Use for vertical surfaces behind wall finish where indicated.
   2. Product: Armortex UL 752 Level 3 ballistic panels.
      a. Nominal Thickness: 1/2”.
      b. Nominal Weight: 5.25 lbs per square foot.
   3. Make Up:
      a. Multiple layers of woven roving ballistic grade fiberglass woven, impregnated with a thermoset polyester resin, and compressed into flat rigid sheets, designed to capture projectiles.

2.04 ACCESSORIES

A. Acoustic Insulation: ASTM C 665; preformed glass fiber, friction fit type, unfaced full thickness of wall cavity. See partition types and floor plans for locations

B. Water-Resistive Barrier: As specified in Section 07 2500.

C. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
   1. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
   2. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
   5. Chemical hardening type compound.


E. Reveal Moldings:
   1. Drywall Control Joint, 1/2”, Fry Reglet DRM-50-25 2PC, or equal

F. Screws: ASTM C 1002; self-piercing tapping type; cadmium-plated for exterior locations.

G. Screws: ASTM C 954; steel drill screws for application of gypsum board to loadbearing steel studs.

H. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application as separate paint primer prior to applying texture finish.
PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members at 24 inches on center or as required to avoid mechanical ductwork.
   1. Level ceiling system to a tolerance of 1/1200.
   2. Laterally brace entire suspension system.

C. Studs: Space studs at 16 inches on center.
   1. Extend partition framing to 12" above ceiling line unless specifically indicated to under side of deck.
   2. Non Bearing Partitions and interior furring terminating at structure: Provide Compression / deflection heads (per 2.02, F above) allowing for a minimum 3/4" deflection. Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical fasteners in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
   3. Provide fire safing at track to deck connection, Hand pack safing material in deck flutes per manufacturer's recommendations.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs. Refer to structural loose lintel schedule.

E. Standard Wall Furring: Install at masonry walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
   2. Spacing: At 16 inches on center.

F. Blocking: Install fire treated wood blocking for support of:
   1. Framed openings.
   2. Wall mounted cabinets.
   3. Plumbing fixtures (unless otherwise specified by Mechanical).
   4. Toilet partitions.
   5. Toilet accessories and grab bars.
   6. Wall mounted door hardware, including door stops.
   7. As noted in section 061000.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

3.04 BOARD INSTALLATION

A. Comply with ASTM C 840 and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Fire / Smoke Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing (Exterior and other wall as noted). Cope gypsum board into deck flutes allowing 1/4" gap between gypsum and deck. Fill gap with fire caulking.

C. Gypsum Sheathing: install in strict accordance with manufacturer's instructions and as directed by the Structural drawings.

D. Cementitious Backing Board: Install over steel framing members where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

E. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

F. Armortex® Opaque Fiberglass Panels: Cut using ordinary carpentry tools using a RemGrit® "Grit Edge" saw blade. Install over steel framing using self-tapping dry wall screws.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings.
   2. Consult Architect to determine proper placement of joints.
B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

3.06 **JOINT TREATMENT**

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.


C. Finish gypsum board in scheduled areas in accordance with levels defined in ASTM C 840 and as scheduled below.
   1. Above Finished Ceilings Concealed From View: Level 1.
   2. Utility Areas and Areas Behind Cabinetry: Level 3.

D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.
   2. Finished taping, filling, and sanding is not required at surfaces behind fixed cabinetry fire tape only these areas.
   3. Sanding is not required at base layer of double layer applications.

E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.07 **TEXTURE FINISH**

A. Apply one coat High Build drywall surfacer to all finished gypsum board as primer prior to application of texture. This application of this primer shall be in addition to the multi coat paint systems specified under Section 099000.
   1. Spray apply primer to manufacturer's recommended dry film thickness.
   2. Immediately back roll spray primed surfaces to insure even coverage and uniform surfacing.

B. Provide light orange peel finish on all wall surfaces except those to be covered with wall coverings. Neatly and completely mask these areas prior to texture application.

C. Apply finish texture coating by means of spraying apparatus in accordance with manufacturer's instructions and to match approved sample.

D. Texture finish not required in Mechanical and Electrical Rooms.

3.08 **TOLERANCES**

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

**END OF SECTION**
SECTION 09 3000
TILING

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Tile for floor applications.
   B. Tile for wall applications.
   C. Ceramic accessories.
   D. Ceramic trim.
   E. Non-ceramic trim.

1.02 RELATED REQUIREMENTS
   A. Section 07 9005 - Joint Sealers.
   B. Section 09 2116 - Gypsum Board Assemblies: Installation of tile backer board.
   C. Section 09 0561 - Common Work results for Flooring Preparation.
   D. Division 22 - Plumbing Fixtures: Toilets.

1.03 REFERENCE STANDARDS
1.04 SUBMITTALS
   A. See Section 01 3000 - 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. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

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 5 years of documented experience.
   C. Installer Qualifications: Company specializing in performing tile installation, with minimum of 5 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 of 50 degrees F during installation of mortar materials.

1.08 EXTRA MATERIALS
   A. Provide 10 sq. ft of each size, color, and surface finish of tile specified.

PART 2 PRODUCTS

2.01 TILE
   A. Manufacturers: All products by the same manufacturer.
      4. Florida Tile: www.floridatile.com
      5. Substitutions: See Section 01 6000 - Product Requirements.
   B. Porcelain Tile: ANSI A137.1, standard grade.
      1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
      2. Color(s): To be selected by Architect from manufacturer's full range.
      4. Trim Units: Matching bullnose, double bullnose, cove base, and cove shapes in sizes coordinated with field tile.
      5. Products:
         a. Basis of Design: Series: Buenos Aires Mood, Various Colors refers to and includes all porcelain wall and floor tiles. Porcelain floor tiles are 2x2 mosaic or 12x12 unpolished.
         b. Substitutions: See Section 01 6000 - Product Requirements.

2.02 TRIM AND ACCESSORIES
   A. Trim: Satin natural anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
      1. Applications:
         a. Transition between floor finishes of different heights; Schluter- Reno-V or approved equal.
         b. Thresholds at exterior door openings; Schluter- Reno-Ramp or approved equal.
         c. Thresholds at interior door openings; Schluter- Reno-TK or approved equal.
         d. Expansion and control joints, floor and wall; Schluter- Dilex-BWS or approved equal.
      2. Manufacturers:
         c. Substitutions: See Section 01 6000 - Product Requirements.

2.03 ADHESIVE MATERIALS
   A. Manufacturers:
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Organic Adhesive: ANSI A136.1, thinset bond type; use Type I in areas subject to prolonged moisture exposure.

2.04 GROUTS
A. Manufacturers:
   5. C-Cure Chemical Co.: www.c-cure.com
   8. Laticrete International Inc.: www.laticrete.com
   9. Mapei Corp.: www.mapei.com
  10. Southern Grout & Mortars, Inc.: www.sgm.cc
  11. Summitville Tiles, Inc.: www.summitville.com
  12. Syracuse Adhesives Co.
  13. Substitutions: See Section 01 6000 - Product Requirements.

B. Epoxy Grout on wall and floors.
   1. Colors: To be selected by Architect from manufacturer's standard range.

2.05 ACCESSORY MATERIALS
A. Anti-Fracture Membrane: Composite membrane composed of chlorinated polyethylene (CPE) and a high-strength, nonwoven polyester material, designed for embedding in latex-portland cement mortar, and as substrate for latex-portland cement mortar setting bed. Provide membrane designed to bridge non-structural cracks and construction joints in concrete slabs.
   1. Manufacturer: Dal-Tile; Product: Dal-Seal CIS or approved equal.

B. Cementitious Backer Board: ANSI A118.9; High density, cementitious, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners and as specified in Section 092116.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
C. Verify that 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 cementitious backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of dry-set mortar to a feather edge.
E. Install tile backer board in strict accordance with manufacturer's instructions, using galvanized roofing nails or corrosion-resistant bugle head drywall screws. Bed fiberglass self-adhesive tape at all joints and corners with material used to set tiles.
F. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.
G. Place anti-fracture membrane following manufacturer's instructions and securely bonded to substrate. Locate only within 6" each side of control joints and cracks in the concrete substrate.

3.03 INSTALLATION - GENERAL
A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1A thru A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
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 non-ceramic trim in accordance with manufacturer’s instructions.

G. Sound tile after setting. Replace hollow sounding units.

H. Keep control and expansion joints free of mortar, grout, and adhesive.

I. Keep expansion joints free of adhesive or grout.

J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

K. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.

L. 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.

M. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

### 3.04 INSTALLATION - FLOORS - THIN-SET METHODS

A. At Porcelain Tile Flooring: Over interior concrete substrates, install in accordance with TCA Handbook Method F115, thin set mortar, with epoxy grout.

1. Where waterproofing membrane is indicated, install in accordance with TCA Handbook Method F122, with latex-portland cement grout.

2. Where epoxy grout is indicated, but not epoxy or furan bond coat, install in accordance with TCNA (HB) Method F115.

### 3.05 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.

B. Over gypsum wallboard on wood or metal studs install in accordance with TCA Handbook Method, unless otherwise indicated.

C. Over interior concrete and masonry install in accordance with TCA Handbook Method W202, thin-set with dry-set or latex-portland cement bond coat.

### 3.06 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 09 5100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Suspended metal grid ceiling system.
   B. Acoustical units.

1.02 RELATED REQUIREMENTS
   A. Section 07 9005 - Joint Sealers: Acoustical sealant.

1.03 REFERENCE STANDARDS
   D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Shop Drawings: Indicate grid layout and related dimensioning and junctions with other ceiling finishes.
   C. Product Data: Provide data on suspension system components and acoustical units.
   D. Samples: Submit two samples 6 by 6 inch in size illustrating material and finish of acoustical units.
   E. Samples: Submit two samples each, 4 inches long, of suspension system main runner and cross runner.
   F. Manufacturer's Installation Instructions: Indicate special procedures.

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

1.06 FIELD CONDITIONS
   A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.07 PROJECT CONDITIONS
   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. Install acoustical units after interior wet work is dry.

1.08 EXTRA MATERIALS
   A. See Section 01 6000 - Product Requirements, for additional provisions.
   B. Provide 2 percent of total acoustical unit area of each type of acoustical unit for Owner's use in maintenance of project.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS
   A. Manufacturers:
      4. Substitutions: See Section 01 6000 - Product Requirements.
B. Acoustical Panel Type: ACT:
   1. Basis of Design: Subject to compliance with project requirements, the design is based on the following: USG Interiors, LLC, 586-“Fissured Basic”.
   2. Classification: Provide ceiling panels complying with ASTM E 1264 for type, form and pattern as follows:
      a. Type: III, mineral base with painted finish
      b. Form: 2, Water Felted
      c. Pattern: C & D, Perforated small holes and Fissured
   4. LR: Not less than 0.81.
   5. NRC: Not less than 0.55.
   6. CAC: Not less than 35.
   7. Edge/Joint Detail: SLT Beveled Reveal.
   10. Recycled Content: Up to [51%].

2.02 SUSPENSION SYSTEM(S)
A. Manufacturers:
   1. Same as for acoustical units.
   2. Substitutions: See Section 01 6000 - Product Requirements.

B. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.

C. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
   1. Finish: White painted.

2.03 ACCESSORIES
A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.
B. Perimeter Moldings: Same material and finish as grid.
   1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
C. Hold Down Clips: Spaced 2'-0" o.c. on all cross tees.
D. Acoustical Insulation: Specified in Section 07 2100.
E. Acoustical Sealant For Perimeter Moldings: Specified in Section 07 9005.
F. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify existing conditions before starting work.
B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM
A. Install suspension system in accordance with ASTM C 636/C 636M, ASTM E 580/E 580M, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system on room axis according to reflected plan.

D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 3 inches of each corner, or support components independently. Comply with UBC Standard 25-2.

I. Do not eccentrically load system or induce rotation of runners.
J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Install in bed of acoustical sealant.
   2. Use longest practical lengths.
   3. Miter corners.

3.03 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.
B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
C. Fit border trim neatly against abutting surfaces. Do not install units less than 1/2 the width of the unit being installed.
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.
G. Where round obstructions occur, provide preformed closures to match perimeter molding.

3.04 TOLERANCES

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

END OF SECTION
CEMENTITIOUS WOOD FIBER CEILINGS

PART 2 GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.02 SUMMARY
   A. Section Includes:
      1. Cementitious wood fiber plank acoustical ceiling system
   B. Related Sections:
      1. Section 06 1053 – Rough Carpentry
      2. Divisions 23 – HVAC Air Distribution
      3. Division 26 – Electrical

1.03 REFERENCES
   A. American Society for Testing and Materials (ASTM)
      1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low-Alloy with Improved Formability
      2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
      3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
      4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
      5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
      6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
      9. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
     11. ASTM E 1264 Classification for Acoustical Ceiling Products
   B. International Building Code
   D. NFPA 70 National Electrical Code
   E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
   H. ESR 1308 – Armstrong Suspension Systems

1.04 SYSTEM DESCRIPTION
   A. Cementitious wood fiber plank attached to 2X wood furring strips at 24" O.C. with 2.5" unfaced batt insulation placed between furring strips.
1.05 SUBMITTALS
A. Product Data: Submit manufacturer’s technical data for each type of Tectum® Direct-Attached™ ceilings required.
B. Samples: Minimum 6 inch x 6 inch samples of specified Tectum® Direct-Attached acoustical ceilings panel.
C. Shop Drawings: Layout and details of Tectum® Direct-Attached wall panels show locations of items that are to be coordinated with the installation.
D. Certifications: Manufacturer’s certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, products must be tested to the A, D-20, C-20, or C-40 method.
E. If the material supplied by the acoustical subcontractor does not conform to manufacturer’s current published values as specified in sub 2.2 of this specification, the material must be removed, disposed of, and replaced with complying product at the expense of the Contractor performing the work.

1.06 QUALITY ASSURANCE
A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.
B. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
   1. Surface Burning Characteristics: Tested per ASTM E 84 and complying with ASTM E 1264 Classification.
C. Tectum® Direct-Attached, as with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.
D. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.07 DELIVERY, STORAGE & HANDLING
A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
B. Provide labels indicating brand name, style, size and thickness.
C. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
D. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.08 PROJECT/SITE CONDITIONS
A. Environmental Requirements:
B. Do not install ceiling panels until building is closed in and HVAC system is operational.
C. Locate materials onsite at least 24 hours before beginning installation to allow materials to reach temperature and moisture content equilibrium.
D. Maintain the following conditions in areas where acoustical materials are to be installed 24 hours before, during and after installation:
   1. Relative Humidity: 65 - 75%.

1.09 WARRANTY
A. Tectum® Direct-Attached Ceiling Panels: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:
   1. Defects in materials or factory workmanship.
B. Tectum® Direct-Attached Ceiling Panels one source manufacturer is Thirty (30) years from date of substantial completion.
C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.
1.010 MAINTENANCE
A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
   1. Tectum® Direct-Attached Ceiling Panels: Furnish quality of full-size units equal to 5.0 percent of amount installed.

PART 2 PRODUCTS
2.01 MANUFACTURER
A. Tectum® Direct-Attached Ceiling Panels:
   1. Tectum® by Armstrong World Industries, Inc.

2.02 TECTUM® DIRECT-ATTACHED CEILING PANELS
A. Acoustical Panels Type AP-1:
   1. Surface Texture: Coarse.
   2. Composition: Aspen wood fibers bonded with inorganic hydraulic cement.
   4. Size: Standard: 47 ¾” x 96”.
   5. Thickness: Standard 1”.
   6. Edge Profile: (long edge beveled; short edge beveled.
   7. Noise Reduction Coefficient (NRC): ASTM C 423; Mounting; C-40(0.85).
   8. Flame Spread: ASTM E 1264; Class A.
   9. Light Reflectance (LR) White Panel: ASTM E 1477; up to 0.75.
   11. Sustainable: EPD (Environmental Product Declaration) and HPD (Health Product Declaration).

PART 3 - EXECUTION
3.01 EXAMINATION
A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer’s printed recommendations.

3.02 PREPARATION
A. Measure each wall area and establish layout of wall units. Coordinate panel layout with mechanical and electrical fixtures.
B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.
   1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

3.03 INSTALLATION
A. Install Tectum® Direct-Attached Ceiling Panels in accordance manufacturer’s installation instructions.
B. For seismic installations follow the requirements of the International Building Code, ASCE 7 and ASTM E580 and in install in accordance with the authorities having jurisdiction.
3.04 ADJUSTING AND CLEANING

A. Replace damaged and broken Tectum® Direct-Attached Ceiling Panels.
B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer’s instructions for cleaning and touch up of minor finish damage. Remove any Tectum® Direct-Attached Ceiling Panels that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES
A. Resilient tile flooring.
B. Resilient base.
C. Resilient stair accessories.
D. Installation accessories.

1.2 RELATED REQUIREMENTS
A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
B. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.
C. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

1.3 REFERENCE STANDARDS
B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.

1.4 SUBMITTALS
A. See Section 01 3000 - 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. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
D. Verification Samples: Submit two samples, 3 by 3 inch in size illustrating color and pattern for each resilient flooring products specified.
E. Concrete Testing Standard: Submit a copy of ASTM F710.
F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Flooring Material: 100 square feet of each type and color.
   3. Extra Wall Base: 20 linear feet of each type and color.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Protect roll materials from damage by storing on end.

1.6 FIELD CONDITIONS
A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.
PART 2 PRODUCTS

2.1 TILE FLOORING

A. QT, Quartz Tile: Homogeneous, with color extending throughout thickness, and:
   1. Minimum Requirements: Comply with ASTM F 1066, Class 2.
   2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648.
   5. Coefficient of Friction: ASTM C1028, meets or exceeds ADA Guidelines of 0.6.
   7. VOC Content Limits: As specified in Section 01 6116.
   8. Thickness: 0.08 inch.
  10. Manufacturers:
      b. Color: To match existing quartz tile flooring.
      c. Substitutions: Not allowed.

B. High Performance Luxury Tile Plank (LVT): Printed film type, with transparent or translucent wear layer.
   1. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
   2. Flame Spread - Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
   3. Smoke Density: Smoke developed 450 or less when tested in accordance with ASTM E 662.
   5. Wear Layer Thickness: 0.020 inch.
   6. Total Thickness: 0.098 inch.
   7. Pattern: As selected by Architect.
   8. Manufacturers:
      a. BASIS OF DESIGN: Patcraft; Typography Letterpress.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.2 STAIR COVERING

A. Stair Treads: Rubber; full width and depth of stair tread in one piece; tapered thickness; nosing not less than 1-5/8 inch deep.
   1. Nominal Thickness: 0.1875 inch.
   3. Style: Contrasting color abrasive grit strips full width.
   5. Manufacturers:
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.3 RESILIENT BASE

A. RB, Resilient Base: ASTM F 1861, Type TP, rubber, thermoplastic; top set, and as follows:
   1. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA253.
   2. Height: RB1, 4 inch and RB2, 6 inch.
   3. Thickness: 0.125 inch thick.
   5. Length: 4 foot sections.
   6. Color: Color as selected from manufacturer's standards.
   7. Accessories: Premolded external corners, internal corners, and end stops.
   8. Manufacturers:
      d. Substitutions: See Section 01 6000 - Product Requirements.
2.4 ACCESSORIES
A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
B. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.
C. FT1, Rubber Transitions:
   1. Transition from carpet tile to vinyl tile, Basis of Design: CTA-XX-A Johnsonite.
   2. Transition from porcelain tile to carpet, Basis of Design: CTA-XX Johnsonite.

PART 3 EXECUTION

3.1 EXAMINATION
A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
C. Verify that concrete sub-floor surfaces are dry enough and ready for resilient flooring installation by testing for moisture and pH.
   1. Test in accordance with Section 090561.
   2. Obtain instructions if test results are not within limits recommended by the resilient flooring manufacturer and adhesive materials manufacturer.
D. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION
A. Prepare floor substrates for installation of flooring in accordance with Section 09 0561.
B. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
C. Prohibit traffic until filler is cured.
D. Clean substrate.
E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

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

3.4 TILE FLOORING
A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless manufacturer's instructions say otherwise.
B. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.

3.5 RESILIENT BASE
A. Fit joints tightly and make vertical. Maintain minimum dimension of 24 inches between joints.
B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
C. Install base on solid backing. Bond tightly to wall and floor surfaces.
D. Scribe and fit to door frames and other interruptions.
3.6 STAIR COVERINGS
   A. Install stair nosings in one piece for full width and depth of tread.
   B. Adhere over entire surface. Fit accurately and securely.

3.7 CLEANING
   A. Remove excess adhesive from floor, base, and wall surfaces without damage.
   B. Clean in accordance with manufacturer's instructions.
   C. For Tile Flooring:
      1. Sweep or vacuum floor thoroughly to remove any loose dirt, dust and other foreign materials.
      2. Scrub floor surface using a buffing machine with 450 or less RPM maximum speed along with a solution of lukewarm water and mild stripper (pH 9 Maximum). After scrubbing is complete, wet-vac surface with heavy duty commercial wet vacuum. Rinse floor thoroughly with clean lukewarm water and again wet-vac surface to remove all excess water.
      3. Do not scrub floor with steel wool pads, wire brushes, aggressive floor cleaners or cleanser. These products can cause severe damage to the floor surface.

3.8 PROTECTION
   A. Prohibit traffic on resilient flooring for 48 hours after installation.
   B. Protect resilient tile flooring against damage during construction period to comply with resilient flooring manufacturer's directions. Keep furniture off the floor for 24 hrs. Do not allow rolling carts to be used on the floor at least 72 hrs.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Modular carpet, fully adhered.
   B. Vestibule Walk-off carpet tile.

1.02 RELATED REQUIREMENTS
   A. Section 03 3000 - Cast-in-Place Concrete

1.03 REFERENCE STANDARDS
   C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
   D. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute; 2011.
   E. CRI (GLA) - Green Label Testing Program - Approved Adhesive Products; Carpet and Rug Institute; Current Edition.

1.04 SUBMITTALS
   A. See Section 01 3000 - 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 for each carpet color selected.
   D. Submit two, 6 inch long samples of edge strip.
   E. Manufacturer's Installation Instructions: Indicate special procedures.
   F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
   G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
      1. See Section 01 6000 - Product Requirements, for additional provisions.
      2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.05 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum five years documented experience.
   B. Installer Qualifications: Company specializing in installing carpet tile with minimum five years documented experience.

1.06 FIELD CONDITIONS
   A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Basis of Design: Patcraft.
   B. Other manufacturers:
      4. Mannington Commercial: www.mannington.com
      5. Shaw Contract Group: www.shawcontractgroup.com
      6. Substitutions: See Section 01 6000 - Product Requirements.
2.02 MATERIALS
A. CPT: Carpet Tile: Multi-level Pattern Loop.
   1. Product: Life & Style Collection / Prose Tile Pattern manufactured by Patcraft. Labeled as CPT on the drawings.
   2. Tile Size: 24 x 24 inch.
   5. Installation: Monolithic.
   6. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
   7. Max. Electrostatic Charge: 3 Kv. at 20 percent relative humidity.
   8. Carpet shall be colorfast to light and crocking and be resistant to insects.
   9. Antimicrobial: Carpet shall have antimicrobial properties and shall have not less than 2-mm halo inhibition for gram-positive bacteria, not less than 1-mm halo inhibition for gram-negative bacteria, and no fungal growth. Must pass AATCC-174.
A. WOC: Patcraft Beyond The Door Collection. Labeled as a WOC on the drawings.
   1. Carpet: Walk off tile 100% "Eco Solution Q nylon", soil protection, conforming to the following criteria:
      a. Surface Burning Characteristics: Flame spread/smoke developed index of 25/450, maximum, Class I when tested in accordance with ASTM E 662 NBS.
      b. Electrostatic propensity less than 3.5KV.
      c. Surface Flammability Ignition: Pass ASTM D 2859 (the "pill test").
   3. Installation: Monolithic.
   5. Primary Backing Material: Non-Woven Synthetic.

2.03 ACCESSORIES
A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.
B. Edge Strips: Rubber, color as selected by Architect.
C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer.
D. Adhesives: Acceptable to carpet tile manufacturer, compatible with materials being adhered; maximum VOC of 50 g/L; CRI Green Label certified; in lieu of labeled product, independent test report showing compliance is acceptable.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.
   1. Test in accordance with ASTM F710.
   2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION
A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
D. Vacuum clean substrate.

3.03 INSTALLATION
A. Starting installation constitutes acceptance of sub-floor 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,, either in ashlar or monolithic pattern as determined by Architect, set parallel to building lines.
F. Locate change of color or pattern between rooms under door centerline.
G. Fully adhere carpet tile to substrate.
H. Trim carpet tile neatly at walls and around interruptions.
I. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING
A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
B. Clean and vacuum carpet surfaces.

END OF SECTION
SECTION 09 7200
DRY ERASE WALLCOVERING

PART 1 - GENERAL

1.1 SUMMARY
A. Division includes:
   1. Magnetic Receptive Dry Erase Wallcovering.
   2. Accessories.

1.2 RELATED DIVISIONS:
A. Division 09 2900 Gypsum Board: Wall substrate.

1.3 REFERENCES
B. Gypsum Association GA-14-M-97 Recommended Levels of Gypsum Board Finish.

1.4 SUBMITTALS
A. Manufacturer's product data and installation instructions for each type of dry erase wallcovering, adhesive, and accessories required.
B. Manufacturer's written product data indicating compliance with specified materials required.
C. Manufacturer's written installation instructions.
D. Manufacturer's written instructions for recommended maintenance of each type of dry erase wallcovering required.
E. Samples:
   1. 7 x 9 inch (18 x 23 centimeter) samples of each dry erase material required.

1.5 QUALITY ASSURANCE
A. Manufacturer: Provide each type of dry erase wallcovering required produced by one manufacturer.
B. Installer: Installation by skilled commercial wallcovering contractor with no less than three years of documented experience installing dry erase wallcovering of the types and extent required.
C. Composition:
   1. Provide scrim backed, ferrous powder, pigmented vinyl capped with dry erase film.
   2. Surface Burning Characteristics Classification: Provide materials that meet Class 1A rating when tested in accordance with ASTM E84 for flame spread and smoke developed.
   3. Field Samples: Prepare field samples for architect's review and establish requirements for seaming and finish trim.
D. Install sample panel of each type presentation wallcovering specified in area designated by architect.
E. Maintain corrected and approved samples to serve as a standard of performance for the project.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING
A. Deliver presentation wallcoverings to the project site in unbroken and undamaged original factory packaging and clearly labeled with the manufacturer's identification label, quality or grade, and lot number.
B. Store materials in a clean, dry storage area with temperature maintained above 55 F with normal humidity.
C. Store material within original packaging to prevent damage.

1.7 PROJECT CONDITIONS
A. Do not apply presentation wallcoverings when surface and ambient temperatures are outside the temperature ranges required by the wallcovering manufacturer.
B. Provide continuous ventilation and heating facilities to maintain substrate surface and ambient temperatures above 55 F unless required otherwise by manufacturer's instructions.
C. Apply adhesive when substrate surface temperature and ambient temperature is above 55 F and relative humidity is below forty percent.
D. Maintain constant recommended temperature and humidity for at least seventy-two hours prior to and throughout the installation period, and for seventy-two hours after wallcovering installation completion.
E. Provide not less than 80-foot-candles per square foot lighting level measured mid-height at sub-1A surfaces.
1.8 WARRANTY
A. Submit manufacturer’s limited five-year written warranty against manufacturing defects.

1.9 MAINTENANCE
A. Maintenance instructions: Include precautions against cleaning materials and methods that may be detrimental to finishes and performance.

PART 2 - PRODUCTS
2.1 MANUFACTURER
   1. Product: Mag-rite II.

2.2 MATERIALS
A. Magnetic receptive, moderate gloss vinyl surface for dry erase markers.
B. 48 inch width, 39 ounce per square yard woven backing.

2.3 ACCESSORIES
A. Adhesives: Heavy-duty clear or clay based premixed vinyl adhesive.
B. Substrate Primer/Sealer: White pigmented acrylic base primer/sealer specifically formulated for use with vinyl wallcoverings.
C. Magnets: Heavy duty magnets, quantity of 2 sets per room containing wall covering.
D. Presentation Starter Kit: 8 dry erase markers, 2 erasers, 10 cleaning towels, one 8 oz. bottle cleaning solution, quantity of 1 kit per room containing wall covering.
E. Magnetic Accessory Tray: Claridge Products Model No. 264M2, 2’-0” long, satin anodized aluminum magnetic tray, quantity of 1 per 18 linear feet of wall covering length or minimum of 1 per covered wall per room; www.claridgeproducts.com.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Examine substrates and installation conditions to ensure surface conditions meet or exceed a Level 5 finish, per GA-214-M-97: Recommended Levels of Gypsum Board Finish, and permanent lighting should be installed and operational.
B. Test substrate with a suitable moisture meter and verify that moisture content does not exceed four percent.
C. Verify substrate surface is clean, dry, smooth, structurally sound, and free from surface defects and imperfections that would show through the finished surface.
D. Evaluate all painted surfaces for the possibility of pigment bleed-through.
E. Notify the contractor and architect in writing of any conditions detrimental to the proper and timely completion of the installation.
F. Beginning of installation means acceptance of surface conditions.

3.2 INSTALLATION
A. Acclimate wallcovering in the area of installation a minimum of twenty-four hours before installation.
B. Read and follow the manufacturer’s installation instruction sheet contained in each roll of the dry erase wallcovering.
C. Examine all materials for pattern, color, quantity and quality, as specified for the correct location prior to cutting.
D. Adhesive: Apply a uniform coat of heavy-duty pre-mixed clay-based or extra strength clear wallcovering adhesive.
E. Primer: Use a quality pigmented acrylic wallcovering primer.
F. Install each strip horizontally and in the same sequence as cut from the roll.
G. Install dry erase wallcovering sheets in exact order as they are cut from bolt. Reverse hang alternate strips (except lined products). Do not crease or bend the wallcovering when handling.
H. Install dry erase wallcovering horizontally using a level line.
I. Using a level or straight edge, double cut the seam with a seam-cutting tool (Ex: Double Seam-Cutter or Swedish Knife). Do not score drywall or plasterboard when cutting material.

J. When covering the entire wall, seam the material out of the main writing and viewing (areas of the wall).

K. Apply wallcovering to the substrate using a wallcovering smoother, wrapped with a soft cloth, to remove air bubbles. Do not use sharp edged smoothing tools. Smooth material on the wall from the middle to the outside edge.

L. Remove excess adhesive immediately after the wallcovering is applied. Clean entire surface with a warm mild soap solution, and clean soft cloths. Rinse thoroughly with water and let dry before using. Change water often to maintain water clarity.

M. Stop installation of material that is questionable in appearance and notify the manufacturer’s representative for an inspection.

3.3 CLEAN-UP

A. Upon completion of installation, remove all exposed adhesive immediately using a soft cloth and a warm, mild soap solution and rinse thoroughly with water and dry with clean towel prior to using.

B. Upon completion of the work, remove surplus materials, rubbish, and debris resulting from the wallcovering installation. Leave areas in neat, clean, and orderly condition.

END OF SECTION
SECTION 09 9000
PAINTING AND COATING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. Section Includes:
      1. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
         a. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
         b. Exposed surfaces of steel lintels and ledge angles.
         c. Wood casework carpentry and paneling so indicated.
         d. Mechanical and Electrical:
            1) In finished areas, paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
      2. Special coating systems.
      3. Do Not Paint or Finish the Following Items:
         a. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
         b. Items indicated to receive other finishes.
         c. Items indicated to remain unfinished.
         d. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
         e. Non-metallic roofing and flashing.
         f. Stainless steel, anodized aluminum, bronze, terne, and lead items.
         g. Ceramic and other tiles.
         h. Cast stone.
         i. Glass.
         j. Acoustical materials, unless specifically so indicated.
         k. Concealed pipes, ducts, and conduits.

1.03 SUBMITTALS
   A. Product Data: Provide data on all finishing products, including VOC content.
   B. Samples:
      1. Submit two paper chip samples, 2 x 2 in size illustrating range of colors and textures available for each surface finishing product scheduled.
      2. Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on tempered hardboard, 8.5 x 11 inch in size.
   C. Alternative paint manufacturers and products requested for approval. Submit proof of equivalency by providing products comparison to Basis of Design products showing description, technical and performance data for each product.

1.04 MAINTENANCE MATERIAL SUBMITTALS
   A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
      1. Maintain containers in clean condition, free of foreign materials and residue.
      2. Remove rags and waste from storage areas daily.
1.06 FIELD CONDITIONS
A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

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. 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:
   4. PPG Architectural Finishes, Inc.
   5. Pratt & Lambert.
   7. Tnemec, Inc.
C. Transparent Finishes:
D. Stains:
E. Primer Sealers: Same manufacturer as top coats.
F. Block Fillers: Same manufacturer as top coats.

2.02 PAINTS AND COATINGS - GENERAL
A. Material Compatibility:
   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   1. Flat Paints and Coatings: 50 g/L.
   2. Nonflat Paints and Coatings: 150 g/L.
   3. Dry-Fog Coatings: 400 g/L.
   4. Primers, Sealers, and Undercoaters: 200 g/L.
   5. Anticorrosive and Antitrust Paints Applied to Ferrous Metals: 250 g/L.
   7. Pretreatment Wash Primers: 420 g/L.
   8. Floor Coatings: 100 g/L.
   9. Shellacs, Clear: 730 g/L.
   10. Shellacs, Pigmented: 550 g/L.
C. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
   1. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
   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.
D. Colors: As selected by Owner after award.
   1. Extend colors to surface edges; colors may change at any edge as directed by Architect.
   2. 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-3L - Ferrous Metals, Unprimed, Latex, 3 Coat: (except as specifically noted in section 05 5000 Metal Fabrications)
   1. One coat of latex primer.
   2. Semi-gloss: Two coats of latex enamel.
B. Paint ME-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
   1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
   2. Semi-gloss: Two coats of latex enamel.
C. Paint MgE-OP-3L - Galvanized Metals, Latex, 3 Coat:
   1. One coat galvanize primer.
   2. Semi-gloss: Two coats of latex enamel.

2.04 PAINT SYSTEMS - INTERIOR
A. Paint CI-OP-3L - Concrete/ Masonry, Opaque, Latex, 3 Coat:
   1. One coat of block filler.
   2. Semi-gloss: Two coats of latex enamel.
B. Paint MI-OP-3L - Ferrous Metals, Unprimed, Latex, 3 Coat:
   1. One coat of latex primer.
   2. Semi-gloss: Two coats of latex enamel.
C. Paint MI-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
   1. Touch-up with latex primer.
   2. Semi-gloss: Two coats of latex enamel.
D. Paint MgI-OP-3L - Galvanized Metals, Latex, 3 Coat:
   1. One coat galvanize primer.
   2. Semi-gloss: Two coats of latex enamel.
E. Paint GI-OP-3A - Gypsum Board/Plaster, Alkyd, 3 Coat: All areas so noted in the finish schedule
   1. One coat of alkyd primer sealer.
   2. Eggshell: Two coats of alkyd enamel.
F. Paint GI-OP-3L - Gypsum Board/Plaster, Latex, 3 Coat: All areas not noted for item G above, and all other spaces not specified.
   1. One coat of latex primer sealer.
   2. Eggshell: Two coats of latex enamel.

2.05 SOURCE QUALITY CONTROL
A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
   1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
   2. Testing agency will perform tests for compliance with product requirements.
   3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION
3.01 EXAMINATION
A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Concrete: 12 percent.
   3. Wood: 15 percent.
   4. Gypsum Board: 12 percent.
C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
E. Proceed with coating application only after unsatisfactory conditions have been corrected.
   1. Application of coating indicates acceptance of surfaces and conditions.

3.02 INSPECTION
A. Thoroughly examine surfaces scheduled to be painted prior to commencement of work. Report in writing any condition that may affect proper application. Do not commence work until such defects have been corrected.
B. Where materials are being applied over previously painted surfaces or questionable surfaces, apply samples and perform in place test to check for compatibility, adhesion and film integrity of new materials to existing painted surfaces. Report in writing any condition that may affect application, appearance or performance of the paint.
C. Painting of surface constitutes contractor's acceptance of surface and responsibility for any paint failure.

3.03 PREPARATION
A. Clean surfaces thoroughly and correct defects prior to coating application.
B. Resinous Materials: Mix components and prepare materials according to special coating manufacturer's written instructions.
C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.04 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. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.05 FIELD QUALITY CONTROL
A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
   1. Contractor shall touch up and restore painted surfaces damaged by testing.
   2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.06 CLEANING AND PROTECTION
A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION
SECTION 10 1101
VISUAL DISPLAY DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Magnetic Markerboards and Tackboards.
B. Extruded Aluminum Snap on Trim.

1.02 RELATED REQUIREMENTS
A. Section 06 1000 - Rough Carpentry: Blocking and concealed supports in metal stud walls.
B. Section 09 2116 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

1.03 REFERENCE STANDARDS
A. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's data on magnetic markerboard, tackboard, tackboard surface covering, trim, and accessories including all board surface color and textures and trim finishes.
C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
D. Samples: Submit two samples 4 by 4 inch in size illustrating materials and finish, color and texture of markerboard, tackboard, tackboard surfacing, and trim.
E. Manufacturer's printed installation instructions.
F. Maintenance Data: Include data on regular cleaning, stain removal.

1.05 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.

1.06 WARRANTY
A. See Section 01 7800 - Closeout Submittals - Closeout Submittals, for additional warranty requirements.
B. Provide five year warranty for magnetic markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Tack Boards and Markerboards:
   5. Newline Products Inc., Plano, TX 75169, 972.881.3318
   6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MAGNETIC MARKERBOARDS AND TACKBOARDS
A. Markerboard / Tackboard combinations:
   1. Configuration: As indicated on drawings.
   2. Units Too Large to Ship Assembled: Fully assembled in factory, then disassembled for shipping.
      a. Join panels with butt joints, aligned and secured with steel spline concealed in edge of core.
   3. Individual components shall conform to the requirements listed below.
B. Magnetic Markerboards: Porcelain enamel on steel, laminated to core, with magnetic surface characteristics.
   1. Color: As selected from manufacturer's full range.
   2. Steel Face Sheet Thickness: 24 gage, 0.0239 inch.
   3. Core:
VISUAL DISPLAY DEVICES

a. Fixed Panels: 3/8" Particle board
5. Backing: Galvanized steel sheet with magnetic attractive properties, 24 gauge laminated to core.
6. Size: As indicated on drawings.
7. Frame: Snap-on aluminum trim.
8. Frame Profile: Manufacturer's standard for accessories listed below; with covers as required to fully conceal all fasteners and attachment points.
10. Accessories: Provide chalk tray.

C. Tackboards
1. Cork Facing:
   a. Finish: Natural
   b. Minimum Thickness: 1/4 Inches
2. Backing: Fiberboard, 1/4 inch thick, laminated to tack surface.
3. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E 84.
4. Sizes: Refer to drawings for sizes as noted. Make in one piece wherever possible.
5. Frame: Extruded aluminum, with concealed fasteners.
6. Frame Profile: Manufacturer's standard for accessories listed below

2.03 ACCESSORIES (MARKERBOARDS ONLY)
   A. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.
   B. Cleaning Instruction Plate: Provide instructions for chalkboard cleaning on a metal plate fastened to perimeter frame near chalkrail.
   C. Marker Tray: Aluminum, manufacturer's standard profile one piece full length of chalkboard, molded ends; concealed fasteners, same finish as frame.
   D. Aluminum, manufacturer's standard profile one piece full length of Markerboard, molded ends; concealed fasteners, same finish as frame.
   E. 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 10 1423**

**ROOM-IDENTIFICATION PANEL SIGNAGE**

**PART 1 - GENERAL**

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. Section Includes:
      1. Panel signs.
      2. Room-identification signs.
   B. Refer to Division 01 sustainable & energy efficiency project requirements affecting work of this section.

1.03 COORDINATION
   A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.04 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings: For panel signs.
      1. Include fabrication and installation details and attachments to other work.
      2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
      3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
   C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
      1. Include representative Samples of available typestyles and graphic symbols.
   D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
      1. Panel Signs: Full-size Sample.
      2. Room-identification Signs: Full-size Sample.
   E. Sign Schedule: Use same designations indicated on Drawings.
   F. Qualification Data: For Installer and manufacturer.
   G. Sample Warranty: For special warranty.

1.05 CLOSEOUT SUBMITTALS
   A. Maintenance Data: For signs to include in maintenance manuals.

1.06 QUALITY ASSURANCE
   A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.07 FIELD CONDITIONS
   A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication and indicate measurements on Shop Drawings.

1.08 WARRANTY
   A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
      1. Failures include, but are not limited to, the following:
         a. Deterioration of finishes beyond normal weathering.
         b. Deterioration of embedded graphic image colors.
         c. Separation or delamination of sheet materials and components.
      2. Warranty Period: Five years from date of Substantial Completion.
PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.02 SIGNS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Ace Sign Systems, Inc.
   2. Advance Corporation; Braille-Tac Division.
   3. ASI Sign Systems, Inc.
   4. InPro Corporation; SignScape Signage and Wayfinding.

B. Refer to Drawings for areas requiring signage.

C. Signs: Plastic, photo-etched to produce raised text and braille; 8 x 8 inch, 1/2 inch radius corners; 1 inch high slip-in.

D. Lettering: Color, position and character style complying with University of Wyoming Standards; characters raised 1/32 inch.
   1. Room numbers and room names 5/8 inch high upper case text, 1 inch high numerals.
   2. Room occupant names 1/2 inch high upper and lower case.

E. Backplate Color: As selected.

F. Braille: Provide Grade 2 Braille translation of printed text.

G. Pictograms: Provide pictograms for stair entry doors.

H. Provide room numbers and room names at each entrance to each room as shown on the Drawings if not indicated on Drawings as directed by Architect.

I. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.03 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
   1. Use concealed fasteners and anchors unless indicated to be exposed.
   2. For exterior exposure, furnish stainless-steel or hot-dip galvanized devices unless otherwise indicated.
   3. Exposed Metal-Fastener Components, General:
      a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
      b. Fastener Heads: Use flathead or oval countersunk screws and bolts with tamper-resistant spanner-head or one-way-head slots unless otherwise indicated.
   4. Sign Mounting Fasteners:
      a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
      b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.

B. Adhesive: As recommended by sign manufacturer.
   1. Adhesives shall have a VOC content of 70 g/L or less

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

D. Magnetic Tape: Manufacturer's standard magnetic tape with adhesive on one side.

2.04 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
   1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
C. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages.

2.05 GENERAL FINISH REQUIREMENTS
A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
B. Verify that items, including anchor inserts are sized and located to accommodate signs.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
3. Install signs after interior surfaces are finished.
4. Locate signs as indicated on Drawings and in accordance with accessibility requirements.
B. Clean signs when installation is completed.

3.03 INSTALLATION - ROOM AND INFORMATIONAL SIGNS
A. Mount room signs with adhesive tape unless otherwise directed by Architect.
B. Locate room identification signs on wall surfaces adjacent to strike side of door, level, 5 feet above finished floor to center line of sign and 3 inches from door jamb trim.
C. Locate informational signs on wall surfaces, level, 5 feet above finished floor to center line of sign at location scheduled.
D. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
E. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.04 INFORMATIONAL, ROOM NAME AND IDENTIFICATION SIGN SCHEDULE
A. Room Identification Signs: Text, and braille for Room Name and Room Number at all non-residential rooms.
B. Stair Entry Signs: Pictogram, text, and braille for "Exit Stair."
   1. Install in corridor at each stair tower entry door.
C. Elevator Signs: Pictogram, text, and braille for "Elevator."
   1. Install in corridor at each elevator call station.
D. Elevator Jamb Floor Level Signs: Text, and braille for floor number.
   1. Install on each elevator jamb at each elevator lobby.
E. Accessible Entrance Signs: Pictogram and the following text “Barrier Free Entrance” with directions to nearest accessible entrance.
   1. Install at each accessible entrance when all entrances are not accessible.
F. Directions to Accessible Entrance Signs: Pictogram and the following text “For barrier free entrance use.” with directions to nearest accessible entrance.
   1. Install at each non-accessible entrance.
G. No Smoking Signs: Pictogram and the following text “No Smoking.”
   1. Install at each elevator lobby and each building entry.
H. Drinking Fountain: Pictogram and braille for “Water Fountain.”
   1. Install adjacent to each drinking fountain.
I. Refer Drawings for signage and additional locations.

3.05 ADJUSTING AND CLEANING
   A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
   B. Remove temporary protective coverings and strippable films as signs are installed.
   C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION
SECTION 10 2113.19
HDPE TOILET COMPARTMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section Includes:
   1. Solid-plastic toilet compartments configured as toilet enclosures and urinal screens.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.
B. Shop Drawings: For toilet compartments.
   1. Include plans, elevations, sections, details, and attachment details.
   2. Show locations of cutouts for compartment-mounted toilet accessories.
   3. Show locations of centerlines of toilet fixtures.
   4. Show locations of floor drains.
C. Samples for Initial Selection: For each type of toilet compartment material indicated.
   1. Include Samples of hardware and accessories involving material and color selection.
D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
   1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
   2. Each type of hardware and accessory.
E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.04 INFORMATIONAL SUBMITTALS
A. Product Certificates: For each type of toilet compartment.

1.05 CLOSEOUT SUBMITTALS
A. Maintenance Data: For each type of toilet compartments to include in maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS
A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents and source.
   1. Door Hinges: One hinge with associated fasteners.
   2. Latch and Keeper: One latch and keeper with associated fasteners.
   3. Door Bumper: One bumper with associated fasteners.
   4. Door Pull: One door pull with associated fasteners.
   5. Fasteners: Ten fasteners of each size and type.

1.07 PROJECT CONDITIONS
A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.
PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Provide plastic toilet compartment assemblies complying with the following as determined by testing identical products by a testing and inspecting agency acceptable to authorities having jurisdiction:
   1. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.02 SOLID-PLASTIC TOILET COMPARTMENTS - NFPA 286 COMPLIANT ASSEMBLY

A. Manufacturers: Basis of Design: Scranton Products.

B. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Accurate Partitions Corp.; ASI Group.
   2. Ampco; by AJW Architectural Products.
   5. Marlite.

C. Toilet-Enclosure Style: Floor anchored.

D. Urinal-Screen Style: Wall hung.

E. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1-inch-thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.
   2. Integral Hinges: Configure doors and pilasters to receive integral hinges.
   3. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum or stainless-steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.

F. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.

G. Brackets (Fittings):
   1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

2.03 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.
   2. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door.
   3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
   4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
   5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
   6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.
2.04 MATERIALS
   A. Aluminum Extrusions: ASTM B 221.
   B. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
   C. Stainless-Steel Castings: ASTM A 743/A 743M.
   D. Zamac: ASTM B 86, commercial zinc-alloy die castings.

2.05 FABRICATION
   A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
   B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
   C. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.01 EXAMINATION
   A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
      1. Confirm location and adequacy of blocking and supports required for installation.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
   A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
      1. Maximum Clearances:
         a. Pilasters and Panels: 1/2 inch.
         b. Panels and Walls: 1 inch.
      2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
         a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
         b. Align brackets at pilasters with brackets at walls.
   B. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
   C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.03 ADJUSTING
   A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION
PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Acoustic operable panel partition.
   B. Ceiling track, ceiling guards, and operating hardware.

1.02 RELATED REQUIREMENTS
   A. Section 06 1000 - Rough Carpentry: Wood blocking and track support shimming.
   B. Section 07 9005 - Joint Sealers: Acoustical sealant.
   C. Unistrut supplied and welded by others.

1.03 REFERENCE STANDARDS
   C. ASTM E413 - Classification for Rating Sound Insulation; 2010.

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on partition materials.
   C. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, and stacking depth.
   D. Samples for Review: Submit two samples of surface finish, 12 x 12 inches size, illustrating quality.
   E. Manufacturer's Instructions: Indicate special procedures.
   F. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

1.05 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing products specified this section with minimum 5 years of documented experience.
   B. Installer Qualifications: Company specializing in performing work of this section with minimum 5 years of experience.

PART 2 PRODUCTS
2.01 MANUFACTURERS
   A. Design is based on Hufcor; Product 632 Operable Partition with trimmed, paired panels.
   B. Other Acceptable Manufacturers:
      4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 OPERABLE PANEL PARTITIONS
   A. Partition Type Operable: Acoustical.
      1. Frame: 16 gauge painted steel with integral factory applied aluminum vertical edge and face protection.
      2. Panels: 3" thick, to 48" in width, top supported, center stacking paired panels, hinged in pairs.
      3. Finish: Woven Fabric; color as selected.
      4. Seals: Top and bottom manually operated mechanical seals; vertical seals are interlocking.
      5. Sound Transmission Class (STC): 49.
      6. Jamb: Stack end; expandable jamb activated from either side.
B. Track: Type 40, Clear Anodized Extruded aluminum; size per manufacturer; thickness and profile designed to support loads; supporting beam in ceiling per structural.

C. Suspension system:
   1. Track shall be of clear anodized architectural grade extruded aluminum alloy 6063-T6. Track design shall provide precise alignment at the trolley running surfaces and provide integral support for adjoining ceiling, soffit, or plenum sound barrier. Track shall be connected to the structural support by pairs of minimum 3/8” [10] dia. threaded steel hanger rods. Guide rails and/or track sweep seals shall not be required.
   a. Each panel shall be supported by one 4-wheeled carrier. Wheels to be of hardened steel ball bearings encased with molded polymer tires.
   2. Plenum closure (by others): Design of plenum closure must permit lifting out of header panels to adjust track height. Plenum closure required for optimum sound control of partition.

D. Accessories
   1. ADA compliant pass door of the same thickness and construction as the basic panels. Pass door panel legs require bottom seals that provide downward force to maintain stability during door operation. Pass door leaf has perimeter trim to protect face finish and to provide visual identification as required by International Building Code. Pass door leaf incorporates a self-adjusting retractable bottom seal providing sound control when door is closed.
   b. Door lock
   e. Peep hole
   2. Inset chalk/writing/projection surfaces
   3. Inset eraser pocket

2.03 FINISH MATERIALS
A. Woven Fabric: Factory applied vertical ribbed carpet (N.R.C. 0.20).
   1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E 84.
   2. Color: As selected from manufacturer's standard range.

2.04 OPERATION
A. Panels shall be manually moved from the storage area, positioned in the opening, and seals set.

B. Retractable Horizontal Seals
   1. Retractable horizontal seals shall be activated by a removable quick-set operating handle located approximately 42” [1067] from the floor in the panel edge.
   2. All retractable seals in each hinged pair shall be operated simultaneously.
   3. Seal activation requires approximately 15 lbs. [6.8 kg] of force per panel and approximately a 190 degree turn of the removable handle.

C. Final partition closure to be by:
   1. Lever closure panel with expanding jamb which compensates for minor wall irregularities and provides a minimum of 250 lbs. seal force against the adjacent wall for optimum sound control. The jamb activator shall be located approximately 45” from the floor in the panel face and be accessed from either side of the panel. The jamb is equipped with a mechanical rack and pinion gear drive mechanism and shall extend 4”-6” by turning the removable operating handle.

D. Stack/Store Panels
   1. Retract seals and move to storage area. Panels may be stored at either or both ends of the track or in a pocket.

2.05 ACOUSTICAL PERFORMANCE
A. Acoustical performance shall be tested at a laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) and in accordance with ASTM E90 Test Standards. Standard panel construction shall have obtained an STC rating of: 49
   1. Complete, unaltered written test report is to be made available upon request.
PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that field measurements are as indicated.
   B. Verify track supports are laterally braced and will permit track to be level within 1/4 inch of required position and parallel to the floor surface.
   C. Verify floor flatness of 1/8 inch in 10 feet, non-cumulative.
   D. Verify wall plumbness of 1/8 inch in 10 feet, non-cumulative.

3.02 INSTALLATION
   A. Install partition in accordance with manufacturer's instructions and ASTM E557.
   B. Fit and align partition assembly and pocket doors level and plumb.
   C. Lubricate moving components.
   D. Apply acoustic sealant to achieve required acoustic performance.

3.03 ADJUSTING
   A. Adjust partition assembly to provide smooth operation from stacked to fully open position. Do not over-compress acoustic seals.
   B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.
   C. Adjust partition assembly to achieve lightproof seal.

3.04 CLEANING
   A. All track and panel surfaces shall be wiped clean and free of handprints, grease, and soil.
   B. Cartoning and other installation debris shall be removed to onsite waste collection area, provided by others.

3.05 CLOSEOUT ACTIVITIES
   A. Installer shall demonstrate proper operation and maintenance procedures to owner's representative.
   B. Operating handle and owner's manuals shall be provided to owner's representative.
   C. Installer shall demonstrate proper operation and maintenance procedures to owner's representative.

END OF SECTION
SECTION 10 2800
TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section Includes:
   1. Accessories for toilet rooms.

1.03 COORDINATION
A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.04 SUBMITTALS
A. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.
B. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

1.05 CLOSEOUT SUBMITTALS
A. Maintenance Data: For accessories to include in maintenance manuals.

PART 2 - PRODUCTS

2.01 PERFORMANCE 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.

2.02 ADMINISTRATIVE REQUIREMENTS
A. Some items of this section are to be furnished by the University or their subcontractors. Coordinate with the University and / or their subcontractors for the installation of these items. Contractor shall install all items supplied by the Owner and / or the subcontractor as listed in this specification section. Confirm all installations with the Deputy Director, Facilities Services of the Physical Plant.
B. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

2.03 MANUFACTURERS
A. Basis-of-Design Product: Subject to compliance with requirements, provide products as specified by Bobrick Corporation.
B. All items of each type to be made by the same manufacturer.

2.04 MATERIALS
A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
B. Keys: Provide 2 keys for each accessory to The Owner; master key all lockable accessories.
C. Stainless Steel Sheet: ASTM A666, Type 304.
D. Stainless Steel Tubing: ASTM A 269, Type 304.
E. Mirror Glass: Float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
F. Adhesive: Two component epoxy type, waterproof.
G. Fasteners, Screws, and Bolts: Stainless steel, tamper-proof.

2.05 FINISHES
A. Stainless Steel: For all toilet room and Utility room Accessories, No. 4 satin brushed finish, unless otherwise noted.
2.06 TOILET ROOM
A. Contractor Provided:
   2. Grab Bars: Bobrick Models B-6806 18, 36, and 42 with the following characteristics; length as noted, 1-1/2" dia. tubing. Constructed of 18-gauge, type 304 satin-finish stainless steel tubing. Concealed mounting flange 1/8" thick, type 304 stainless steel plate, 2" W x 3 1/8" H, with screw holes for concealed anchors. Cover is 22-gauge, type 304 stainless steel with satin finish, 3 1/4" diameter. Cover snaps over mounting flange to conceal screws. Stainless steel. Location, orientation and configuration: As indicated on drawings.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Verify existing conditions before starting work.
B. Verify exact location of accessories for installation.
C. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION
A. Deliver inserts and rough-in frames to site for timely installation.
B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION
A. to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F446.
C. Install plumb and level, securely and rigidly anchored to substrate.
D. Mounting Heights and Locations: As required by accessibility regulations and as indicated on drawings
E. Provide all accessories in numbers and locations indicated in drawings.

3.04 ADJUSTING AND CLEANING
A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
B. Remove temporary labels and protective coatings.
C. Clean and polish exposed surfaces according to manufacturer's written instructions.

3.05 SCHEDULE
A. Refer to Drawings.

END OF SECTION
SECTION 10 4400
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 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.
   B. Section 09 9123 - Interior Painting: Field paint finish.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Shop Drawings: Indicate cabinet physical dimensions.
   C. Product Data: Provide extinguisher operational features.
   D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
   E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
   F. 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 Extinguisher Cabinets and Accessories:
      4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FIRE EXTINGUISHERS
   A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   B. Dry Chemical Type Fire Extinguishers: Cast steel tank, with pressure gage.
      1. Class A,B,C.
      2. Size 10 pound.
      3. Finish: Baked enamel, red color.

2.03 FIRE EXTINGUISHER CABINETS:
   A. Metal: Formed aluminum.
   B. Cabinet Configuration: Semi-recessed type.
      1. Sized to accommodate accessories.
      2. Exterior nominal dimensions of 9-1/2 inch wide by 24 inch high by 6 inch deep.
      3. Trim: exposed, Rolled, 2-1/2 inch.
      4. Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim and door stiles.
C. Door: 1/2 inch thick, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with two butt hinge. Provide nylon catch.
D. Door Glazing: Glass, clear, 1/8 inch thick tempered. Set in resilient channel gasket glazing.
E. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
F. Weld, fill, and grind components smooth.
G. Finish of Cabinet Exterior Trim and Door: Anodized Aluminum.
H. Finish of Cabinet Interior: White enamel.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

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

END OF SECTION
SECTION 12 4940
ROLLER SHADES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section Includes:
   1. Electrically and Manually operated room-darkening shades.
   2. Local group and master control system for shade operation.

1.03 COORDINATION
A. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
B. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.

1.04 SUBMITTALS
A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
   3. Storage and handling requirements and recommendations.
   4. Mounting details and installation methods.
   5. Typical wiring diagrams including integration of motor controllers with building management system, audiovisual and lighting control systems as applicable.
B. Selection Samples: For each finish product specified, one set of shade cloth options and aluminum finish color samples representing manufacturer's full range of available colors and patterns.
C. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements. Shadecloth sample and aluminum finish sample as selected. Mark face of material to indicate interior faces.

1.05 CLOSEOUT SUBMITTALS
A. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

1.06 QUALITY ASSURANCE
A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years' experience in manufacturing products comparable to those specified in this section.
B. Installer Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years' experience in installing products comparable to those specified in this section.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Deliver shades in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.08 FIELD CONDITIONS
A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.09 WARRANTY
A. Roller Shade Hardware, Chain and Shadecloth: Manufacturer's standard non-depreciating twenty-five year limited warranty.
B. Roller Shade Motors and Motor Control Systems: Manufacturer's standard non-depreciating five-year warranty.
PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Passes NFPA 701-99 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

B. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing.

C. Anti-Microbial Characteristics: 'No Growth' per ASTM G21 results for fungi ATCC9642, ATCC 9644, ATCC9645.

2.02 MANUFACTURERS

A. Acceptable Manufacturers:
   2. Draper, Inc.; 411 South Pearl Street, Spiceland, IN 47385; Tel: (765) 987-7999; Fax: (866) 637-5611; Tollfree: (800) 238-7999; E-mail: drapercontract@draperinc.com; Web site: http://www.draperinc.com.
   3. Crown Shade Company, 775 Chesaco Avenue, Baltimore, MD 21237; Tel: (800) 445-5557; Fax: (877) 686-6015; E-mail: sales@crownshadeco.com; Web site: http://www.crownshadeco.com.

B. Substitutions: Refer to Section 01 6000 - Product Requirements

2.03 SHADE CLOTH

A. Content: 82% PVC (coating), 18% polyester (yarn)

B. Opacity factor: approx. 3% throughout and where specifically noted 1%

C. Stocked: 96 in. wide

D. NFPA 701-2004: pass

2.04 SHADE BAND

A. Shade Bands: Construction of shade band includes the fabric, the hem weight, hem-pocket, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.
   1. Hem Pockets and Hem Weights: Fabric hem pocket with RF-welded seams (including welded ends) and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside a sealed hem pocket. Hem pocket construction and hem weights shall be similar, for all shades within one room.

B. Shade band and Shade Roller Attachment:
   a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection and to accommodate motorized operation.
   b. Provide for positive mechanical engagement with drive / brake mechanism.
   c. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on" snap-off" spline mounting, without having to remove shade roller from shade brackets.
   d. Mounting spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
   e. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets are not acceptable.
2.05 SHADE FABRICATION
   A. Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.
   B. Fabricate shadecloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shadecloth to roll true and straight without shifting sideways more than 1/8 inch in either direction per 8 feet of shade height due to warp distortion or weave design. Fabricate hem as follows:

2.06 COMPONENTS
   A. Access and Material Requirements:
      1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
      2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.
   B. Shade Hardware and Shade Brackets:
      1. Provide shade hardware constructed of minimum 1/8-inch thick plated steel, or heavier, thicker, as required to support 150 percent of the full weight of each shade.
      2. Provide shade hardware system that allows for field adjustment of motor or replacement of any operable hardware component without requiring removal of brackets, regardless of mounting position (inside, or outside mount).

2.07 SHADE MOTOR DRIVE SYSTEM
   A. Shade Motors:
      1. Tubular, asynchronous (non-synchronous) motors, with built-in reversible capacitor operating at 110v AC (60hz), single phase, temperature Class A, thermally protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each motor.
      2. Conceal motors inside shade roller tube.
      3. Maximum current draw for each shade motor of 2.3 amps.
      4. Use motors rated at the same nominal speed for all shades in the same room.
   B. Total hanging weight of shade band shall not exceed 80 percent of the rated lifting capacity of the shade motor and tube assembly.

2.08 MOTOR CONTROL SYSTEMS
   A. IQ/MLC: Specifications and design of shade motors and motor control system are based on the IQ/MLC motor logic control system manufactured by MechoShade Systems, Inc. Other systems may be acceptable provide that all of the following performance capabilities are provided. Motor logic control systems not in complete compliance with these performance criteria shall not be accepted as equal systems.
      1. Motor Control System:
         a. Provide power to each shade motor via individual 3 conductor line voltage circuits connecting each motor to the relay based motor logic controllers (IQ/MLC).
         b. Control system components shall provide appropriate (spike and brown out) over-current protection (+/- 10 percent of line voltage) for each of the four individual motor circuits and shall be rated by UL or ETL as a recognized component of this system and tested as an integrated system.
         c. Motor control system shall allow each group of four shade motors in any combination to be controlled by each of four local switch ports, with up to fourteen possible "sub-group" combinations via local 3 button wall switches and all at once via a master 3 button switch. System shall allow for overlapping switch combinations from two or more local switches.
         d. Multiple "sub-groups" from different IQ/MLC control components shall be capable of being combined to form "groups" operated by a single 3 button wall switch, from either the master port or in series from a local switch port.
         e. Each shade motor shall be accessible (for control purposes) from up to four local switches and one master switch.
f. Control system shall allow for automatic alignment of shade hem bars in stopped position at 25 percent, 50 percent, and 75 percent of opening heights, and up to three user-defined intermediate stopping positions in addition to all up / all down, regardless of shade height, for a total of five positions. Control system shall allow shades to be stopped at any point in the opening height noting that shades may not be in alignment at these non-defined positions.

g. Control system shall have two standard operating modes: Normal mode allowing the shades to be stopped anywhere in the window’s opening height and uniform mode, allowing the shades to only be stopped at the predefined intermediate stop positions. Both modes shall allow for all up / all down positioning.

h. Control system components shall allow for interface with both audiovisual system components and building fire and life safety system via a dry contact terminal block.

i. Control system components shall allow for interface with external analog input control devices such as solar activated controllers, 24 hour timers, and similar items; via a dry contact terminal block.

j. Reconfiguration of switch groups shall not require rewiring of the hardwired line voltage motor power supply wiring, or the low voltage control wiring. Reconfiguration of switch groups shall be accomplished within the motor control device (IQ/MLC).

2. Wall Switches:
   a. Three-button architectural flush mounted switches with metal cover plate and no exposed fasteners.
   b. Connect local wall switches to control system components via low voltage (12V DC) 4-conductor modular cable equipped with RJ-11 type connectors supplied, installed and certified under Division 16 - Electrical.
   c. Connect master wall switches to control system components via low voltage (12V DC) 6-conductor modular cable equipped with RJ-12 type connectors supplied, installed and certified under Division 26 - Electrical.

2.09 ACCESSORIES

A. Fascia:
   1. Continuous removable extruded aluminum fascia that attaches to shade mounting brackets without the use of adhesives, magnetic strips, or exposed fasteners.
   2. Fascia shall fully conceal brackets, shade roller and fabric on the tube.
   3. Provide bracket / fascia end caps where mounting conditions expose outside of roller shade brackets.
   4. Color: Custom color as selected by Architect.

B. Pockets:
   1. Pockets: By shade manufacturer, custom-designed pockets with accessories for mounting and as necessary to accommodate concealment above various ceiling systems. Depending on size, location and ceiling system may be extruded aluminum or bent steel.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

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. Install roller shades level, plumb, square, and true according to manufacturer’s written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow proper clearances for window operation hardware.

B. Turn-Key Single-Source Responsibility for all Interior Roller Shades: To control the responsibility for performance of motorized roller shade systems, assign the design, engineering, and installation of motorized roller shade systems, motors, controls, and low voltage electrical control wiring specified in this Section to a single manufacturer and their authorized installer/dealer. The Architect will not produce a set
of electrical drawings for the installation of control wiring for the motors, or motor controllers of the motorized roller shades. Power wiring (line voltage), shall be provided by the roller shade installer/dealer, in accordance with the requirements provided by the manufacturer. Coordinate the following with the roller shade installer/dealer:

1. Main Contractor shall provide power panels and circuits of sufficient size to accommodate roller shade manufacturer's requirements, as indicated on the mechanical and electrical drawings.
2. Main Contractor shall coordinate with requirements of roller shade installer/dealer, before inaccessible areas are constructed.
3. Roller shade installer/dealer shall run line voltage as dedicated home runs (of sufficient quantity, in sufficient capacity as required) terminating in junction boxes in locations designated by roller shade dealer.
4. Roller shade installer/dealer shall provide and run all line voltage (from the terminating points) to the motor controllers, wire all roller shade motors to the motor controllers, and provide and run low voltage control wiring from motor controllers to switch/ control locations designated by the Architect. All above-ceiling and concealed wiring shall be plenum-rated, or installed in conduit, as required by the electrical code having jurisdiction.
5. Main Contractor shall provide conduit with pull wire in all areas, which might not be accessible to roller shade contractor due to building design, equipment location or schedule.

3.04 ADJUSTING
   A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.05 CLEANING AND PROTECTION
   A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
   B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
   C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.06 DEMONSTRATION
   A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION
SECTION 22 0010
GENERAL PROVISIONS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Quality Assurance
B. Methods of Request for Approval
C. Submittals
D. Job Conditions
E. Project Coordination
F. Drawings and Measurements
G. Workmanship
H. Patching Materials
I. Equipment Housekeeping Pads
J. Kitchen Equipment
K. Equipment Clean-Up
L. Cutting and Patching
M. Sealing of Penetrations
N. Excavating, Trenching and Backfilling
O. Project Conditions
P. Preparation
Q. General Installation Requirements
R. Existing Utilities
S. Laying Out the Work
T. Temporary Heating
U. Progress Cleaning
V. Protection of Installed Work
W. System Startup
X. Demonstration and Instruction
Y. Adjusting
Z. Final Cleaning
AA. Closeout Procedures
AB. Project Record Documents
AC. Warranty and Bonds

1.02 DEFINITIONS

A. Contractor
   1. The term “Contractor” refers to the installation Contractor responsible for the furnishing
      and installation of all work indicated within this Specification.

B. Furnish
   1. The term “furnish” is used to mean “purchase, supply, provide and deliver to the Project
      site, protect and provide interim storage and be ready for unloading, unpacking, assembly,
      installation, and similar operations in accordance with Manufacturer’s specifications.”

C. Provide
1. The terms “provide” means to “furnish and install, complete and ready for the intended use.”

D. Install
1. The term “install” is used to describe operations at project site including the actual “unloading, unpacking, rigging in place, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations”.

E. Installer
1. The “Installer” is the Contractor, Subcontractor and/or supplier who uses their own employees for performance of all construction

F. If Applicable:
1. The term “if applicable” will be that work which may be required for completed construction at applicable locations, but is not necessarily shown or described in the Contract Documents.

G. As Necessary
1. The term “as necessary” will be that work which is required for completed construction, but is not necessarily shown or described in the Contract Documents.

H. As Required
1. The term “as required” will be that work which is required for completed construction and is shown on the drawings or described in the project Specification.

I. Concealed
1. The term “concealed” means hidden from sight, buried as in chases, furred spaces, shafts, fixed ceiling or embedded in construction.

J. Exposed
1. The term “exposed” means bare, open to the elements, out in the open, uncovered.

K. Product
1. The term “product” will mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.

L. Substantial Completion
1. “Substantial Completion” is deemed that the project is sufficiently complete to be utilized for its intended use as stated in the body of this written Specification.

M. Words in the singular will also mean and include the plural, wherever the context so indicates, and words in the plural will mean the singular, wherever the context so indicates.

1.03 RELATED DOCUMENTS
A. The attached General Conditions, Supplementary General Conditions and Special Conditions or General Requirements are hereby incorporated into and shall become a part of all sections under DIVISION 22 – PLUMBING. In certain instances where the terms of this Division of the Specifications conflict with the terms of the General Conditions, or Special Conditions, this Division of the Specifications shall govern (or the more stringent requirement shall apply).

B. Where “Contractor” is referred to in this Specification it shall mean “Contractor, Sub-Contractor and/or Sub-Contractors under the Prime Contractor.”

1.04 DESCRIPTION OF WORK
A. The work shall include everything in this Division of the Specifications and everything indicated on the Drawings that is complementary to this Division of the Specifications. Refer to the Index of Drawings to determine what Drawings apply directly to this work.

1.05 QUALITY ASSURANCE
A. Codes and Standards:
1. All work shall be executed in accordance with the Local, State and other attending rules and regulations applicable to the trade affected and be subject to the inspection of these departments.
2. Materials and equipment shall be new and of best quality, of the type best suited for the purpose intended, and be made by nationally recognized and substantially established manufacturers. The type and weight of material used for each purpose shall be as herein specified, and material shall conform with the requirements of the latest standard specifications of the “ASTM” for that particular material.

3. Fire protection materials used in this work shall be listed by the Underwriters Laboratories, Inc. where testing is provided and shall bear their label.

4. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

5. Where the notation of NFPA is indicated the equipment shall conform to National Fire Protection Association Standard.

6. The following list of codes, technical societies, trade organizations and governing agencies shall set the standards by which all work shall be executed:
   a. City Fire Protection Ordinances
   b. State Fire Protection Laws and Statutes
   c. NFPA 13 and 14 Current Edition
   d. Underwriters Laboratories (UL)
   e. International Building Code (IBC)
   f. International Plumbing Code (IPC)
   g. International Fire Code (IFC)

B. Fees
   1. All fees, permits, licenses, etc., necessary in order to complete the work of this section shall be obtained and paid by this Contractor.

C. Alternate Equipment
   1. Where items of equipment and materials are specifically identified herein by a single manufacturer’s name, or as many as three manufacturer’s names, model or catalog numbers, and the words “or equal and approved” do not follow the manufacturer’s names, only such specific items may be used in the base bid, except as hereinafter provided.
   2. Items of equipment of the Contractor’s choice may be offered as alternates to such specified items, either in the spaces provided for same in the proposal form or if no space is provided, on the bidder’s letterhead attached to each copy of the proposal form.
   3. Alternate proposal must be accompanied by full descriptive and technical data for item proposed, together with statement or amount of cost addition or deduction from the base bid if alternate is accepted. Substitutions proposed by the Contractor will not be considered in the award of the contract.
   4. The Contractor must judge that such alternate equipment is of equal quality and character to the specified equipment, and it is physically adaptable for installation within the allotted space with all required service clearances. Unless otherwise specified with this Division, the Engineer will not approve or disapprove any alternate equipment or materials before the bids are opened.
   5. The cost of any changes to other trades as a result of use of the alternate material or equipment must be borne by the Contractor submitting such material or equipment.

D. Equipment of Substitution:
   1. Where items of equipment and materials are specifically identified herein by a single manufacturer’s name, or as many as three manufacturer’s names, model or catalog numbers, and the words “or equal and approved” follow the manufacturer’s name, such items may be substituted until such time that the “Schedule of Materials and Equipment” is submitted to the Architect or Engineer. The base bid and any alternate shall be based on materials only as specified or approved.

E. Where work required by the drawings and specification is above the standard required by local regulations, it shall be done as shown and/or specified.
1.06 METHODS OF REQUEST FOR APPROVAL:

A. The listing of any manufacturer as “acceptable” does not imply automatic approval. It is the sole responsibility of the Division 22 Contractor to ensure that any price quotations received and submittals made are for products which meet or exceed the specifications included herein.

B. The Contractor must judge that such items of substitution are of equal quality and character to the specified items and it is physically adaptable for installation within the allotted space with all required service clearances. This includes the following:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Will provide the same (or better) warranty for the substitution as for the specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to the Owner.
   4. Waives claims for additional costs or time extensions which may subsequently become apparent.
   5. Will reimburse Owner and Architect/Engineer for review or redesign services associated with re-approval by authorities.

C. The cost of any changes to other trades as a result of use of the substitution material or equipment must be borne by the Contractor submitting such material or equipment.

D. After the award of the contract, any request for a substitution must be made in writing by the Contractor (not material supplier or Sub-Contractor). Such request shall state the name of the product specified, the name of the product proposed for substitution, the reason for requesting the substitution, and any change in contract amount resulting from the substitution. No such substitution shall be made until an appropriate Contract Modification has been issued and approved.

E. Manufactured materials hereinafter specified or shown on the Drawings shall be installed or applied in accordance with the directions of the manufacturer unless specifically designated otherwise in the Specifications or on the Drawings.

F. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

G. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

H. Substitution Submittal Procedure:
   1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
   2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
   3. The Architect will notify Contractor in writing of decision to accept or reject request.
   4. Request shall be made in writing and be delivered to A/E no later than seven days prior to receipt of bids.

1.07 SUBMITTALS

A. Submittals for Review
   1. When the following are specified in individual sections, submit them for review:
      a. Product data.
      b. Shop drawings.
      c. Samples for selection.
      d. Samples for verification.
   2. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below.

B. Submittals for Information
   1. When the following are specified in individual sections, submit them for information:
a. Design data.
b. Certificates.
c. Test reports.
d. Inspection reports.
e. Manufacturer's instructions.
f. Other types indicated.

C. Submittals for Project Closeout
   1. When the following are specified in individual sections, submit them at project closeout:
      a. Project record documents.
      b. Operation and maintenance data.
      c. Warranties.
      d. Bonds.
      e. Test and balance reports.
      f. System certification as required.
      g. Other types as indicated.

D. Submittal of Shop Drawings:
   1. All hard copy submittals shall be compiled into an indexed three ring binder prior to submittal. Any loose leaf or stapled sheets will be rejected.
      a. Documents for Review:
         1) Small Size Sheets, Not Larger Than 8-1/2 x 11 inches (215 x 280 mm): Submit the number of copies that Contractor requires, plus three copies that will be retained by Architect.
         2) Larger Sheets, Not Larger Than 36 x 48 inches (910 x 1220 mm): Submit the number of opaque reproductions that Contractor requires, plus three copies that will be retained by Architect. A minimum of eight submittals shall be submitted.
      2. Electronic submittals shall be in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible or scanned files will be rejected.
         a. Submittals shall be for specific equipment to be provided on the project and not an entire catalog.
         3. Major components of the system shall be submitted at one time under a protective cover with each section indexed with visible file tabs. All equipment shall be labeled per the equipment tags on the drawings, ie. Equipment names, etc.
         4. Shop drawings shall indicate manufacturer name, model number, dimensions, voltage and current characteristics, construction and rough-in connections of all materials to be used. Each shop drawing shall be certified as being checked and approved by the Contractor before submittal.
         5. Shop drawings not indicated as being approved by the Contractor will be returned without review.
         6. The Contractor shall provide approved shop drawings with the Operating and Maintenance Manual.
         7. The following wording will appear on shop drawings reviewed by the Engineer. Contractors not wishing to comply with these conditions shall not submit a bid.
            "Corrections or comments made on the shop drawings during this review do not relieve Contractor from compliance with requirements of the Drawings and Specifications. This check is only for review of general compliance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating their work with that of all other trades and performing their work in a safe and satisfactory manner."
         8. The Engineer is not an error checker. Where the Contractor is submitting shop drawings that differ from the specifications, the Contractor must itemize in writing, each variance from the specifications. Failure to do so will be considered an error on the Contractors part and the specified materials shall be furnished. Shop drawings submitted in error or with
errors as compared to Specifications and Drawings will be the responsibility of the Contractor to correct such error later.

9. Shop drawings must only be those materials as specified or approved in published addendum. Others will be returned without review.

10. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of the completed Work.

11. When revised for resubmission, identify all changes made since previous submission.

12. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

13. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

E. Guarantee:

1. The Contractor shall assume responsibility for any defects which may develop in any part of his work caused by faulty workmanship, material or equipment, and agrees to replace, repair or alter, at his expense, any such faulty workmanship, material or equipment that has been brought to his attention during a period of one year from the date of the final certificate for payment. Acceptance of the work shall not waive this guarantee.

2. Note that individual specification sections may indicate longer warranty periods on specific components or parts. In each case, the more stringent warranty period shall govern.

3. For equipment or component parts of equipment put into service during construction for use by Owner, submit documents within 10 days after acceptance.

4. Any requested use of the equipment or component parts of equipment by the contractor for the contractor, whether the General Contractor or any subcontractor, shall be the responsibility of the contractor. The equipment or components shall be cleaned to new condition prior to substantial completion. Warranty shall begin at time of the project's substantial completion.

F. Operating and Maintenance Instructions:

1. For Each Item of Equipment and Each System:
   a. Description of unit or system, and component parts.
   b. Identify function, normal operating characteristics, and limiting conditions.
   c. Include performance curves, with engineering data and tests.
   d. Complete nomenclature and model number of replaceable parts.

2. 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.

3. 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.

4. Provide servicing and lubrication schedule, and list of lubricants required.

5. Include manufacturer's printed operation and maintenance instructions for each component.

6. Include sequence of operation by controls manufacturer.

7. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

8. Provide control diagrams by controls manufacturer as installed. (Record Drawings)

9. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

10. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

11. Include test and balancing reports.

12. One copy of each shop drawing shall be included in the notebooks but shall not serve in lieu of maintenance and operating instructions. Temperature control diagrams must include a description of the sequence of control.

13. The Contractor shall submit O&M Manuals to the Engineer, not the owner, for review. The Engineer will forward the manuals to the Owner.
14. This Contractor shall also supervise the initial operation as required to acquaint him thoroughly with the best practice.

15. This Contractor shall furnish the Engineer with a written statement from the Owner indicating complete acceptance of the equipment data and instruction of the operator. The Engineer will not approve the request for final payment until such statement has been submitted.

16. Additional Requirements: As specified in individual product specification sections.

17. Assembly of Operation and Maintenance Manuals
   a. Assemble operation and maintenance data into durable manuals for Owner's personnel use.
      1) Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; [3] inch ([76] mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
      2) Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify Contractor Name; identify Architect and Engineer Firms names; identify subject matter of contents.
      3) Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
      4) 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.
      5) 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. Where systems involve more than one specification section, provide separate tabbed divider for each system.
      6) Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
      7) Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
      8) Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.
      9) Arrange and organize the paper and digital version in the same manner.
   c. Provide both an electronic version of the O&M Manuals and a hard copy.

18. Additional Requirements: As specified in individual product specification sections.

G. Test Reports:
   1. Work which is required to be placed within the construction or concealed shall be carefully tested and inspected before being permanently concealed.
   2. Tests shall be made in the presence of the Engineer and the Owner, and shall meet with their approval. The Contractor shall notify the Engineer at a time sufficiently prior to the performance of any test to allow time for the Engineer to be present for the test.
   3. Instruments for making tests shall be furnished by this Contractor.
   4. The final test shall be performed as soon as possible after the work is entirely completed
   5. Test reports submitted electronically shall be in standard PDF format or submitted with software to view the file.

H. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.

1.08 JOB CONDITIONS:
   A. General:
      1. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
2. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.

B. Fees and Service Charges:
1. Permits, licenses, fees and service charges required in connection with the work shall be secured and paid for by this Contractor, and upon completion of the work he shall furnish proof of acceptance from the proper Local and State Department having jurisdiction.

C. Mechanical Symbols and Abbreviations:
1. Symbols and abbreviations are as indicated in legends on the Drawings.

D. Correlation of Work:
1. This Contractor shall be responsible for close correlation of his work with that of other Contractors and shall organize his work so that it will not interfere with or delay the work of other Contractors.
2. Field verification of scale dimensions on Plans is directed since actual locations, distances and levels will be governed by actual field conditions.
3. The Division 22 Contractor shall check architectural, structural, plumbing, heating and ventilating plans to avert possible installation conflicts. Should drastic changes from original Plans be necessary to resolve such conflicts, the Sub-Contractor shall notify the Prime Contractor who in turn shall notify the Architect or Engineer and secure written approval and agreement on necessary adjustments before the installation is started.
4. Discrepancies shown on different Plans, or between Plans and actual field conditions, or between Plans and Specifications, shall promptly be brought to the attention of the Architect or Engineer for a decision.
5. Where a discrepancy exists between drawing and specifications or other disciplines the worst cost case shall be provided.
6. Coordinate work of alterations and renovations to expedite completion sequentially and to accommodate occupancy requirements.
7. Verify utility requirements and characteristics of 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.
8. Coordinate space requirements, supports, and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility to other installations, for maintenance, and for repairs.
9. Coordinate completion and clean-up of work of separate sections.
10. 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.

E. Final Inspection:
1. Upon completion of work, the Contractor shall notify the Architect or Engineer in writing and make arrangements for a final observation. The Contractor shall also submit the operating and maintenance manuals at this time. The Engineer will not schedule nor perform a final inspection without successful submittal of operating and maintenance manuals by the Contractor.
2. During the final observation, pre-final or follow-up final, the Contractor and all his Prime Sub-Contractors shall have the foreman of the project present.
3. After the final observation is made, the Contractor will receive a list of items requiring adjustment, correction, replacement, or completion.
4. The Contractor shall comply completely with all the listed requirements within a negotiated number of days of receipt of list. Should the Contractor fail to complete items on the list within this time limit, the Owner reserves the right to have the work completed by others and the cost deducted from the contract price, including change orders.
5. The Contractor shall notify in writing to the Architect and/or Engineer once all punch list items are corrected, that he is ready for a follow-up final. The written notice shall contain explanations for those known items not completed and a schedule for completing them.

6. The Architect and/or Engineer shall schedule a follow-up final to confirm completion. Repeated observation trips required of the Engineer by the Contractor’s inability to complete the project satisfactorily will require the Contractor to reimburse the Engineer for all incurred costs after the follow-up final observation.

1.09 PROJECT COORDINATION

A. Project Coordinator: Construction Manager/General Contractor.

B. This section applies to all work performed and specified under Division 22.

C. Cooperate with the Construction manager/General Contractor and Owner in allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.

D. During construction, coordinate use of site and facilities through the Construction Manager/General Contractor.

E. Comply with specified procedures for intra-project communications, submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.

F. Comply with instructions of the Construction Manager / General Contractor for use of temporary utilities and construction facilities.

G. Coordinate field engineering and layout work under instructions of the Construction Manager/General Contractor.

H. 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.

I. Notify affected utility companies and comply with their requirements.

J. 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.

K. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

L. Coordinate installation of equipment, piping, ductwork, etc. with electrical gear. Equipment shall not be located in front of panels. Ductwork and piping shall not be routed above panels. Coordinate location of fire sprinkler equipment with Division 26.

M. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

N. Coordinate completion and clean-up of work of separate sections.

O. 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.

P. Make the following types of submittals to Architect/Engineer through the Construction Manager/General Contractor.

1. Requests for interpretation/information.
2. Requests for substitution.
3. Shop drawings, product data and samples.
4. Test and inspection reports.
5. Manufacturer’s instructions and field reports.
6. Applications for payment and change order requests.
7. Progress schedules.
8. Coordination drawings.
   a. Warranties
   b. Bonds
   c. System Certification
   d. Test and Balance Reports
10. As-built Record Drawings.
11. Operation and Maintenance Manuals.

1.10 DRAWINGS AND MEASUREMENTS
   A. Contract drawings for mechanical work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement of equipment, ducts, conduits, piping and approximate sizes and locations of equipment and outlets.
   B. Mechanical trades shall follow these drawings in laying out their work, consult general construction drawings to familiarize themselves with all conditions affecting their work, and shall verify spaces in which their work will be installed.
   C. Coordinate work with other trades as job conditions reasonably require.
   D. Where job conditions require reasonable changes in indicated locations and arrangement, make such changes without extra cost to Owner.
   E. The drawings are not intended to be scaled for roughing in measurements nor to serve as shop drawings.
   F. The Contractor shall consult the architectural, structural, mechanical, electrical, or equipment drawings for dimensions, obstructions, and location of equipment or other trades. Any discrepancies between architectural, structural, electrical, or equipment drawings and the mechanical work shown on these drawings shall be reported to the Engineers for adjustment.
   G. The installation details, instructions, and recommendations of the manufacturer of the product used, or modified to obtain the best end result, shall be the basis of attaining installation of the products for usage on this project except where definite and specific instructions are set forth herein or details are shown on the plans.

1.11 WORKMANSHIP
   A. The installation work included in this specification shall be performed in a neat workmanlike manner by people experienced and skilled in the Mechanical trade. Only the best quality workmanship will be accepted. All exposed parts of the systems such as exposed piping, plumbing fixtures, etc., shall be square and true with the building construction.

1.12 PATCHING MATERIALS
   A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

1.13 EQUIPMENT HOUSEKEEPING PADS
   A. Provide reinforced concrete housekeeping pads for all floor mounted plumbing equipment (i.e. water heaters, water softeners, compressors, etc.)
   B. Provide anchor bolts, per equipment manufacturer's directions, to attach equipment to pads.

1.14 KITCHEN EQUIPMENT
   A. Furnished and set in place under Division 114000.
   B. Final connections, sized and located as shown on the contract drawings shall be provided under Division 22. Contractor shall coordinate work with Kitchen Equipment Shop Drawings and make minor modifications regarding final connection requirements as needed for proper installation.

1.15 TRANSPORTATION AND HANDLING
   A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
B. Transport and handle products in accordance with manufacturer's instructions.
C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
F. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

1.16 STORAGE AND PROTECTION
A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
B. Store and protect products in accordance with manufacturers' instructions.
C. Store with seals and labels intact and legible.
D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
E. For exterior storage of fabricated products, place on sloped supports above ground.
F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
G. Prevent contact with material that may cause corrosion, discoloration, or staining.
H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.17 EQUIPMENT CLEAN-UP
A. Special care must be taken for protection of panels, switches, etc. All must be kept completely protected from weather elements, painting, etc. until the building is substantially completed. Damage from rust, paint, scratches, etc. shall be corrected as directed by the A/E.
B. Clean all plumbing fixtures, equipment, etc., thoroughly, just prior to final inspection. Plumbing fixtures, equipment, etc. shall be cleaned by an approved method.
C. Protection of plumbing equipment during painting of the building shall be the responsibility of the Painting Contractor. This shall not relieve the Plumbing Contractor of the responsibility for checking to assure that adequate protection is being provided.

1.18 CUTTING AND PATCHING
A. Execute cutting and patching to complete the work, to uncover work to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit Products together to integrate with other work.
B. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing.
C. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
D. In existing construction, this Contractor shall perform all cutting required and all necessary patching after completion to restore the surface to its original condition, unless otherwise indicated.
E. Should the cutting of walls, floors, ceiling, partitions, etc., be required for proper installation of the work or apparatus of this Contractor, or be made necessary on account of his failure to give General Contractor proper information at the time required, such cutting shall be done at his own expense, restoring the work to its original condition.

F. All cutting and patching done by this Contractor shall be subject to the direction and approval of the A/E. This Contractor shall not endanger the stability of the structure by cutting, digging, or otherwise, and shall not at any time cut or alter work of any other contractor without A/E’s consent.

1.19 SEALING OF PENETRATIONS
A. All penetrations for piping, etc. furnished under Division 22 of these specifications which penetrate fire and/or smoke walls and full height partitions (including chase walls), shall be sealed with a UL System specifically approved for the application.

1.20 EXCAVATING, TRENCHING AND BACKFILLING
A. This Contractor shall perform all excavation to the depths required, indicated on the drawings or specified. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from trench or other excavations to prevent slides or cave ins. All excavated materials not required or usable for backfilling shall be removed from the site. Necessary grading shall be done to prevent surface water from flowing into trenches or other excavations and onto adjacent property. Furnish all pumping required to keep excavated space clear of water during construction. The A/E will inspect excavation and approve soil conditions and direct procedure if unsatisfactory conditions are discovered. Provide sheeting and shoring as may be necessary for the protection of the work and the safety of personnel. Protect bottom of excavation from frost and do not place structures or pipe on frozen ground.

B. Except where excavations will be covered by at least 4” of concrete, this contractor shall provide electrical warning tape at least 6” above buried conduit or wire.

C. Backfill excavations below finished grades with similar materials to that removed in excavation, free from rubbish and other unsuitable material. Backfilling shall be done to finished grades indicated on drawings. If no finished grading is to be done in excavated areas, this Contractor shall backfill to existing grades and restore the surface to its original condition. All backfill shall be compacted in 6 inch lifts to 95% maximum density.

D. The Contractor shall be responsible for protecting trenches and provided adequate crossovers where pedestrian and vehicular traffic occurs. Guard rails, flags, lamps, etc. shall be used for such protection.

E. This Contractor shall be responsible for the replacement of existing street pavement, curbs, sidewalks, etc. removed or damaged by him in the course of the work unless such pavement, curbs and sidewalks are to be reconstructed under the General Contract. This Contractor shall make necessary arrangements to perform such repairs and shall pay all costs in connection therewith and include it in his bid.

F. Prior to any excavation, effort shall be made to determine whether underground installations (i.e., sewer, telephone, water, fuel, electric lines, etc.) will be encountered, and if so, where such underground installations are located. When the excavation approaches the estimated location of such installation, the exact location shall be determined and when it is uncovered, proper supports shall be provided for the existing installation. Utility companies shall be contacted and advised of proposed work prior to the start of actual excavation.

1.21 PROJECT CONDITIONS
A. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water.

C. ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere.
E. Erosion and Sediment Control: Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
   4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

F. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

G. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.

H. Verify that demolition is complete in alterations areas and areas are ready for installation of new work.

I. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

J. Verify that utility services are available, of these of the correct characteristics, and in the correct location.

K. 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. Protect work of other trades.

1.22 PREPARATION
A. Cut, move, or remove items as necessary for access to alterations and renovation work. Replace and restore at completion.
B. Remove unsuitable materials not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for furnished work.
C. Remove debris and abandoned items from area and from concealed spaces.
D. Close openings in exterior surfaces to protect existing work and salvage items from weather and extremes of temperature and humidity. Insulate ducts and piping to prevent condensation in exposed areas.
E. Prepare surfaces and remove surface finishes to provide for proper installation of new work and finishes.
F. Clean substrate surfaces prior to applying next materials or substance.
G. Seal cracks or openings of substrate prior to applying next material or substance.
H. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

1.23 GENERAL INSTALLATION REQUIREMENTS
A. Install products as specified in individual sections.
B. Make neat transitions. Patch work to match adjacent work in texture and appearance.

1.24 EXISTING UTILITIES
A. The plans indicate as accurately as possible the location, type and sizes of existing underground utilities at the site. It is the Contractor’s responsibility to have all utilities located prior to starting work. Contractor shall contact appropriate utility company and One Call for locating utilities prior to commencement of any work. The Owner also has underground conduit and other systems in place. Contractor shall contact the Owner prior to excavation in any area to determine any items that may be impacted by excavation.
B. This Contactor shall protect all utilities and Owner items affected by his work, and shall repair any damage caused by his forces at no additional cost to the Owner.

C. The Owner and the Owners’ of all underground facilities shall be notified at least 5 business days prior to excavation.

1.25 LAYING OUT THE WORK
A. Verify locations of survey control points prior to starting work.
B. Promptly notify Architect/Engineer of any discrepancies discovered.
C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
D. Promptly notify Architect/Engineer the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.
F. Utilize recognized engineering survey practices.
G. Establish elevations, lines and levels. Locate and layout by instrumentation and similar appropriate means.
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.
H. Periodically verify layouts by same means.
I. Maintain a complete and accurate log of control and survey work as it progresses.

1.26 TEMPORARY HEATING
A. Provide all temporary heating required for the facility during construction. Install and maintain facilities in a manner that will protect the public and workmen. Coordinate requirements with Prime Contractor.
B. Upon completion of work, remove all temporary heating from the project site.

1.27 PROGRESS CLEANING
A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition per OSHA standards.
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 rubbish from site periodically and dispose off-site.

1.28 PROTECTION OF INSTALLED WORK
A. Protect installed work and provide special protection where specified in individual specification sections.
B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage. This includes the protection of the work of other trades.
C. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
D. 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.
E. Prohibit traffic from landscaped area.

1.29 SYSTEM STARTUP
A. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
B. Verify that wiring and support components for equipment are complete and tested.
C. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
D. Any irregularities, faulty equipment, etc. shall be repaired or replaced as required prior to acceptance.
E. All equipment shall be freshly oiled, filters charged with clean media and installation completely finished prior to acceptance.

1.30 DEMONSTRATION AND INSTRUCTION
A. Contractor shall complete all start-up and perform all intimal testing of each system prior to scheduling or requesting to schedule training. All systems shall be completely operational before training or demonstration will occur.
B. Demonstrate operation and maintenance of Products to Owner's personnel prior to date of final inspection.
C. Demonstrate operation and maintenance of Products to Owner's representative at a scheduled time with the Owner.
D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.
E. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner Personnel.
F. Utilize operation and maintenance e manuals as basis for instruction. Review contents of manuals with Owner's personnel in detail to explain all aspects of operation and maintenance.

1.31 ADJUSTING
A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.32 FINAL CLEANING
A. Execute final cleaning prior to final project assessment.
B. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
C. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

1.33 CLOSEOUT PROCEDURES
A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect.
B. Notify Architect when work is considered finally complete.
C. Complete items of work determined by Architect's final inspection.

1.34 PROJECT RECORD DOCUMENTS
A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.
B. Ensure entries are complete and accurate, enabling future reference by Owner.
C. Record information concurrent with construction progress.
D. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Changes made by Addenda and modifications.
E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   2. Field changes of dimension and detail.
   3. Details not on original Contract Documents.
F. At completion of project Contractor shall provide a minimum of two (2) sets of As-Built Record drawings. Additional sets shall be provided if required under General Requirements.

1.35 WARRANTY AND BONDS
A. Obtain warranties and bonds, executed in duplicate by responsible Sub-Contractors, suppliers and manufacturers, within ten 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 the 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.
F. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Sub-Contractor, Supplier, and Manufacturer, with name address, and telephone number of responsible principal.
G. Warranty:
   1. The Contractor shall assume responsibility for any defects which may develop in any part of his work caused by faulty workmanship, material or equipment, and agrees to replace, repair or alter, at his expense, any such faulty workmanship, material or equipment that has been brought to his attention during a period of one year from the date of the final certificate for payment. Acceptance of the work shall not waive this guarantee.
   2. Note that individual specification sections may indicate longer warranty periods on specific components or parts. In each case, the more stringent warranty period shall govern.
   3. For equipment or component parts of equipment put into service during construction for use by Owner, submit documents within 10 days after acceptance.
      a. Any requested use of the equipment or component parts of equipment by the contractor for the contractor, whether the General Contractor or any subcontractor, shall be the responsibility of the contractor. The equipment or components shall be cleaned to new condition prior to substantial completion. Warranty shall begin at time of the project's substantial completion.

END OF SECTION
SECTION 22 0513
COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL
1.01 SECTION INCLUDES
  A. General construction and requirements.
  B. Applications.
  C. Single phase electric motors.
  D. Three phase electric motors.

1.02 RELATED REQUIREMENTS
  A. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.
  B. Section 26 2913 - Enclosed Controllers.

1.03 REFERENCE STANDARDS
  A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.
  C. NEMA MG 1 - Motors and Generators; 2018.
  D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS
  A. See Section 220010 - GENERAL PROVISIONS for submittal procedures.
  B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
  C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
  D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
  E. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.05 DELIVERY, STORAGE, AND HANDLING
  A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 PRODUCTS
2.01 MANUFACTURERS
  B. General Electric.
  C. Reliance Electric/Rockwell Automation.
  D. Louis Allis.
  E. TECO-Westinghouse.
  F. Toshiba.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS
  A. Electrical Service: Refer to Section 26 2717 for required electrical characteristics.
  B. Construction:
     1. Open drip-proof type except where specifically noted otherwise.
2. Design for continuous operation in 104 degrees F (40 degrees C) environment.
3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
4. Motors shall be of high efficiency type.
5. Provide inverter duty rated motors and shaft grounding kits for all motors driven by variable frequency drives (VFD’s).

C. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

D. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.03 APPLICATIONS

2.04 SINGLE PHASE POWER - SPLIT PHASE MOTORS
   A. Starting Torque: Less than 150 percent of full load torque.
   B. Starting Current: Up to seven times full load current.
   C. Breakdown Torque: Approximately 200 percent of full load torque.
   D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

2.05 SINGLE PHASE POWER - CAPACITOR START MOTORS
   A. Starting Torque: Three times full load torque.
   B. Starting Current: Less than five times full load current.
   C. Pull-up Torque: Up to 350 percent of full load torque.
   D. Breakdown Torque: Approximately 250 percent of full load torque.
   E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
   F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.

2.06 THREE PHASE POWER - SQUIRREL CAGE MOTORS
   B. Insulation System: NEMA Class B or better.
   C. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
   D. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
   E. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
   F. Sound Power Levels: To NEMA MG 1.
   G. Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
   H. Motors less than 5 HP shall have flexible power leads of sufficient length to extend 3 inches minimum beyond the face of the conduit terminal box.
I. Motors 5 HP and larger shall have terminal lugs.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
C. Check line voltage and phase and ensure agreement with nameplate.
D. Coordinate all final electrical requirements with Division 26.

END OF SECTION
SECTION 22 0519
METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Pressure gauges and pressure gauge taps.
B. Thermometers and thermometer wells.

1.02 RELATED REQUIREMENTS
A. 22 1005 - Plumbing Piping
B. Section 23 2213 - Steam and Condensate Heating Piping.

1.03 REFERENCE STANDARDS
A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.
D. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.04 SUBMITTALS
A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
B. Project Record Documents: Record actual locations of components and instrumentation.

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

PART 2 PRODUCTS

2.01 PRESSURE GAUGES
A. Manufacturers:
   1. Ashcroft (Duragage): www.ashcroft.com
   2. Crosby
   3. Trerice: www.trerice.com
   5. Miljoco
   6. Winters Instruments
   7. Weiss
B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
   2. Size: 4-1/2 inch (115 mm) diameter.
   3. Mid-Scale Accuracy: One percent.
   4. Scale: Psi.
   5. Range: Typical range shall be 1-1/2 times the normal operating pressure of the fluid being measured unless otherwise specified.
   6. Provide snubbers on gauges located at pumps.

2.02 PRESSURE GAUGE TAPPINGS
A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi (1034 kPa).
B. Needle Valve: Brass, 1/4 inch (6 mm) NPT for minimum 150 psi (1034 kPa).
2.03 STEM TYPE THERMOMETERS

A. Manufacturers:
   1. Moeller
   2. Trerice: www.trerice.com
   3. Dwyer Instruments, Inc: www.dwyer-inst.com
   4. Miljoco
   5. Winters Instruments
   6. Weiss

B. Scale range shall be as specified on the drawings with 2 degree division.

C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
   1. Size: 9 inch (225 mm) scale.
   2. Window: Clear Lexan.
   3. Accuracy: 2 percent, per ASTM E77.
   4. Calibration: Degrees F.

2.04 DIAL THERMOMETERS

A. Manufacturers:
   1. Dwyer Instruments, Inc: www.dwyer-inst.com
   2. Trerice: www.trerice.com
   3. Dwyer Instruments, Inc: www.dwyer-inst.com
   4. Miljoco
   5. Winters Instruments
   6. Weiss

B. Thermometers - Fixed Mounting: Dial type bimetallic actuated; ASTM E1; stainless steel case, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
   1. Size: 3 inch (75 mm) diameter dial.
   2. Lens: Clear Lexan.
   3. Accuracy: 1 percent.
   4. Calibration: Degrees F.

2.05 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B. Flange: 3 inch (75 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.06 TEST PLUGS

A. Test Plug: 1/4 inch (6 mm) or 1/2 inch (13 mm) brass fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F (176 degrees C).

B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch (60 mm) diameter pressure gauges, one gauge adapters with 1/8 inch (3 mm) probes, two 1 inch (25 mm) dial thermometers.
   1. Pressure gage range: 0 to 160 PSI.
   2. Thermometer ranges: -40 deg. F to 160 deg. F and 0 deg. F to 220 deg. F.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

C. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage. Extend nipples and siphons to allow clearance from insulation. Provide siphon on gages in steam systems.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch (60 mm) for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

E. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 23 0923.

F. Coil and conceal excess capillary on remote element instruments.

G. Provide instruments with scale ranges selected according to service with largest appropriate scale.

H. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

I. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.02 SCHEDULES

A. Pressure Gauges, Location and Scale Range:
   1. Pumps, 0 to 100 psi (0 to 690 kPa).
   2. Expansion tanks, 0 to 100 psi (0 to 690 kPa).
   3. Pressure reducing valves, 0 to 100 psi (0 to 690 kPa).

B. Pressure Gauge Tappings, Location:
   1. Major coils - inlets and outlets.

C. Stem Type Thermometers, Location and Scale Range:
   1. Coil banks - inlets and outlets, 0 to 200 degrees F (0 to 93 Degrees C).
   2. Heat exchangers - inlets and outlets, 0 to 200 degrees F (0 to 93 Degrees C).
   3. Domestic hot water supply and recirculation, 0 to 200 degrees F (0 to 93 Degrees C).

END OF SECTION
SECTION 22 0548
VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Vibration-isolated equipment support bases.
B. Vibration isolators.
C. Concrete bases.

1.02 RELATED REQUIREMENTS
A. Section 03 3000 - Cast-in-Place Concrete.

1.03 SUBMITTALS
A. See Section 220010 - GENERAL PROVISIONS, for submittal procedures.
B. Shop Drawings - Vibration Isolation Systems:
   1. Provide schedule of vibration isolator type with location and load on each.
   2. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
   3. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.
C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

PART 2 PRODUCTS
2.01 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

2.02 VIBRATION ISOLATORS
A. General Requirements:
   2. Spring Elements for Spring Isolators:
      a. Color code or otherwise identify springs to indicate load capacity.
      b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
      c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
      d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
      e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
      f. Selected to function without undue stress or overloading.
B. Vibration Isolators for Non-Seismic Applications:
   1. Resilient Material Isolator Mounts, Non-Seismic:
      a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material; fail-safe type.
   2. Restrained Spring Isolators, Non-Seismic:
      a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
      b. Bottom Load Plate: Steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
      c. Furnished with integral leveling device for positioning and securing supported equipment.
      d. Provides constant free and operating height.
3. Spring Isolator Hangers, Non-Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.

2.03 CONCRETE BASES
A. Provide concrete bases for mechanical equipment furnished under Division 15 unless otherwise indicated.
B. Construct bases of 3000 PSI, 28-day strength concrete.
C. Bases shall be plumb, smooth and shall be 4" high unless otherwise indicated.
D. Bases shall be set a minimum of seven (7) days prior to mounting equipment.
E. Set expansion bolts in bases for attachment of equipment and/or isolators.

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

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Nameplates.
   B. Tags.
   C. Pipe markers.

1.02 REFERENCE STANDARDS
   B. All marking codes shall be in accordance with ANSI standards.

1.03 SUBMITTALS
   A. See Section 220010 - GENERAL PROVISIONS, for submittal procedures.
   B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
   C. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS
   A. Piping: Tags.
   B. Pumps: Nameplates.
   C. Small-sized Equipment: Tags.
   D. Tanks: Nameplates.
   E. Valves: Tags.
   F. Water Treatment Devices: Nameplates.

2.02 MANUFACTURERS
   A. Brimar
   B. Brady Corporation
   C. Champion America
   D. Seton Identification Products

2.03 NAMEPLATES
   A. Description: Laminated three-layer plastic with engraved letters.
      2. Letter Height: 1/2 inch (13 mm).

2.04 TAGS
   A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.
   B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

2.05 PIPE MARKERS
   A. Comply with ASME A13.1.
   B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
C. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

PART 3 EXECUTION

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

3.02 INSTALLATION
A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
B. Install tags with corrosion resistant chain.
C. Install plastic pipe markers in accordance with manufacturer’s instructions.
D. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
E. Identify pumps, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
F. Identify control panels and major control components outside panels with plastic nameplates.
G. Identify valves in main and branch piping with tags.
H. Identify piping, concealed or exposed, with plastic tape pipe markers. Use tags on piping 3/4 inch (20 mm) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION
SECTION 22 0716
PLUMBING EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Equipment insulation.
   B. Covering.

1.02 RELATED REQUIREMENTS
   A. Section 22 0553 - Identification for Plumbing Piping and Equipment.
   B. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS
   B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
   J. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.

1.04 SUBMITTALS
   A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.
   B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 FIELD CONDITIONS
   A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
   B. Maintain temperature during and after installation for minimum period of 24 hours.
PART 2  PRODUCTS

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

2.02  GLASS FIBER, FLEXIBLE
  A. Manufacturers:
  B. Insulation: ASTM C553; flexible, noncombustible.
     1. K (Ksi) Value: 0.36 at 75 degrees F (0.052 at 24 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
     3. Maximum Water Vapor Absorption: 5.0 percent by weight.
  C. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
     1. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
     2. Secure with self-sealing longitudinal laps and butt strips.
  D. Vapor Barrier Lap Adhesive: Compatible with insulation.
  E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.03  GLASS FIBER, RIGID
  A. Manufacturer:
  B. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
     1. K (Ksi) Value: 0.25 at 75 degrees F (0.036 at 24 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
     3. Maximum Water Vapor Absorption: 5.0 percent by weight.
     4. Maximum Density: 8.0 lb/cu ft (128 kg/cu m).
  C. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
     1. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
     2. Secure with self-sealing longitudinal laps and butt strips.
     4. Secure with outward clinch expanding staples and vapor barrier mastic.
  D. Facing: 1 inch (25 mm) galvanized steel hexagonal wire mesh stitched on one face of insulation.
  E. Vapor Barrier Lap Adhesive: Compatible with insulation.
  F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.04  HYDROUS CALCIUM SILICATE
  A. Insulation: ASTM C533; rigid molded, asbestos free, gold color.
     1. K (Ksi) Value: 0.40 at 300 degrees F (0.057 at 148 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
3. Density: 15 lb/cu ft (249 kg/cu m).

B. Tie Wire: 0.048 inches (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

C. Insulating Cement: ASTM C449.

2.05 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3, in sheet form.
1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).

2.06 JACKETS

A. PVC Plastic:
1. Manufacturers:
2. Jacket: Sheet material, off-white color.
   a. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
   b. Maximum Service Temperature: 150 degrees F (66 degrees C).
   c. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
   d. Thickness: 10 mil (0.25 mm).
   e. Connections: Brush on welding adhesive.

B. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

1. Thickness: 0.016 inch (0.40 mm) sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
4. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Factory Insulated Equipment: Do not insulate.

C. Exposed Equipment: Locate insulation and cover seams in least visible locations.

D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

F. Insulated equipment containing fluids below ambient temperature: Insulate entire system.

G. For fiberglass insulated equipment containing fluids below ambient temperature, provide vapor barrier jackets, factory-applied or field-applied, and finish with glass cloth and vapor barrier adhesive.
H. For hot equipment containing fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
I. For hot equipment containing fluids over 140 degrees F (60 degrees C), insulate flanges and unions with removable sections and jackets.
J. Fiberglass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
K. Finish insulation at supports, protrusions, and interruptions.
L. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
M. Exterior Applications:
   1. Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement.
   2. Cover with aluminum or stainless steel.
N. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.
O. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
P. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.03 SCHEDULES
A. Plumbing Systems:
   1. Domestic Hot Water Storage Tanks:
      a. Glass Fiber, Rigid Insulation: 3 inches (75 mm) thick.
      b. Hydrous Calcium Silicate Insulation: 2 inches (50 mm) thick.

   END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Piping insulation.
   B. Jackets and accessories.

1.02 RELATED REQUIREMENTS
   A. Section 07 8400 - Firestopping.
   B. Section 09 9123 - Interior Painting: Painting insulation jacket.
   C. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS
   B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

1.04 SUBMITTALS
   A. See Section 220010 - GENERAL PROVISIONS, for submittal procedures.
   B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
   C. Manufacturer’s Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

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

1.06 FIELD CONDITIONS
   A. Maintain ambient conditions required by manufacturers of each product.
   B. Maintain temperature before, during, and after installation for minimum of 24 hours.
PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
B. All products shall conform to NFPA 90A and 90B.
C. Cold system insulation shall provide a complete vapor barrier.

2.02 GLASS FIBER

A. Manufacturers:

B. Insulation: ASTM C547; rigid molded, noncombustible.
   1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Insulation: ASTM C547; semi-rigid, noncombustible, end grain adhered to jacket.
   1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
   3. Maximum Moisture Absorption: 0.2 percent by volume.

D. Vapor Barrier Jacket: White polymer paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (0.029 ng/Pa s m).

E. Vapor Barrier Lap Adhesive: Compatible with insulation.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
   1. Manufacturers:

G. Fibrous Glass Fabric:
   1. Blanket: 1.0 lb/cu ft (16 kg/cu m) density.

H. Indoor Vapor Barrier Finish:
   1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
   2. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.03 HYDROUS CALCIUM SILICATE

A. Manufacturers:

B. Insulation: ASTM C533; rigid molded, asbestos free, gold color.
   1. K (Ksi) Value: 0.40 at 300 degrees F (0.057 at 149 degrees C) when tested in accordance with ASTM C177 or ASTM C518.
   3. Density: 15 lb/cu ft (240 kg/cu m).

C. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

D. Insulating Cement: ASTM C449.
2.04 JACKETS

A. PVC Plastic.
   1. Manufacturers:
      b. Speed-Line.
      c. Substitutions: See Section 01 6000 - Product Requirements.

2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
   a. Minimum Service Temperature: 0 degrees F (Minus 18 degrees C).
   b. Maximum Service Temperature: 150 degrees F (66 degrees C).
   c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
   d. Thickness: 10 mil (0.25 mm).
   e. Connections: Brush on welding adhesive.


B. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
   1. Lagging Adhesive: Compatible with insulation.

   1. Thickness: 0.016 inch (0.40 mm) sheet.
   2. Finish: Smooth.
   3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
   4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
   5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Exposed Piping: Locate insulation and cover seams in least visible locations.
C. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
D. Glass fiber insulated pipes conveying fluids below ambient temperature:
   1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
E. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
F. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.
G. Glass fiber insulated pipes conveying fluids above ambient temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
H. Inserts and Shields:
1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
2. Shields: [] between pipe hangers or pipe hanger rolls and inserts or piping on pipe diameters below 1-1/2 inch (38 mm).
   a. 16 gauge sheet metal for pipes 4 inch (102 mm) and over.
   b. 20 gauge sheet metal for pipes smaller than 4 inch (102 mm).
   c. Shield length shall be as follows:
      1) 4 inch (102 mm) diameter and smaller: 9 inch (229 mm)
      2) 6 inch (153 mm) to 10 inch (254 mm) diameter: 12 inch (305 mm)
   d. Form the shields to bear on the lower 1/3 periphery of the insulated pipe.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.

I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.

J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with PVC jacket and fitting covers.

K. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum or field applied jacket with seams located on bottom side of horizontal piping.

L. Items concealed within the insulation shall be clearly marked on the outside of the insulation covering.

M. Insulation of cold surfaces where vapor barrier jackets are used, jackets shall be applied with a continuous, unbroken vapor seal (hangers on outside of insulation jacket).

3.03 SCHEDULES
A. Plumbing Systems:
1. Domestic Hot Water Supply:
   a. Glass Fiber Insulation:
      1) Pipe Size Range: 1-1/2 inch (38 mm) or smaller run outs less than 12 feet (3.6 m) in length.
         (a) Thickness: 1 inch (25 mm).
      2) Pipe Size Range: thru 1-1/4 inch (32 mm)
         (a) Thickness: 1-1/2 inch (38 mm)
      3) Pipe Size Range: greater than 1-1/4 inch (32 mm)
         (a) Thickness: 2 inch (51 mm)
   b. Domestic Hot Water Recirculation:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: thru 1-1/4 inch (32 mm)
            (a) Thickness: 1 inch (25 mm)
      2) Pipe Size Range: Greater than 1-1/4 inch
         (a) Thickness: [1.5] inch
   c. Domestic Cold Water:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: greater than 1/2 inch (50 mm).
            (a) Thickness: 1 inch (25 mm).
   d. Roof Drain Bodies:
      a. Glass Fiber Insulation:
         1) Thickness: 1 inch (25 mm).
   e. Roof Drainage Above Grade:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: All sizes.
(a) Thickness: 1 inch (25 mm).

6. Plumbing Vents Within 5 Feet (___ Meters) of the Exterior:
   a. Glass Fiber Insulation:
      1) Pipe Size Range: All sizes.
         (a) Thickness: 1 inch (25 mm).

B. Other Systems:
   1. Condensate Drain Piping:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: 1 inch (25 mm) and less.
            (a) Thickness: 1/2 inch (12.5 mm).
         2) Pipe Size Range: thru 2 inch (50 mm).
            (a) Thickness: 3/4 inch (20 mm).
         3) Pipe Size Range: greater than 2 inch (50 mm).
            (a) Thickness: 1 inch (25 mm).

   END OF SECTION
SECTION 22 1005
PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, specialties, and connections for piping systems.
   1. Sanitary sewer.
   2. Domestic water.
   3. Storm water.
   4. Gas.
   5. Miscellaneous Drain Lines:
      a. Condensate.
   6. Flanges, unions, and couplings.
   7. Pipe hangers and supports.
   8. Valves.
   10. Water pressure reducing valves.

1.02 RELATED REQUIREMENTS

A. Section 22 0516 - Expansion Fittings and Loops for Plumbing Piping.
B. Section 22 0553 - Identification for Plumbing Piping and Equipment.
C. Section 22 0719 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
F. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.
G. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; 2012.
I. ASME B31.9 - Building Services Piping; 2014.
J. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.
1.04 QUALITY ASSURANCE
A. Perform work in accordance with State of Wyoming Standards.
B. Valves: Manufacturer’s name and pressure rating marked on valve body.
C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.05 REGULATORY REQUIREMENTS
A. Perform Work in accordance with State of Wyoming plumbing code.
B. Conform to applicable code for installation of backflow prevention devices.
C. All piping, equipment, valves, and fittings below 2" for use in systems designed for human consumption shall meet the federal lead free requirements outlined in Senate Bill S.3874. Lead free products shall not contain more that 0.2 percent lead when used with respect to solder and
flux; and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures.

1. Exemptions:
   a. Pipes, pipe fittings, or fixtures, including backflow preventers that are used exclusively for non-potable services such as manufacturing, industrial processing, irrigation, outdoor water, or any other uses where the water is not anticipated to be used for human consumption.
   b. Toilets, bidets, urinals, fill valves, flushometer valves, tub fillers, shower valves, service saddles, or water distribution main gate valves that are 2 inches in diameter or larger.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Provide temporary protective coating on cast iron and steel valves.
   B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
   C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS
   A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

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

2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING
   A. Cast Iron Pipe: ASTM A74 extra heavy weight.
      1. Fittings: Cast iron.
   B. Cast Iron Pipe: CISPI 301, hubless.
      1. Fittings: Cast iron.
      2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
   C. PVC Pipe: ASTM D2665 or ASTM D3034.
      1. Fittings: PVC.

2.03 SANITARY SEWER PIPING, ABOVE GRADE
   A. PLASTIC PIPING IS NOT PERMISSIBLE IN RETURN AIR PLENUM LOCATIONS.
   B. Cast Iron Pipe: ASTM A74, service weight.
      1. Fittings: Cast iron.
   C. Cast Iron Pipe: CISPI 301, hubless, service weight.
      1. Fittings: Cast iron.
   D. Copper Tube: ASTM B88 (ASTM B88M), Type L (B).
      1. Fittings: PVC.
2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. JOINTS WILL NOT BE ALLOWED UNDER FLOOR.
B. Piping [3] inch ([76] mm) size and larger shall be ductile-iron, piping [2] inch ([51] mm) and smaller shall be Type "K" soft drawn copper water tube. Schedule 80 PVC AWWA C900 plastic pipe shall be permitted where accepted by Local Code.
C. Copper Pipe: ASTM B42, annealed.
   1. Fittings: Ductile or gray iron, standard thickness.
   2. Joints: AWWA C111/A21.11, styrene butadiene rubber (SBR) or vulcanized SBR gasket with 3/4 inch (19 mm) diameter rods.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   3. Except as otherwise specified elsewhere, Type "L" soft drawn copper may be used adjacent to fixtures and equipment.
   5. Grooved Fittings: Cast bronze, grooved ends, ASTM B-584-87, or wrought copper, grooved ends ASTM B-75. Victaulic or approved equivalent.

2.06 STORM WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Coated inside and out.
   2. Fittings: Cast iron.
B. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC.

2.07 STORM WATER PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74 extra heavy weight.
   1. Coated inside and out.
   2. Fittings: Cast iron.
B. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
C. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC.

2.08 NATURAL GAS PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.

2.09 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
2. Joints: Threaded or welded to ASME B31.1.

B. Exposed piping in equipment rooms above push-up ceiling, and at equipment connections 2” and smaller pipe, below 1 psi (7 kPa):
1. Piping shall be black steel, Schedule 40, screw ends.
2. Fittings black malleable iron, screwed, standard weight 150 lb (68 kg) banded. Apply aluminum paint on visible threads after assembly.

2.10 MISCELLANEOUS DRAIN LINES RECEIVING CONDENSATE, DRIP FOR HUMIDIFIER, ETC.
A. Piping shall be Type "DWV" copper, fittings wrought copper, solder joint. Joints 50-50 solder and No. 50 flux.
B. Piping for condensate from high efficiency furnaces, water heaters, boiler vents (flues) and other condensing type equipment shall be as directed by equipment manufacturer.
C. Piping with in plenum ceilings shall also meet the 25/50 flame-smoke spread requirements.

2.11 FLANGES, UNIONS, AND COUPLINGS
A. ALL MATERIALS SHALL BE ACCEPTABLE FOR USE WITH THE MEDIUM BEING CARRIED IN THE PIPING SYSTEM.
B. Natural Gas:
   1. Piping 2 inch (51 mm) and smaller:
      a. Malleable iron unions with ground joint brass to iron seat, 150 psi (1034 kPa) working steam pressure.
   2. Pipe sizes 2-1/2 inch (64 mm) and larger (welded):
      a. Forged steel flanges, 150 psi (1034 kPa), welding neck or slip on with raised faces and 1/16 inch (1.6 mm) cross laminated gaskets and carbon steel bolts.
   3. Pipe sizes 2-1/2 inch (64 mm) and larger (screwed):
      a. Cast iron flanged unions, threaded, galvanized or black, 175 psi (1207 kPa) water, gasket type with carbon steel bolts.
C. Copper Piping:
   1. All pipe sizes:
      a. Copper, ground joint union.
D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.12 PIPE HANGERS AND SUPPORTS
A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
   3. Trapeze Hangers: Welded steel channel frames attached to structure.
B. Plumbing Piping - Drain, Waste, and Vent:
   1. Hangers for Pipe Sizes 1/2 Inch (15 mm) to 1-1/2 Inches (40 mm): Malleable iron, adjustable swivel, split ring.
   2. Hangers for Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
   3. Wall Support for Pipe Sizes to 3 Inches (80 mm): Cast iron hook.
   4. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
   5. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
   6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
C. Plumbing Piping - Water:
1. Hangers for Pipe Sizes 1/2 Inch (15 mm) to 1-1/2 Inches (40 mm): Malleable iron, adjustable swivel, split ring.
2. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
3. Hangers for Hot Pipe Sizes 2 Inches (50 mm) to 4 Inches (100 mm): Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.
5. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
6. Wall Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
7. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
8. Floor Support for Hot Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.

2.13 BALL VALVES
A. Manufacturers:
   1. Nibco, Inc; ______: www.nibco.com/#sle.
   2. Apollo.
   3. Watts
B. Construction, 4 Inches (100 mm) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.

2.14 BUTTERFLY VALVES
A. Manufactured in the USA.
B. Construction 1-1/2 Inches (40 mm) and Larger: MSS SP-67, 200 psi (1380 kPa) CWP, cast or ductile iron body, nickel-plated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, 10 position lever handle.
C. Provide gear operators for valves 8 inches (150 mm) and larger, and chain-wheel operators for valves mounted over 8 feet (2400 mm) above floor.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that excavations are to required grade, dry, and not over-excavated.

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

3.03 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. ABSOLUTELY NO PVC/ABS PLASTIC PIPING SHALL BE ALLOWED IN A RETURN AIR PLENUM.
C. PVC or ABS piping exposed to direct sunlight shall be fully coated with synthetic latex paint to protect against UV light.
D. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
E. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
F. Install piping to maintain headroom, conserve space, and not interfere with use of space.
G. Group piping whenever practical at common elevations.
H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 0516.
I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
J. Provide access where valves and fittings are not exposed. Doors shall be of approved dimensions with frame, brass hinges, handle, locking device and gasket for air tight joint.
K. Provide access where valves and fittings are not exposed.
L. Establish elevations of buried piping outside the building to ensure not less than 7 ft (2.1 m) of cover for water piping and [42] inch ([1] m) for sanitary sewer service.
M. Provide support for utility meters in accordance with requirements of utility companies.
N. Install bell and spigot pipe with bell end upstream.
O. Install valves with stems upright or horizontal, not inverted. Refer to Section 22 0523.
P. Extend valve handles beyond insulation where necessary.
Q. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
R. Install water piping to ASME B31.9.
S. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
T. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
U. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
V. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.
   2. Support horizontal piping as indicated.
   3. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
   4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
   5. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   9. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
10. HANGING FROM ONE PIPE TO ANOTHER SHALL BE STRICTLY PROHIBITED.
11. Provide copper plated hangers and supports for copper piping.
12. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
13. Support cast iron drainage piping at every joint.
14. Isolate copper piping from bearing on the cross member with an electrically insulating material.
15. Bear hot piping directly on hangers and cold piping on insulation shielded as described in Section 22 0719.

W. The right is reserved to authorize minor changes in pipe location to avoid conflicts with other trades at no additional cost to the Owner.
X. All lines shall be graded where possible to facilitate drainage. Provide drain valves at bottoms of risers.
Y. Where fixtures are supplied from overhead branch lines, branch lines where possible shall connect at bottom of mains and shall pitch down toward fixtures so that branch lines and/or mains may be drained through fixture.
Z. Branch lines shall be connected to top of mains where branches serve only fixtures located on floor above branch lines.
AA. Install chrome plated steel plates (escutcheons) with set screw and concealed hinge at all wall penetrations. Cut plates to fit flush at close spaced piping locations.
AB. Where waste and water piping is run in the same trench, installation shall conform to all governing codes.
AC. All gas piping shall be installed with plugged drip pockets at low points.

3.04 APPLICATION
A. Use grooved mechanical couplings and fasteners only in accessible locations.
B. Install unions downstream of valves and at equipment or apparatus connections.
C. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
D. Install globe valves for throttling, bypass, or manual flow control services.
E. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

3.05 TOLERANCES
A. Drainage Piping: Establish invert elevations and slopes as follows:
   1. 1/4 inch (6.4 mm) per 1 foot (0.3 m) minimum for pipe sizes 3 inch (76 mm) and smaller. Maintain gradients.
   2. 1/8 inch (3.2 mm) per 1 foot (0.3 m) minimum for pipe sizes 4 inch (102 mm) and larger. Maintain gradients.
B. Water Piping: Slope at minimum of 1/32 inch per foot (1:400) and arrange to drain at low points.
C. Soil, waste, vent piping and rainwater conductors, etc. shall be tested in accordance with applicable state and local codes.

3.06 PIPE TESTING
A. Test underground pipes, or pipes in chases and walls, before piping is concealed.
B. Test pipes before insulation is applied.
   1. If insulation is applied before pipe is tested and leak(s) occur which ruins insulation, pipe installing contractor arranged and pays for replacing damaged insulation and other damaged building components.
C. Domestic water piping shall be tested and proven water tight under a hydrostatic pressure of 100 PSIG. Pipe shall be tested with water pressure or equal inert gas such as nitrogen.
   1. Hold test pressure for minimum 8 hours.
   2. Test witnessed by Architect/Engineer or representative, if requested by University Construction Manager.
D. Hydrostatically test soil, waste, vent, and storm piping inside of building with 15 feet head of water and allow to stand for one hour for inspection before connecting fixtures. If leaks occur, repair and retest.

E. Water test pressurized soil mains at pressure equal to 1-1/2 times operating pump discharge pressure.

F. Test all other piping systems to a pressure of 150 percent of normal operating pressure and hold for 1 hour without showing a drop in pressure.
   1. Test piping using water, nitrogen or air compatible with the final piping service.

3.07 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfection of new systems shall meet all applicable Local Codes in addition to the following:
   1. Provide necessary connections to facilitate disinfection of entire system.
   2. Prior to starting work, verify system is complete, flushed and clean.
      a. Operate flush valves, faucets and other valves as needed until flow is clean.
      b. After flushing, remove inlet strainers, aerators and other devices, thoroughly clean and replace.
      c. Remove valve assemblies to clean out foreign material when necessary and replace assemblies.
   3. Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
   4. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
   5. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 30 percent of outlets.
   6. Maintain disinfectant in system for 24 hours.
   7. If final disinfectant residual tests less than 25 mg/L, repeat treatment until piping meets state and local bacteriological tests and is approved.
   8. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
   9. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.08 SERVICE CONNECTIONS

A. Coordinate with Owner’s Representative to make required service connections to existing systems.

B. Provide new sanitary and storm sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
   1. See Site Plan to verify extent of work under Division 22.

C. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve.
   1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
   2. Provide 18 gage, 0.0478 inch (1.21 mm) galvanized sheet metal sleeve around service main to 6 inch (150 mm) above floor and 6 feet (1800 mm) minimum below grade. Size for minimum of 2 inches (50 mm) of loose batt insulation stuffing.
   3. Provide remote readout on meter where required by local Water Department
   4. See Site Plan to verify extent of work under Division 22.

D. Provide new fire protection service complete with approved double check backflow preventer and shut-off valves with supervisory switches as indicated on the drawings.
   1. Provide 18 gage galvanized sheet metal sleeve around service main to 6 inch (152 mm) above floor and 6 inch (1.8 mm) minimum below grade. Size for minimum of 2 inch (51 mm) of loose batt insulation stuffing.
2. See Site Plan to verify extent of work under Division 22. Coordinate work requirements between Division 22 and Division 21.

E. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 7 inch wg. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

3.09 SCHEDULES

A. Pipe Hanger Spacing:
   1. Metal Piping:
      a. Pipe Size: 1/2 inches (15 mm) to 1-1/4 inches (32 mm):
         1) Maximum Hanger Spacing: 6.5 ft (2 m).
         2) Hanger Rod Diameter: 3/8 inches (9 mm).
      b. Pipe Size: 1-1/2 inches (40 mm) to 2 inches (50 mm):
         1) Maximum Hanger Spacing: 10 ft (3 m).
         2) Hanger Rod Diameter: 3/8 inch (9 mm).
      c. Pipe Size: 2-1/2 inches (65 mm) to 3 inches (75 mm):
         1) Maximum Hanger Spacing: 10 ft (3 m).
         2) Hanger Rod Diameter: 1/2 inch (13 mm).
      d. Pipe Size: 4 inches (100 mm) to 6 inches (150 mm):
         1) Maximum Hanger Spacing: 10 ft (3 m).
         2) Hanger Rod Diameter: 5/8 inch (15 mm).
      e. Pipe Size: 8 inches (200 mm) to 12 inches (300 mm):
         1) Maximum hanger spacing: 14 ft (4.25 m).
         2) Hanger Rod Diameter: 7/8 inch (22 mm).

END OF SECTION
SECTION 22 1006
PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Drains.
   B. Cleanouts.
   C. Hose bibbs.
   D. Hydrants.
   E. Refrigerator valve and recessed box.
   F. Back water valves.
   G. Backflow preventers.
   H. Double check valve assemblies.
   I. Water hammer arrestors.

1.02 RELATED REQUIREMENTS
   A. Section 22 1005 - Plumbing Piping.
   B. Section 22 3000 - Plumbing Equipment.
   C. Section 22 4000 - Plumbing Fixtures.

1.03 REFERENCE STANDARDS
   A. ASME A112.6.3 - Floor and Trench Drains; 2016.
   B. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2008 (Reaffirmed 2012).
   C. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2004, with Errata.
   D. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2009.
   E. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2011.
   F. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011 (Reaffirmed 2016).

1.04 SUBMITTALS
   A. See Section 220010 - GENERAL PROVISIONS, for submittal procedures.
   B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
   C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
   D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
   E. Operation Data: Indicate frequency of treatment required for interceptors.
   F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.05 REGULATORY REQUIREMENTS
   A. Perform Work in accordance with State of Wyoming plumbing code.
   B. Conform to applicable code for installation of backflow prevention devices.
   C. All piping, equipment, and fittings shall meet the federal lead free requirements.
PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

A. Manufacturers:
   2. Mifab.
   3. Sioux Chief.

B. Roof Drains:
   1. Assembly: ASME A112.6.4.
   2. Body: Lacquered cast iron with sump.
   4. Accessories: Coordinate with roofing type:
      a. Membrane flange and membrane clamp with integral gravel stop.
      b. Adjustable under deck clamp.
      c. Roof sump receiver.
      d. Waterproofing flange.
      e. Adjustable extension sleeve for roof insulation.

C. Roof Overflow Drains:
   1. Construction shall be the same as Roof Drain; pipe extended to [2] inches above flood elevation.

D. Downspout Nozzles:
   1. Bronze round with offset bottom section.

E. Floor Drain (FD-1):
   1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

F. Floor Drain (FD-3):
   1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer with polished bronze funnel or anti-splash rim.

G. Floor Drain (FD-4):
   1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze extra heavy duty strainer.

H. Floor Sink (FS-2):
   1. Square lacquered cast iron body with integral seepage pan, epoxy coated interior, aluminum dome strainer, nickel bronze frame, full grate.

2.03 CLEANOUTS

A. Manufacturers:
   4. MiFab.
   5. Sioux Chief.
   6. Substitutions: 220010 - GENERAL PROVISIONS.

B. Cleanouts at Exterior Surfaced Areas (CO-1):
1. Round cast nickel bronze access frame and non-skid cover.

C. Cleanouts at Exterior Unsurfaced Areas (CO-2):
   1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.

D. Cleanouts at Interior Finished Floor Areas (CO-3):
   1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

E. Cleanouts at Interior Finished Wall Areas (CO-4):
   1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

F. Cleanouts at Interior Unfinished Accessible Areas (CO-5): Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.04 HOSE BIBBS
A. Manufacturers:
   4. Substitutions: 220010 - GENERAL PROVISIONS.

2.05 HYDRANTS
A. Manufacturers:
   4. Woodford.
   5. Substitutions: 220010 - GENERAL PROVISIONS.

B. Wall Hydrants:
   1. ASSE 1019; freeze resistant, self-draining type with chrome plated wall plate hose thread spout, lockshield and removable key, and integral vacuum breaker.

2.06 REFRIGERATOR VALVE AND RECESSED BOX
A. Box Manufacturers:

B. Description: Plastic preformed rough-in box with brass valves with wheel handle, slip in finishing cover.

2.07 BACK WATER VALVES
A. Cast Iron Back Water Valves: ASME A112.6.4; lacquered cast iron body and cover, brass valve, extension sleeve, and access cover.

B. Plastic Back Water Valves: ABS body and valve, extension sleeve, and access cover.

2.08 BACKFLOW PREVENTERS
A. Manufacturers:

B. Reduced Pressure Backflow Preventers:
   1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back
pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.09 DOUBLE CHECK VALVE ASSEMBLIES

A. Manufacturers:

B. Double Check Valve Assemblies:
   1. ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.10 WATER HAMMER ARRESTORS

A. Manufacturers:
   4. Sioux Chief.

B. Water Hammer Arrestors:
   1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F (minus 73 to 149 degrees C) and maximum 250 psi (1700 kPa) working pressure.

2.11 DOMESTIC WATER RECIRCULATION BALANCING VALVES

A. Construction: Brass or bronze body with union on inlet and outlet, pressure compensating, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain. All valves shall have access capability to allow field exchange of internal components without removing valve body from piping. Valves shall have 2-32 psi operating range. Valve shall be lead free.

B. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3 psi.

C. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.

D. Accessories: Flow control valve shall be in a union (or flanged)/flow control device/ball valve configuration.

E. All valves shall be permanently marked to show direction of flow, flow rate and pressure range.
   1. Provide chain hung tags to indicate device served, service medium and flow rate.

F. Flow for each balancing valve shall be 0.33 GPM.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. CLEANOUTS MUST BE PROVIDED IN ACCORDANCE WITH THE LOCAL CODE AND AS SHOWN ON THE DRAWINGS.

D. Encase exterior cleanouts in concrete flush with grade.

E. Install floor cleanouts at elevation to accommodate finished floor.

F. Roof extension from soil, waste and vent pipes shall be extended at least 12 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.

1. These plugs must be of a type readily seen until removed.
2. Remove the plugs at once after the piping system has been tested.

G. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

H. Pipe relief from backflow preventer to nearest drain.

I. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks, washing machine outlets, or cold water supply to flush valves.

J. Install pressure reducing valves where indicated on drawings and where domestic water service pressure is 65 PSIG or higher at the meter. Install with specialties as indicated on the plans.

END OF SECTION
SECTION 22 3000
PLUMBING EQUIPMENT

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Water Heaters:
   B. Diaphragm-type compression tanks.
   C. In-line circulator pumps.

1.02 RELATED REQUIREMENTS
   A. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS
   A. ANSI Z21.10.1 - Gas Water Heaters - Volume I - Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less; 2014.
   B. ANSI Z21.10.3 - Gas-Fired Water Heaters - Volume III - Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous; 2015.

1.04 SUBMITTALS
   A. See Section 220010 - GENERAL PROVISIONS, for submittals procedures.
   B. Product Data:
      1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
      2. Indicate pump type, capacity, power requirements.
      3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
      4. Provide electrical characteristics and connection requirements.
   C. Shop Drawings:
      1. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
   D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
   E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE
   A. Certifications:
      3. Water heaters over 120 gallons or 199,000 BTUH shall be ASME Rated.
   B. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.07 WARRANTY
   A. See Section 220010 - GENERAL PROVISIONS, for additional warranty requirements.
   B. Provide five year manufacturer warranty for in-line circulator.
C. Provide ten year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.01 WATER HEATERS

A. Manufacturers:
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Commercial Gas Fired:
   1. Type: Automatic, natural gas-fired, vertical storage.
   2. Performance:
      3. Tank: Glass lined welded steel ASME labeled; multiple flue passages, 4 inch (100 mm) diameter inspection port, thermally insulated with minimum 2 inches (50 mm) glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
      4. Accessories:
         b. Dip Tube: Brass.
         c. Drain valve.
         d. Anode: Magnesium.
      5. Certified For The Following Applications:
         a. Automatic storage water heater.
         b. Automatic circulating tank water heater.
         c. For operation at 180 degrees F (82 degrees C).
         d. For operation on combustible floors.
         e. For operation in high altitude installations.
      6. Controls: Automatic direct immersion thermostat with temperature range adjustable minimum 175 degrees F (97 degrees C) differential, automatic reset high temperature limiting thermostat factory set at 195 degrees F (90 degrees C), gas pressure regulator, multi-ribbon or tubular burner, 100 percent safety shut-off pilot and thermocouple, intermittent electronic ignition monitoring pilot and main flame, trial for re-ignition for momentary loss of flame, shutdown of pilot and main burner in “2 to 4” seconds after loss of flame, and automatic flue damper.
      7. Water heater shall be UL listed and exceed the minimum efficiency requirements of the latest US Department of Energy approved version of ASHRAE 90.1.

2.02 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Manufacturers:
   5. Wilkins.

B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig (860 kPa), with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig (80 kPa).

PART 3 EXECUTION

3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
B. Coordinate with plumbing piping and related electrical work to achieve operating system.
C. Domestic Water Storage Tanks:
1. Provide steel pipe support, independent of building structural framing members.
2. Clean and flush prior to delivery to site. Seal until pipe connections are made.

D. Pumps:
1. Ensure shaft length allows sump pumps to be located minimum 24 inches (600 mm) below lowest invert into sump pit and minimum 6 inches (150 mm) clearance from bottom of sump pit.
2. Provide air cock and drain connection on horizontal pump casings.
3. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
4. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches (100 mm) and over.
5. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
6. Starters and wiring shall be provided under Division 26, Electrical.
7. Provide aquastat for control of domestic hot water circulating where indicated. Wiring shall be under Division 26.
8. Provide electrical interlocking from cooling condensate pump safety switch to associated HVAC unit(s) furnished under other Sections.

3.02 STARTING EQUIPMENT AND SYSTEMS
A. Provide manufacturer's field representative to prepare and start equipment.
B. Adjust for proper operation within manufacturer's published tolerances.
C. Demonstrate proper operation of equipment to Owner's designated representative.

3.03 SCHEDULES
A. Water Heaters:
   1. Drawing Code:
   2. Manufacturer:
   3. Model:
   4. Input:
   5. Heating Element Size:
   6. Number of Heating Elements:
   7. Recovery:
   8. Recovery Temperature Rise:
   9. Storage Capacity:
   10. Volt/phase:

B. Tanks:
   1. Drawing Code:
   2. Location:
   3. Service:
   4. Capacity:
   5. Diameter:
   6. Length:

C. Pumps:
   1. Drawing Code:
   2. Manufacturer:
   3. Model No.:
   4. Location:
   5. Service:
   6. Capacity:
   7. Head:
   8. Minimum Efficiency:
9. Seal Type:
10. Motor Size:
11. Motor volt/phase:

END OF SECTION
SECTION 22 4000
PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water closets.
B. Urinals.
C. Lavatories.
D. Sinks.
E. Service sinks.
F. Electric water coolers.
G. Piping Safety Covers.

1.02 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping.
B. Section 22 1006 - Plumbing Piping Specialties.
C. Section 22 3000 - Plumbing Equipment.
D. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

C. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).
D. ASME A112.18.1 - Plumbing Supply Fittings; 2018.
E. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2013.
F. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2017.
G. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2017.

1.04 SUBMITTALS

A. See Section 220010 - GENERAL PROVISIONS, for submittal procedures.
B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
C. Manufacturer's Instructions: Indicate installation methods and procedures.
D. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.
B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
B. All sensors on sensor operated fixtures shall be adjustable.
2.02 FLUSH VALVE WATER CLOSETS

A. Water Closets: Vitreous china, ASME A112.19.2, wall hung or floor mounted, siphon jet flush action, china bolt caps.
   1. Flush Volume: 1.6 gallon (6 liters), maximum.
   2. Maximum Performance (MaP): 750 grams per single flush, minimum rating.
   3. Flush Valve: Exposed (top spud).
   5. Handle Height: 44 inches (1117 mm) or less.
   6. Manufacturers:
      e. Sloan Company.

B. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
   1. Exposed Type: Chrome plated, escutcheon, integral screwdriver stop.
   2. Manufacturers:

C. Seats:
   1. Manufacturers:
   2. Solid white plastic, open front, extended back, self-sustaining hinge, brass bolts, with cover.

D. Water Closet Carriers:
   1. Manufacturers:

2.03 TANK TYPE WATER CLOSETS

A. Tank Type Water Closet Manufacturers:
   4. Eljer: www.eljer.com
   5. Sloan Company.

B. Bowl: ASME A112.19.2; floor mounted, siphon jet, vitreous china, 16.5 inches (420 mm) high, close-coupled closet combination with elongated rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps, vandalproof cover locking device.
   1. Water Consumption: Maximum 1.6 gallons (6 liters) per flush.

C. Seat Manufacturers:
D. Seat: Solid white plastic, open front, brass bolts, without cover.

2.04 WALL HUNG URINALS
A. Wall Hung Urinal Manufacturers:
   4. Eljer.
   5. Sloan Company
   1. Flush Volume: 1.0 gallons (3.7 liters), maximum.
   2. Flush Valve: Exposed (top spud).
   4. Trap: Integral.
C. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
   1. Sensor-Operated Type: Solenoid or motor-driven operator, low voltage hard-wired, infrared sensor with mechanical over-ride or over-ride push button.
   2. Exposed Type: Chrome plated, escutcheon, integral screwdriver stop.
D. Carriers:
   1. Manufacturers:
      c. Sloan Valve Company.
      d. Wade.

2.05 LAVATORIES
A. Lavatory Manufacturers:
   4. Eljer.
   5. Sloan Company.
B. Vitreous China Wall Hung Basin: ASME A112.19.2; vitreous china wall hung lavatory, 18 by 18 inch (___ by ___ mm) minimum, with 4 inch (100 mm) high back, rectangular basin with splash lip, front overflow, and soap depression.
   1. Drilling Centers: 4 inch (100 mm).
C. Vitreous China Counter Top Basin: ASME A112.19.2; vitreous china self-rimming counter top lavatory, 17 by 17 inch (___ by ___ mm) with drillings on 4 inch (100 mm) centers, front overflow, soap depression, seal of putty, calking, or concealed vinyl gasket.
D. Supply Faucet Manufacturers:
   4. Delta Commercial.
   5. Symmons.
E. Supply Faucet: ASME A112.18.1; chrome plated combination supply fitting with open grid strainer, water economy aerator with maximum flow of 2.2 gallons per minute (8.3 liters per minute), single lever handle.

F. Sensor Operated Faucet: Cast brass, chrome plated, deck mounted with sensor located on neck of spout.
   2. Power Supply: Battery, easily replaceable, alkaline or lithium, minimum 200,000 cycles.
   3. Mixing Valve: None, single line for tempered water.
   5. Aerator: Vandal resistant, 0.5 GPM (1.89 LPM), laminar flow device.
      a. Accessory: Optional remote reprogrammer module to adjust pre-set factory functions.
   7. Finish: Polished chrome.
   8. Accessory: 4 inch (102 mm) deck plate.
   9. Lead Content: Extra low; maximum 0.25 percent by weighed average.

G. Accessories:
   1. Offset waste with perforated open strainer.
   2. Loose key stops.
   3. Rigid supplies.
   4. Carrier:
      a. Manufacturers:
         3) Sloan Valve Company.

2.06 SINKS

A. Sink Manufacturers:
   5. Kohler: www.us.kohler.com

B. Single Compartment Bowl: ASME A112.19.3; outside dimensions 18 gage, 18 inch (___ mm) thick, Type 316 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
   1. Drain: 1-1/2 inch (38 mm) chromed brass drain.

C. Double Compartment Bowl: ASME A112.19.3; outside dimensions 18 gage, 18 inch (___ mm) thick, Type 316 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
   1. Drain: 1-1/2 inch (38 mm) chromed brass drain.

D. Trim:
   1. Manufacturers:
      e. Chicago.
      f. Speakman.
      g. Zurn AquaSpec.
   2. ASME A112.18.1M; chrome plated brass supply with swing spout, water economy aerator with maximum 2.2 gpm flow, single lever handle or indexed lever handles where indicated.
   3. Accessories: Chrome plated 17 gage brass P-trap and arm with escutcheon, loose key wheel handle stops, flexible supplies.
2.07 ELECTRIC WATER COOLERS
A. Electric Water Cooler Manufacturers:
   3. Oasis, a Lynn Tilton Company: www.oasiscoolers.com
B. Water Cooler: Electric, ARI 1010, mechanically refrigerated; surface handicapped mounted;
   stainless steel top, stainless steel body, elevated anti-squirt bubbler with stream guard,
   automatic stream regulator, push button, mounting bracket; with integral air cooled condenser
   mounted behind unit.
C. Water cooler shall be recessed behind unit.
D. Accessories:
   1. Flexible supplies.
   2. Loose key stops.
   3. Chrome plated 17 gage brass P-trap.
   4. "Lead Free" material certification from manufacturer.
   5. Bottle filler (where indicated).

2.08 SERVICE SINKS
A. Service Sink Manufacturers:
   4. Zurn Industries: www.zurn.com
B. Bowl: 24 by 24 by 10 inch (600 by 600 by 250 mm) high white molded stone, floor mounted,
   with one inch (25 mm) wide shoulders, vinyl bumper guard, stainless steel strainer.
C. Trim:
   1. Manufacturers:
      a. Delta Commercial.
      b. Fiat.
      c. T&S Brass.
      d. Chicago.
      e. Zurn AquaSpec.
   2. ASME A112.18.1 exposed wall type supply with lever handles, spout wall brace, vacuum
      breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops
      with covering caps and adjustable threaded wall flanges.
D. Accessories:
   1. 5 feet (1.5 m) of 1/2 inch (13 mm) diameter plain end reinforced plastic hose.
   2. Hose clamp hanger.
   3. Mop hanger.

2.09 PIPING SAFETY COVERS
A. Provide products that comply with the following:
   2. Requirements of applicable building code.
B. Manufacturers:
   1. Truebro Inc: ipscorp.com/plumbing/truebro
C. Characteristics: Three-piece molded assembly, minimum 1/8 inch (3 mm) wall thickness, with
   internal ribs to provide air space between piping and piping insulation jacket, molded to receive
   manufacturer's snap-clip fasteners.
D. Vinyl Material: Impact-resistant and stain-resistant molded closed-cell anti-microbial vinyl
   compound, UV-stable, non-fading, non yellowing; having the following performance
   characteristics:
1. Burning Characteristics: 0 seconds Average Time of Burning (ATB), 0 mm Area of Burning (AEB), when tested in accordance with ASTM D 635.
2. Thermal Conductivity: K-value 1.17 (2.02), when tested in accordance with ASTM C 177.
3. Indentation Hardness: 60, minimum, when tested in accordance with ASTM D 2240, using Type A durometer.

E. Trap Assembly Cover: Three-piece assembly, with removable clean-out nut enclosure.
F. Angle Stop Covers: Formed with hinged cap for access to valve without requiring cover removal.
G. Configurations: In accordance with manufacturer's product data for project piping configurations indicated on drawings.
H. Color: China White, gloss finish; paintable.
I. Fasteners: Manufacturer's standard re-usable snap-clip fasteners; wire-tie fasteners not permitted.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
B. Verify that electric power is available and of the correct characteristics.
C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.02 PREPARATION
A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION
A. Install each fixture with trap, easily removable for servicing and cleaning.
B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
C. Install components level and plumb.
D. Install and secure fixtures in place with wall supports and bolts.
E. All fixtures fitted to the walls or floor shall be ground and true and be sealed with a non-hardening white silicon caulk bead.
F. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.
G. 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.
H. Coordinate installation of wall sensor plates with grab bars.
I. Install chromium plated wall or floor plates (escutcheons) with set screw and concealed hinge where pipe passes through walls or floors.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS
A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
B. Coordinate wiring of sensor faucets with Division 26, Electrical.

3.05 ADJUSTING
A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING
A. Clean plumbing fixtures and equipment.
3.07 PROTECTION
A. Protect installed products from damage due to subsequent construction operations.
B. Do not permit use of fixtures by construction personnel.
C. Repair or replace damaged products before Date of Substantial Completion.

3.08 SCHEDULES
A. Fixture Heights: Install fixtures to heights above finished floor as indicated.
   1. Water Closet:
      a. Standard: 15 inches (380 mm) to top of bowl rim.
      b. Accessible: 18 inches (455 mm) to top of seat.
   2. Water Closet Flush Valves:
      a. Standard: 11 inches (280 mm) min. above bowl rim.
      b. Recessed: 10 inches (255 mm) min. above bowl rim.
   3. Urinal:
      a. Standard: 22 inches (560 mm) to top of bowl rim.
      b. Accessible: 17 inches (430 mm) to top of bowl rim.
   4. Lavatory:
      a. Standard: 31 inches (785 mm) to top of basin rim.
      b. Accessible: 34 inches (865 mm) to top of basin rim.
   5. Drinking Fountain:
      a. Standard Adult: 40 inches (1015 mm) to top of basin rim.
      b. Accessible: 36 inches (915 mm) to top of spout.
   6. Shower Heads:
      a. Adult Male: 69.5 inches (1765 mm) to bottom of head.
      b. Adult Female: 64.5 inches (1640 mm) to bottom of head.
   7. Emergency Eye and Face Wash:
      a. Standard: 38 inches (965 mm) to receptor rim.

END OF SECTION
SECTION 23 0010
GENERAL PROVISIONS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Quality Assurance
B. Methods of Request for Approval
C. Submittals
D. Job Conditions
E. Project Coordination
F. Additional General Provisions
G. Drawings and Measurements
H. Workmanship
I. Patching Materials
J. Equipment Housekeeping Pads
K. Kitchen Equipment
L. Equipment Clean-Up
M. Cutting and Patching
N. Sealing of Penetrations
O. Excavating, Trenching and Backfilling
P. Project Conditions
Q. Preparation
R. General Installation Requirements
S. Existing Utilities
T. Laying Out the Work
U. Temporary Heating
V. Progress Cleaning
W. Protection of Installed Work
X. System Startup
Y. Demonstration and Instruction
Z. Adjusting
AA. Final Cleaning
AB. Closeout Procedures
AC. Project Record Documents
AD. Warranty and Bonds

1.02 DEFINITIONS

A. Contractor
   1. The term “Contractor” refers to the installation Contractor responsible for the furnishing and installation of all work indicated within this Specification.

B. Furnish
   1. The term “furnish” is used to mean “purchase, supply, provide and deliver to the Project site, protect and provide interim storage and be ready for unloading, unpacking, assembly, installation, and similar operations in accordance with Manufacturer’s specifications.”

C. Provide
1. The terms “provide” means to “furnish and install, complete and ready for the intended use.”

D. Install
1. The term “install” is used to describe operations at project site including the actual “unloading, unpacking, rigging in place, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations”.

E. Installer
1. The “Installer” is the Contractor, Subcontractor and/or supplier who uses their own employees for performance of all construction

F. If Applicable:
1. The term “if applicable” will be that work which may be required for completed construction at applicable locations, but is not necessarily shown or described in the Contract Documents.

G. As Necessary
1. The term “as necessary” will be that work which is required for completed construction, but is not necessarily shown or described in the Contract Documents.

H. As Required
1. The term “as required” will be that work which is required for completed construction and is shown on the drawings or described in the project Specification.

I. Concealed
1. The term “concealed” means hidden from sight, buried as in chases, furred spaces, shafts, fixed ceiling or embedded in construction.

J. Exposed
1. The term “exposed” means bare, open to the elements, out in the open, uncovered.

K. Product
1. The term “product” will mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.

L. Substantial Completion
1. “Substantial Completion” is deemed that the project is sufficiently complete to be utilized for its intended use as stated in the body of this written Specification.

M. Words in the singular will also mean and include the plural, wherever the context so indicates, and words in the plural will mean the singular, wherever the context so indicates.

1.03 RELATED DOCUMENTS
A. The attached General Conditions, Supplementary General Conditions and Special Conditions or General Requirements are hereby incorporated into and shall become a part of all sections under DIVISION 23 – HEATING, VENTILATION, AND AIR CONDITIONING. In certain instances where the terms of this Division of the Specifications conflict with the terms of the General Conditions, or Special Conditions, this Division of the Specifications shall govern (or the more stringent requirement shall apply).

B. Where “Contractor” is referred to in this Specification it shall mean “Contractor, Sub-Contractor and/or Sub-Contractors under the Prime Contractor.”

1.04 DESCRIPTION OF WORK
A. The work shall include everything in this Division of the Specifications and everything indicated on the Drawings that is complementary to this Division of the Specifications. Refer to the Index of Drawings to determine what Drawings apply directly to this work.

1.05 QUALITY ASSURANCE
A. Codes and Standards:
1. All work shall be executed in accordance with the Local, State and other attending rules and regulations applicable to the trade affected and be subject to the inspection of these departments.
2. Materials and equipment shall be new and of best quality, of the type best suited for the purpose intended, and be made by nationally recognized and substantially established manufacturers. The type and weight of material used for each purpose shall be as herein specified, and material shall conform with the requirements of the latest standard specifications of the “ASTM” for that particular material.

3. Fire protection materials used in this work shall be listed by the Underwriters Laboratories, Inc. where testing is provided and shall bear their label.

4. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

5. Where the notation of NFPA is indicated the equipment shall conform to National Fire Protection Association Standard.

6. The following list of codes, technical societies, trade organizations and governing agencies shall set the standards by which all work shall be executed:
   a. City Fire Protection Ordinances
   b. State Fire Protection Laws and Statutes
   c. NFPA 13 and 14 Current Edition
   d. Underwriters Laboratories (UL)
   e. International Building Code (IBC)
   f. International Plumbing Code (IPC)
   g. International Fire Code (IFC)

B. Fees
   1. All fees, permits, licenses, etc., necessary in order to complete the work of this section shall be obtained and paid by this Contractor.

C. Alternate Equipment
   1. Where items of equipment and materials are specifically identified herein by a single manufacturer’s name, or as many as three manufacturer’s names, model or catalog numbers, and the words “or equal and approved” do not follow the manufacturer’s names, only such specific items may be used in the base bid, except as hereinafter provided.
   2. Items of equipment of the Contractor’s choice may be offered as alternates to such specified items, either in the spaces provided for same in the proposal form or if no space is provided, on the bidder’s letterhead attached to each copy of the proposal form.
   3. Alternate proposal must be accompanied by full descriptive and technical data for item proposed, together with statement or amount of cost addition or deduction from the base bid if alternate is accepted. Substitutions proposed by the Contractor will not be considered in the award of the contract.
   4. The Contractor must judge that such alternate equipment is of equal quality and character to the specified equipment, and it is physically adaptable for installation within the allotted space with all required service clearances. Unless otherwise specified with this Division, the Engineer will not approve or disapprove any alternate equipment or materials before the bids are opened.
   5. The cost of any changes to other trades as a result of use of the alternate material or equipment must be borne by the Contractor submitting such material or equipment.

D. Equipment of Substitution:
   1. Where items of equipment and materials are specifically identified herein by a single manufacturer’s name, or as many as three manufacturer’s names, model or catalog numbers, and the words “or equal and approved” follow the manufacturer’s name, such items may be substituted until such time that the “Schedule of Materials and Equipment” is submitted to the Architect or Engineer. The base bid and any alternate shall be based on materials only as specified or approved.

E. Where work required by the drawings and specification is above the standard required by local regulations, it shall be done as shown and/or specified.
1.06 METHODS OF REQUEST FOR APPROVAL:

A. The listing of any manufacturer as “acceptable” does not imply automatic approval. It is the sole responsibility of the Division 23 Contractor to ensure that any price quotations received and submittals made are for products which meet or exceed the specifications included herein.

B. The Contractor must judge that such items of substitution are of equal quality and character to the specified items and it is physically adaptable for installation within the allotted space with all required service clearances. This includes the following:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Will provide the same (or better) warranty for the substitution as for the specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to the Owner.
   4. Waives claims for additional costs or time extensions which may subsequently become apparent.
   5. Will reimburse Owner and Architect/Engineer for review or redesign services associated with re-approval by authorities.

C. The cost of any changes to other trades as a result of use of the substitution material or equipment must be borne by the Contractor submitting such material or equipment.

D. After the award of the contract, any request for a substitution must be made in writing by the Contractor (not material supplier or Sub-Contractor). Such request shall state the name of the product specified, the name of the product proposed for substitution, the reason for requesting the substitution, and any change in contract amount resulting from the substitution. No such substitution shall be made until an appropriate Contract Modification has been issued and approved.

E. Manufactured materials hereinafter specified or shown on the Drawings shall be installed or applied in accordance with the directions of the manufacturer unless specifically designated otherwise in the Specifications or on the Drawings.

F. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

G. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

H. Substitution Submittal Procedure:
   1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
   2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
   3. The Architect will notify Contractor in writing of decision to accept or reject request.
   4. Request shall be made in writing and be delivered to A/E no later than seven days prior to receipt of bids.

1.07 SUBMITTALS

A. Submittals for Review
   1. When the following are specified in individual sections, submit them for review:
      a. Product data.
      b. Shop drawings.
      c. Samples for selection.
      d. Samples for verification.
   2. After review, provide copies and distribute in accordance with SUBMITTALL PROCEEDURES article below.

B. Submittals for Information
   1. When the following are specified in individual sections, submit them for information:
a. Design data.
b. Certificates.
c. Test reports.
d. Inspection reports.
e. Manufacturer’s instructions.
f. Other types indicated.

C. Submittals for Project Closeout
   1. When the following are specified in individual sections, submit them at project closeout:
      a. Project record documents.
      b. Operation and maintenance data.
      c. Warranties.
      d. Bonds.
      e. Test and balance reports.
      f. System certification as required.
      g. Other types as indicated.

D. Submittal of Shop Drawings:
   1. All hard copy submittals shall be compiled into an indexed three ring binder prior to submission. Any loose leaf or stapled sheets will be rejected.
      a. Documents for Review:
         1) Small Size Sheets, Not Larger Than 8-1/2 x 11 inches (215 x 280 mm): Submit the number of copies that Contractor requires, plus three copies that will be retained by Architect.
         2) Larger Sheets, Not Larger Than 36 x 48 inches (910 x 1220 mm): Submit the number of opaque reproductions that Contractor requires, plus three copies that will be retained by Architect. A minimum of eight submittals shall be submitted.
      2. Electronic submittals shall be in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible or scanned files will be rejected.
         a. Submittals shall be for specific equipment to be provided on the project and not an entire catalog.
      3. Major components of the system shall be submitted at one time under a protective cover with each section indexed with visible file tabs. All equipment shall be labeled per the equipment tags on the drawings, ie. Equipment names, etc.
      4. Shop drawings shall indicate manufacturer name, model number, dimensions, voltage and current characteristics, construction and rough-in connections of all materials to be used. Each shop drawing shall be certified as being checked and approved by the Contractor before submittal.
      5. Shop drawings not indicated as being approved by the Contractor will be returned without review.
      6. The Contractor shall provide approved shop drawings with the Operating and Maintenance Manual.
      7. The following wording will appear on shop drawings reviewed by the Engineer. Contractors not wishing to comply with these conditions shall not submit a bid.
         “Corrections or comments made on the shop drawings during this review do not relieve Contractor from compliance with requirements of the Drawings and Specifications. This check is only for review of general compliance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating their work with that of all other trades and performing their work in a safe and satisfactory manner.”
      8. The Engineer is not an error checker. Where the Contractor is submitting shop drawings that differ from the specifications, the Contractor must itemize in writing, each variance from the specifications. Failure to do so will be considered an error on the Contractors part and the specified materials shall be furnished. Shop drawings submitted in error or with
errors as compared to Specifications and Drawings will be the responsibility of the Contractor to correct such error later.

9. Shop drawings must only be those materials as specified or approved in published addendum. Others will be returned without review.

10. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of the completed Work.

11. When revised for resubmission, identify all changes made since previous submission.

12. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

13. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

E. Guarantee:
1. The Contractor shall assume responsibility for any defects which may develop in any part of his work caused by faulty workmanship, material or equipment, and agrees to replace, repair or alter, at his expense, any such faulty workmanship, material or equipment that has been brought to his attention during a period of one year from the date of the final certificate for payment. Acceptance of the work shall not waive this guarantee.

2. Note that individual specification sections may indicate longer warranty periods on specific components or parts. In each case, the more stringent warranty period shall govern.

3. For equipment or component parts of equipment put into service during construction for use by Owner, submit documents within 10 days after acceptance.

4. Any requested use of the equipment or component parts of equipment by the contractor for the contractor, whether the General Contractor or any subcontractor, shall be the responsibility of the contractor. The equipment or components shall be cleaned to new condition prior to substantial completion. Warranty shall begin at time of the project's substantial completion.

F. Operating and Maintenance Instructions:
1. For Each Item of Equipment and Each System:
   a. Description of unit or system, and component parts.
   b. Identify function, normal operating characteristics, and limiting conditions.
   c. Include performance curves, with engineering data and tests.
   d. Complete nomenclature and model number of replaceable parts.

2. 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.

3. 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.

4. Provide servicing and lubrication schedule, and list of lubricants required.

5. Include manufacturer's printed operation and maintenance instructions for each component.

6. Include sequence of operation by controls manufacturer.

7. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

8. Provide control diagrams by controls manufacturer as installed. (Record Drawings)

9. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

10. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

11. Include test and balancing reports.

12. One copy of each shop drawing shall be included in the notebooks but shall not serve in lieu of maintenance and operating instructions. Temperature control diagrams must include a description of the sequence of control.

13. The Contractor shall submit O&M Manuals to the Engineer, not the owner, for review. The Engineer will forward the manuals to the Owner.
14. This Contractor shall also supervise the initial operation as required to acquaint him thoroughly with the best practice.

15. This Contractor shall furnish the Engineer with a written statement from the Owner indicating complete acceptance of the equipment data and instruction of the operator. The Engineer will not approve the request for final payment until such statement has been submitted.

16. Additional Requirements: As specified in individual product specification sections.

17. Assembly of Operation and Maintenance Manuals
   a. Assemble operation and maintenance data into durable manuals for Owner's personnel use.
      1) Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; [3] inch ([76] mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
      2) Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify Contractor Name; identify Architect and Engineer Firms names; identify subject matter of contents.
      3) Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
      4) 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.
      5) 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. Where systems involve more than one specification section, provide separate tabbed divider for each system.
      6) Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
      7) Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
      8) Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.
      9) Arrange and organize the paper and digital version in the same manner.
   c. Provide both an electronic version of the O&M Manuals and a hard copy.

18. Additional Requirements: As specified in individual product specification sections.

G. Test Reports:
   1. Work which is required to be placed within the construction or concealed shall be carefully tested and inspected before being permanently concealed.
   2. Tests shall be made in the presence of the Engineer and the Owner, and shall meet with their approval. The Contractor shall notify the Engineer at a time sufficiently prior to the performance of any test to allow time for the Engineer to be present for the test.
   3. Instruments for making tests shall be furnished by this Contractor.
   4. The final test shall be performed as soon as possible after the work is entirely completed.
   5. Test reports submitted electronically shall be in standard PDF format or submitted with software to view the file.

H. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.

1.08 JOB CONDITIONS:
   A. General:
      1. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
2. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.

B. Fees and Service Charges:
   1. Permits, licenses, fees and service charges required in connection with the work shall be secured and paid for by this Contractor, and upon completion of the work he shall furnish proof of acceptance from the proper Local and State Department having jurisdiction.

C. Mechanical Symbols and Abbreviations:
   1. Symbols and abbreviations are as indicated in legends on the Drawings.

D. Correlation of Work:
   1. This Contractor shall be responsible for close correlation of his work with that of other Contractors and shall organize his work so that it will not interfere with or delay the work of other Contractors.
   2. Field verification of scale dimensions on Plans is directed since actual locations, distances and levels will be governed by actual field conditions.
   3. The Division 23 Contractor shall check architectural, structural, plumbing, heating and ventilating plans to avert possible installation conflicts. Should drastic changes from original Plans be necessary to resolve such conflicts, the Sub-Contractor shall notify the Prime Contractor who in turn shall notify the Architect or Engineer and secure written approval and agreement on necessary adjustments before the installation is started.
   4. Discrepancies shown on different Plans, or between Plans and actual field conditions, or between Plans and Specifications, shall promptly be brought to the attention of the Architect or Engineer for a decision.
   5. Where a discrepancy exists between drawing and specifications or other disciplines the worst cost case shall be provided.
   6. Coordinate work of alterations and renovations to expedite completion sequentially and to accommodate occupancy requirements.
   7. Verify utility requirements and characteristics of 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.
   8. Coordinate space requirements, supports, and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility to other installations, for maintenance, and for repairs.
   9. Coordinate completion and clean-up of work of separate sections.
   10. 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.

E. Final Inspection:
   1. Upon completion of work, the Contractor shall notify the Architect or Engineer in writing and make arrangements for a final observation. The Contractor shall also submit the operating and maintenance manuals at this time. The Engineer will not schedule nor perform a final inspection without successful submittal of operating and maintenance manuals by the Contractor.
   2. During the final observation, pre-final or follow-up final, the Contractor and all his Prime Sub-Contractors shall have the foreman of the project present.
   3. After the final observation is made, the Contractor will receive a list of items requiring adjustment, correction, replacement, or completion.
   4. The Contractor shall comply completely with all the listed requirements within a negotiated number of days of receipt of list. Should the Contractor fail to complete items on the list within this time limit, the Owner reserves the right to have the work completed by others and the cost deducted from the contract price, including change orders.
5. The Contractor shall notify in writing to the Architect and/or Engineer once all punch list items are corrected, that he is ready for a follow-up final. The written notice shall contain explanations for those known items not completed and a schedule for completing them.

6. The Architect and/or Engineer shall schedule a follow-up final to confirm completion. Repeated observation trips required of the Engineer by the Contractor’s inability to complete the project satisfactorily will require the Contractor to reimburse the Engineer for all incurred costs after the follow-up final observation.

1.09 PROJECT COORDINATION

A. Project Coordinator: Construction Manager/General Contractor.

B. This section applies to all work performed and specified under Division 23.

C. Cooperate with the Construction manager/General Contractor and Owner in allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.

D. During construction, coordinate use of site and facilities through the Construction Manager/General Contractor.

E. Comply with specified procedures for intra-project communications, submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.

F. Comply with instructions of the Construction Manager / General Contractor for use of temporary utilities and construction facilities.

G. Coordinate field engineering and layout work under instructions of the Construction Manager/General Contractor.

H. 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.

I. Notify affected utility companies and comply with their requirements.

J. 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.

K. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

L. Coordinate installation of equipment, piping, ductwork, etc. with electrical gear. Equipment shall not be located in front of panels. Ductwork and piping shall not be routed above panels. Coordinate location of HVAC equipment with Division 26.

M. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

N. Coordinate completion and clean-up of work of separate sections.

O. 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.

P. Make the following types of submittals to Architect/Engineer through the Construction Manager/General Contractor.
   1. Requests for interpretation/information.
   2. Requests for substitution.
   3. Shop drawings, product data and samples.
   4. Test and inspection reports.
   5. Manufacturer's instructions and field reports.
   6. Applications for payment and change order requests.
   7. Progress schedules.
8. Coordination drawings.
   a. Warranties
   b. Bonds
   c. System Certification
   d. Test and Balance Reports
10. As-built Record Drawings.
11. Operation and Maintenance Manuals.

1.10 DRAWINGS AND MEASUREMENTS
   A. Contract drawings for mechanical work are in part diagrammatic, intended to convey the scope
      of work and indicate general arrangement of equipment, ducts, conduits, piping and
      approximate sizes and locations of equipment and outlets.
   B. Mechanical trades shall follow these drawings in laying out their work, consult general
      construction drawings to familiarize themselves with all conditions affecting their work, and shall
      verify spaces in which their work will be installed.
   C. Coordinate work with other trades as job conditions reasonably require.
   D. Where job conditions require reasonable changes in indicated locations and arrangement,
      make such changes without extra cost to Owner.
   E. The drawings are not intended to be scaled for roughing in measurements nor to serve as shop
      drawings.
   F. The Contractor shall consult the architectural, structural, mechanical, electrical, or equipment
      drawings for dimensions, obstructions, and location of equipment or other trades. Any
      discrepancies between architectural, structural, electrical, or equipment drawings and the HVAC
      work shown on these drawings shall be reported to the Engineers for adjustment.
   G. The installation details, instructions, and recommendations of the manufacturer of the product
      used, or modified to obtain the best end result, shall be the basis of attaining installation of the
      products for usage on this project except where definite and specific instructions are set forth
      herein or details are shown on the plans.

1.11 WORKMANSHIP
   A. The installation work included in this specification shall be performed in a neat workmanlike
      manner by people experienced and skilled in the HVAC trade. Only the best quality
      workmanship will be accepted. All exposed parts of the systems such as exposed piping, HVAC
      Equipment, etc., shall be square and true with the building construction.

1.12 PATCHING MATERIALS
   A. New Materials: As specified in product sections; match existing products and work for patching
      and extending work.

1.13 EQUIPMENT HOUSEKEEPING PADS
   A. Provide reinforced concrete housekeeping pads for all floor mounted HVAC equipment (i.e. air
      handling units, pumps, expansion tanks, chillers, heat pumps, etc.)
   B. Provide anchor bolts, per equipment manufacturer's directions, to attach equipment to pads.

1.14 KITCHEN EQUIPMENT
   A. Furnished and set in place under Division 114000.
   B. Final connections, sized and located as shown on the contract drawings shall be provided under
      Division 23. Contractor shall coordinate work with Kitchen Equipment Shop Drawings and make
      minor modifications regarding final connection requirements as needed for proper installation.

1.15 TRANSPORTATION AND HANDLING
   A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site
      storage time and potential damage to stored materials.
B. Transport and handle products in accordance with manufacturer's instructions.
C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
F. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

1.16 STORAGE AND PROTECTION
A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
B. Store and protect products in accordance with manufacturers' instructions.
C. Store with seals and labels intact and legible.
D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
E. For exterior storage of fabricated products, place on sloped supports above ground.
F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
G. Prevent contact with material that may cause corrosion, discoloration, or staining.
H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.17 EQUIPMENT CLEAN-UP
A. Special care must be taken for protection of air handling equipment, pumps, etc. All must be kept completely protected from weather elements, painting, etc. until the building is substantially completed. Damage from rust, paint, scratches, etc. shall be corrected as directed by the A/E.
B. Clean all registers, grilles, diffusers, air handling equipment, etc., thoroughly, just prior to final inspection. Equipment shall be cleaned by an approved method.
C. Protection of HVAC equipment during painting of the building shall be the responsibility of the Painting Contractor. This shall not relieve the HVAC Contractor of the responsibility for checking to assure that adequate protection is being provided.

1.18 CUTTING AND PATCHING
A. Execute cutting and patching to complete the work, to uncover work to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit Products together to integrate with other work.
B. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing.
C. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
D. In existing construction, this Contractor shall perform all cutting required and all necessary patching after completion to restore the surface to its original condition, unless otherwise indicated.
E. Should the cutting of walls, floors, ceiling, partitions, etc., be required for proper installation of
the work or apparatus of this Contractor, or be made necessary on account of his failure to give
General Contractor proper information at the time required, such cutting shall be done at his
own expense, restoring the work to its original condition.

F. All cutting and patching done by this Contractor shall be subject to the direction and approval of
the A/E. This Contractor shall not endanger the stability of the structure by cutting, digging, or
otherwise, and shall not at any time cut or alter work of any other contractor without A/E's
consent.

1.19 SEALING OF PENETRATIONS

A. All penetrations for piping, etc. furnished under Division 23 of these specifications which
penetrate fire and/or smoke walls and full height partitions (including chase walls), shall be
sealed with a UL System specifically approved for the application.

1.20 EXCAVATING, TRENCHING AND BACKFILLING

A. This Contractor shall perform all excavation to the depths required, indicated on the drawings or
specified. During excavation, material suitable for backfilling shall be piled in an orderly manner
a sufficient distance from trench or other excavations to prevent slides or cave ins. All
evacuated materials not required or usable for backfilling shall be removed from the site.
Necessary grading shall be done to prevent surface water from flowing into trenches or other
excavations and onto adjacent property. Furnish all pumping required to keep excavated space
clear of water during construction. The A/E will inspect excavation and approve soil conditions
and direct procedure if unsatisfactory conditions are discovered. Provide sheeting and shoring
as may be necessary for the protection of the work and the safety of personnel. Protect bottom
of excavation from frost and do not place structures or pipe on frozen ground.

B. Except where excavations will be covered by at least 4” of concrete, this contractor shall provide
electrical warning tape at least 6” above buried conduit or wire.

C. Backfill excavations below finished grades with similar materials to that removed in excavation,
free from rubbish and other unsuitable material. Backfilling shall be done to finished grades
indicated on drawings. If no finished grading is to be done in excavated areas, this Contractor
shall backfill to existing grades and restore the surface to its original condition. All backfill shall
be compacted in 6 inch lifts to 95% maximum density.

D. The Contractor shall be responsible for protecting trenches and provided adequate crossovers
where pedestrian and vehicular traffic occurs. Guard rails, flags, lamps, etc. shall be used for
such protection.

E. This Contractor shall be responsible for the replacement of existing street pavement, curbs,
sidewalks, etc. removed or damaged by him in the course of the work unless such pavement,
curbs and sidewalks are to be reconstructed under the General Contract. This Contractor
shall make necessary arrangements to perform such repairs and shall pay all costs in connection
therewith and include it in his bid.

F. Prior to any excavation, effort shall be made to determine whether underground installations
(i.e., sewer, telephone, water, fuel, electric lines, etc.) will be encountered, and if so, where such
underground installations are located. When the excavation approaches the estimated location
of such installation, the exact location shall be determined and when it is uncovered, proper
supports shall be provided for the existing installation. Utility companies shall be contacted and
advised of proposed work prior to the start of actual excavation.

1.21 PROJECT CONDITIONS

A. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water.

C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent
accumulation of dust, fumes, vapors, or gases.

D. Dust Control: Execute work by methods to minimize raising dust from construction operations.
Provide positive means to prevent air-borne dust from dispersing into atmosphere.
E. Erosion and Sediment Control: Plan and execute construction by methods to control surface
drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and
sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   3. Construct fill and waste areas by selective placement to avoid erosive surface silts or
      clays.
   4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly
      apply corrective measures.

F. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil,
water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by
construction operations.

G. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work.
Beginning new work means acceptance of existing conditions.

H. Verify that demolition is complete in alterations areas and areas are ready for installation of new
work.

I. Verify that existing substrate is capable of structural support or attachment of new work being
    applied or attached.

J. Verify that utility services are available, of these of the correct characteristics, and in the correct
    location.

K. 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. Protect work of other trades.

1.22 PREPARATION

A. Cut, move, or remove items as necessary for access to alterations and renovation work.
   Replace and restore at completion.

B. Remove unsuitable materials not marked for salvage, such as rotted wood, corroded metals,
   and deteriorated masonry and concrete. Replace materials as specified for furnished work.

C. Remove debris and abandoned items from area and from concealed spaces.

D. Close openings in exterior surfaces to protect existing work and salvage items from weather
   and extremes of temperature and humidity. Insulate ducts and piping to prevent condensation
   in exposed areas.

E. Prepare surfaces and remove surface finishes to provide for proper installation of new work and
   finishes.

F. Clean substrate surfaces prior to applying next materials or substance.

G. Seal cracks or openings of substrate prior to applying next material or substance.

H. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to
   applying any new material or substance in contact or bond.

1.23 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections.

B. Make neat transitions. Patch work to match adjacent work in texture and appearance.

C. All ceiling mounted devices (i.e. registers, grilles, diffusers, fans, etc.) shall be installed centered
   in ceiling tiles (unless otherwise noted). Coordinate with ceiling installer.

1.24 EXISTING UTILITIES

A. The plans indicate as accurately as possible the location, type and sizes of existing
   underground utilities at the site. It is the Contractor's responsibility to have all utilities located
   prior to starting work. Contractor shall contact appropriate utility company and One Call for
locating utilities prior to commencement of any work. The Owner also has underground conduit and other systems in place. Contractor shall contact the Owner prior to excavation in any area to determine any items that may be impacted by excavation.

B. This Contactor shall protect all utilities and Owner items affected by his work, and shall repair any damage caused by his forces at no additional cost to the Owner.

C. The Owner and the Owners' of all underground facilities shall be notified at least 5 business days prior to excavation.

1.25 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect/Engineer of any discrepancies discovered.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly notify Architect/Engineer the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.

F. Utilize recognized engineering survey practices.

G. Establish elevations, lines and levels. Locate and layout by instrumentation and similar appropriate means.
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.

H. Periodically verify layouts by same means.

I. Maintain a complete and accurate log of control and survey work as it progresses.

1.26 TEMPORARY HEATING

A. Provide all temporary heating required for the facility during construction. Install and maintain facilities in a manner that will protect the public and workmen. Coordinate requirements with Prime Contractor.

B. Upon completion of work, remove all temporary heating from the project site.

1.27 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition per OSHA standards.

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 rubbish from site periodically and dispose off-site.

1.28 PROTECTION OF INSTALLED WORK

A. Protect installed work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage. This includes the protection of the work of other trades.

C. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
D. 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.

E. Prohibit traffic from landscaped area.

1.29 SYSTEM STARTUP

A. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

B. Verify that wiring and support components for equipment are complete and tested.

C. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

D. Any irregularities, faulty equipment, etc. shall be repaired or replaced as required prior to acceptance.

E. All equipment shall be freshly oiled, filters charged with clean media and installation completely finished prior to acceptance.

1.30 DEMONSTRATION AND INSTRUCTION

A. Contractor shall complete all start-up and perform all intimal testing of each system prior to scheduling or requesting to schedule training. All systems shall be completely operational before training or demonstration will occur.

B. Demonstrate operation and maintenance of Products to Owner's personnel prior to date of final inspection.

C. Demonstrate operation and maintenance of Products to Owner's representative at a scheduled time with the Owner.

D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.

E. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner Personnel.

F. Utilize operation and maintenance e manuals as basis for instruction. Review contents of manuals with Owner's personnel in detail to explain all aspects of operation and maintenance.

1.31 ADJUSTING

A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.32 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.

B. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

C. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

1.33 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect.

B. Notify Architect when work is considered finally complete.

C. Complete items of work determined by Architect's final inspection.

1.34 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed shop drawings, product data, and samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Record information concurrent with construction progress.

D. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Changes made by Addenda and modifications.

E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   2. Field changes of dimension and detail.
   3. Details not on original Contract Documents.

F. At completion of project Contractor shall provide a minimum of two (2) sets of As-Built Record drawings. Additional sets shall be provided if required under General Requirements.

1.35 WARRANTY AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Sub-Contractors, suppliers and manufacturers, within ten 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 the 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.

F. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Sub-Contractor, Supplier, and Manufacturer, with name address, and telephone number of responsible principal.

G. Warranty:
   1. The Contractor shall assume responsibility for any defects which may develop in any part of his work caused by faulty workmanship, material or equipment, and agrees to replace, repair or alter, at his expense, any such faulty workmanship, material or equipment that has been brought to his attention during a period of one year from the date of the final certificate for payment. Acceptance of the work shall not waive this guarantee.
   2. Note that individual specification sections may indicate longer warranty periods on specific components or parts. In each case, the more stringent warranty period shall govern.
   3. For equipment or component parts of equipment put into service during construction for use by Owner, submit documents within 10 days after acceptance.
      a. Any requested use of the equipment or component parts of equipment by the contractor for the contractor, whether the General Contractor or any subcontractor, shall be the responsibility of the contractor. The equipment or components shall be cleaned to new condition prior to substantial completion. Warranty shall begin at time of the project's substantial completion.

END OF SECTION
SECTION 23 0513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1  GENERAL
1.01  SECTION INCLUDES
   A. General construction and requirements.
   B. Applications.
   C. Single phase electric motors.
   D. Three phase electric motors.

1.02  RELATED REQUIREMENTS
   A. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.
   B. Section 26 2913 - Enclosed Controllers.

1.03  REFERENCE STANDARDS
   A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.
   C. NEMA MG 1 - Motors and Generators; 2018.
   D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04  SUBMITTALS
   A. See Section 230010 - GENERAL PROVISIONS for submittal procedures.
   B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
   C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
   D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
   E. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.05  DELIVERY, STORAGE, AND HANDLING
   A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.06  WARRANTY
   A. See Section 230010 - GENERAL PROVISIONS for additional warranty requirements.
   B. Provide one year manufacturer warranty for motors larger than 1/5 horsepower.

PART 2  PRODUCTS
2.01  GENERAL CONSTRUCTION AND REQUIREMENTS
   A. Electrical Service: Refer to Section 26 2717 for required electrical characteristics.
      1. Three phase motors for use on 208V systems shall be rated for 200 volts and 480V systems shall be rated for 460 volts. Motors rated for 220V or 230V are not acceptable.
   B. Construction:
      1. Open drip-proof type except where specifically noted otherwise.
      2. Design for continuous operation in 104 degrees F (40 degrees C) environment.
      3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
4. Motors 5 HP and larger shall be of the premium efficiency type.
5. Provide premium efficiency, inverter duty motors per NEMA MG 1, Part 30 & 31 for all motors driven by variable frequency drives (VFD's). Inverter "rated" motors are NOT acceptable.
6. Motors shall be suitable for load, duty, voltage, frequency and hazard, for service and location intended.
7. NEMA classification of motor enclosures shall apply when motor types are specified as open drip proof, splash proof, totally enclosed, etc.
8. Motors shall have ball or roller type bearings with pressure grease lubrication.
10. Motors shall be capable of withstanding momentary overloads of 50%, without injurious overheating.
11. Motors for belt drive shall have adjustable bases.
12. Motors shall have nameplates giving manufacturer's name, voltage, phase, HZ, HP, RPM, full load current and service factor.
14. Provide shaft grounding kits for all motors driven by variable frequency drives (VFD's).

C. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

D. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.02 APPLICATIONS

A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.
B. Single phase motors for shaft mounted fans, oil burners, and centrifugal pumps: Split phase type.
C. Single phase motors for fans, pumps, blowers, and air compressors: Capacitor start type.

2.03 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque.
B. Starting Current: Up to seven times full load current.
C. Breakdown Torque: Approximately 200 percent of full load torque.
D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

2.04 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.
B. Starting Current: Less than five times full load current.
C. Pull-up Torque: Up to 350 percent of full load torque.
D. Breakdown Torque: Approximately 250 percent of full load torque.
E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
2.05 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.
B. Starting Current: Six times full load current.
C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
E. Insulation System: NEMA Class B or better.
F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
H. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
I. Sound Power Levels: To NEMA MG 1.
J. Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
K. Motors less than 5 HP shall have flexible power leads of sufficient length to extend 3 inches minimum beyond the face of the conduit terminal box.
L. Motors 5 HP and larger shall have terminal lugs.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
C. Check line voltage and phase and ensure agreement with nameplate.
D. Coordinate all final electrical requirements with Division 26.

END OF SECTION
SECTION 23 0516
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Flexible pipe connectors.
   B. Expansion joints and compensators.
   C. Pipe loops, offsets, and swing joints.

1.02 RELATED REQUIREMENTS
   A. Section 23 2113 - Hydronic Piping.
   B. Section 23 2213 - Steam and Condensate Heating Piping.

1.03 REFERENCE STANDARDS
   B. EJMA (STDS) - EJMA Standards; Tenth Edition.

1.04 SUBMITTALS
   A. See Section 230010 - GENERAL PROVISIONS, for submittal procedures.
   B. Product Data:
      1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
      2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
   C. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
   D. Maintenance Data: Include adjustment instructions.
   E. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Hyspan
   B. Pathway
   C. Metraflex Company
   D. Minnesota Flexible
   E. Twin City Hose

2.02 FLEXIBLE PIPE CONNECTORS - STEEL PIPING
   A. Inner Hose: Stainless Steel.
   C. Pressure Rating: 125 psi and 450 degrees F (862 kPa and 232 degrees C).
   D. Joint: As Specified for Pipe Joints.
   E. Size: Use pipe sized units.
   F. Maximum offset: 3/4 inch (20 mm) on each side of installed center line.

2.03 FLEXIBLE PIPE CONNECTORS - COPPER PIPING
   A. Inner Hose: Bronze.
B. Exterior Sleeve: Braided bronze.
C. Pressure Rating: 125 psi and 450 degrees F (862 kPa and 232 degrees C).
D. Joint: As specified for pipe joints.
E. Size: Use pipe sized units.
F. Maximum offset: 3/4 inch (20 mm) on each side of installed center line.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s instructions.
B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

END OF SECTION
SECTION 23 0519
METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Pressure gauges and pressure gauge taps.
   B. Thermometers and thermometer wells.

1.02 RELATED REQUIREMENTS
   A. Section 23 0923 - Direct-Digital Control System for HVAC.
   B. Section 23 0993 - Sequence of Operations for HVAC Controls.
   C. Section 23 2113 - Hydronic Piping.
   D. Section 23 2213 - Steam and Condensate Heating Piping.

1.03 REFERENCE STANDARDS
   A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.
   D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014, with
      Editorial Revision (2017).
   E. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All
      Revisions.
   F. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Current Edition, Including
      All Revisions.

1.04 SUBMITTALS
   A. See Section 230010 - GENERAL PROVISIONS, for submittal procedures.
   B. Product Data: Provide list that indicates use, operating range, total range and location for
      manufactured components.
   C. Project Record Documents: Record actual locations of components and instrumentation.

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

PART 2 PRODUCTS

2.01 PRESSURE GAUGES
   A. Manufacturers:
      2. Miljoco.
      3. Winters Instruments
      4. Weiss
   B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube,
      rotary brass movement, brass socket, with front recalibration adjustment, black scale on white
      background.
      1. Case: Steel with brass bourdon tube.
      2. Size: 4-1/2 inch (115 mm) diameter.
      3. Mid-Scale Accuracy: One percent.
      4. Scale: Psi.
      5. Range: Typical range shall be 1-1/2 times the normal operating pressure of the fluid being
         measured unless otherwise specified.
      6. Provide snubbers on gauges located at pumps.
2.02 PRESSURE GAUGE TAPPINGS
A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi (1034 kPa).
B. Needle Valve: Brass, 1/4 inch (6 mm) NPT for minimum 150 psi (1034 kPa).
C. Pulsation Damper: Pressure snubber, brass with 1/4 inch (6 mm) connections.

2.03 STEM TYPE THERMOMETERS
A. Manufacturers:
   2. Moeller.
   3. Winters Instruments
   4. Weiss
   5. Miljoco
   6. Trerice
   7. Substitutions: See Section 01 6000 - Product Requirements.
B. Scale range shall be as specified within this manual or on the drawings with 2 degree division.
C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
   1. Size: 9 inch (225 mm) scale.
   2. Window: Clear Lexan.
   3. Accuracy: 2 percent, per ASTM E77.
   4. Calibration: Degrees F.

2.04 DIAL THERMOMETERS
A. Manufacturers:
   2. Trerice.
   3. Miljoco
   4. Weiss
B. Thermometers - Fixed Mounting: Dial type bimetallic actuated; ASTM E1; stainless steel case, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
   1. Size: 5 inch (125 mm) diameter dial.
   2. Lens: Clear glass.
   3. Accuracy: 1 percent.
   4. Calibration: Degrees F.
C. Thermometers: Dial type vapor or liquid actuated; ASTM E1; stainless steel case, with brass or copper bulb, copper or bronze braided capillary, white with black markings and black pointer, glass lens.
   1. Size: 4-1/2 inch (115 mm) diameter dial.
   2. Lens: Clear glass.
   3. Length of Capillary: Minimum 5 feet (1500 mm).
   4. Accuracy: 2 percent.
   5. Calibration: Degrees F.

2.05 THERMOMETER SUPPORTS
A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
2.06 TEST PLUGS
A. Test Plug: 1/4 inch (6 mm) or 1/2 inch (13 mm) brass fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F (176 degrees C).
   1. Plugs shall be complete with gasketed cap and units rated for 1000 PSI.
B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch (60 mm) diameter pressure gauges, one gauge adapters with 1/8 inch (3 mm) probes, two 1 inch (25 mm) dial thermometers.
   1. Pressure gage range: 0 to 160 PSI.
   2. Thermometer ranges: -40 deg. F to 160 deg. F and 0 deg. F to 220 deg. F.

PART 3 EXECUTION
3.01 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
C. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Provide siphon on gauges in steam systems. Extend nipples and siphons to allow clearance from insulation.
D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch (60 mm) for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
E. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets. Refer to Section 23 0943.
F. Coil and conceal excess capillary on remote element instruments.
G. Provide instruments with scale ranges selected according to service with largest appropriate scale.
H. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
I. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.02 SCHEDULE
A. Pressure Gauges, Location and Scale Range:
   1. Pumps, 0 to 100 psi (0 to _____ kPa).
   2. Expansion tanks, 0 to 100 psi (0 to _____ kPa).
B. Pressure Gauge Tappings, Location:
   1. Major coils - inlets and outlets.
   3. Chiller - inlets and outlets.
C. Stem Type Thermometers, Location and Scale Range:
   1. Coil banks - inlets and outlets, 0 to 200 degrees F (0 to _____ Degrees C).
   2. Heat exchangers - inlets and outlets, 0 to 200 degrees F (0 to _____ Degrees C).
   3. Water Boilers - inlets and outlets, 0 to 200 degrees F (0 to _____ Degrees C).
   4. Chiller - inlets and outlets, 0 to 200 degrees F (0 to _____ Degrees C).
D. Thermometer Sockets, Location:
   1. Control valves 1 inch (25 mm) & larger - inlets and outlets.

END OF SECTION
SECTION 23 0548
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

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

1.02 RELATED REQUIREMENTS
   A. Section 03 3000 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 230010 - GENERAL PROVISIONS, for submittal procedures.
   B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
      1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification method for spring element load capacities.
      2. Seismic Controls: Include seismic load capacities.
   C. Shop Drawings - Vibration Isolation Systems:
      1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
      2. Fully dimensioned fabrication drawings and installation details for vibration isolation bases, member sizes, attachments to isolators, and supported equipment.
      3. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.
   D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS
   A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
   B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements.
   C. General Requirements:
      1. Select vibration isolators to provide required static deflection.
      2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
      3. Steel springs to function without undue stress or overloading.
      4. Steel springs to operate in the linear portion of the load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
      5. Select vibration isolators for outdoor equipment to comply with wind design requirements.
      6. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2 inch (50 mm) operating clearance beneath base unless otherwise indicated.
2.02 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A. Manufacturers:
   1. Vibration-Isolated Equipment Support Bases:

B. Vibration-Isolated Structural Steel Bases:
   1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
   2. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
   3. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.

C. Vibration-Isolated Concrete Inertia Bases:
   1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
   2. Minimum Base Depth: 6 inches (152 mm).
   3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
   4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
   5. Concrete: Filled on site with minimum 3000 psi (20 mPa) concrete in accordance with Section 03 3000.

2.03 VIBRATION ISOLATORS

A. General Requirements:
   2. Spring Elements for Spring Isolators:
      a. Color code or otherwise identify springs to indicate load capacity.
      b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
      c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
      d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
      e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
      f. Selected to function without undue stress or overloading.

B. Vibration Isolators for Non-Seismic Applications:
   1. Restrained Spring Isolators, Non-Seismic:
      a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
      b. Bottom Load Plate: Steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
      c. Furnished with integral leveling device for positioning and securing supported equipment.
      d. Provides constant free and operating height.
      e. Equipment Wind Loading: Adequate means for fastening isolator top to equipment and isolator base plate to supporting structure.
   2. Spring Isolator Hangers, Non-Seismic:
      a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
      b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.
3. Combination Resilient Material/Spring Isolator Hangers, Non-Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g. neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.

4. Thrust Restraints:
   a. Description: Assembly utilizing free-standing, laterally stable steel spring designed for resisting horizontal motion due to thrust (e.g. air pressure from a fan), and intended for installation in pairs.

2.04 CONCRETE BASES
A. Provide concrete bases for mechanical equipment furnished under this Division unless otherwise indicated.
B. Construct bases of 3000 PSI, 28-day strength concrete.
C. Bases shall be plumb, smooth and shall be 4” high unless otherwise indicated.
D. Bases shall be set a minimum of seven (7) days prior to mounting equipment.
E. Set expansion bolts in bases for attachment of equipment and/or isolators.

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

10. Provide pairs of horizontal limit springs on fans with more than 6.0 inches WC static pressure, and on hanger supported, horizontally mounted axial fans.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Nameplates.
   B. Tags.
   C. Pipe markers.

1.02 RELATED REQUIREMENTS
   A. Section 09 9123 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 230010 - GENERAL PROVISIONS for submittal procedures.
   B. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS
   A. Air Handling Units: Nameplates.
   B. Air Terminal Units: Tags.
   C. Automatic Controls: Tags. Key to control schematic.
   D. Control Panels: Nameplates.
   F. Major Control Components: Nameplates.
   G. Piping: Tags.
   H. Pumps: Nameplates.
   I. Small-sized Equipment: Tags.
   J. Tanks: Nameplates.
   K. Thermostats: Nameplates.
   L. Valves: Tags.
   M. Water Treatment Devices: Nameplates.

2.02 MANUFACTURERS
   A. Brimar
   B. Brady Corporation
   C. Champion America
   D. Seton Identification Products

2.03 NAMEPLATES
   B. Letter Height: 1/4 inch (6 mm).
   C. Background Color: Black.
2.04 TAGS
   A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.
   B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

2.05 PIPE MARKERS
   B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
   C. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

PART 3 EXECUTION

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

3.02 INSTALLATION
   A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
   B. Install tags with corrosion resistant chain.
   C. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch (20 mm) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
   D. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
   E. Identify air handling units, rooftop units, heat transfer equipment, pumps, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
      1. Coordinate nameplate requirements with Owner. See example in drawings. Nameplates shall be approximately 5” x 2-1/2” in size.
      2. Minimum information to be noted shall include:
         a. Equipment tag - 1/2” letters. (ex. AHU8)
         b. Equipment description - 3/16” letters. (ex. AIR HANDLING UNIT)
   F. Identify control panels and major control components outside panels with plastic nameplates.
      1. Coordinate nameplate requirements with Owner. See example in drawings.
      2. Minimum information to be noted shall include:
         a. Equipment tag - 1/2” letters. (ex. AHU8)
         b. Equipment description - 3/16” letters. (ex. AIR HANDLING UNIT)

END OF SECTION
SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Testing, adjustment, and balancing of air systems.
   B. Testing, adjustment, and balancing of hydronic systems.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS
   A. See Section 230010 - GENERAL PROVISIONS, for submittal procedures.
   B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
      1. Include at least the following in the plan:
         a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
         b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
         c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
         d. Final test report forms to be used.
            1) Forms shall be similar to AABC latest addition.
         e. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
         f. Time schedule for TAB work to be done in phases (by floor, etc.).
         g. Procedures for formal deficiency reports, including scope, frequency and distribution.
   C. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
   D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
      1. Revise TAB plan to reflect actual procedures and submit as part of final report.
      2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
      3. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
      4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
      5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
      6. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
      7. Include the following on the title page of each report:
         a. Name of Testing, Adjusting, and Balancing Agency.
         b. Address of Testing, Adjusting, and Balancing Agency.
         c. Telephone number of Testing, Adjusting, and Balancing Agency.
d. Project name.
e. Project location.
f. Project Architect.
g. Project Engineer.
h. Project Contractor.
i. Report date.

E. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Testing and Balancing Agency shall be a subcontractor to the General Contractor or contracted directly by the Owner.
   1. The Testing and Balancing Agency shall not be an employee of the Mechanical Contractor or its subsidiaries.

B. Perform total system balance in accordance with one of the following:
   1. AABC (NSTSB), AABC National Standards for Total System Balance.
   3. SMACNA (TAB).
   4. Maintain at least one copy of the standard to be used at project site at all times.

C. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

D. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

E. TAB Agency Qualifications:
   1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
   2. Certified by one of the following:

F. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

G. Completely coordinate with work of all other trades.

H. Testing and Balancing Agency shall furnish all labor, materials, tools, equipment, and services to test, balance and adjust all mechanical systems as indicated, in accordance with provisions of Contract Documents.

3.02 RESPONSIBILITIES OF TESTING AND BALANCING AGENCY

A. Directly responsible to the Owner.
   1. Will not have a contractual relationship with the Installing Contractor.

B. Accurately calibrate and maintain all test instruments in good working order.
   1. If requested, conduct tests of instruments in the presence of the Owner's Representative.

C. Check component parts of complete system for their independent functions and composite operation in the system so that all capacities and requirements as shown on drawings and outlined in specifications have been met.
D. Inspect the installation and operation of the mechanical piping systems, sheet metal work, temperature controls and other components of the HVAC systems as relates to proper arrangement and adequate provisions for testing and balancing.
   1. Advise the Owner's Representative of necessary adjustments and corrective measures.

E. Schedule work with trades involved.

F. Check, adjust and balance system components to obtain optimum conditions in each conditioned space.

G. Record all inspections, tests and adjustments.

H. Prepare and submit reports of all tests.

3.03 RESPONSIBILITIES OF INSTALLING CONTRACTOR

A. Startup all systems and keep in correct operation during balancing operations.

B. Assign personnel as required to make necessary adjustments and corrections to balance systems.

C. Maintain accessibility to test locations and devices requiring adjustment.

D. Allow adequate time in project schedule for completion of TAB Activity prior to substantial completion.

3.04 JOB CONDITIONS

A. Perform work at time as agreed upon by Installing Contractor and Owner.
   1. If work is not done during peak cooling season, demonstrate satisfactory balancing during next peak cooling season.

3.05 CORRECTIVE WORK

A. Provide extended warranty of 90 days, after completion of test and balance work, during which time the Owner may, at their discretion, request recheck or resetting of any equipment or system which is not performing satisfactorily.
   1. Provide technicians to assist as required in making such tests.

3.06 EXAMINATION

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

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Advise A/E and Owner of necessary adjustments and corrective measures.

D. Beginning of work means acceptance of existing conditions.
3.07 ADJUSTMENT TOLERANCES

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

3.08 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
   1. Running log of events and issues.
   2. Discrepancies, deficient or uncompleted work by others.
   4. Lists of completed tests.
B. Ensure recorded data represents actual measured or observed conditions.
C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

3.09 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
B. Balance system utilizing the 'proportional' method.
C. Balance each air system that is served by air filters, using artificial static loading of system, to demonstrate, test and obtain system design pressure drop.
   1. Provide dirty filter pressure drop conditions on system. Approximate 80% of peak pressure drop value.
   2. Do not use high efficiency filters (75% and above) in testing and balancing.
   3. Static pressure losses may be simulated by using sheet steel blanking plates in high efficiency filter racks and housings.
   4. Do not install blanking plates within 2 ft. of any low efficiency filter unit or rack
D. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
E. Measure air quantities at air inlets and outlets.
   1. Identify location and area of each grille, diffuser and register.
   2. Identify and list size and type of diffusers, grilles and registers.
   3. Use manufacturer's ratings on all equipment to make required calculations.
   4. Adjust to minimize drafts.
F. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
G. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
H. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
I. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

J. Determine system static pressures at suction and discharge of each fan, midpoint of supply and return ductwork system, and inlet to end of system air terminal unit.
   1. If volumes and static pressures are within plus or minus 10 percent of design, proceed with system balancing.
   2. If volumes and static pressures exceed 10 percent of design, confer with the Owner's Representative and determine if fan speeds are to be adjusted prior to any system balancing.

K. After all terminal units and exhaust and return air systems are balanced, take a second set of CFM and static pressure readings at suction and discharge of each supply, return and exhaust fan.
   1. Notify A/E and Owner if air quantities are not within the specified tolerances.
   2. Installing Contractor and/or equipment supplier shall be notified to facilitate adjustment or replacement of the fan drives or unit to obtain proper fan air quantities.

L. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
   1. Determine outside air flow (CFM) at both maximum and minimum supply air volume flow rates.

M. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

O. On fan powered VAV boxes, adjust air flow switches for proper operation.

P. In cooperation with the Temperature Control's Contractor, set automatically operated dampers to operate as indicated.
   1. Check all controls for proper calibration and list all controls requiring adjustment by controls installer.

Q. Balance supply, return and exhaust air to provide the designed pressure relationships to adjacent spaces.

3.10 WATER SYSTEM PROCEDURE

A. Complete air balancing prior to commencing water balancing.

B. Adjust water systems to provide required or design quantities.

C. Use a combination of "Pete's" plugs at pump suction and discharge connections plus flow measuring devices or additional "Pete's" plugs at each piece of equipment.

D. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

E. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

F. Adjust coil valves:
   1. Use differential pressure gages and "Pete's" plugs on control valve and read pressure drop through coil at flow rate for maximum cooling, and again for maximum heating.
   2. Set pressure drop across coil to match coil maximum flow pressure drop.
   3. Adjust flow rate through each coil in coil banks.

G. After completing coil balancing, test hot water and chilled water pressures and flows at the pumps and readjust if required.
H. Effect system balance with automatic control valves fully open to heat transfer elements.
I. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
J. Check operation of relief valves.
K. Examine water in system and determine if water has been treated and cleaned.
L. Set temperature controls for all coils at maximum cooling. Check for full closure of all automatic valves at coils and chiller. Use similar procedure for checking valves on hot water coils at maximum heat setting.
M. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.11 SCOPE
A. Test, adjust, and balance the following:
   1. Plumbing Pumps.
   2. HVAC Pumps.
   3. Air Coils.
   4. Air Handling Units.
   5. Fans.
   6. Air Terminal Units.
   7. Air Inlets and Outlets.

3.12 MINIMUM DATA TO BE REPORTED
A. Electric Motors:
   1. Manufacturer.
   2. Model/Frame.
   3. HP/BHP.
   4. RPM.
   5. Service factor.
B. V-Belt Drives:
   1. Identification/location.
   2. Required driven RPM.
   3. Driven sheave, diameter and RPM.
   4. Belt, size and quantity.
   5. Motor sheave diameter and RPM.
   6. Center to center distance, maximum, minimum, and actual.
C. Pumps:
   1. Identification/number.
   2. Manufacturer.
   3. Size/model.
   4. Impeller.
   5. Service.
   6. Design flow rate, pressure drop, BHP.
   7. Actual flow rate, pressure drop, BHP.
   8. Discharge pressure.
   10. Total operating head pressure.
D. Chillers:
   1. Identification/number.
   2. Manufacturer.
   3. Capacity.
   4. Model number.
5. Serial number.
6. Evaporator entering water temperature, design and actual.
7. Evaporator leaving water temperature, design and actual.
8. Evaporator pressure drop, design and actual.
9. Evaporator water flow rate, design and actual.

E. Cooling Coils:
   1. Identification/number.
   2. Location.
   4. Manufacturer.
   5. Air flow, design and actual.
   6. Entering air DB temperature, design and actual.
   7. Entering air WB temperature, design and actual.
   8. Leaving air DB temperature, design and actual.
   9. Leaving air WB temperature, design and actual.
  10. Water flow, design and actual.
  11. Water pressure drop, design and actual.
  12. Entering water temperature, design and actual.
  13. Leaving water temperature, design and actual.

F. Heating Coils:
   1. Identification/number.
   2. Location.
   4. Manufacturer.
   5. Air flow, design and actual.
   6. Water flow, design and actual.
   7. Water pressure drop, design and actual.
   8. Entering water temperature, design and actual.
   9. Leaving water temperature, design and actual.
  10. Entering air temperature, design and actual.
  11. Leaving air temperature, design and actual.

G. Air Moving Equipment:
   1. Location.
   2. Manufacturer.
   3. Model number.
   4. Serial number.
   5. Arrangement/Class/Discharge.
   6. Air flow, specified and actual.
   7. Return air flow, specified and actual.
   8. Outside air flow, specified and actual.
      a. Adjust for both minimum and maximum quantities
   9. Total static pressure (total external), specified and actual.
  10. Inlet pressure.
  11. Discharge pressure.
  12. Pressure at midpoint of supply duct system
  13. Pressure at midpoint of return duct system
  14. Pressure at inlet to end of system air terminal unit
  15. Sheave Make/Size/Bore.
  16. Number of Belts/Make/Size.
  17. Fan RPM.

H. Exhaust Fans:
   1. Location.
   2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
10. Number of Belts/Make/Size.
11. Fan RPM.

I. Duct Leak Tests:
   1. Description of ductwork under test.
   2. Duct design operating pressure.
   3. Duct design test static pressure.
   4. Duct capacity, air flow.
   5. Maximum allowable leakage duct capacity times leak factor.
   6. Test apparatus:
      a. Blower.
      b. Orifice, tube size.
      c. Orifice size.
      d. Calibrated.
   7. Test static pressure.
   8. Test orifice differential pressure.
   9. Leakage.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Duct insulation.
   B. Duct liner.
   C. Insulation jackets.

1.02 RELATED REQUIREMENTS
   A. Section 23 3100 - HVAC Ducts and Casings.

1.03 SUBMITTALS
   A. See Section 230010 - GENERAL PROVISIONS, for submittal procedures.
   B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
   C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

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

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

PART 2 PRODUCTS

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

2.02 GLASS FIBER, FLEXIBLE
   A. Manufacturer:
   B. Vapor Barrier Jacket:
      1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   C. Vapor Barrier Tape:
      1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
   D. Outdoor Vapor Barrier Mastic:
      1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
   E. Tie Wire: Annealed steel, 16 gage, 0.0508 inch diameter (1.29 mm diameter).

2.03 GLASS FIBER, RIGID
   A. Manufacturer:

B. Insulation: ASTM C612; rigid, noncombustible blanket.
1. K (Ksi) Value: 0.24 at 75 degrees F (0.036 at 24 degrees C), when tested in accordance with ASTM C518.
3. Maximum Water Vapor Absorption: 5.0 percent.

C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Secure with two coats of vapor barrier mastic and glass tape.

D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

2.04 JACKETS
A. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

1. Thickness: 0.016 inch (0.40 mm) sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

2.05 DUCT LINER
A. Manufacturers:

B. Glass Fiber Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.
1. Fungal Resistance: No growth when tested according to ASTM G21.
2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F (0.045 at 24 degrees C).
3. Service Temperature: Up to 250 degrees F (121 degrees C).
4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm (25.4 m/s), minimum.

C. Liner Fasteners: Galvanized steel, self-adhesive pad or impact applied with integral head.

2.06 KITCHEN EXHAUST GREASE DUCTWORK
A. Manufacturer:
1. 3M Fire Barrier Duct Wrap 615+

B. Insulation: Lightweight, non-asbestos, high temperature, bio-soluble, calcium-magnesium-silicate (CMS) non-woven blanket, encapsulated in a scrim-reinforced foil for ventilation and grease duct applications.
1. Blanket thickness: 1.5 inches (38mm).
3. Weight: 0.9 psf (4.38 kg/m2).
5. Thermal Conductivity (k-value) at 500 Degrees F (260 Degrees C) (ASTM C411, ASTM C518): 0.48 Btu/(ft2 × h × F) (0.07 W/(m × K)).
6. R-Value per ASTM C 518 at ambient (77 F/ 25 C): at least 6.3 (F-ft2-hr / Btu)
7. Service range up to 2000°F (1093°C)
8. ASTM E2336 and ISO 6944 test standard.

C. Tape
1. High performance filament tape, 3M No. 898 1 inch (25mm) wide.
2. FSK Facing Tape with aluminum foil, fiberglass scrim, kraft paper backing: nominal 3 inches (76mm) or 4 inches (102mm) wide (for sealing cut blanket edges and seams), 3M No. 3320.

D. Banding Material:
1. Stainless or carbon steel banding: 1/2 inch (13mm) wide X 0.015 inch (0.4mm) thick, as stated in duct wrap Design Listing.

E. Insulation pins and clips:
1. Copper-coated steel pins, 12 gauge with a minimum length of 4 inches (102mm) with square galvanized steel speed clips: 2.5 inch (64mm).
2. 12 gauge insulated cup head steel pins.

F. Through-penetration firestop materials:
1. Packing materials: Pieces of 3M Fire Barrier Duct Wrap, or 4 pcf mineral wool.
2. Sealants: 3M Fire Barrier: 1000 NS non-slump silicone sealant, 1003 SL self-leveling silicone sealant, 2000+ premium non-slump silicone sealant, or CP 25WB+ premium intumescent latex caulk, as stated in firestop Design Listing.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that ducts have been tested before applying insulation materials.
B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Install in accordance with NAIMA National Insulation Standards.
C. Insulated ducts conveying air below ambient temperature:
1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. All round duct run outs shall be externally insulated within concealed locations.
E. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section.
F. External Duct Insulation Application:
1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
3. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
4. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

G. Duct Liner Application:
1. Adhere insulation with adhesive for 100 percent coverage.
2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.
6. Installation shall meet NFPA 90A and 90B fire resistant requirements.

3.03 SCHEDULES

A. Combustion Air Duct:
   1. Flexible Glass Fiber Duct Insulation: 1-1/2 inches (38 mm) thick.

B. Relief Ducts:
   1. Rigid Glass Fiber Duct Insulation: 1-1/2 inches (38 mm) thick.

C. Exhaust Ducts Within 10 ft (3 m) of Exterior Openings:
   1. Rigid Glass Fiber Duct Insulation: 1-1/2 inches (38 mm) thick.

D. Exhaust Ducts Exposed to Outdoor Air:
   1. Rigid Glass Fiber Duct Insulation: 2 inches (50 mm) thick.
   2. Cover with aluminum jacket.

E. Outside Air Intake Ducts:
   1. Rigid Glass Fiber Duct Insulation: 1-1/2 inches (38 mm) thick.

F. Primary Air Ducts (round):
   1. Flexible Glass Fiber Duct Insulation: 1 inches (25 mm) thick.
   2. Note: Primary Air Ducts include all ductwork between Air Handling Unit and VAV.

G. Primary Air Ducts (rectangular):
   1. Glass Fiber Duct Liner Insulation: 1 inches (25 mm) thick.
   2. Note: Primary Air Ducts include all ductwork between Air Handling Unit and VAV.

H. Supply Ducts (round):
   1. Flexible Glass Fiber Duct Insulation: 1 inches (25 mm) thick.

I. Supply, Exhaust, and Return Ducts (rectangular):
   1. Glass Fiber Duct Liner Insulation: 1 inches (25 mm) thick.
   2. NOTE: This includes transfer ducts between rooms.

J. Ducts Exposed to Outdoors:
   1. Rigid Glass Fiber Duct Insulation: 3 inches (76 mm) thick.
   2. Cover with aluminum jacket.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Equipment insulation.
   B. Covering.

1.02 REFERENCE STANDARDS
   B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
   J. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.

1.03 SUBMITTALS
   A. See Section 230010 - GENERAL PROVISIONS, for submittal procedures.
   B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.
   C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 DELIVERY, STORAGE, AND HANDLING
   A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
   B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.
1.05 FIELD CONDITIONS
   A. Maintain ambient temperatures and conditions required by manufacturers of adhesives,
      mastics, and insulation cements.
   B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

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

2.02 GLASS FIBER, FLEXIBLE
   A. Manufacturers:
   B. Insulation: ASTM C553; flexible, noncombustible.
      1. K (Ksi) Value: 0.36 at 75 degrees F (0.052 at 24 degrees C), when tested in accordance
         with ASTM C177 or ASTM C518.
      3. Maximum Water Vapor Absorption: 5.0 percent by weight.
   C. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized
      film.
      1. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance
         with ASTM E96/E96M.
      2. Secure with self-sealing longitudinal laps and butt strips.
   D. Vapor Barrier Lap Adhesive: Compatible with insulation.

2.03 GLASS FIBER, RIGID
   A. Manufacturer:
   B. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
      1. K (Ksi) Value: 0.25 at 75 degrees F (0.036 at 24 degrees C), when tested in accordance
         with ASTM C177 or ASTM C518.
      3. Maximum Water Vapor Absorption: 5.0 percent by weight.
      4. Maximum Density: 8.0 lb/cu ft (128 kg/cu m).
   C. Vapor Barrier Jacket:
      1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
      2. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance
         with ASTM E96/E96M.
   D. Facing: 1 inch (25 mm) galvanized steel hexagonal wire mesh stitched on one face of
      insulation.
   E. Vapor Barrier Lap Adhesive: Compatible with insulation.
   F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.04 HYDROUS CALCIUM SILICATE
   A. Manufacturer:
B. Insulation: ASTM C533; rigid molded, asbestos free, gold color.
   1. K (Ksi) Value: 0.40 at 300 degrees F (0.057 at 148 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
   3. Density: 15 lb/cu ft (249 kg/cu m).

C. Tie Wire: 0.048 inches (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

D. Insulating Cement: ASTM C449.

2.05 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
   1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.06 JACKETS

A. PVC Plastic:
   1. Manufacturers:
      b. Proto.
   2. Jacket: Sheet material, off-white color.
      a. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
      b. Maximum Service Temperature: 150 degrees F (66 degrees C).
      c. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
      d. Thickness: 20 mil (0.50 mm).
      e. Connections: Brush on welding adhesive.

B. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
   1. Lagging Adhesive: Compatible with insulation.

   1. Thickness: 0.016 inch (0.40 mm) sheet.
   2. Finish: Smooth.
   3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

A. Install in accordance with manufacturer’s instructions.
B. Factory Insulated Equipment: Do not insulate.
C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

F. Insulated equipment containing fluids below ambient temperature; insulate entire system.

G. Fiber glass insulated equipment containing fluids below ambient temperature; provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.

H. For hot equipment containing fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions, but bevel and seal ends of insulation.

I. For hot equipment containing fluids over 140 degrees F (60 degrees C), insulate flanges and unions with removable sections and jackets.

J. Fiber glass insulated equipment containing fluids above ambient temperature; provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.

K. Finish insulation at supports, protrusions, and interruptions.

L. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers.

M. Exterior Applications:
   1. Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement.
   2. Cover with aluminum, stainless steel, or ____________.

N. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.

O. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

P. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.03 SCHEDULE

A. Heating Systems:
   1. Pump Bodies:
      a. Glass Fiber, Rigid Insulation: 3 inches (____ mm) thick.
      b. Hydrous Calcium Silicate Insulation: 2 inches (____ mm) thick.
   2. Air Separators:
      a. Glass Fiber, Rigid Insulation: 3 inches (____ mm) thick.
      b. Hydrous Calcium Silicate Insulation: 2 inches (____ mm) thick.
   3. Expansion Tanks:
      a. Glass Fiber, Rigid Insulation: 3 inches (____ mm) thick.
      b. Hydrous Calcium Silicate Insulation: 2 inches (____ mm) thick.

B. Cooling Systems:
   1. Pump Bodies:
      a. Glass Fiber, Rigid Insulation: 1-1/2 inches (____ mm) thick.
      b. Cellular Foam Insulation: 1-1/2 inches (____ mm) thick may be used on irregular surfaces such as fittings, valves and pumps.
   2. Air Separators:
      a. Glass Fiber, Rigid Insulation: 1-1/2 inches (____ mm) thick.
   3. Expansion Tanks:
      a. Glass Fiber, Rigid Insulation: 1-1/2 inches (____ mm) thick.
   4. Chiller Cold Surfaces (Not Factory Insulated):
      a. Glass Fiber, Rigid Insulation: 1-1/2 inches (____ mm) thick.
      b. Cellular Foam Insulation: 1-1/2 inches (____ mm) thick may be used on irregular surfaces such as fittings, valves and pumps.
   5. Cold Thermal Storage Tanks:
      a. Glass Fiber, Rigid Insulation: 1-1/2 inches (____ mm) thick.
b. Cellular Foam Insulation: 1-1/2 inches (____ mm) thick may be used on irregular surfaces such as fittings, valves and pumps.

C. Heat Recovery Systems:
   1. Air Separators:
      a. Glass Fiber, Rigid Insulation: 1-1/2 inches (____ mm) thick.
   2. Expansion Tanks:
      a. Glass Fiber, Rigid Insulation: 1-1/2 inches (____ mm) thick.

END OF SECTION
SECTION 23 0719
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Piping insulation.
   B. Flexible removable and reusable blanket insulation.
   C. Jackets and accessories.

1.02 RELATED REQUIREMENTS
   A. Section 07 8400 - Firestopping.

1.03 REFERENCE STANDARDS
   B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

1.04 SUBMITTALS
   A. See Section 230010 - GENERAL PROVISIONS, for submittal procedures.
   B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
   C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.06 FIELD CONDITIONS
   A. Maintain ambient conditions required by manufacturers of each product.
   B. Maintain temperature before, during, and after installation for minimum of 24 hours.
PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

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

B. All products shall conform to NFPA 90A and 90B.

2.02 GLASS FIBER, RIGID

A. Manufacturers:

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
   1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
   1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
   3. Maximum Moisture Absorption: 0.2 percent by volume.

D. Vapor Barrier Jacket: White polymer paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (0.029 ng/Pa s m).

E. Vapor Barrier Lap Adhesive: Compatible with insulation.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

G. Fibrous Glass Fabric:
   1. Blanket: 1.0 lb/cu ft (16 kg/cu m) density.

H. Indoor Vapor Barrier Finish:
   1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
   2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.03 HYDROUS CALCIUM SILICATE

A. Manufacturers:

B. Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.
   1. K (Ksi) Value: 0.40 at 300 degrees F (0.057 at 149 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
   3. Density: 15 lb/cu ft (240 kg/cu m).

C. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

D. Insulating Cement: ASTM C449.

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
   1. Armacell LLC: wwwarmacell.us.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3; use molded tubular material wherever possible.
1. 'K' ('Ksi') value: ASTM C 177; 0.27 at 75 degrees F (0.04 at 24 degrees C).
2. Maximum Moisture Absorption - Pipe Insulation: 3.5 percent, by weight, when tested in accordance with ASTM D 1056.
3. Maximum Moisture Absorption - Sheets: 6.0 percent, by weight, when tested in accordance with ASTM D 1056.
4. Water Vapor Permeability: 0.20 perm-inches, when tested in accordance with ASTM E 96.
5. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.05 JACKETS

A. PVC Plastic.
   1. Manufacturers:
   2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F (minus 18 degrees C).
      b. Maximum Service Temperature: 150 degrees F (66 degrees C).
      c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
         d. Thickness: 10 mil (0.25 mm).
         e. Connections: Brush on welding adhesive.

B. Canvas Jacket: UL listed 6 oz/sq yd (220 g/sq m) plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
   1. Lagging Adhesive: Compatible with insulation.

   1. Thickness: 0.016 inch (0.40 mm) sheet.
   2. Finish: Smooth.
   3. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
   4. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
   5. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

2.06 REMOVABLE/REUSABLE INSULATION JACKETS:

A. Non-Asbestos Glass mat, type E needle fiber.
B. Temperature maximum of 450°F, Maximum water vapor transmission of 0.00 perm, and maximum moisture absorption of 0.2 percent by volume.
C. Jacket Material: Silicon/fiberglass and LFP 2109 pure PTFE.
D. Construction: One piece jacket body with three-ply braided pure Teflon or Kevlar thread and insulation sewn as part of jacket. Belt fastened.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Exposed Piping: Locate insulation and cover seams in least visible locations.
C. Insulated pipes conveying fluids below ambient temperature; insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
D. Glass fiber insulated pipes conveying fluids below ambient temperature:
   1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

E. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.

G. Glass fiber insulated pipes conveying fluids above ambient temperature.
   1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

H. Inserts and Shields:
   1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
      a. 16 gauge sheet metal for pipes 4" and over.
      b. 20 gauge sheet metal for pipes smaller than 4".
      c. Shield length shall be as follows:
         1) 4" diameter and smaller: 9"
         2) 6" to 10" diameter: 12"
      d. Form the shields to bear on the lower 1/3 periphery of the insulated pipe.
   3. Insert location: Between support shield and piping and under the finish jacket.
   4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

I. Bevel all ends of insulation and seal with vapor barrier mastic.

J. Hangers, supports, anchors, etc. that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.

K. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 8400.

L. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with PVC jacket and fitting covers.

M. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

N. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

O. Insulation of cold surfaces where vapor barrier jackets are used, jackets shall be applied with a continuous, unbroken vapor seal (hangers on outside of insulation jacket).

P. Items concealed within the insulation shall be clearly marked on the outside of the insulation covering.
Q. Refrigerant Suction Piping: Apply insulation to clean, dry surface of pipe. Insulation may be applied prior to pipe assembly or by cutting insulation longitudinally after pipe assembly. Fittings, elbows, valves, etc. shall be insulated with mitered segments of pipe insulation. Apply adhesive on all butted joints, longitudinal seams, and mitered segments.

3.03 SCHEDULE

A. Heating Systems:
   1. Heating Water Supply and Return:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: through 1-1/2 inch.
            (a) Thickness: 1.5 inch.
         2) Pipe Size Range: greater than 1-1/2 inch.
            (a) Thickness: 2 inch.

B. Cooling Systems:
   1. Chilled Water:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: through 2 inch.
            (a) Thickness: 1.5 inch.
         2) Pipe Size Range: greater than 2 inch.
            (a) Thickness: 2 inch.
   2. Condensate Drains from Cooling Coils:
      a. Glass Fiber Insulation:
         1) Thickness: 1/2 inch.

3. Refrigerant Suction:
   a. Cellular Foam Insulation:
      1) Pipe Size Range: through 1-1/2 inch.
         (a) Thickness: 1 inch.
      2) Pipe Size Range: greater than 1-1/2 inch.
         (a) Thickness: 1.5 inch.

END OF SECTION
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

SECTION 23 0913

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Control panels.
B. Control Valves:
C. Dampers.
D. Damper Operators:
E. Input/Output Sensors:
   1. Static pressure (air pressure) sensors.
   2. Equipment operation (current) sensors.
   3. Damper position indicators.
F. Thermostats:
   1. Electric room thermostats.
   2. Line voltage thermostats.
   3. Room thermostat accessories.
   4. Outdoor reset thermostats.
   5. Airstream thermostats.
   7. Electric high limit duct thermostats.
G. Transmitters:
   1. Building static pressure transmitters.
   2. Pressure transmitters.

1.02 RELATED REQUIREMENTS

A. Section 23 0519 - Meters and Gauges for HVAC Piping: Thermometer sockets and gauge taps.
B. Section 23 0923 - Direct-Digital Control System for HVAC.
C. Section 23 0993 - Sequence of Operations for HVAC Controls.
D. Section 23 3300 - Air Duct Accessories: Installation of automatic dampers.
E. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
B. NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats; 2013.

1.04 SUBMITTALS

A. See Section 230010 - GENERAL PROVISIONS, for submittal procedures.
B. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
C. Manufacturer's Instructions: Provide for all manufactured components.
D. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
E. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
   1. Revise shop drawings to reflect actual installation and operating sequences.
1.05 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

1.06 MAINTENANCE SERVICE
   A. Provide service and maintenance of control system for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

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

2.03 CONTROL PANELS
   A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.
   B. NEMA 250, general purpose utility enclosures with enameled finished face panel.
   C. Provide common keying for all panels.

2.04 INPUT/OUTPUT SENSORS
   A. Static Pressure (Air Pressure) Sensors:
      1. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
      2. Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F (5 to 40 degrees C).
      3. Accuracy: One percent of full scale with repeatability 0.3 percent.
      4. Output: 0 to 5 vdc with power at 12 to 28 vdc.
   B. Equipment Operation (Current) Sensors:
      1. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg (0 to 1250 Pa).
      2. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 8 to 60 psi (50 to 400 kPa).
   C. Damper Position Indicators: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 to 100 percent damper travel.
   D. Carbon Dioxide Sensors, Duct and Wall:
      1. Air Temperature: Range of 32 to 122 degrees F (0 to 50 degrees C).
      2. Relative Humidity: Range of 0 to 95 percent (non-condensing).
      3. Calibration Characteristics:
         a. Automatically compensating algorithm for sensor drift due to sensor degradation.
         b. Maximum Drift: 2 percent.
         c. User calibratable with a minimum calibration interval of 5 years.
      4. Construction:
         a. Sensor Chamber: Non-corrosive material for neutral effect on carbon dioxide sample.
         b. Provide duct mounted sensors with duct probe designed to protect sensing element from dust accumulation and mechanical damage.
         c. Housing: High impact plastic.
E. Carbon Monoxide Detectors:
   1. Single or multichannel dual level detectors, using solid state sensors with three year
      minimum life. Sensor replacement shall take maximum 15 minutes. Suitable over
      temperature range of 23 to 130 degrees F (-5 to 55 degrees C).
   2. Provide individual indicators and contactors for each level, initially calibrated for 50 ppm
      and 100 ppm.
   3. Maximum response time to 100 ppm CO calibration gas: Two minutes.

2.05 THERMOSTATS
A. Electric Room Thermostats:
   1. Type: NEMA DC 3, 24 volts, with setback/setup temperature control.
   2. Service: Cooling only.
   3. Covers: Locking with set point adjustment and setpoint indication, with thermometer.
B. Line Voltage Thermostats:
   1. Integral manual On/Off/Auto selector switch, single or two pole as required.
   2. Dead Band: Maximum 2 degrees F (one degree C).
   3. Cover: Locking with set point adjustment, with thermometer.
C. Room Thermostat Accessories:
   1. Thermostat Covers: Brushed aluminum.
   2. Insulating Bases: For thermostats located on exterior walls.
D. Outdoor Reset Thermostats:
   1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable throttling
      range, adjustable setpoint.
   2. Scale range: Minus 10 to 70 degrees F (2 to 35 degrees C).
E. Airstream Thermostats:
   1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in
      middle of range and adjustable throttling range.
   2. Averaging service remote bulb element: 7.5 feet (2.3 m).
F. Electric Low Limit Duct Thermostats:
   1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed
      across any 12 inches (300 mm) of bulb length is equal to or below setpoint,
   2. Bulb length: Minimum 20 feet (6 m).
G. Electric High Limit Duct Thermostats:
   1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed
      across any 12 inches (300 mm) of bulb length is equal to or above setpoint,
   2. Bulb length: Minimum 20 feet (6 m).

2.06 TRANSMITTERS
A. Building Static Pressure Transmitters:
   1. One pipe, differential type with temperature compensation, scale range 0.01 to 6.0 inch wg
      (.0025 to 1.5 kPa) positive or negative, and sensitivity of 0.0005 inch wg (0.125 Pa).
      Transmit electronic signal to receiver with matching scale range.
B. Pressure Transmitters:
   1. One pipe direct acting indicating type for gas, liquid, or steam service, range suitable for
      system, proportional electronic output.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that systems are ready to receive work.
B. Sequence work to ensure installation of components is complementary to installation of similar
   components in other systems.
C. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of thermostats with plans and room details before installation. Locate 48 inches (1200 mm) above floor. Align with lighting switches and humidistats. Refer to Section 26 2726.

C. Mount freeze protection thermostats using flanges and element holders.

D. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.

E. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.

F. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

G. Provide conduit and electrical wiring in accordance with Section 26 2717. Electrical material and installation shall be in accordance with appropriate requirements of .

END OF SECTION
SECTION 23 0923
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. System description.
B. Operator interface.
C. Controllers.
D. Power supplies and line filtering.
E. System software.
F. Controller software.
G. HVAC control programs.

1.02 RELATED REQUIREMENTS

A. Section 23 0913 - Instrumentation and Control Devices for HVAC.
B. Section 23 0993 - Sequence of Operations for HVAC Controls.
C. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
B. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SYSTEM DESCRIPTION

A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units.
B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, and fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 0913.
E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.
G. BAS shall be web accessible and shall be installed on a standalone network, separate network by this contractor.

1.05 SUBMITTALS

A. See Section 230010 - GENERAL PROVISIONS for submittal procedures.
B. Product Data: Provide data for each system component and software module.
C. Shop Drawings:
   1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
   2. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
3. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
4. Indicate description and sequence of operation of operating, user, and application software.
D. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
   1. Revise shop drawings to reflect actual installation and operating sequences.
   2. Include submittals data in final "Record Documents" form.
E. Operation and Maintenance Data:
   1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
   2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
   3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

1.06 QUALITY ASSURANCE
A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of documented experience and approved by manufacturer.
B. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

1.07 MAINTENANCE SERVICE
A. Provide service and maintenance of energy management and control systems for one years from Date of Substantial Completion.
B. Provide two complete inspections, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.

PART 2 PRODUCTS
2.01 MANUFACTURERS

2.02 SYSTEM DESCRIPTION
A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units with communications to Building Management System specified in Section 230993.
B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 23 0913.
E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.
G. BAS shall be web accessible and shall be installed on a standalone network, separate from the facility provided one.

2.03 OPERATOR INTERFACE
A. PC Based Work Station:
   1. Resides on high speed network with building controllers.
B. Workstation, controllers, and control backbone to communicate using BACnet protocol and addressing.
C. Hardware:
   1. Desktop:
      a. Computer(s) and display(s) to be provided by DDC controls manufacturer.
      b. Quantity: As indicated on the Drawings.
      c. Minimum RAM: 16 GIG.
      d. Minimum Processing Speed: 4 GHZ.
      e. Minimum Hard Drive Memory: 2 TB.
      f. Monitor: 23” LCD.
      g. Location(s): As indicated on the Drawings.
      h. Network Connection:
         1) Ethernet interface card.
         2) Minimum Speed: 1 GBS.

2.04 CONTROLLERS
A. Building Controllers:
   1. General:
      a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
      b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
      c. Share data between networked controllers.
      d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
      e. Utilize real-time clock for scheduling.
      f. Continuously check processor status and memory circuits for abnormal operation.
      g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
      h. Communication with other network devices to be based on assigned protocol.
   2. Communication:
      a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
      b. Perform routing when connected to a network of custom application and application specific controllers.
      c. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
   3. Anticipated Environmental Ambient Conditions:
      a. Outdoors and/or in Wet Ambient Conditions:
         1) Mount within waterproof enclosures.
         2) Rated for operation at 40 to 150 degrees F (4 to 65 degrees C).
      b. Conditioned Space:
         1) Mount within dustproof enclosures.
         2) Rated for operation at 32 to 120 degrees F (0 to 50 degrees C).
   4. Provisions for Serviceability:
      a. Diagnostic LEDs for power, communication, and processor.
b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.

5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.

6. Power and Noise Immunity:
   a. Maintain operation at 90 to 110 percent of nominal voltage rating.
   b. Perform orderly shutdown below 80 percent of nominal voltage.
   c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet (1 m).

B. Input/Output Interface:
1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
2. All Input/Output Points:
   a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
   b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
3. Binary Inputs:
   a. Allow monitoring of On/Off signals from remote devices.
   b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
   c. Sense dry contact closure with power provided only by the controller.
4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
   a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
   b. Compatible with and field configurable to commonly available sensing devices.
6. Binary Outputs:
   a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
   b. Outputs provided with three position (On/Off/Auto) override switches.
   c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
   a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
   b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
   c. Drift to not exceed 0.4 percent of range per year.
8. Tri State Outputs:
   a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
   b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
   c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
9. System Object Capacity:
   a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
   b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.
2.05 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies:
   1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
   2. Limit connected loads to 80 percent of rated capacity.
   3. Match DC power supply to current output and voltage requirements.
   4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
   5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
   6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
   7. Operational Ambient Conditions: 32 to 120 degrees F (0 to 50 degrees C).
   8. Line voltage units UL recognized and CSA approved.

B. Power Line Filtering:
   1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
   2. Minimum surge protection attributes:
      a. Dielectric strength of 1000 volts minimum.
      b. Response time of 10 nanoseconds or less.
      c. Transverse mode noise attenuation of 65 dB or greater.
      d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

2.06 LOCAL AREA NETWORK (LAN)

A. Provide communication between control units over local area network (LAN).

B. LAN Capacity: Not less than 60 stations or nodes.

C. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.

D. LAN Data Speed: Minimum 19.2 Kb.

E. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.

F. Transmission Median: Fiber optic or single pair of solid 24 gage twisted, shielded copper cable.

G. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

2.07 SYSTEM SOFTWARE

A. Operating System:
   1. Concurrent, multi-tasking capability.
   2. System Graphics:
      a. Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
      b. Animation displayed by shifting image files based on object status.
      c. Provide method for operator with password to perform the following:
         1) Move between, change size, and change location of graphic displays.
         2) Modify on-line.
         3) Add, delete, or change dynamic objects consisting of:
            (a) Analog and binary values.
            (b) Dynamic text.
            (c) Static text.
(d) Animation files.

3. Custom Graphics Generation Package:
   a. Create, modify, and save graphic files and Visio format graphics in PCX formats.
   b. HTML graphics to support web browser compatible formats.
   c. Capture or convert graphics from AutoCAD.

4. Standard HVAC Graphics Library:
   a. HVAC Equipment:
      1) Chillers.
      2) Boilers.
      3) Air Handlers.
      4) Terminal HVAC Units.
      5) Fan Coil Units.
      6) Unit Ventilators.
   b. Ancillary Equipment:
      1) Fans.
      2) Pumps.
      3) Coils.
      4) Valves.
      5) Piping.
      6) Dampers.
      7) Ductwork.

B. Workstation System Applications:

1. Automatic System Database Save and Restore Functions:
   a. Current database copy of each Building Controller is automatically stored on hard disk.
   b. Automatic update occurs upon change in any system panel.
   c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.

2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
   a. Save database from any system panel.
   b. Clear a panel database.
   c. Initiate a download of a specified database to any system panel.

3. Software provided allows system configuration and future changes or additions by operators under proper password protection.

4. On-line Help:
   a. Context-sensitive system assists operator in operation and editing.
   b. Available for all applications.
   c. Relevant screen data provided for particular screen display.
   d. Additional help available via hypertext.

5. Security:
   a. Operator log-on requires user name and password to view, edit, add, or delete data.
   b. System security selectable for each operator.
   c. System supervisor sets passwords and security levels for all other operators.
   d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
   e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
   f. All system security data stored in encrypted format.

6. System Diagnostics:
   a. Operations Automatically Monitored:
      1) Workstations.
      2) Printers.
3) Modems.
4) Network connections.
5) Building management panels.
6) Controllers.
	b. Device failure is annunciated to the operator.

7. Alarm Processing:
   a. All system objects are configurable to "alarm in" and "alarm out" of normal state.
   b. Configurable Objects:
      1) Alarm limits.
      2) Alarm limit differentials.
      3) States.
      4) Reactions for each object.

8. Alarm Messages:
   b. Recognizable Features:
      1) Source.
      2) Location.
      3) Nature.

9. Configurable Alarm Reactions by Workstation and Time of Day:
   a. Logging.
   b. Printing.
   c. Starting programs.
   d. Displaying messages.
   e. Dialing out to remote locations.
   f. Paging.
   g. Providing audible annunciation.
   h. Displaying specific system graphics.

10. Custom Trend Logs:
    a. Definable for any data object in the system including interval, start time, and stop time.
    b. Trend Data:
       1) Sampled and stored on the building controller panel.
       2) Archivable on hard disk.
       3) retrievable for use in reports, spreadsheets and standard database programs.
       4) Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
       5) Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.

11. Alarm and Event Log:
    a. View all system alarms and change of states from any system location.
    b. Events listed chronologically.
    c. Operator with proper security acknowledges and clears alarms.
    d. Alarms not cleared by operator are archived to the workstation hard disk.

12. Object, Property Status and Control:
    a. Provide a method to view, edit if applicable, the status of any object and property in the system.
    b. Status Available by the Following Methods:
       1) Menu.
       2) Graphics.
       3) Custom Programs.

13. Reports and Logs:
    a. Reporting Package:
       1) Allows operator to select, modify, or create reports.
       2) Definable as to data content, format, interval, and date.
3) Archivable to hard disk.
   b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
   c. Stored on hard disk and readily accessible by standard software applications,
      including spreadsheets and word processing.
   d. Set to be printed on operator command or specific time(s).

14. Reports:
   a. Standard:
      1) Objects with current values.
      2) Current alarms not locked out.
      3) Disabled and overridden objects, points and SNVTs.
      4) Objects in manual or automatic alarm lockout.
      5) Objects in alarm lockout currently in alarm.
   b. Logs:
      (a) Alarm History.
      (b) System messages.
      (c) System events.
      (d) Trends.
   c. Custom:
      1) Daily.
      2) Weekly.
      3) Monthly.
      4) Annual.
      5) Time and date stamped.
      6) Title.
      7) Facility name.
   c. Tenant Override:
      1) Monthly report showing total, requested, after-hours HVAC and lighting services
         on a daily basis for each tenant.
      2) Annual report showing override usage on a monthly basis.
   d. Electrical, Fuel, and Weather:
      1) Electrical Meter(s):
         (a) Monthly showing daily electrical consumption and peak electrical demand
             with time and date stamp for each meter.
         (b) Annual summary showing monthly electrical consumption and peak demand
             with time and date stamp for each meter.
      2) Fuel Meter(s):
         (a) Monthly showing daily natural gas consumption for each meter.
         (b) Annual summary showing monthly consumption for each meter.
      3) Weather:
         (a) Monthly showing minimum, maximum, average outdoor air temperature and
             heating/cooling degree-days for the month.

C. Workstation Applications Editors:
   1. Provide editing software for each system application at PC workstation.
   2. Downloaded application is executed at controller panel.
   3. Full screen editor for each application allows operator to view and change:
      a. Configuration.
      b. Name.
      c. Control parameters.
      d. Set-points.
   4. Scheduling:
      a. Monthly calendar indicates schedules, holidays, and exceptions.
      b. Allows several related objects to be scheduled and copied to other objects or dates.
      c. Start and stop times adjustable from master schedule.
   5. Custom Application Programming:
a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.

b. Programming Features:
   1) English oriented language, based on BASIC, FORTRAN, C, or PASCAL syntax allowing for free form programming.
   2) Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
   3) Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
   4) Allows the development of independently, executing, program modules designed to enable and disable other modules.
   5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
   6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
   7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.
   8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values can be used in IF/THEN comparisons, calculations, programming statement logic, etc.
   9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

2.08 CONTROLLER SOFTWARE
A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.

B. System Security:
   1. User access secured via user passwords and user names.
   2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
   3. User Log On/Log Off attempts are recorded.
   4. Automatic Log Off occurs following the last keystroke after a user defined delay time.

C. Object or Object Group Scheduling:
   1. Weekly Schedules Based on Separate, Daily Schedules:
      a. Include start, stop, optimal stop, and night economizer.
      b. 10 events maximum per schedule.
      c. Start/stop times adjustable for each group object.

D. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.

E. Alarms:
   1. Binary object is set to alarm based on the operator specified state.
   2. Analog object to have high/low alarm limits.
   3. All alarming is capable of being automatically and manually disabled.
   4. Alarm Reporting:
      a. Operator determines action to be taken for alarm event.
      b. Alarms to be routed to appropriate workstation.
      c. Reporting Options:

F. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.
G. Sequencing: Application software based upon specified sequences of operation in Section 23 0993.

H. PID Control Characteristics:
   1. Direct or reverse action.
   2. Anti-windup.
   3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.

I. Staggered Start Application:
   1. Prevents all controlled equipment from simultaneously restarting after power outage.
   2. Order of equipment startup is user selectable.

J. Energy Calculations:
   1. Accumulated instantaneous power or flow rates are converted to energy use data.
   2. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.
   3. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.

K. Anti-Short Cycling:
   1. All binary output objects protected from short-cycling.
   2. Allows minimum on-time and off-time to be selected.

L. On-Off Control with Differential:
   1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
   2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.

M. Run-Time Totalization:
   1. Totalize run-times for all binary input objects.
   2. Provides operator with capability to assign high run-time alarm.

2.09 HVAC CONTROL PROGRAMS

A. General:
   1. Identify each HVAC Control system.

B. Optimal Run Time:
   1. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
   2. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
   3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
   4. Use outside air temperature to determine early shut down with ventilation override.
   5. Operator commands:
      a. Define term schedule.
      b. Add/delete fan status point.
      c. Add/delete outside air temperature point.
      d. Define heating/cooling parameters.
      e. Lock/unlock program.
      f. Request optimal run time control summary.
      g. Request optimal run time mass temperature summary.
      h. Request HVAC point summary.
      i. Request HVAC saving profile summary.

   6. Control Summary:
      a. HVAC Control system begin/end status.
      b. Optimal run time lock/unlock control status.
      c. Heating/cooling mode status.
d. Optimal run time schedule.
e. Start/Stop times.
f. Optimal run time system normal start times.
g. Occupancy and vacancy times.
h. Optimal run time system heating/cooling mode parameters.

7. HVAC point summary:
   a. Control system identifier and status.
   b. Point ID and status.
   c. Outside air temperature point ID and status.
   d. Calculated optimal start and stop times.
   e. Period start.

C. Supply Air Reset:
   1. Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot
dock and cold deck temperatures on dual duct and multizone systems, single zone unit
discharge temperatures.
   2. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
      a. Raising cooling temperatures to highest possible value.
      b. Reducing heating temperatures to lowest possible level.
   3. Operator commands:
      a. Add/delete fan status point.
      b. Lock/unlock program.
      c. Request HVAC point summary.
      d. Add/Delete discharge controller point.
      e. Define discharge controller parameters.
   4. Control summary:
      a. HVAC control system status (begin/end).
      b. Supply air reset system status.
      c. Heating and cooling loop.

5. Space load summary:
   a. HVAC system status.
   b. Heating/cooling loop status.
   c. Space load point ID.
   d. Control heat/cool limited.

D. Enthalpy Switchover:
   1. Calculate outside and return air enthalpy using measured temperature and relative
   humidity; determine energy expended and control outside and return air dampers.
   2. Control summary:
      a. HVAC control system begin/end status.
      b. Enthalpy switchover optimal system status.
      c. Current outside air enthalpy.
      d. Calculated mixed air enthalpy.

2.10 CHILLER CONTROL PROGRAMS
   A. Control function of condenser water reset, chilled water reset, and chiller sequencing. Support
   inch-pounds and SI (metric) units of measurement.
   B. Chilled Water Reset: Automatically reset controlled chilled water temperature satisfying cooling
   coil requiring greatest cooling.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify existing conditions before starting work.
B. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.02 INSTALLATION
   A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
   B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 23 0993.
   C. Provide conduit and electrical wiring in accordance with Section 26 2717. Electrical material and installation shall be in accordance with appropriate requirements of .

3.03 MANUFACTURER’S FIELD SERVICES
   A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
   B. Provide service engineer to instruct Owner’s representative in operation of systems plant and equipment for 3 day period.
   C. Provide basic operator training for 2 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 40 hours dedicated instructor time. Provide training on site.

3.04 DEMONSTRATION AND INSTRUCTIONS
   A. Demonstrate complete and operating system to Owner.

END OF SECTION
SECTION 23 0993
SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1  GENERAL
1.01  SECTION INCLUDES
   A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.
   B. Sequence of operation for:
      1. Air terminal units.
      2. Cabinet heaters.
      3. Central refrigeration systems.
      4. Central fan systems.
      5. Elevator machine rooms.
      6. Fan coil units.
      7. Pumps
      8. Radiant panels.
      9. Unit heaters.

1.02  RELATED REQUIREMENTS
   A. Section 23 0913 - Instrumentation and Control Devices for HVAC.
   B. Section 23 0923 - Direct-Digital Control System for HVAC.
   C. Section 26 2817 - Enclosed Circuit Breakers.

1.03  SUBMITTALS
   A. See Section 230010 - GENERAL PROVISIONS for submittal procedures.
   B. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
      1. Label with settings, adjustable range of control and limits.
      2. Include written description of control sequence.
      3. Include flow diagrams for each control system, graphically depicting control logic.
      4. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
   C. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

PART 2  PRODUCTS - NOT USED

PART 3  EXECUTION
3.01  MISCELLANEOUS
   A. The Temperature Control Contractor shall provide all control wiring for all equipment provided under Division 23 unless specifically stated otherwise herein. All wiring shall be installed within conduit. Refer to division 26.
   B. Unless otherwise indicated, control loops shall be enabled and disabled based on the status of the system being controlled to prevent windup.
   C. When a control loop is enabled or re-enabled, it and all its constituents (such as the proportional and integral terms) shall be set initially to a Neutral value.
   D. A control loop in Neutral shall correspond to a condition that applies the minimum control effect, i.e., valves/dampers closed, VFDs at minimum speed, etc.
   E. When there are multiple outdoor air temperature sensors, the system shall use the valid sensor that most accurately represents the outdoor air conditions at the equipment being controlled.
1. Outdoor air temperature sensors at air handler outdoor air intakes shall be considered valid only when the supply fan is proven on and unit is in Occupied Mode or in any other Mode with the economizer enabled.

2. The outdoor air temperature used for optimum start, plant lockout, and other global sequences shall be the average of all valid sensor readings. If there are four or more valid outdoor air temperature sensors, discard the highest and lowest temperature readings.

F. The term "proven" (i.e., “proven on”/ “proven off”) shall mean that the equipment’s DI status point (where provided, e.g. current switch, DP switch, or VFD status) matches the state set by the equipment’s DO command point.

G. The term “software point” shall mean an analog variable, and “software switch” shall mean a digital (binary) variable, that are not associated with real I/O points. They shall be read/write capable (e.g., BACnet analog variable and binary variable).

H. The term “control loop” or “loop” is used generically for all control loops. These will typically be PID loops, but proportional plus integral plus derivative gains are not required on all loops. Unless specifically indicated otherwise, the following guidelines shall be followed:
   1. Use proportional only (P-only) loops for limiting loops (such as zone CO2 control loops, etc.).
   2. Do not use the derivative term on any loops unless field tuning is not possible without it.

I. To avoid abrupt changes in equipment operation, the output of every control loop shall be capable of being limited by a user adjustable maximum rate of change, with a default of 25% per minute.

J. All setpoints, timers, deadbands, PID gains, etc., listed in sequences shall be adjustable by the user with appropriate access level whether indicated as adjustable in sequences or not. Software points shall be used for these variables. Fixed scalar numbers shall not be embedded in programs except for physical constants and conversion factors.

K. Values for all points, including real (hardware) points used in control sequences shall be capable of being overridden by the user with appropriate access level (e.g., for testing and commissioning). If hardware design prevents this for hardware points, they shall be equated to a software point and the software point shall be used in all sequences.

L. Alarms:
   1. There shall be 5 levels of alarm
      a. Level 1: Critical/life safety
      b. Level 2: Significant equipment failure
      c. Level 3: Non-critical equipment failure/operation
      d. Level 4: Energy conservation monitor
      e. Level 5: Maintenance indication, notification

M. VFD Speed Points
   1. The speed analog output sent to VFDs shall be configured such that 0% speed corresponds to 0 Hz and 100% speed corresponds to maximum speed configured in the VFD.
   2. For each piece of equipment, the minimum speed shall be stored in a single software point. This value shall be written to the VFD’s minimum speed setpoint via the drive’s network interface; in the case of a hard-wired VFD interface, the minimum speed shall be the lowest speed command sent to the drive by the BAS. See 3.2A.2 for minimum speed setpoints.

3.02 TRIM & RESPOND (T&R) SETPOINT RESET LOGIC

A. Trim & Respond setpoint reset logic and zone/system reset Requests where referenced in sequences shall be implemented as described below.

B. A “Request” is a call to reset a static pressure or temperature setpoint, generated by downstream zones or air handling systems. These Requests are sent upstream to the plant or system that serves the zone or air handler that generated the Request.
1. For each downstream zone or system, and for each type of setpoint reset request listed for the zone/system, provide the following software points:
   a. Importance Multiplier (default = 1)
   b. Request-Hours. Provided SystemOK is true, every x minutes (default 5 minutes), add x/60 times the current number of Requests to this request-hours accumulator point. The request-hours point is reset to zero upon a global command from the system/plant serving the zone/system – this global point simultaneously resets the request-hours point for all zones/systems served by this system/plant.
   c. Cumulative%-Request-Hours. This is the zone/system Request Hours divided by the zone/system run-hours (the hours in any Mode other than Unoccupied Mode) since the last reset, expressed as a percentage.
   d. A Level 4 alarm is generated if the zone Importance Multiplier is greater than zero, the zone/system Cumulative% Request Hours exceeds 70%, and the total number of zone/system run hours exceeds 40.

C. See zone and air handling system control sequences for logic to generate requests.

D. Multiply the number of Requests determined from zone/system logic times the Importance Multiplier and send to the system/plant that serves the zone/system. See system/plant logic to see how Requests are used in Trim & Respond logic.

3.03 EQUIPMENT STAGING AND ROTATION

A. Exceptions:
   1. None.

B. Automatic Even Wear Rotation
   1. Lead/lag: Unless otherwise noted, parallel staged devices (such as pumps, towers) that are not redundant shall be lead/lag alternated when more than one is off or more than one is on so that the device with the most operating hours is made the later stage device and the one with the least number of hours is made the earlier stage device. For example, assuming there are three devices, if all three are off or all are on, the staging order will simply be based on run hours from lowest to highest. If two devices are on, the one with the most hours will be set to be stage 2 while the other is set to stage 1; this may be the reverse of the operating order when the devices were started. If two devices are off, the one with the most hours will be set to be stage 3 while the other is set to stage 2; this may be the reverse of the operating order when the devices were stopped.

   2. Lead/standby: Unless otherwise noted, parallel devices (such as pumps, towers) that are 100% redundant shall be lead/standby alternated when more than one is off so that the device with the most operating hours is made the later stage device and the one with the least number of hours is made the earlier stage device. For example, assuming there are three devices, if all three are off, the staging order will be based on run hours from lowest to highest. If devices run continuously, lead/standby shall switch at an operator-specified runtime; standby device shall first be started and proven on before former lead device is changed to standby and shut off.

   3. Operators with appropriate access level shall be able to manually command staging order via software points overriding the Even Wear or Periodic Rotation logic above, but not overriding the In Alarm or Hand Operation logic below.

   4. In Alarm: If the lead device has a fault condition or has been manually switched off, a Level 2 alarm shall be generated and the device shall be set to the last stage position in the lead/lag order until alarm is reset by operator. Staging position of remaining devices shall follow the prevailing (Even Wear or Periodic Rotation) logic. A device in alarm can only automatically move up in the staging order if another device goes into alarm. Fault conditions include the following:

   5. Hand Operation: If a device is on in Hand (e.g., via an HOA switch or local control of VFD), the device shall be set to the lead device and a Level 4 alarm shall be generated. The device will remain as lead until the alarm is reset by the operator. Hand operation is determined by
      a. Variable Speed Fans
1) Status point not matching its on/off point for 15 seconds while the device is commanded off, or
2) VFD in local "hand" mode, or
3) Supervised HOA at control panel in ON position

3.04 AIR TERMINAL UNITS
A. Single-duct Variable Volume:
   1. Cooling with Reheat:
      a. Occupied Mode:
         1) An individual zone sensor (one per zone/box) transmits zone temperature and zone set point information to the VAV box controller. The controller in turn modulates the primary air damper in order to deliver the appropriate amount of cool air from the medium pressure duct into the zone.
            (a) When the damper reaches the 90% open position, the VAV shall signal the associated air handling unit to increase the supply air duct static pressure.
         2) As the zone temperature falls toward set point, the damper is modulated closed toward its minimum position. If the temperature in the zone continues to fall, then the hot water heat is engaged and the hot water valve is modulated. The further the temperature falls from zone set point, the more hot water is allowed to flow through the coil.
            (a) When the two-way control valve serving the reheat coil reaches the 90% open position, the VAV shall signal the heating water pumps to increase the heating water differential pressure.
      b. Unoccupied Mode:
         1) The air handling unit fan and two-way control valve shall operate to maintain heating setpoint (adjustable).
      c. Provide 3-way control valves for VAV-3.

3.05 CABINET HEATERS
A. Single temperature room thermostat set at 68 degrees F (20 degrees C) (adj) maintains constant space temperature by cycling unit fan motor and modulating 2-way control valve.

3.06 CENTRAL REFRIGERATION SYSTEMS
A. CENTRAL REFRIGERATION SYSTEMS (AIR COOLED)
   1. When the building has a call for cooling and the outside air temperature is above 65°F (adj.), energize the chilled water pump and chiller.
   2. When chilled water pump starts, open chiller control valve.
   3. When chilled water flow and condensing water flow are proven by flow switches, allow refrigeration machine to start.

3.07 CENTRAL FAN SYSTEMS
A. Air Handling Unit System Modes
   1. AHU system Modes are the same as the Mode of the Zone Group served by the system. When Zone Group served by an air handling system are in different modes, the following hierarchy applies (highest one sets AHU mode).
      a. Occupied Mode
      b. Cool-down Mode
      c. Setup Mode
      d. Warmup Mode
      e. Setback Mode
      f. Freeze Protection Setback Mode
      g. Unoccupied Mode
   2. Multiple Zone VAV Air Handling Unit
      a. Supply Fan Control
         1) Supply Fan Start/Stop
(a) Supply fan shall run when system is in the Cool-down Mode, Setup Mode, or Occupied Mode.
(b) If there are any VAV-reheat boxes on perimeter zones, supply fan shall also run when system is in Setback Mode or Warmup Mode (i.e., all Modes except Unoccupied).
(c) Totalize current airflow rate from VAV boxes to a software point, Vps.

b. Static Pressure Setpoint Reset
1) Static pressure setpoint: Setpoint shall be reset using Trim & Respond logic using the following parameters:
   (a) Variable: Value
   (b) Device: Supply Fan
   (c) SP(0): 0.5 inches (120 Pa.)
   (d) SP(min): 0.1 inches (25 Pa.)
   (e) SP(max): Max_DSP (See 3.2A.1) NEEDS TO BE CONFIRMED.
   (f) T(d): 10 minutes
   (g) T: 2 minutes
   (h) I: 2
   (i) R: Zone Static Pressure Reset Requests
   (j) SP(trim): -0.05 inches (-12 Pa)
   (k) SP(res): +0.06 inches (15 Pa)
   (l) SP(res-max): +13 inches (32 Pa)

c. Static Pressure Control
1) Supply fan speed is controlled to maintain duct static pressure at setpoint when the fan is proven on. Where the Zone Groups served by the system are small, provide multiple sets of gains that are used in the control loop as a function of a load indicator (such as supply fan airflow rate, the area of the Zone Groups that are occupied, etc.).

d. Supply Air Temperature Control
1) Control loop is enabled when the supply air fan is proven on, and disabled and output set to Deadband (no heating, minimum economizer) otherwise.

e. Supply Air Temperature Setpoint
1) See 0) for Min_SAT, Des_SAT, Max_SAT, OAT_Min, and OAT_Max setpoints.
2) During Occupied Mode: Setpoint shall be reset from Min_SAT when the outdoor air temperature is OAT_Max and above, proportionally up to T-max when the outdoor air temperature is OAT_Min and below.
   (a) T-max shall be reset using Trim & Respond logic between Des_SAT and Max_SAT. The following parameters are suggested as a starting place, but they will require adjustment during the commissioning/tuning phase:
      (1) Variable: Value
      (2) Device: Supply Fan
      (3) SP(0): SP(max)
      (4) SP(min): Des_SAT
      (5) SP(max): Max_SAT
      (6) T(d): 10 minutes
      (7) T: 2 minutes
      (8) I: 2
      (9) R: Zone Cooling SAT Requests
      (10) SP(trim): +0.2 degrees F (+0.1 degrees C)
      (11) SP(res): -0.3 degrees F (-0.2 degrees C)
      (12) SP(res-max): -1.0 degrees F (-0.6 degrees C)
3) During Setup or Cool-Down Modes: Setpoint shall be Min_SAT.
4) During Warmup and Setback Modes: Setpoint shall be 95 degrees F (35 degrees C).

f. Supply air temperature shall be controlled to setpoint using a control loop whose output is mapped to sequence the hot water valve or modulating electric heating coil
SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

(if applicable), outdoor air damper, return air damper, and chilled water valve as shown in the diagram below.

1) Economizer damper maximum (MaxOA-P) position is limited for economizer high limit lockout.

B. Time Schedule: Start and stop supply and return fans. Determine fan status through auxiliary contactors in motor starter. If fan fails to start as commanded, signal alarm.

C. Safety Devices:
   1. Freeze Protection: Stop fans and close outside air dampers if temperature before supply fan is below 37 degrees F (3 degrees C); signal alarm.
   2. High Temperature Protection: Stop fans and close outside dampers if temperature in return air is above 300 degrees F (150 degrees C); signal alarm.
   3. Smoke Detector: Stop fans, close outside dampers, and close smoke dampers if smoke is detected; signal alarm.

D. Outside Air Damper: When supply fan is running, open outside air damper to minimum position. Prevent supply fan starting until outside air damper is open and position is verified.

E. Outside, Return, and Relief Dampers:
   1. When supply fan is not running, outside and relief dampers are closed and return damper is open.
   2. When supply fan is running, dampers are controlled and operate with outside and relief dampers opening, and return damper closing.
   3. For cooling and outside air temperatures below 55 degrees F (12 degrees C), modulate dampers to maintain mixed air temperature of 55 degrees F (12 degrees C) or higher.
   4. For cooling and outside air temperatures above 55 degrees F (12 degrees C) outside and relief dampers are open and return damper is closed.
   5. For cooling and outside air temperatures above 55 degrees F (12 degrees C) compare return and outside air temperatures. If return air temperature is lower, drive outside damper to minimum, close relief damper, and open return damper.
   6. For outside air temperatures above 79 degrees F (26 degrees C), drive outside damper to minimum, close relief damper, and open return damper.
   7. For heating, drive outside damper to minimum, close relief damper, and open return damper.

F. Multizone System:
   1. Space sensor set at 75 degrees F (24 degrees C), modulates zone dampers and maintains constant space temperature during the day and 15 degrees F cooler at night (during the day and 8 degrees C cooler at night).
   2. Room calling for greatest heating modulates reheat coil valve. Room thermostat calling for greatest cooling modulates cooling coil valve.

G. AHU-1
   1. UNIT CONTROLS:
      a. Building Automation System (BAS) interface: The factory unit controller will interface with BACnet MSTP, IP and LON BAS systems (requires optional communication card).
      b. Head Pressure Control: The condenser head pressure will be monitored by the unit controller to maintain head pressure and the compressor operating envelope at all times to avoid high pressure trips on high load days. Condenser fans with ECM motors shall be provided as well as factory sensors to provide this protection.
      c. Compressor Envelope Control: The unit controller will continually monitor the suction and discharge pressure and temperature conditions during compressor operation. The unit will modulate the compressor, condenser head pressure, and electronic expansion valve to maintain a safe compressor operating conditions to add reliability, and limit unit shut down during fringe operating conditions.
   2. CHANGE OVER SETPOINTS: The unit change over source temperature is the variable, Outdoor air temperature (OAT), Return air temperature (RAT), or space temperature (ST),
that drives the change of unit states. The unit state will change from cooling, fan only or heating based on the changeover heating or cooling setpoints.

3. **SUPPLY FAN:** The RTU will be factory supplied with a direct drive supply fan.
   a. **VAV Duct Pressure:** The supply fan will operate continuously. The unit will modulate the supply fan as required to maintain the duct pressure set point.

4. **OUTSIDE AIR DAMPER CONTROL:**
   a. **Proportional damper reset:** The unit controller will proportionally modulate the outside air dampers open and closed as the supply fan speed changes to provide a constant volume of fresh outside air.
   b. **Outdoor air monitor:** The unit controller will modulate the outside air damper as required to maintain the outside air cfm setpoint as measured by the factory provided flow station (Requires Optional OA Monitor).
   c. **DCV:** A space or duct mounted CO2 sensor will supply a PPM reading to the unit controller. The unit controller will open the OA damper to provide more ventilation air as required by the CO2 PPM reading (Requires Optional CO2 Sensor).
   d. **External Reset:** An external 0-10 VDC or 4-20 mA signal can be wired to the unit controller to control the OA damper position by a third party.

5. **COOLING:**
   a. **Discharge Air Control:** In the cooling mode, the unit capacity will modulate the variable speed compressor to maintain the unit cooling discharge air set point. The cooling DAT set point will be adjustable at the unit controller. Unit capacity will be modulated by the variable speed compressor operation.
   b. **Cooling DAT reset:** The cooling DAT setpoint may be reset by the space temp, return temp, OAT or external Voltage/mA signals. A linear relationship between the DAT and the reset variable will be created for the minimum and maximum DAT setpoints. As the reset variable changes the DAT will adjust according to the relationship.

6. **ECONOMIZER:** A comparative dry bulb (standard option) or comparative enthalpy (selectable option) shall be engaged whenever the outdoor enthalpy or dry bulb is less than the return air enthalpy or dry bulb to utilize outside air for cooling. Outside air and return air dampers shall modulate to maintain supply air temperature set point.

7. **EXHAUST FAN CONTROL:** If the optional exhaust fans are provided they will be direct drive electrically commutated motor(s) (ECM). If powered exhaust is not provided barometric relief dampers are standard. Powered exhaust control options are as follows:
   a. **Building pressure Control:** A differential pressure transducer shall compare the indoor building pressure to ambient atmospheric pressure. The exhaust fan(s) shall modulate to maintain the building pressure set point.
   b. **Speed Control:** The exhaust fan(s) will run at a constant speed.
   c. **Network Control:** Exhaust fan speed is commanded from the building automation system.
   d. **Outdoor Air Damper Tracking:** The exhaust fan(s) will activate based on the outside air damper position and will modulate between an adjustable minimum and maximum as the OA damper opens to provide relief.

H. **AHU-2**

1. **UNIT CONTROLS:**
   a. **Building Automation System (BAS) interface:** The factory unit controller may interface with BACnet MSTP, IP or LON BAS systems. (Requires optional BACnet MSTP, BACnet IP or LON card)
   b. **Head Pressure Control Condenser Control:** The condenser head pressure will be monitored by the unit controller to maintain head pressure and the compressor operating envelope at all times to void high pressure trips on high load days. ECM motors should be provided as well as factory sensors to provide this protection.
   c. **Compressor Envelope Control:** The unit controller will continually monitor the suction and discharge pressure and temperature conditions during compressor operation. The unit will modulate the compressor, condenser head pressure, and electronic...
expansion valve to maintain a safe compressor operating conditions to add reliability, and limit unit shut down during fringe operating conditions.

2. CHANGE OVER SETPOINTS: The unit change over source temperature is the outdoor air temperature (OAT), the unit state will change from cooling, fan only or heating based on the changeover heating or cooling setpoints.

3. SUPPLY FAN: The supply fan will be factory supplied with a direct drive supply fan and will operate as follows:
   a. CAV: The supply fan will operate at a constant speed.

4. COOLING:
   a. Discharge Air Temperature Control (DAT): In the cooling mode, the unit capacity will modulate the variable speed compressor to maintain the unit cooling discharge air set point. The cooling DAT set point will be adjustable at the unit controller. Unit capacity will be modulated by the variable speed compressor operation.
   b. Cooling DAT reset: The cooling DAT setpoint may be reset by the space temp (requires optional space sensor), return temp (if applicable), OAT, Network/BAS, or external Voltage/mA signals. A linear relationship between the DAT and the reset variable will be created for the minimum and maximum DAT setpoints. As the reset variable changes the DAT will adjust according to the relationship.

5. Sequence of Operations ENERGY RECOVERY WHEEL:
   a. Wheel Control: The enthalpy wheel is turned on whenever the exhaust fan is running and the outdoor air dampers are at the minimum position (i.e. the unit is not in the economizer operating state). The wheel is shut off if the exhaust fan ever turns off or if the unit enters the economizer operating state.
      1) Bypass Dampers1,2: On economizer units (not 100% outside air units) the wheel is equipped with bypass dampers. Bypass dampers are opened when the unit enters the economizer operating state. Otherwise the bypass dampers remain closed.
      2) Wheel Effectiveness Control: The energy recovery wheel will start/stop or modulate its speed (if equipped with the optional VFD) to meet the discharge air temperature set point using factory mounted temperature sensors. The energy wheel is the first form of heating or cooling when active. Compressors or heat will only be active when the energy recovery wheel cannot satisfy the DAT.
      3) On/Off Defrost Control (standard option) - When the outside air temp is below an adjustable frost temperature (default 32F) the wheel is stopped for an adjustable period of time (default 5 minutes) once every 60 minutes (adjustable).
      4) Frost Prevention Control (selectable option) - The unit will monitor return air temperature and humidity, outside air temperature, and exhaust air temperature. Assuming an outdoor air relative humidity of 95% the unit will calculate the point at which condensate will develop in the exhaust air (see the intersection point in figure 1 below). When the exhaust air reaches this temperature the wheel will begin to start/stop (no VFD is included) or modulate (VFD is included) to reduce the effectiveness of the wheel and avoid frost buildup. This allows the wheel to remain on at these frost prevention times and still recover some energy.

6. Notes
   a. Bypass dampers are not provided on 100% OA units. On these units bypass dampers are omitted to allow for the installation of a larger energy wheel. 100% outside air units require conditioning of the air at most if not all times of the year, so a larger wheel without bypass dampers is provided instead.
   b. Wheel bypass dampers are not required for 100% recirculation morning warmup/precool/night setback control. The standard set of dampers downstream of the energy wheel allow for this on both economizer and 100% outside air units.
   c. Outside air must also be below an adjustable frost temperature (default 32F)

7. EXHAUST FAN CONTROL: Exhaust fans are direct drive electrically commutated motor(s) (ECM). Powered exhaust control options are as follows:
a. Building pressure Control: A differential pressure transducer shall compare the indoor building pressure to ambient atmospheric pressure. The exhaust fan(s) shall modulate to maintain the building pressure set point.

b. Speed Control: The exhaust fan(s) will run at a constant speed.

c. Network Control: Exhaust fan speed is commanded from the building automation system.

d. Outdoor Air Damper Tracking (Mixed air units only): The exhaust fan(s) will activate based on the outside air damper position and will modulate between an adjustable minimum and maximum as the OA damper opens to provide relief.

I. AHU-3
   1. UNIT CONTROLS:
      a. Building Automation System (BAS) interface: The factory unit controller may interface with BACnet MSTP, IP or LON BAS systems. (Requires optional BACnet MSTP, BACnet IP or LON card)
      b. Head Pressure Control Condenser Control: The condenser head pressure will be monitored by the unit controller to maintain head pressure and the compressor operating envelope at all times to void high pressure trips on high load days. ECM motors should be provided as well as factory sensors to provide this protection.
      c. Compressor Envelope Control: The unit controller will continually monitor the suction and discharge pressure and temperature conditions during compressor operation. The unit will modulate the compressor, condenser head pressure, and electronic expansion valve to maintain a safe compressor operating conditions to add reliability, and limit unit shut down during fringe operating conditions.

2. CHANGE OVER SETPOINTS: The unit change over source temperature is the outdoor air temperature (OAT), the unit state will change from cooling, fan only or heating based on the changeover heating or cooling setpoints.

3. SUPPLY FAN: The supply fan will be factory supplied with a direct drive supply fan and will operate as follows:
   a. CAV: The supply fan will operate at a constant speed.

4. COOLING:
   a. Discharge Air Temperature Control (DAT): In the cooling mode, the unit capacity will modulate the variable speed compressor to maintain the unit cooling discharge air set point. The cooling DAT set point will be adjustable at the unit controller. Unit capacity will be modulated by the variable speed compressor operation.
   b. Cooling DAT reset: The cooling DAT setpoint may be reset by the space temp (requires optional space sensor), return temp (if applicable), OAT, Network/BAS, or external Voltage/mA signals. A linear relationship between the DAT and the reset variable will be created for the minimum and maximum DAT setpoints. As the reset variable changes the DAT will adjust according to the relationship.

5. Sequence of Operations ENERGY RECOVERY WHEEL:
   a. Wheel Control: The enthalpy wheel is turned on whenever the exhaust fan is running and the outdoor air dampers are at the minimum position (i.e. the unit is not in the economizer operating state). The wheel is shut off if the exhaust fan ever turns off or if the unit enters the economizer operating state.
      1) Bypass Dampers1,2: On economizer units (not 100% outside air units) the wheel is equipped with bypass dampers. Bypass dampers are opened when the unit enters the economizer operating state. Otherwise the bypass dampers remain closed.
      2) Wheel Effectiveness Control: The energy recovery wheel will start/stop or modulate its speed (if equipped with the optional VFD) to meet the discharge air temperature set point using factory mounted temperature sensors. The energy wheel is the first form of heating or cooling when active. Compressors or heat will only be active when the energy recovery wheel cannot satisfy the DAT.
3) On/Off Defrost Control (standard option) - When the outside air temp is below an adjustable frost temperature (default 32F) the wheel is stopped for an adjustable period of time (default 5 minutes) once every 60 minutes (adjustable).

4) Frost Prevention Control (selectable option) - The unit will monitor return air temperature and humidity, outside air temperature, and exhaust air temperature. Assuming an outdoor air relative humidity of 95% the unit will calculate the point at which condensate will develop in the exhaust air3 (see the intersection point in figure 1 below). When the exhaust air reaches this temperature the wheel will begin to start/stop (no VFD is included) or modulate (VFD is included) to reduce the effectiveness of the wheel and avoid frost buildup. This allows the wheel to remain on at these frost prevention times and still recover some energy.

(a) Figure 1: Exhaust Air Temperature Intersection Point

6. Notes
   a. Bypass dampers are not provided on 100% OA units. On these units bypass dampers are omitted to allow for the installation of a larger energy wheel. 100% outside air units require conditioning of the air at most if not all times of the year, so a larger wheel without bypass dampers is provided instead.
   b. Wheel bypass dampers are not required for 100% recirculation morning warmup/precool/night setback control. The standard set of dampers downstream of the energy wheel allow for this on both economizer and 100% outside air units.
   c. Outside air must also be below an adjustable frost temperature (default 32F)

7. EXHAUST FAN CONTROL: Exhaust fans are direct drive electrically commutated motor(s) (ECM). Powered exhaust control options are as follows:
   a. Building pressure Control: A differential pressure transducer shall compare the indoor building pressure to ambient atmospheric pressure. The exhaust fan(s) shall modulate to maintain the building pressure set point.
   b. Speed Control: The exhaust fan(s) will run at a constant speed.
   c. Network Control: Exhaust fan speed is commanded from the building automation system.
   d. Outdoor Air Damper Tracking (Mixed air units only): The exhaust fan(s) will activate based on the outside air damper position and will modulate between an adjustable minimum and maximum as the OA damper opens to provide relief.

J. AHU-4

1. UNIT CONTROLS:
   a. Building Automation System (BAS) interface: The factory unit controller may interface with BACnet MSTP, IP or LON BAS systems. (Requires optional BACnet MSTP, BACnet IP or LON card)
   b. Head Pressure Control Condenser Control: The condenser head pressure will be monitored by the unit controller to maintain head pressure and the compressor operating envelope at all times to void high pressure trips on high load days. ECM motors should be provided as well as factory sensors to provide this protection.
   c. Compressor Envelope Control: The unit controller will continually monitor the suction and discharge pressure and temperature conditions during compressor operation. The unit will modulate the compressor, condenser head pressure, and electronic expansion valve to maintain a safe compressor operating conditions to add reliability, and limit unit shut down during fringe operating conditions.
   d. CHANGE OVER SETPOINTS: The unit change over source temperature is the outdoor air temperature (OAT), the unit state will change from cooling, fan only or heating based on the changeover heating or cooling setpoints.

2. SUPPLY FAN: The supply fan will be factory supplied with a direct drive supply fan and will operate as follows:
   a. CAV: The supply fan will operate at a constant speed.

3. COOLING:
   a. Discharge Air Temperature Control (DAT): In the cooling mode, the unit capacity will modulate the variable speed compressor to maintain the unit cooling discharge air set
point. The cooling DAT set point will be adjustable at the unit controller. Unit capacity will be modulated by the variable speed compressor operation.

b. Cooling DAT reset: The cooling DAT setpoint may be reset by the space temp (requires optional space sensor), return temp (if applicable), OAT, Network/BAS, or external Voltage/mA signals. A linear relationship between the DAT and the reset variable will be created for the minimum and maximum DAT setpoints. As the reset variable changes the DAT will adjust according to the relationship.

4. Sequence of Operations ENERGY RECOVERY WHEEL:
   a. Wheel Control: The enthalpy wheel is turned on whenever the exhaust fan is running and the outdoor air dampers are at the minimum position (i.e. the unit is not in the economizer operating state). The wheel is shut off if the exhaust fan ever turns off or if the unit enters the economizer operating state.
      1) Bypass Dampers1,2: On economizer units (not 100% outside air units) the wheel is equipped with bypass dampers. Bypass dampers are opened when the unit enters the economizer operating state. Otherwise the bypass dampers remain closed.
      2) Wheel Effectiveness Control: The energy recovery wheel will start/stop or modulate its speed (if equipped with the optional VFD) to meet the discharge air temperature set point using factory mounted temperature sensors. The energy wheel is the first form of heating or cooling when active. Compressors or heat will only be active when the energy recovery wheel cannot satisfy the DAT.
      3) On/Off Defrost Control (standard option) - When the outside air temp is below an adjustable frost temperature (default 32F) the wheel is stopped for an adjustable period of time (default 5 minutes) once every 60 minutes (adjustable).
      4) Frost Prevention Control (selectable option) - The unit will monitor return air temperature and humidity, outside air temperature, and exhaust air temperature. Assuming an outdoor air relative humidity of 95% the unit will calculate the point at which condensate will develop in the exhaust air3 (see the intersection point in figure 1 below). When the exhaust air reaches this temperature the wheel will begin to start/stop (no VFD is included) or modulate (VFD is included) to reduce the effectiveness of the wheel and avoid frost buildup. This allows the wheel to remain on at these frost prevention times and still recover some energy.
   (a) Figure 1: Exhaust Air Temperature Intersection Point

5. Notes
   a. Bypass dampers are not provided on 100% OA units. On these units bypass dampers are omitted to allow for the installation of a larger energy wheel. 100% outside air units require conditioning of the air at most if not all times of the year, so a larger wheel without bypass dampers is provided instead.
   b. Wheel bypass dampers are not required for 100% recirculation morning warmup/precold/night setback control. The standard set of dampers downstream of the energy wheel allow for this on both economizer and 100% outside air units.
   c. Outside air must also be below an adjustable frost temperature (default 32F)

6. EXHAUST FAN CONTROL: Exhaust fans are direct drive electrically commutated motor(s) (ECM). Powered exhaust control options are as follows:
   a. Building pressure Control: A differential pressure transducer shall compare the indoor building pressure to ambient atmospheric pressure. The exhaust fan(s) shall modulate to maintain the building pressure set point.
   b. Speed Control: The exhaust fan(s) will run at a constant speed.
   c. Network Control: Exhaust fan speed is commanded from the building automation system.
   d. Outdoor Air Damper Tracking (Mixed air units only): The exhaust fan(s) will activate based on the outside air damper position and will modulate between an adjustable minimum and maximum as the OA damper opens to provide relief.
K. Maintain constant supply static pressure of 1.5 inches wg (380 Pa) by modulating supply and return fan inlet vane dampers in sequence. Locate sensor minimum 50 ft (15 m) downstream of supply fan in supply air duct.

L. Display:
   1. System graphic.
   2. System on/off indication.
   3. System day/night mode.
   4. System fan on/off indication.
   5. Return fan on/off indication.
   6. Preheat coil pump on/off indication.
   7. Outside air temperature indication.
   8. Mixed air temperature indication.
  10. Reheat zone air temperature indication.
  11. Fan discharge temperature control point adjustment.
  12. Reheat zone control point adjustment.
  14. Supply static pressure control point adjustment.
  15. Building static pressure indication.
  16. Building static pressure control point adjustment.
  17. System on/off auto switch.
  18. System day/night/auto switch.
  19. Supply fan on/off switch.
  20. Return fan on/off/auto switch.

3.08 ELEVATOR MACHINE ROOMS
   A. On room temperature above 85 degrees F (29 degrees C), open intake dampers and start exhaust fans.
   B. On room temperatures above 90 degrees F (32 degrees C), signal alarm.

3.09 FAN COIL UNITS
   A. Occupied Mode:
      1. Single temperature unit mounted thermostat set at 75 degrees F (24 degrees C) (adj) maintains constant space temperature by modulating two-way control heating valve and two-way cooling control valve depending on call for heating and/or cooling.
   B. Unoccupied Mode:
      1. Single temperature unit mounted thermostat set maintains a reduced space temperature by modulating two-way control heating valve and two-way cooling control valve depending on call for heating and/or cooling.

3.10 HEATING WATER ZONE CONTROL
   A. Flow switch in heating pump discharge provides on/off indication.
   B. Control heating water supply temperature set at 140 degrees F in accordance with outdoor reset schedule by step firing boilers.
   C. Control heating water at maximum 140 degrees F at outdoor temperature of minus 30 degrees F, and minimum 130 degrees F at outdoor temperature of 75 degrees F, with straight line relationship between.
   D. On outside temperatures above 65 degrees F (adj.), de-energize heating pumps and suppress alarm.

3.11 RADIANT PANELS
   A. Single temperature thermostat maintains constant space temperature set at 75 degrees F(adj.) by modulating two-way control heating valve.
3.12 PUMPS

A. DOMESTIC HOT WATER RECIRCULATING PUMPS:
   1. Pumps shall be controlled by aquastat to maintain water temperature at 130 deg. F (adj.).

B. HEATING LOOP CIRCULATING PUMPS:
   1. The zone which cannot meet its heating setpoint shall signal the heating water pump to start.
   2. The pumps shall have a rotating auto restart and auto lead/lag. One of the two pumps shall operate continuously when a zone cannot maintain the heating setpoint. If one pump fails to operate or fails to start, the other pump shall start.
   3. Both pumps are operated on variable speed and will receive a 4 to 20 milliamp signal to maintain the dominate differential pressure setpoint. Refer to the plans for differential pressure sensor locations.
   4. Sensors, control wiring, and conduit shall be provided by this contractor.

C. CHILLED WATER LOOP CIRCULATING PUMPS:
   1. The zone which cannot meet its cooling setpoint shall signal the cooling water pump to start.
   2. The pumps shall have a rotating auto restart and auto lead/lag. One of the two pumps shall operate continuously when a zone cannot maintain the heating setpoint. If one pump fails to operate or fails to start, the other pump shall start.
   3. Both pumps are operated on variable speed and will receive a 4 to 20 milliamp signal to maintain the dominate differential pressure setpoint. Refer to the plans for differential pressure sensor locations.
   4. Flow meter/transmitter in the chilled water piping shall control the pressure independent bypass control valve to maintain minimum of __________ gpm (adj.) flow in the chilled water system.
   5. Maximum rate of change of the chilled water flow through the chiller shall be no more than 20% change per minute (adj.).
   6. Sensors, control wiring, and conduit shall be provided by this contractor.

3.13 RADIANT PANELS

A. Single temperature thermostat maintains constant space temperature set at 75 degrees F (24 degrees C) (adj.) by modulating two-way control heating valve.

3.14 PUMPS

A. DOMESTIC HOT WATER RECIRCULATING PUMPS:
   1. Pumps shall be controlled by aquastat to maintain water temperature at 130 deg. F (adj.).

B. HEATING LOOP CIRCULATING PUMPS:
   1. The zone which cannot meet its heating setpoint shall signal the heating water pump to start.
   2. The pumps shall have a rotating auto restart and auto lead/lag. One of the two pumps shall operate continuously when a zone cannot maintain the heating setpoint. If one pump fails to operate or fails to start, the other pump shall start.
   3. Both pumps are operated on variable speed and will receive a 4 to 20 milliamp signal to maintain the dominate differential pressure setpoint. Refer to the plans for differential pressure sensor locations.
   4. Sensors, control wiring, and conduit shall be provided by this contractor.

C. CHILLED WATER LOOP CIRCULATING PUMPS:
   1. The zone which cannot meet its cooling setpoint shall signal the cooling water pump to start.
   2. The pumps shall have a rotating auto restart and auto lead/lag. One of the two pumps shall operate continuously when a zone cannot maintain the heating setpoint. If one pump fails to operate or fails to start, the other pump shall start.
3. Both pumps are operated on variable speed and will receive a 4 to 20 milliamp signal to maintain the dominate differential pressure setpoint. Refer to the plans for differential pressure sensor locations.
4. Flow meter/transmitter in the chilled water piping shall control the pressure independent bypass control valve to maintain minimum of 20% of design flow gpm (adj.) flow in the chilled water system.
5. Maximum rate of change of the chilled water flow through the chiller shall be no more than 20% change per minute (adj.).
6. Sensors, control wiring, and conduit shall be provided by this contractor.

3.15 UNIT HEATERS
   A. Single temperature room thermostat set at 68 degrees F (20 degrees C) (adj.) maintains constant space temperature by cycling unit fan motor and energizing electric heating elements.

3.16 GRAPHICAL ENERGY USE INDICATION:
   A. Provide a graphic energy use page indicating the following:
      1. Building heating requirements in BTUH per the building heating water flow and the temperature differential between the heating water supply and return.
      2. Building cooling requirements in BTUH per the building chilled water flow and the temperature differential between the chilled water supply and return.
      3. Building lighting energy use by installing current transformers (CT) (by this contractor) around feeder conductors to electrical panel ________.
      4. Building HVAC energy use by installing current transformers (CT) (by this contractor) around feeder conductors to mechanical equipment.
      5. Building miscellaneous energy use by subtracting the lighting energy use and the HVAC energy use from the electrical meter with a BAS connection by the electrical contractor.
   B. The energy use web page shall show energy use along with graphs, one graph showing energy use comparisons for the previous week, another one for the previous month, and then another one for the previous year use.

3.17 ALARMS
   A. Temperature control system shall report user selected alarms via text message or email based on specific alarm preference.

END OF SECTION
SECTION 23 2113
HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hydronic system requirements.
B. Heating water and glycol piping, above grade.
C. Chilled water piping, buried.
D. Chilled water piping, above grade.
E. Equipment drains and overflows.
F. Pipe hangers and supports.
G. Unions, flanges, mechanical couplings, and dielectric connections.
H. Valves:
   1. Ball valves.
   2. Butterfly valves.
   3. Check valves.

1.02 RELATED REQUIREMENTS

A. Section 23 0516 - Expansion Fittings and Loops for HVAC Piping.
B. Section 23 0548 - Vibration and Seismic Controls for HVAC.
C. Section 23 0553 - Identification for HVAC Piping and Equipment.
D. Section 23 0719 - HVAC Piping Insulation.
E. Section 23 2114 - Hydronic Specialties.
F. Section 23 2500 - HVAC Water Treatment: Pipe cleaning.

1.03 REFERENCE STANDARDS

A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.
C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
E. ASME B31.9 - Building Services Piping; 2014.
L. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2016.
O. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).
Q. AWWA C606 - Grooved and Shouldered Joints; 2015.

1.04 SUBMITTALS
A. See Section 230010 - GENERAL PROVISIONS, for submittal procedures.
B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.
C. Product Data:
   1. Radiant Heating Piping Systems:
      a. Indicate [system layout including heating capacity, flow rate, pressure drops, pressure ratings (both operating and burst), bend radius, material composition, accessories, circuit lengths and pipe sizes].

1.05 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
B. Welder Qualifications: Certify in accordance with ASME BPVC-IX.
   1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
B. Provide temporary protective coating on cast iron and steel valves.
C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS
A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS
2.01 HYDRONIC SYSTEM REQUIREMENTS
A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:
   1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
   2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
   3. Grooved mechanical joints may be used in accessible locations only.
      a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect.
      b. Grooved mechanical connections and joints comply with AWWA C606.
         1) Ductile Iron: Comply with ASTM A536, Grade 65-45-12.
         2) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.
      c. Use rigid joints unless otherwise indicated.
   4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

D. Valves: Provide valves where indicated:
   1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch (20 mm) gate valves with cap; pipe to nearest floor drain.
   2. On discharge of condenser water pumps, use spring loaded check valves.
   3. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings.
   4. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.
   5. In heating water, chilled water, or condenser water systems, butterfly valves may be used interchangeably with gate and globe valves.
   6. For shut-off and to isolate parts of systems or vertical risers, use gate, ball, or butterfly valves.

2.02 HEATING WATER AND GLYCOL PIPING, ABOVE GRADE
A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:

B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:
      a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
      b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
   2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.

2.03 CHILLED WATER PIPING, ABOVE GRADE
A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:

B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), hard drawn; using one of the following joint types:
      a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
   2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.

2.04 EQUIPMENT DRAINS AND OVERFLOWS
A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized; using one of the following joint types:
   1. Threaded Joints: Galvanized cast iron, or ASME B16.3 malleable iron fittings.

B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:
   1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
2.05 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
   3. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Greater: Carbon steel, adjustable, clevis.
   4. Hangers for Hot Pipe Sizes 2 to 4 Inches (50 to 100 mm): Carbon steel, adjustable, clevis.
   5. Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Greater: Adjustable steel yoke, cast iron roll, double hanger.
   6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.
   8. Wall Support for Pipe Sizes to 3 Inches (76 mm): Cast iron hook.
   10. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
   11. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.06 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe 2 Inches (50 mm) and Less:
   1. Ferrous Piping: 150 psig (1034 kPa) malleable iron, threaded.
   2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe 2 Inches (50 mm) and Greater:
   1. Ferrous Piping: 150 psig (1034 kPa) forged steel, slip-on.
   2. Copper Piping: Bronze.
   3. Gaskets: 1/16 inch (1.6 mm) thick preformed neoprene.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
   1. Dimensions and Testing: In accordance with AWWA C606.
   2. Mechanical Couplings: Comply with ASTM F1476.
   3. Housing Material: Ductile iron, galvanized complying with ASTM A536.
   4. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C).
   5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
   6. When pipe is field grooved, provide coupling manufacturer's grooving tools.
   7. Manufacturers:

D. Dielectric Connections:
   1. Waterways:
      a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
      b. Dry insulation barrier able to withstand 600 volt breakdown test.
      c. Construct of galvanized steel with threaded end connections to match connecting piping.
      d. Suitable for the required operating pressures and temperatures.
2.07 BUTTERFLY VALVES
A. Body: Cast or ductile iron with resilient replaceable EPDM seat, lug or grooved ends, extended neck.
B. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM encapsulation, or Buna-N encapsulation.
C. Operator: Infinite position lever handle with memory stop.

2.08 SWING CHECK VALVES
A. Up To and Including 2 Inches (50 mm):
   1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder or threaded ends.
B. Over 2 Inches (50 mm):
   1. Iron body, bronze trim, stainless steel, bronze, or bronze faced rotating swing disc, renewable disc and seat, flanged or grooved ends.

PART 3 EXECUTION

3.01 PREPARATION
A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
C. Remove scale and dirt on inside and outside before assembly.
D. Prepare piping connections to equipment using jointing system specified.
E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
F. After completion, fill, clean, and treat systems. Refer to Section 23 2500 for additional requirements.
G. Entire chilled water and condenser water systems shall be completely insulated and sealed prior to placing those systems into service.
H. Pipe sizes shown on the drawings are nominal pipe sizes, not outside diameters.

3.02 INSTALLATION
A. Install in accordance with manufacturer’s instructions.
B. Install heating water and chilled water piping to ASME B31.9 requirements.
C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
D. Install piping to conserve building space and to avoid interfere with use of space.
E. Group piping whenever practical at common elevations.
F. Sleeve pipe passing through partitions, walls and floors.
G. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified under Division 1.
H. Slope piping and arrange to drain at low points.
   1. Minimum pitch of 1/8 inch per ten (10) lineal feet.
I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 0516.
   1. Flexible couplings may be used in header piping to accommodate thermal growth, thermal contraction in lieu of expansion loops.
   2. Use flexible couplings in expansion loops.
J. Grooved Joints:
   1. Install in accordance with the manufacturer’s latest published installation instructions.
   2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.
K. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

L. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
   2. Support horizontal piping as scheduled.
   3. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
   4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
   5. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   7. Provide copper plated hangers and supports for copper piping.

M. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 0719.

N. Provide access where valves and fittings are not exposed.
   1. Provide access doors in ceilings, walls, etc. wherever required to afford easy access to valves and other equipment requiring inspection, servicing or cleaning. Doors shall be of approved dimensions with frame, brass hinges, handle, locking device and gasket for airtight joint. Provide fire-rated doors where required.

O. Use eccentric reducers to maintain top of pipe level.

P. Install valves with stems upright or horizontal, not inverted.

Q. Where valves are used in insulated piping, handle extensions shall be provided. Extension shall be manufactured as an option for the valve furnished and shall extend the handle a minimum of 1/4" beyond the insulation jacket. Where valves are used in insulated piping, handle extensions shall be provided. Extension shall be manufactured as an option for the valve furnished and shall extend the handle a minimum of 1/4" beyond the insulation jacket.

R. Install chrome plated steel plates (escutcheons) with set screw and concealed hinge at all exposed wall penetrations. Cut plates to fit flush at close spaced piping locations.

S. The right is reserved to authorize minor changes in pipe location to avoid conflicts with other trades at no additional cost to the Owner.

T. The hot water heating system shall have manual air vents only at all high points and at all points where drops occur in lines.

U. Except where otherwise specified, chilled water system shall have automatic air eliminators at high points of rises and drops, complete with drain line run to an accessible open drain.

V. Install isolating valves on all items subject to repair or replacement.

3.03 SCHEDULES

A. Hanger Spacing for Copper Tubing.
   1. 1/2 inch (15 mm) and 3/4 inch (20 mm): Maximum span, 5 feet (1500 mm); minimum rod size, 1/4 inch (6 mm).
   2. 1 inch (25 mm): Maximum span, 6 feet (1800 mm); minimum rod size, 1/4 inch (6 mm).
   3. 1-1/2 inch (40 mm) and 2 inch (50 mm): Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9 mm).
4. 2-1/2 inch (65 mm): Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9 mm).
5. 3 inch (80 mm): Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9 mm).

B. Hanger Spacing for Steel Piping,
   1. 1/2 inch (15 mm), 3/4 inch (20 mm), and 1 inch (25 mm): Maximum span, 7 feet (2100 mm); minimum rod size, 1/4 inch (6 mm).
   2. 1-1/4 inches (32 mm): Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9 mm).
   3. 1-1/2 inches (40 mm): Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9 mm).
   4. 2 inches (50 mm): Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9 mm).
   5. 2-1/2 inches (65 mm): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (9 mm).
   6. 3 inches (80 mm): Maximum span, 12 feet (3.6 m); minimum rod size, 3/8 inch (9 mm).
   7. 4 inches (100 mm): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).
   8. 6 inches (150 mm): Maximum span, 17 feet (5.1 m); minimum rod size, 1/2 inch (13 mm).

END OF SECTION
SECTION 23 2114
HYDRONIC SPECIALTIES

PART 1  GENERAL

1.01  SECTION INCLUDES
A.  Expansion tanks.
B.  Air vents.
C.  Air separators.
D.  Strainers.
E.  Suction diffusers.
F.  Combination pump discharge valves.
G.  Combination flow controls.
H.  Flow meters.
I.  Relief valves.
J.  Glycol system.

1.02  RELATED REQUIREMENTS
A.  Section 22 1006 - Plumbing Piping Specialties: Backflow preventers.
B.  Section 23 2113 - Hydronic Piping.
C.  Section 23 2500 - HVAC Water Treatment: Pipe cleaning.

1.03  REFERENCE STANDARDS

1.04  SUBMITTALS
A.  See Section 230010 - General Provisions for submittal procedures.
B.  Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
C.  Manufacturer’s Installation Instructions: Indicate hanging and support methods, joining procedures.
D.  Project Record Documents: Record actual locations of flow controls, flow meters, and other equipment.
E.  Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.
F.  Maintenance Materials: Furnish the following for Owner’s use in maintenance of project.

1.05  DELIVERY, STORAGE, AND HANDLING
A.  Accept valves on site in shipping containers with labeling in place. Inspect for damage.
B.  Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
C.  Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2  PRODUCTS

2.01  EXPANSION TANKS
A.  Manufacturers:

B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psi (860 kPa), with flexible EPDM diaphragm or bladder sealed into tank, and steel support stand.

C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psi (80 kPa).

D. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

E. Hot Water, Chilled Water, and Heat Pumps System:
1. Select expansion tank pressure relief valve at 50 psi (_____ kPa) maximum.

2.02 AIR VENTS

A. Manufacturers:
4. Wessels.
5. Wheatley.

B. Manual Type: Short vertical sections of 2 inch (50 mm) diameter pipe to form air chamber, with 1/8 inch (3 mm) brass needle valve at top of chamber.

C. Float Type:
1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2.03 AIR SEPARATORS

A. Centrifugal Air Separators/Strainers:
1. Manufacturers:
2. Steel, tested and stamped in accordance with ASME BPVC-VIII-1; for 125 psi (860 kPa) operating pressure, with integral bronze strainer, tangential inlet and outlet connections, and internal stainless steel air collector tube.

B. Coalescing Air/Dirt Separators:
1. Manufacturers:
   d. Taco.
   e. Thrush.
   f. Wessels.
2. Tank: Fabricated steel tank; tested and stamped in accordance with ASME BPVC-VIII-1; for 150 psi (1034 kPa) operating pressure and 270 degrees F (132 degrees C) maximum operating temperature; subject to the requirements of the application and the manufacturer's standard maximum operating conditions.
3. Coalescing Medium: Provide structured copper or stainless steel medium filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100 percent free air, 100 percent entrained air, and 99.6 percent dissolved air at the installed location.
4. Air Vent: Integral float actuated air vent at top fitting of tank rated at 150 psi (1030 kPa), threaded to the top of the separator.
5. Inlet and Outlet Connections: Threaded for 2 NPS (50 DN) and smaller; Class 150 flanged connections for 2-1/2 NPS (65 DN) and larger.
7. Size: Match system flow capacity.

2.04 STRAINERS
A. Size 2 inch (50 mm) and Under:
   1. Screwed brass or iron body for 175 psi (1200 kPa) working pressure, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
B. Size 2-1/2 inch (65 mm) to 4 inch (100 mm):
   1. Provide flanged or grooved iron body for 175 psi (1200 kPa) working pressure, Y pattern with 1/16 inch (1.6 mm), or 3/64 inch (1.2 mm) stainless steel perforated screen.
C. Size 5 inch (125 mm) and Larger:
   1. Provide flanged or grooved iron body for 175 psi (1200 kPa) working pressure, basket pattern with 1/8 inch (3.2 mm) stainless steel perforated screen.

2.05 SUCTION DIFFUSERS
A. Manufacturers:
   4. Taco, Inc.
   5. Patterson Pump.
B. Fitting: Angle pattern, cast-iron body, threaded for 2 inch (50 mm) and smaller, flanged for 2-1/2 inch (65 mm) and larger, rated for 175 psi (1200 kPa) operating pressure, with inlet vanes, cylinder strainer with 3/16 inch (5 mm) diameter openings, disposable 5/32 inch (4 mm) mesh strainer to fit over cylinder strainer, 16 start up screen, and permanent magnet located in flow stream and removable for cleaning.
C. Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

2.06 COMBINATION PUMP DISCHARGE VALVES
A. Manufacturers:
   2. Bell & Gossett.
B. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psi (1200 kPa) operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

2.07 COMBINATION FLOW CONTROLS
A. Manufacturers:
   1. AutoFlow Model AC Series
   2. Griswold.
   3. Pro Hydronic Specialties
B. Construction: Brass or bronze body with union on inlet, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain.
C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, minimum pressure 3.5 psi (24 kPa).
D. Control Mechanism: Provide stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring or elastomeric diaphragm and polyphenylsulfone orifice plate.
   1. Accessories: In-line strainer on inlet and ball valve on outlet.
2. Strainer shall be in a union/strainer/ball valve configuration with pressure and temperature test plugs.

E. All valves shall have access capability to allow field exchange of internal components without removing valve body from piping. Valves shall have 2-32 psi operating range.

F. All valves shall be permanently marked to show direction of flow, flow rate and pressure range.

2.08 MANUAL BALANCING VALVES

A. Manufacturers:
   1. ITT Bell & Gossett Model Circuit Setter.
   2. Other acceptable manufacturers offering equivalent products.
      b. Griswold.
      c. Nexus Valve.

B. Balancing valves shall be combination balancing and shut-off, with memory.

C. Where ball type valves are used for balancing, they shall have stainless steel balls.

D. Accessories: Combination ball valve/in-line strainer on inlet and test ports on both inlet and outlet.

E. Valves shall be sized based on flow, not pipe size. Provide necessary reducers for valves other than pipe size.

2.09 RELIEF VALVES

A. Manufacturers:
   3. Hoffman Specialty.
   4. Watts

B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.10 GLYCOL SYSTEM

A. Mixing Tank: 55 gallon (205 L) steel drum with fittings suitable for filling and hand pump for charging, rubber hose for connection of hand pump to system.

B. Storage Tank: Closed type, welded steel constructed, tested and stamped in accordance with ASME BPVC-VIII-1; 100 psi (690 kPa) rating; cleaned, prime coated, and supplied with steel support saddles. Construct with tappings for installation of accessories.

C. Expansion Tank: Diaphragm type with vent fitting with air separator, and automatic air vent.

D. Air Pressure Reducing Station: Pressure reducing valve with shut-off valves, strainer, check valve and needle valve bypass.

E. Glycol Solution:
   1. Inhibited propylene glycol and water solution mixed 30 percent glycol - 70 percent water, suitable for operating temperatures from 10 degrees F (-10 degrees C) to 250 degrees F (121 degrees C).
   2. Fluid must be industrially inhibited, with phosphate-based and copper corrosion inhibitors to passivate the system and buffer the acidic degradation products of glycol. Silicate-based inhibitors, typical of automotive antifreeze, are not acceptable. The fluid must be easily analyzed for glycol concentration and inhibitor concentration. Inhibitor concentration level shall be easily adjusted using replacement inhibitor readily available from the fluid manufacturer.
   3. For a system containing more than 250 gallons of fluid, an analysis shall be provided free of charge by the fluid manufacturer at the 11 month operation point of the system. The analysis shall report glycol concentration, freeze point temperature, inhibitor level, pH, reserve alkalinity and contaminants such as chloride, sulfate, nitrite, nitrate, and total...
hardness. Recommendations on additions of glycol or inhibitors shall also be given as needed.

4. The fluid must pass ASTM D1384 (less than 0.5 mil penetration per year for all system metals).

5. The water used to dilute the concentrated inhibited glycol-based heat transfer fluid must be either distilled, deionized, or contain less than 25 ppm each of chloride and sulfate and less than 50 ppm each of hard water ions (calcium and magnesium as calcium carbonate) with a total hardness not to exceed 100 ppm.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Provide manual air vents at system high points and as indicated.

C. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

D. Provide air separator on suction side of system circulation pump and connect to expansion tank.
   1. Support air separator in piping system with clearance provided for strainer removal.

E. Provide valved drain and hose connection on strainer blow down connection.

F. Provide pump suction fitting on suction side of base mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.

G. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps where indicated.

H. Support pump fittings with floor mounted pipe and flange supports.

I. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.

J. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

K. Pipe relief valve outlet to nearest floor drain.

L. Clean and flush glycol system before adding glycol solution. Refer to Section 23 2500.

M. Provide combination flow control valves on water outlet from all coils and terminal heating units as indicated.

N. Provide combination strainer valves on water inlet to all coils and terminal heating units as indicated.

O. Each main line strainer shall have valved sensing points at inlet and outlet, piped to a common pressure gauge.

P. Provide additional isolating valve at pump discharge when triple-duty valves are installed.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. In-line Circulators.
   B. Vertical In-line pumps.
   C. Tango Vertical Inline Pumping System

1.02 RELATED REQUIREMENTS
   A. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
   B. Section 23 0548 - Vibration and Seismic Controls for HVAC.
   C. Section 23 0719 - HVAC Piping Insulation.
   D. Section 23 2113 - Hydronic Piping.
   E. Section 23 2114 - Hydronic Specialties.
   F. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS
   A. NEMA MG 1 - Motors and Generators; 2018.
   B. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.
   C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS
   A. See Section 230010 - GENERAL PROVISIONS, for submittal procedures.
   B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
   C. Millwright's Certificate: Certify that base mounted pumps have been aligned.
   D. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.
   E. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.
   F. Pump fluid properties for selection, unless stated otherwise, shall be at 65 degrees F, 30% propylene glycol.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   B. Bell & Gossett, a Xylem Inc. brand: www.bellgossett.com.
   C. Taco

2.02 HVAC PUMPS - GENERAL
   A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
   B. Base Mounted Pumps: Aligned by qualified millwright.
   C. Products Requiring Electrical Connection: Listed and classified by UL or testing agency acceptable to Authority Having Jurisdiction as suitable for the purpose specified and indicated.
2.03 IN-LINE CIRCULATORS
A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 125 psi (860 kPa) maximum working pressure.
B. Casing: Bronze, with flanged pump connections.
C. Impeller: Stamped brass or cast bronze, keyed to shaft.
D. Bearings: Oil-lubricated bronze sleeve.
E. Shaft: Stainless steel with bronze sleeve, integral thrust collar.
F. Seal: Mechanical seal, 225 degrees F (107 degrees C) maximum continuous operating temperature.
G. Drive: Flexible coupling.
H. Electrical Characteristics:
   1. Motor: 1750 rpm unless indicated otherwise; refer to Section 23 0513.
   2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

2.04 VERTICAL IN-LINE PUMPS
A. Type: Vertical, single stage, close coupled, radially or horizontally split casing, for in-line mounting, for 175 psi (1200 kPa) working pressure.
B. Casing: Cast iron, with suction and discharge gauge port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.
C. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.
D. Shaft: Carbon steel with stainless steel impeller cap screw or nut and bronze sleeve.
E. Seal: Mechanical seal, 225 degrees F (107 degrees C) maximum continuous operating temperature.
F. Electrical Characteristics:
   1. Motor: 1750 rpm unless specified otherwise; refer to Section 23 0513.
   2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

2.05 TANGO VERTICAL INLINE PUMPING SYSTEM
A. DESCRIPTION
   1. Single stage, single suction type, Tango vertical inline design pump with integrated intelligent controls. The cast casing with equal size suction and discharge flanges, each having separate tapped flush line and pressure gauge connections, shall incorporate two radially split, single stage centrifugal pumps.
   2. The inlet and outlet ports on the casing shall be a common size, so that both units may operate in parallel or individually in duty / standby operation.
   3. The discharge port shall be fitted with a component that allows each unit to operate independently, without bypassing fluid through the idle pump and for duty / standby operation.
   4. Mechanical Seals: Split-coupled, close-coupled serviceable without disturbing motor, controls or piping connections.
B. MATERIALS
      a. Test casing to 150 % maximum working pressure.
      b. Ensure casing is radially split to allow for removal of rotating element without disturbing pipe connections.
      c. Casing wetted surfaces shall be e-coated to prevent seizing of impeller to casing after periods of inactivity.
      d. Drill and tap casing for gauge ports on both suction and discharge connections.
      e. Drill and tap casing at lowest point for drain port.
2. Impeller: To ASTM A743 CF8M, stainless steel 316, fully enclosed and dynamically balanced to ANSI G6.3 and fitted to shaft with key. Use two-plane balancing when installed impeller diameter is less than 6 times impeller width.

3. Pump Shafts:
   a. Close-coupled: Steel motor shaft with shaft Sleeve: Stainless steel to ASTM A276, Type 316

   a. Design coupling for easy removal on site to reveal space between pump and motor shaft.
      1) Ensure revealed space is sufficient for removal of mechanical seal components without disturbing pump, controls or motor.
   b. Include an OSHA compliant coupling guard.
   c. Include lower seal chamber throttle bushing to ensure seals maintain positive cooling and lubrication.
   d. Include sight flow indicator in flush line to mechanical seal and [50-micron cartridge filter to suit system working pressure] [maintenance-free sediment separator for pump differential pressures greater than 30 psig].

5. Flanges: To ANSI/ASME B16.5, Class 125.


7. Casing O-ring: EPDM.

8. Mechanical Seal: [Potable] [Non-potable], Type [AB2] [AT-70] outside balanced seal design and rated to [200°F] [300°F] maximum
   a. Rotating face: [Resin bonded carbon] [Antimony loaded carbon] [Sintered Silicon Carbide]
   b. Stationary face: Sintered Silicon Carbide.
   c. Seal rotating hardware: Stainless Steel

C. MOTOR

1. Permanent Magnet Motor: To IE5 efficiency
   a. Enclosure: TEFC.
   b. Efficiency: IE5 efficiency To IEC 60034-30-1
   c. Power supply: 200 - 240 V, 60 Hertz

2.

D. PUMP CONTROLS

1. Control: Integrated with UL type 12 minimum enclosure rating, sensorless controls complete with fused disconnect switch and menu-driven graphical touchscreen interface.
   a. Provide near unity displacement power factor (cos Ø) without need for external power factor correction capacitors at all loads and speeds using VVC-PWM type integrated controls
      1) Incorporate DC link reactors for reduction of mains borne harmonic currents and DC link ripple current to increase DC link capacitor lifetime.
      2) Fit RFI filters as standard to ensure integrated controls meets low emission and immunity requirements.
      3) Ensure additional 3 % AC line reactor is available for controls with saturating non linear DC link reactors.
   4) Orientation: Controls face pump discharge.
   5) Protocol: [BACnet™ MS/TP] [BACnet™ TCP/IP] [Modbus RTU]
   6) Sensorless override for BAS/BMS control signal.
   7) Enclosure: UL Type [12] [4X]
   8) EMI/RFI Control: Integrated filter designed to DIN EN61800-3.
   9) Harmonic suppression: Equivalent: 5% impedance AC line reactor to mitigate harmonics to support IEEE 519 system requirements.
   10) Cooling: Fan cooled, surface cooling.
   11) Ambient working conditions: [14°F to +113°F], up to [3300] feet above sea level.
12) Analog I/O: 2 inputs minimum, 1 output minimum. Output can be configured for voltage or current.

13) Digital I/O: 2 inputs minimum, 2 outputs minimum. Outputs can be configured as inputs.

14) Pulse inputs: 2 programmable minimum.

15) Relay outputs: 2 programmable minimum.


17) One volt free contact.

18) Auto alarm reset.

E. SOFTWARE: Ensure software for sensorless control includes automatic speed control in variable volume systems without need for pump mounted (internal/external) or remotely mounted differential pressure sensor.

1. Operating mode under sensorless control: Quadratic Pressure Control (QPC).
   a. Ensure head reduction with reducing flow conforms to quadratic control curve.
   b. Head at zero flow: [40] % minimum of design duty head.

2. Linear or Proportional Pressure Control without sensor is unacceptable.

3. Ensure control mode setting and minimum/maximum head setpoints are user adjustable using built-in programming interface.

4. Ensure integrated control software is capable of controlling pump performance for non-overloading power at every point of operation.

5. Ensure integrated control software is capable of flow rate display and data output of ± 5% accuracy to BAS/BMS.

6. Ensure the controls can display and digitally transmit real-time flow & head values

7. Include energy monitoring log function to ASHRAE 189.1P.

8. For multiple pump configuration ensure [parallel Sensorless pump control with best efficiency staging] [duty/standby] is applied

9. Parallel pump staging will be provided without the use of BAS / BMS. Min / max speed / frequency based staging shall not be acceptable and a locally mounted logic controller shall be used for best efficiency staging.

10. Parallel pump speed control shall be achieved without the need for differential pressure sensors either in the mechanical room or remotely installed in the system.

11. The parallel sensorless pump control will have in-built redundancy features including:
   a. Factory installed power connection to each pump controller
   b. Controller ‘offline’ operational protection preventing loss of system flow

F. PUMP AND CONTROLS PROTECTION

1. Include protection as follows:
   a. Motor phase to phase fault.
   b. Motor phase to ground fault.
   c. Loss of supply phase.
   d. Over voltage.
   e. Under voltage.
   f. Motor over temperature.
   g. Inverter overload.
   h. Over current.

2. Ensure controls run automatic motor adaptation (AMA) for superior motor protection and control.

G. ACCESSORIES


2. Hangers and Supports: in accordance with Section [23 05 29 - Hangers and Supports for HVAC Piping and Equipment].

3. Vibration isolators, neoprene isolation pads in accordance with Section [23 05 48 - Vibration and Seismic Controls for HVAC].

4. Suction Diffuser: For ANSI Class 150 pipe flange and ANSI 125 pump flange.
5. Triple Duty Valve: Ductile iron valve body, tight shut-off, spring-closure type silent non-slam check valve with effective throttling design capability.
   a. Valve stem: Stainless steel with flat surfaces for adjustment with open-end wrench.
6. Pressure Gauges: 4½inch diameter sized to meet system pressure requirements.

PART 3  EXECUTION

3.01  PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02  INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.
C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close-coupled or base-mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches (102 mm) and over.
D. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.
   1. Provide a separate shut-off isolation valve on pump discharge in addition to the combination pump discharge valve.
E. Check, align, and certify alignment of base-mounted pumps prior to start-up.
F. Lubricate pumps before start-up.
G. Extreme care shall be taken when installing pumps such that no strain is placed on the mains due to pump position.
H. Adjust alignment of pump and motor shafts for angular and parallel alignment by one of the two methods specified in the Hydraulic Institute "Centrifugal Pumps - Instructions for Installation, Operation and Maintenance."
I. After alignment is correct, tighten the foundation bolts evenly, but not too firmly.
J. Alignment tolerances shall meet manufacturer's recommendations.
K. Two sets of strainer mesh are to be supplied with each pump. A fine mesh startup strainer and a running size mesh. Remove start-up strainer after completion of cleaning procedure. See Sections 23 21 13 and 23 21 14.

END OF SECTION
SECTION 23 2500
HVAC WATER TREATMENT

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Materials.
   1. System cleaner.
   2. Closed system treatment (water).
B. By-pass (pot) feeder.
C. Cleaning of piping systems
D. Chemical feeder equipment
E. Chemical treatment

1.02 RELATED REQUIREMENTS
A. Section 23 0913 - Instrumentation and Control Devices for HVAC.
B. Section 23 2113 - Hydronic Piping.
C. Section 23 2114 - Hydronic Specialties.
D. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 SUBMITTALS
A. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.
B. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.
C. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.
D. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.
E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Sufficient chemicals for treatment and testing during required maintenance period.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS
A. Comply with applicable codes for addition of non-potable chemicals to building mechanical systems and to public sewage systems.

2.02 MATERIALS
A. System Cleaner:
   1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodiumtripoly phosphate and sodium molybdate.
   2. Biocide chlorine release agents such as sodium hypochlorite or calcium hypochlorite or microbiocides such as quarternary ammonia compounds, tributyltin oxide, methylene bis (thiocyanate).
B. Closed System Treatment (Water):
   1. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
   2. Corrosion inhibitors; boron-nitrite, sodium nitrite and borax, sodium tolytriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
   3. Conductivity enhancers; phosphates or phosphonates.

2.03 BY-PASS (POT) FEEDER
A. Manufacturers:
4. Sage WC-32288
5. Industrial Chemical Corporation.
6. General Treatment

B. 1.8 gal (6.8 L) quick opening cap for working pressure of 175 psi (1200 kPa).

PART 3 EXECUTION

3.01 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
B. Place terminal control valves in open position during cleaning.
C. Verify that electric power is available and of the correct characteristics.

3.02 CLEANING SEQUENCE

A. Concentration:
   1. As recommended by manufacturer.
B. Hot Water Heating Systems:
   1. Apply heat while circulating, slowly raising temperature to 160 degrees F (71 degrees C) and maintain for 12 hours minimum.
   2. Remove heat and circulate to 100 degrees F (37.8 degrees C) or less; drain systems as quickly as possible and refill with clean water.
   3. Circulate for 6 hours at design temperatures, then drain.
   4. Refill with clean water and repeat until system cleaner is removed.
C. Chilled Water Systems:
   1. Circulate for 48 hours, then drain systems as quickly as possible.
   2. Refill with clean water, circulate for 24 hours, then drain.
   3. Refill with clean water and repeat until system cleaner is removed.
D. Steam Systems:
   1. Apply heat, slowly raising boiler temperature to 160 degrees F (71 degrees C) and maintain for 12 hours minimum.
   2. Cool, then drain as quickly as possible.
   3. Refill with clean water, drain, refill and check for sludge.
   4. Repeat until system is free of sludge.
   5. Apply heat to produce steam for piping system and maintain for 8 hours minimum. Bypass traps and waste condensate.
E. Use neutralizer agents on recommendation of system cleaner supplier and approval of Architect.
F. Flush open systems and glycol filled closed systems with clean water for one hour minimum. Drain completely and refill.
G. Remove, clean, and replace strainer screens.
H. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.
I. Submit water samples to glycol supplier to ensure systems are sufficiently clean as to not cause foaming and are generally compatible with the glycol.
J. Contractor to provide initial water treatment chemicals.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.
3.04 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

C. Only DI water shall be used for dilution of closed system chemical solutions.

D. Provide 3/4 inch (19 mm) water coupon rack around circulating pumps with space for 4 test specimens.
   1. Coupon rack shall be suitable for the system being served with minimum temperature rating of 225 degrees F and 100 psi operating pressure.

3.05 CONDENSER WATER SYSTEMS (COOLING TOWERS)

A. Provide automatic condenser water control systems for inhibitor feed, blowdown and biocide feeds. Inhibitor application shall be meter activated, blowdown shall be conductivity activated, and biocide shall be meter fed with blowdown locked out to ensure biocide retention time.

B. Control system shall incorporate solid state integrated circuits and digital LED displays, in NEMA-12 steel enclosure. Provide gasketed and lockable door.

C. Base dissolved solids control on conductivity and include:
   1. LED digital readout display (micro-ohm/cm).
   2. Temperature compensated sensor probe adaptable to sample stream manifold.
   3. High, low, normal conductance indicator lights (LED).
   4. High or low conductance alarm light (flash or steady switch), trip points field adjustable. Flash or steady switch shall have silence position.
   5. Illuminated legend shall indicate "ALARM" whenever alarm condition exists.
   7. Illuminated legend shall indicate "BLEED" when valve is operated.
   8. Adjustable hysteresis or dead-band (internal).

D. Base inhibitor feed control on make-up volume and include:
   1. Solid state counter (1-15 field selectable).
   2. Test switch.
   3. Hand-off-automatic switch for chemical pump.
   4. Illuminated legend shall indicate "FEED" when pump is activated.
   5. Solid state lock-out timer (adjustable 1/4 to 3 hours) and indicator light. Lock-out timer shall deactivate the pump and activate alarm circuits.
   6. Panel totalizer (amount of makeup), electro-mechanical type.

E. Biocide programmer to include:
   1. 24 hour timer with 14 day skip feature to permit activation any hour of the day.
   2. Precision solid state bleed lock-out timer (0-9 hours) and biocide pump timer (0 - 2-1/4 hours), clock controlled.
   3. Solid state alternator to enable the use of two different formulations.
   4. Digital display of the time of day (24 hours).
   5. LED display of day of week (14 days).
   6. Fast and slow clock set controls (internal).
   7. Battery back-up so clock is not disturbed by power outages, quartz timekeeping accuracy.

F. Provide water meter on system make-up, wired to control system.

G. Provide solution pumps to feed sequestering agent and corrosion inhibitor from solution tank into condenser water supply to tower. Provide agitator as required.

H. Provide conductivity controller to sample condenser water and operate 1 inch (25 mm) solenoid bleed valve and piping to blowdown controller sampler wired to open when condensing water pump is operating.
I. Provide liquid level switch in each solution tank to deactivate solution pump and agitator and sound local alarm bell.
J. Provide 3/4 inch (19 mm) water coupon rack around circulating pumps with space for 4 test specimens.

3.06 CLOSEOUT ACTIVITIES

A. Training: Train Owner's personnel on operation and maintenance of chemical treatment system.
   1. Provide minimum of two hours of instruction for two people.
   2. Have operation and maintenance data prepared and available for review during training.
   3. Conduct training using actual equipment after treated system has been put into full operation.

3.07 MAINTENANCE

A. Perform maintenance work using competent and qualified personnel under the supervision and in the direct employ of the equipment manufacturer or original installer.
B. Provide service and maintenance of treatment systems for one year from Date of Substantial Completion.
C. Provide monthly technical service visits to perform field inspections and make water analysis on-site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.
D. Provide laboratory and technical assistance services during this maintenance period.
E. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Metal ductwork.
B. Duct cleaning.
C. Duct leak testing

1.02 RELATED REQUIREMENTS
A. Section 23 0713 - Duct Insulation: External insulation and duct liner.
B. Section 23 3300 - Air Duct Accessories.
C. Section 23 3600 - Air Terminal Units.
D. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC

1.03 REFERENCE STANDARDS
D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
L. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).
N. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.

1.04 SUBMITTALS
A. See Section 230010 - GENERAL PROVISIONS, for submittal procedures.
B. Product Data: Provide data for duct materials.
C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for 4 inch pressure class and higher systems.
   1. Submit shop drawings for all kitchen exhaust ductwork systems.
   2. Submit ductwork system layout drawings to indicate where each pressure class, material and joining method is to be applied throughout the project for all systems noted to be submitted on.

D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK).

E. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 FIELD CONDITIONS
A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS
2.01 DUCT ASSEMBLIES
A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.
B. Ducts: Galvanized steel, unless otherwise indicated.
C. Low Pressure Supply (System with Cooling Coils): 2 inch w.g. (500 Pa) pressure class, galvanized steel.
D. Medium Pressure Supply: 4 inch w.g. (1000 Pa) pressure class, galvanized steel.
   1. Medium pressure ductwork shall include all ductwork between the air handling unit and the VAV terminals.
E. High Pressure Supply: 6 inch w.g. (1500 Pa) pressure class, galvanized steel.
   1. High pressure ductwork shall include all ductwork between the air handling unit and the VAV terminals.
F. Return and Relief: 2 inch w.g. (500 Pa) pressure class, galvanized steel.
G. General Exhaust: 2 inch w.g. (500 Pa) pressure class, galvanized steel.
H. Outside Air Intake: 2 inch w.g. (500 Pa) pressure class, galvanized steel.
I. Combustion Air: 2 inch w.g. (500 Pa) pressure class, galvanized steel.
J. Low velocity sheet metal ductwork shall be designed for a duct pressure class of 2" W.G. This includes all ducts serving supply, return, relief and exhaust air systems, unless otherwise specified elsewhere in this section or on the Drawings.
K. Medium velocity sheet metal ductwork shall be designed for a duct pressure class of 4" W.G, unless noted otherwise in this section. Medium velocity ductwork shall include all ductwork between the air handling unit and the VAV terminals.

2.02 MATERIALS
A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
C. Stainless Steel for Ducts: ASTM A666, Type 316.
D. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
HVAC DUCTS AND CASINGS

1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
2. VOC Content: Not more than 250 g/L, excluding water.
3. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.

E. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.03 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
C. Construct T’s, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
D. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
F. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
G. The minimum duct construction shall be 24 ga.
H. Brace turning vanes to prevent objectionable noise.
I. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
J. Standard 45 degree lateral wye takeoffs unless otherwise indicated may be used where 90 degree conical tee connections are used.
K. All ducts over 18” wide shall be cross broken.
L. No single thickness partitions between ducts will be allowed.
M. No open joints at the Corners or elsewhere will be allowed.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
   1. Low velocity sheet metal ductwork shall be designed for a duct pressure class of 2” W.G. This includes all ducts serving supply, return, relief and exhaust air systems, unless otherwise specified elsewhere in this section or on the Drawings.
   2. Medium velocity sheet metal ductwork shall be designed for a duct pressure class of 4” W.G. Medium pressure ductwork shall include all ductwork between the air handling unit (supply and/or exhaust fan) and the VAV terminals. Longitudinal seam round ductwork is not allowed in this pressure class.
B. Spiral Round and Flat Oval Ducts: Machine made from round spiral lockseam duct.
   1. Manufacture in accordance with SMACNA (DCS).
   2. Fittings: Manufacture at least two gages heavier metal than duct.
   3. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
   4. Manufacturers:
      a. Norlock.
b. Semco.
c. United McGill.

C. Longitudinal Seam Round and Flat Oval Ducts:
   1. Manufacturers:
      a. Norlock
      b. Semco
      c. United McGill
   2. Machine made from round spiral lockseam duct with light reinforcing corrugations. Fittings shall be manufactured of at least two gages heavier metal than the duct or heavier as required by the manufacturer.
   3. Spiral ductwork, including fittings, shall be joined by one of the following methods:
      a. Welded or "Van Stone" flange construction, angle ring bolted - flange connection.
      b. Lightweight flanged connection using "Marman" coupling.
      c. United "Flex-Lock" Coupling.
      d. Slip joint with fitting collar, "United" duct sealer or approved equal, and "United" tape or approved equal applied in strict accordance with manufacturer's recommendations (Not allowed in exposed areas)
      e. Ductmate Spiralmate or Ovalmate duct connector system.
      f. Thermofit Bands,

D. Double Wall Insulated Round Ducts: Round spiral lockseam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with solid inner wall.
   1. Manufacture in accordance with SMACNA (DCS).
   2. Insulation:
      a. Thickness: 1 inch (25 mm).

E. Flexible Ducts: Two ply vinyl film supported by helically wound spring steel wire.
   1. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
   2. Pressure Rating: 10 inches WG (2.50 kPa) positive and 1.0 inches WG (250 Pa) negative.
   3. Maximum Velocity: 4000 fpm (20.3 m/sec).
   4. Temperature Range: Minus 10 degrees F to 160 degrees F (Minus 23 degrees C to 71 degrees C).

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).
B. Install in accordance with manufacturer's instructions.
C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
D. Flexible Ducts: Connect to metal ducts with draw bands.
E. Kitchen Hood Exhaust: Provide residue traps at base of vertical risers with provisions for clean out.
F. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
G. All ductwork shall be run substantially as shown on the plans with bends and curves. 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.
H. Where ducts run through bar joist 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.
I. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
J. Round branch duct connections to rectangular mains shall be made with Spin-in Conical takeoff. Takeoff shall have volume damper with quadrant operator.
K. Butter and seal all longitudinal and transverse joints in ductwork. Apply sealer along entire length of joint before putting "drive" in place and apply a secondary layer of sealant or putty at corners before drive ends are bent over. On duct systems in the 4" W.G. and above pressure classification, the duct wall penetrations and longitudinal joints shall also be sealed. Sealant shall be similar to Dura-Dyne, 3M Ductseal 800 or equal. Sealant on both low and medium pressure ductwork shall be a minimum of 0.06 inches thick along all joints.

L. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

M. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

N. Use crimp joints with or without bead for joining round duct sizes 8 inch (200 mm) and smaller with crimp in direction of air flow.

O. Use double nuts and lock washers on threaded rod supports.

P. In connecting to masonry and/or stud wall construction, masonry flues, joining shall be made practically airtight by the use of caulking compounds, forced from the inside of the duct to the outside and then molded and clinched into place as not to permit leakage after setting. The caulking compound shall be such in character that it will remain resilient after final setting.

Q. Where vertical duct risers pass through floors, securely fasten supporting angles on at least two sides of the ducts with rivets, screws, or bolts and support the assembly on the adjoining floor construction in an approved manner. Angles shall be black iron primed with zinc chromate.

R. Where vertical duct risers are enclosed in vertical mechanical chases, the ducts shall be self supporting with hangers located at each floor. Hangers shall conform to SMACNA standards for size and construction.

S. Exhaust air, relief air, and air intake ducts shall be equipped with 2" deep watertight pans to collect moisture and condensate. Seal all joints with Alcoa aluminum gutter sealant, Tremco mono acrylic terpolymer sealant, GE silicone sealant, or equal. Where moisture may condense within the duct system, pitch ductwork to low points and provide drip pans and drain connections with plugs for removal of condensate.
1. Drain pans located in mechanical rooms shall have drain line piped to nearest floor drain in lieu of the plugged drain connection.
2. Pitch ductwork to drain out louver where applicable.

T. Connect terminal units to supply ducts directly or with one foot (300 mm) maximum length of flexible duct. Do not use flexible duct to change direction.

U. Securely attach all ductwork to the building construction in a manner to be free from vibration and swaying under all conditions.

V. Flexible ductwork shall not be located in rated corridors (except where serving diffuser in corridor), or in exposed locations.

W. Flexible duct supports to be maximum 5'-0" o.c.

X. Ducts shall be substantially supported with hangers located according to SMACNA standards. Hang ducts from beams and joists wherever possible.

Y. No obstructions will be allowed in ducts except places where absolutely necessary and prior approval has been received from the A/E. In such cases they shall be installed so as to least interfere with the passage of air.

Z. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.

AA. At exterior wall louvers, seal duct to louver frame and install blank-out panels.
3.02 CLEANING
   A. Clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

3.03 DUCT LEAK TESTING
   A. All ductwork systems above 2" pressure Duct Construction Class shall be leak tested per SMACNA standards.
      1. See Section 23 0593 for additional requirements.
      2. Leak testing to be performed under this section, witnessed by TAB Authority. Coordinate with TAB authority for scheduling the testing.
      3. Remediate any issues found during this testing. Tests and necessary repairs shall be completed prior to concealment of ducts.
      4. Any leaks which may be felt or heard shall also be repaired or sealed.
      5. All ductwork with pressure class at or above 4" positive or negative shall be leak tested.
      6. Leakage class of all ductwork shall be as per SMACNA for scheduled pressure class and based on round or rectangular duct as indicated in SMACNA Leakage Test Manual Section 4 typical classifications unless otherwise noted. The leakage amount shall not exceed the allotted amount for the pressure class or the allotted amount for that portion of the system, whichever is applicable.
      7. Leakage test procedure shall follow the outlines and classifications in the SMACNA HVAC Duct Leakage Test Manual.
      8. Contractor shall, at the beginning of the work construct, erect and leak test a representative sample of the duct construction to be used at the 4" pressure class. The sample specimen shall include at least five transverse joints, typical seams, an access door and at least two typical branch connections plus one elbow. Test this prior to installation of any ductwork within the system.
      9. Similar test of representative sections of actual installed ductwork shall be conducted for all systems rated at 4" pressure class and higher. Tests shall be conducted for 2 representative sections of each fan system rated at 4" pressure class and higher. Two additional tests shall be required on same duct system for each failed test of that duct system.
     10. Test pressure shall be equal to 150% of fan pressure or rated duct pressure, whichever is less.
     11. Any duct accessories which are to be installed, should be installed within the system prior to testing. Including, but not limited to dampers, access doors, etc.
     12. Coordinate testing with TAB and Commissioning Agent when appropriate for witnessing the test.

3.04 SCHEDULES
   A. Ductwork Material:
      1. Low Pressure Supply: Steel.
         a. Duct construction class: 2".
         b. Leakage Class:
            1) Rectangular: 12
            2) Round: 6
         a. Duct construction class: 4".
         b. Leakage Class:
            1) Rectangular: 6
            2) Round: 3
      3. Return and Relief: Steel, Aluminum.
         a. Duct construction class: 2".
         b. Leakage Class:
            1) Rectangular: 12
2) Round: 6

   a. Duct construction class: 2".
   b. Leakage Class:
      1) Rectangular: 12
      2) Round: 6

5. Outside Air Intake: Steel.
   a. Duct construction class: 2".
   b. Leakage Class:
      1) Rectangular: 12
      2) Round: 6

END OF SECTION
SECTION 23 3300
AIR DUCT ACCESSORIES

PART 1  GENERAL

1.01  SECTION INCLUDES
A. Air turning devices/extractors.
B. Backdraft dampers
C. Combination fire and smoke dampers.
D. Duct access doors.
E. Duct test holes.
F. Fire dampers.
G. Flexible duct connectors.
H. Smoke dampers.
I. Volume control dampers.

1.02  RELATED REQUIREMENTS
A. Section 23 3100 - HVAC Ducts and Casings.

1.03  REFERENCE STANDARDS
D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).
E. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.

1.04  SUBMITTALS
A. Shop Drawings: Indicate for shop fabricated assemblies including combination fire/smoke dampers, fire damper, volume control dampers, duct access doors, and duct test holes.
B. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.

1.05  EXTRA MATERIALS
A. Provide 2 spare fusible links per damper requiring fusible links.

1.06  DELIVERY, STORAGE, AND HANDLING
A. Protect dampers from damage to operating linkages and blades.

PART 2  PRODUCTS

2.01  BACKDRAFT DAMPERS
A. Manufacturers:
   5. Greenheck
B. Gravity Backdraft Dampers, Size 18 by 18 inches (450 by 450 mm) or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

C. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch (150 mm) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.02 BACKDRAFT DAMPERS - FABRIC

A. Fabric Backdraft Dampers: Factory-fabricated.
   2. Birdscreen: 1/2 inch (12 mm) nominal mesh of galvanized steel or aluminum.
   3. Maximum Velocity: 1000 fpm (5 mps) face velocity.

2.03 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:
   4. PCI Industries, Inc; Pottorff Brand: www.pottorff.com
   5. Cesco
   6. Greenheck
   7. Air Balance

B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.

C. Provide factory sleeve and collar for each damper.

D. Multiple Blade Dampers: UL Class 1 rated, fabricated with 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 x 1/2 inch plated steel concealed linkage, silicon rubber blade seals, stainless steel closure spring, blade stops, and lock, and 1/2 inch actuator shaft.

E. Provide fusible link rated at 50 deg. F above maximum operating temperature but not less than 160 deg. F.

F. Operators: UL listed and labelled spring return electric type suitable for 120 volts, single phase, 60 Hz. Locate damper operator on exterior of duct and link to damper operating shaft.

G. Electro Thermal Link: Fusible link melting at 165 degrees F (74 degrees C); 120 volts, single phase, 60 Hz; UL listed and labeled.

2.04 DUCT ACCESS DOORS

A. Manufacturers:

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Doors shall be attached to duct with zinc plated cam latches. 18"x18" and smaller doors shall have a minimum of 2 latches, larger doors to have a minimum of 4 latches.

D. Panel shall set in rigid frame with sponge rubber gasketing to prevent air leakage.

E. Where ductwork is uninsulated, panels may be of single wall uninsulated construction.

F. Where ductwork is insulated, panels shall be of double wall construction with 1" rigid insulation fill.

G. Access doors with sheet metal screw fasteners are not acceptable.

2.05 FIRE DAMPERS

A. Manufacturers:
5. Cesco
6. Greenheck
7. Air Balance

B. All dampers shall be of Type B construction with the dampers out of the airstream.
C. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
D. Ceiling (Radiation) Dampers: Galvanized steel, 22 gage, 0.0299 inch (0.76 mm) frame and 16 gage, 0.0598 inch (1.52 mm) flap, two layers 0.125 inch (3.2 mm) ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
   1. Rated for three hour service in compliance with UL 555C.
E. Horizontal Dampers: Galvanized steel, 22 gage, 0.0299 inch (0.76 mm) frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
F. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1.0 inch (250 Pa) pressure class ducts up to 12 inches (300 mm) in height.
G. Fusible Links: UL 33, separate at 160 degrees F (71 degrees C) with adjustable link straps for combination fire/balancing dampers.

2.06 FLEXIBLE DUCT CONNECTORS
A. Fabricate in accordance with SMACNA (DCS) and as indicated.
B. Flexible Duct Connections: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd (1.0 kg/sq m).
      a. Net Fabric Width: Approximately 2 inches (50 mm) wide.
   2. Metal: 3 inches (75 mm) wide, 24 gage, 0.0239 inch (0.61 mm) thick galvanized steel.
C. Maximum Installed Length: 14 inch (356 mm).

2.07 SMOKE DAMPERS
A. Manufacturers:
   5. Cesco
   6. Greenheck
   7. Air Balance

B. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.
C. Dampers: UL Class 1 airfoil blade type smoke damper, normally open automatically operated by electric actuator.
   1. Provide remote reset located in an accessible location. Reset shall be located at 48" AFF in Mechanical Rooms, or just above ceilings with ceiling access door being provided in hard ceiling areas.

2.08 VOLUME CONTROL DAMPERS
A. Manufacturers:
   5. Cesco
   6. Greenheck
B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Splitter Dampers:

D. Single Blade Dampers:
   1. Dampers shall have 16 gauge frame with 16 gauge blades with neoprene edge seals.
   2. Provide quadrants of suitable size for each damper.
   3. Fabricate for duct sizes up to 6 by 30 inch (150 by 760 mm).

E. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch (200 by 1825 mm). Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
   1. Dampers shall have 16 gauge frame with 16 gauge blades with neoprene edge seals.
   2. Provide quadrants of suitable size for each damper.

F. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

2.09 CONSTANT FLOW VOLUME FLOW CONTROLLERS

A. Manufacturers:

B. Description: Volume flow controller for constant volume systems, mechanical system-powered without external power supply required, suitable for supply or return/exhaust air systems with a preset or field adjusted CFM matching as scheduled.

C. Construction: Rectangular or circular casing with an internal control damper blade, mechanical system-powered, to maintain a CFM as scheduled.

D. Features:
   1. Mechanical system-powered, without external power supply.
   2. Preset or Field adjusted CFM with +/- 4% accuracy of the scheduled CFM.

E. Minimum differential pressure: 0.21 in wc.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 3100 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96. Provide minimum 8 x 8 inch (200 x 200 mm) size for hand access, 18 x 18 inch (450 x 450 mm) size for shoulder access, and as indicated. Provide 4 x 4 inch (100 x 100 mm) for balancing dampers only. Review locations prior to fabrication.
   1. If above sizes do not fit, provide 2" smaller than duct size.

D. Access doors for fire, smoke and combination fire/smoke dampers shall be labeled with minimum 1/2" lettering as "FIRE DAMPER", "SMOKE DAMPER", or "FIRE/SMOKE DAMPER" as appropriate.

E. Access doors shall not be located in top side of duct.
F. Access doors shall be located in position to allow maintenance on the equipment being accessed.

G. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

H. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.

I. Demonstrate re-setting of fire dampers to Owner's representative.

J. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

K. At locations calling for duct expansion connections due to building expansion joints, provide a 12" long flexible duct connection with flange-to-flange distance set at 8" in all ductwork sections crossing the building expansion joint.

L. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

M. Manual balancing dampers shall be provided with a locking type quadrant at exterior of duct.

N. Use splitter dampers only where indicated.

O. All volume dampers provided for special duct systems shall be constructed of the same material as the duct.

P. Provide and install insulated roof curb for each roof mounted piece of equipment provided by this contractor. Provide counterflashing for each curb. Flashing to be under the General Contract.

Q. Wash all flashings and counterflashing with acetic acid, and paint with one coat of lead and oil paint, black in color.

R. Provide access where dampers and fittings are not exposed.
   1. Provide access doors in ceilings, walls, etc. wherever required to afford easy access to dampers and other equipment requiring inspection, servicing or cleaning. Doors shall be of approved dimensions with frame, brass hinges, handle, locking device and gasket for airtight joint. Provide fire-rated doors where required.

S. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION
SECTION 23 3423
HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Roof exhausters.
   B. Dryer exhaust duct power ventilators.
   C. Inline centrifugal fans.
   D. Kitchen hood upblast roof exhausters.
   E. Laboratory and fume exhaust.

1.02 RELATED REQUIREMENTS
   A. Section 23 0548 - Vibration and Seismic Controls for HVAC.
   B. Section 23 3300 - Air Duct Accessories: Backdraft dampers.
   C. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS
   A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
   C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2005.
   E. AMCA 300 - Reverbant Room Method for Sound Testing of Fans; 2014.
   F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.
   G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
   I. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

1.04 SUBMITTALS
   A. See Section 230010 - GENERAL PROVISIONS, for submittal procedures.
   B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.
      1. Fan manufacturer shall furnish a certificate of guarantee stating that the fan, mixing plenum, outlet nozzle, stack extension if any, and all related accessories specified herein have been pre-tested at the factory and that the curves supplied as stated above have been de-rated for any and all system effects created by the accessories. Manufacturer's Instructions: Indicate installation instructions.
   C. Manufacturer's Instructions: Indicate installation instructions.
   D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.05 FIELD CONDITIONS
   A. Permanent ventilators may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.
PART 2 PRODUCTS

2.01 MANUFACTURERS

F. Twin City Fan & Blower: www.tcf.com/#sle.

2.02 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: AMCA 204 - Balance Quality and Vibration Levels for Fans.
B. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
C. Sound Ratings: AMCA 301, tested to AMCA 300 and bearing AMCA Certified Sound Rating Seal.
D. Fabrication: Comply with AMCA 99.
E. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
G. Enclosed Safety Switches: Comply with NEMA 250.
H. Kitchen Hood Exhaust Fans: Comply with requirements of NFPA 96 and UL 762.

2.03 ROOF EXHAUSTERS

A. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch (13 mm) mesh, 0.62 inch (1.6 mm) thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
   1. Motor shall be mounted out of the airstream.
B. Roof Curb: 12 inch (300 mm) high self-flashing of galvanized steel with continuously welded seams, built-in cant strips.
C. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor and wall mounted multiple speed switch.
D. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
F. Options/Accessories:
   1. Automatic Belt Tensioner (for belt drive fans): Automatic device that adjusts for correct belt tension for single drives.

2.04 CABINET EXHAUST FANS

A. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
B. Disconnect Switch: Cord and plug in housing for thermal overload protected motor and wall mounted switch.
C. Grille: Aluminum with baked white enamel finish.
D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.05 KITCHEN HOOD UPBLAST ROOF EXHAUSTERS

A. Direct or belt Drive Fan:
   1. Fan Wheel:
      a. Type: Non-overloading, backward inclined centrifugal.
      b. Material: Aluminum.
   2. Statically and dynamically balanced.
   3. Motors:
      a. Open drip-proof (ODP).
      b. Heavy duty ball bearing type.
      c. Mount on vibration isolators or resilient cradle mounts, out of air stream.
      d. Fully accessible for maintenance.
   4. Housing:
      a. Construct of heavy gage aluminum including curb cap, windband, and motor compartment.
      b. Rigid internal support structure.
      c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
      d. Construct drive frame assembly of heavy gage steel, mounted on vibration isolators.
      e. Provide breather tube for fresh air motor cooling and wiring.

B. Shafts and Bearings:
   1. Fan Shaft:
      a. Ground and polished steel with anti-corrosive coating.
      b. First critical speed at least 25 percent over maximum cataloged operating speed.
   2. Bearings:
      a. Permanently sealed or pillow block type.
      b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
      c. 100 percent factory tested.

C. Drive Assembly:
   1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
   2. Belts: Static free and oil resistant.
   3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
   4. Motor pulley adjustable for final system balancing.
   5. Readily accessible for maintenance.

D. Drain Trough: Allows for single-point drainage of water, grease, and other residues.

E. Options/Accessories:
   1. Automatic Belt Tensioner: Automatic device that adjusts for correct belt tension for single drives.
   2. Birdscreen:
      a. Provide galvanized steel construction.
      b. Protects fan discharge.
   3. Roof Curb Extension: Vented curb extension where required for compliance with minimum clearances required by NFPA 96.
   4. Grease Trap:
      a. Aluminum.
      b. Includes drain connection.
      c. Collects grease residue.
   5. Hinge Kit:
      a. Aluminum hinges.
b. Hinges and restraint cables mounted to base (sleeve).
c. Allows fan to tilt away for access to wheel and ductwork for inspection and cleaning.

6. Tie-down Points: Four brackets located on windband secures fan in heavy wind applications.

7. External motor speed controllers for field mounting.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Secure roof exhausters with stainless steel lag screws to roof curb.
C. Roof exhausters shall be attached to roof curbs with a minimum of 2 screws per side (total of 8 screws).
D. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
E. Provide sheaves required for final air balance.
F. Install motorized backdraft dampers on inlet to roof and wall exhausters (except kitchen hood fans).
G. Install backdraft dampers on inlet to roof and wall exhausters.
H. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Variable volume regulators.
   B. Integral sound attenuator.
   C. Integral heating coils.
   D. Integral damper motor operators.
   E. Integral controls.

1.02 RELATED REQUIREMENTS
   A. Section 23 0548 - Vibration and Seismic Controls for HVAC.
   B. Section 23 0913 - Instrumentation and Control Devices for HVAC: Thermostats and actuators.
   C. Section 23 0923 - Direct-Digital Control System for HVAC.
   D. Section 23 0993 - Sequence of Operations for HVAC Controls.
   E. Section 23 3100 - HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS
   B. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2011 with Addendum 1.
   C. ASHRAE Std 130 - Methods of Testing Air Terminal Units; 2016.
   G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
   J. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.

1.04 SUBMITTALS
   A. See Section 230010 - GENERAL PROVISIONS for submittal procedures.
   B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
   C. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
   D. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.
   E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 WARRANTY
   A. See Section 230010 - GENERAL PROVISIONS, for additional warranty requirements.
   B. Provide five year manufacturer warranty for air terminal units.
PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Ceiling mounted variable air volume supply and/or exhaust pressure independent air control terminals for connection to single duct, central air systems with system powered variable volume controls.

B. Identify each terminal unit with clearly marked identification label and air flow indicator. Include unit nominal air flow, maximum factory set airflow, minimum factory set airflow, and coil type.

2.02 SINGLE-DUCT, VARIABLE-VOLUME AND CONSTANT-VOLUME UNITS

A. General:
   1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
   2. Regulator Assembly: System-air powered bellows section incorporating polypropylene bellows for volume regulation and thermostatic control. Polypropylene material shall perform at temperatures of 0 to 140 degrees F and be impervious to moisture and fungus. Design bellows for static pressure and factory check for leaks.
   3. Configuration: Air volume damper and automatic flow control assemblies inside unit casing.
   4. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.
   5. Provide internally insulated, gasketed access door in bottom of each unit. Allow for access to these doors through ceiling. Provide access door with 1/4 turn sash or cam latches. Sheet metal screws shall not be acceptable for these access panels.

B. Unit Casing:
   1. Minimum 22 gage, 0.0299 inch (0.76 mm) galvanized steel.
   2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.
   3. Unit Discharge: Rectangular, with slip-and-drive connections.
   5. Acceptable Liners:
      a. 1/2 inch (13 mm) thick neoprene or vinyl coated, fibrous-glass insulation ___ lb/cu ft (_____ mm) density, meeting NFPA 90A requirements and UL 181 erosion requirements and complying with ASTM C1071. Face lining with Tedlar film.
         1) Secure with adhesive.
         2) Coat edges exposed to airstream with NFPA 90A approved sealant.
         3) Cover liner with non-porous foil.
      b. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.
      c. Lining: 13/16" compressed glass fiber rigid insulation with non-porous face for IAQ, 4 lb/cu ft density, meeting NFPA 90A requirements and UL 181 erosion requirements and the bacteriological standards of ASTM C 665.
      d. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.
      e. Configuration: Air volume damper assembly and fan in series arrangement inside unit casing. Locate control components inside protective metal shroud. Control housing to be provided with unit.

C. Sound Attenuator:
   1. Provide if required to meet scheduled acoustical performance requirements.
   2. Construction to consist of a continuous extension of the casing and liner as required to achieve required attenuation.
3. At 2000 fpm (10.16 m/s) inlet velocity, the minimum operating pressure with attenuator added not to exceed 0.14 inch wg (34.84 Pa).
4. Attenuator Section: Line attenuator sections with 2 inch thick insulation.
   a. Multi Outlet Attenuator Section: With 6 inch diameter collars, each with butterfly balancing damper with lock.
   b. Round Outlet: Discharge collar matching inlet size.

D. Multi Outlet Attenuator Section: With 6 inch diameter collars, each with butterfly balancing damper with lock.

E. Fan Assembly:
   1. Fan: Forward curved centrifugal type with direct drive permanent split capacitor type, thermally protected motor. Refer to Section 23 0513 - Common Motor Requirements for HVAC Equipment
   2. Speed Control: Infinitely adjustable with electronic controls.
   4. Fan Relay: Contactor assembly suitable for switching the 277 VAC fan motor. Contactor to have 24 VAC coil, drawing less than 12 VA. Box manufacturer shall provide the contactor.

F. Damper Assembly:
   1. Shall consists of heavy gauge and galvanized steel construction with solid steel, nickel-plated shaft pivoting on HDPE; maximum damper leakage: 2% of design air flow at 1 inch inlet static pressure.
   2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
   3. Incorporate low leak damper blades for tight airflow shutoff.
   4. Mount damper operator to position damper normally open.
   5. Airstream Temperature Sensor (Provided and installed under 23 0913 - Instrumentation and Control Devices for HVAC).

G. Hot Water Heating Coil:
   1. Refer to Air Coils section and drawing schedules for more information.
   2. Construction: UL listed, slip-in type, open coil design, integral control box factory wired and installed with:
      a. Silicon Controlled Rectifier (SCR) Control.
      b. Provide with factory mounted airflow proving sensor.
      c. Primary and secondary over-temperature protection.
   3. Coil Casing: Minimum 22 gage, 0.0299 inch (0.76 mm) galvanized steel, factory-installed on terminal discharge with rectangular outlet, duct connection type.
   4. Coil Fins: Aluminum or aluminum plated fins, mechanically-bonded to seamless copper tubes.
   5. Coil leak tested to minimum 350 psig (2413 kPa).
   6. Base performance data on tests run in accordance with AHRI 410 and units to bear AHRI 410 label.

H. Wiring:
   1. Factory mount and wire controls. Mount electrical and electronic components in control box with removable cover. Incorporate single point electrical connection to power source.
   2. Factory mount transformer for control voltage on electric and electronic control units. Provide terminal strip in control box for field wiring of power source.
   3. Wiring Terminations: Wire fan and controls to terminal strip. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70
   4. Disconnect Switch: Factory mount fused disconnect switch in control panel.
   5. ACS supplier shall deliver controls to the box manufacturer's factory. The controls will be a damper actuator and a controller for each box. The ACS supplier shall supply a wiring


diagram showing the interconnection of the controller to the actuator and the fan contactor. The ACS supplier shall bear all costs of the controls, factory mounting, and their delivery.


I. Controls:
1. General:
   a. Suitable for operation with duct pressures between 2.5 inches and 1 inch static pressure.
   b. Mount controls in sheet metal enclosure on unit.
   c. Factory mounted and piped 5 micron filter, velocity resetting adjustable high limit control and amplifying relay.
   d. System powered aspirating diffuser mounted thermostat.
   e. Limit switch shall activate heating system.
   f. Provide morning warmup control to sense duct temperature and control unit at maximum airflow during heating mode.

2. Electric:
   a. Damper Actuator: 24 volt, powered microswitch to energize heating control circuit.
   b. Wall-mounted thermostat with Celsius and Fahrenheit display including clock display and set-point of occupied space.
   c. Changeover Thermostat: Duct-mounted to reverse control action upon duct temperature rise to 130 degrees F.
   d. 24 VAC. Actuator provided by ACS supplier.
   e. See Section 23 0913 - Instrumentation and Control Devices for HVAC.

3. Electronic:
   a. Damper Actuator: 24 volt, power open/closed, spring return open.
   b. Velocity Controller:
      1) Settings for minimum/maximum air volumes, factory-calibrated, and field adjustable at thermostat.
      2) Maintain constant airflow dictated by thermostat to within 5 percent of set point while compensating for inlet static-pressure variations up to 4 inch wg (1 kPa), when tested in accordance with ASHRAE Std 130.
      3) Provide controller with multi-point with velocity sensors located in air inlets and outlet.
   c. Thermostat: Wall-mounted, with integral control of room temperature, time-proportional with reheat-coil control including a temperature set-point display in Celsius and Fahrenheit.
   d. See Section 23 0913 - Instrumentation and Control Devices for HVAC.

4. DDC (Direct-Digital Controls):
   a. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
   b. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFM's.
      1) Occupied and unoccupied operating mode.
      2) Remote reset of temperature or CFM set points.
      3) Proportional, plus integral control of room temperature.
      4) Monitoring and adjusting with portable terminal.
   c. Room Sensor:
      1) Compatible with temperature controls specified.
      2) Wall-mounted, system powered, with temperature set-point adjustment including connection access for portable operator terminal.
   d. See Section 23 0923 - Lighting Control Devices.

5. Control Sequence:
   a. Suitable for operation with duct pressures between 0.25 and 3.0 inch wg (60 and 750 Pa) inlet static pressure.
b. Include factory-mounted and piped, 5-micron filter; and adjustable, velocity-resetting, high-limit control with amplifying relay.

c. See Section 23 0993 Instrumentation and Control Devices for HVAC.

2.03 DUCTLESS CEILING CASSETTE - HYDRONIC

A. General
   1. The supplied product shall be a Modine chilled water ceiling cassette unit.

B. Cases
   1. The unit casing is manufactured from lightweight galvanized sheet steel with integral fan mounting rails for added strength. Fire resistant foam insulation (to UL94 VO) is fitted internally to provide both thermal and acoustic insulation.

C. Coils
   1. Chilled water units utilize large surface area coils positioned to optimize heat transfer and airflow. Each coil is manufactured from refrigeration quality copper tubes with mechanically bonded aluminum fins and are circuited from headers to ensure low water pressure drops.

D. Condensate Pump
   1. A condensate pump and check valve are fitted to carry water out of the unit and stop water from flowing back into the condensate tray. The pump is fixed to a mounting bracket which can be withdrawn from the side of the chassis and incorporates an inspection hole to allow a visual check of the pump during operation. A float switch is fitted to stop the cooling action should the pump become blocked or fail.

E. Air Vanes
   1. Air outlet vanes are designed to prevent condensation from forming. Vanes are manually adjustable on the 2 x 2 model units but driven by an electric motor on all other model units. Where fitted, the motorized air vanes can be set to auto sweep or can be stopped in a fixed position. Polystyrene blanking pieces are supplied with Cassette packing so that up to two fascia discharge slots can be blanked off.

F. Fans & Fan Motor
   1. All units, utilizing backward curved centrifugal fans, are statically and dynamically balanced for quiet operation. Fan impellers are made from either aluminum or fire retardant plastic (UL94 VO) for light weight and corrosion resistant operation. Fans are driven by an enclosed multi-speed external rotor motor allowing good heat dissipation and an increased motor efficiency. Fans come complete with thermal overload protection and sealed-for-life lubricated bearings.

G. Filter
   1. MERV 10, 1” thick radial pleated disposable cotton and synthetic blend filters. Minimum Efficiency Reporting Value of MERV 10 per ASHRAE standard 52.2.

H. Carel Controls
   1. The unit shall be fitted with a programmable microprocessor controller designed to operate the unit according to pre-engineered control strategies.

I. Options - Factory Installed
   1. Microprocessor Controls - BacNet Plug-In Card
      a. The standard Carel microprocessor controls shall come equipped with a plug-in card allowing for complete compatibility with an MS/TP BacNet control system.

       2. Hot Water Coil
          a. A hot water heating coil will be factory fitted in addition to the standard DX or chilled water coil to provide heating. The coil is manufactured from refrigeration quality copper tubes with mechanically bonded aluminum fins.

       3. Disconnect Switch
          a. The unit shall be fitted with a power disconnect switch located on the control panel, sized for the full load amperage of the unit to enable the unit to be disconnected from the power supply prior to any maintenance.

J. Accessories - Field Installed
1. Thermostat
   a. For units fitted with the Carel microprocessor controller, a digital thermostat shall be mounted on the wall.
2. One additional spare set of Merv 8 filters shall be provided.
3. Modulating Control Valves
4. Hot Water Heating Control Valve: Heating capacity control is achieved by a three-way modulating valve supplied for on site installation.
5. Cold Water Control Valve: Cooling capacity control is achieved by a three-way modulating valve supplied for on site installation.

PART 3 EXECUTION

3.01 INSTALLATION

   A. Install in accordance with manufacturer's instructions.
   B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.
   C. Provide ceiling access doors or locate units above easily removable ceiling components.
   D. Support units individually from structure with wire rope complying with ASTM A492 and ASTM A603 in accordance with SMACNA (SRM). See Section 23 0548.
   E. Do not support from ductwork.
   F. Connect to ductwork in accordance with Section 23 3100 - HVAC Ducts and Casing.

END OF SECTION
SECTION 23 3700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Diffusers:
   B. Rectangular ceiling diffusers.
   C. Round ceiling diffusers.
   D. Registers/grilles:
      1. Ceiling-mounted, egg crate exhaust and return register/grilles.
      2. Wall-mounted, supply register/grilles.
   E. Louvers:

1.02 RELATED REQUIREMENTS
   A. Section 09 9123 - Interior Painting: Painting of ducts visible behind outlets and inlets.
   B. Section 26 5100 - Interior Lighting: Air handling light troffers.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 230010 - GENERAL PROVISIONS for submittal procedures.
   B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
   C. Project Record Documents: Record actual locations of air outlets and inlets.

1.05 QUALITY ASSURANCE
   A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Carnes, a division of Carnes Company Inc: www.carnes.com/#sle.

2.02 ROUND CEILING DIFFUSERS
   A. Type: Round, adjustable pattern, stamped or spun, multi-core diffuser to discharge air in 360 degree pattern, with sectorizing baffles where indicated. Diffuser collar shall project not more than 1 inch (25 mm) above ceiling. In plaster ceilings, provide plaster ring and ceiling plaque.
   B. Fabrication: Steel with baked enamel finish.
C. Color: As indicated.

2.03 RECTANGULAR CEILING DIFFUSERS
   A. Type: Provide square, stamped, multi-core, square, adjustable pattern, stamped, multi-core, square and rectangular, multi-louvered, square and rectangular, adjustable pattern, and multi-louvered diffuser to discharge air in 360 degree, one way, two way, three way, and four way pattern with sectorizing baffles where indicated.
   B. Fabrication: Steel with baked enamel finish.
   C. Color: As indicated.

2.04 CEILING/WALL SLOT DIFFUSERS
   A. Type: Continuous 1/2 inch (13 mm) wide slot, 1 slots wide, with adjustable vanes for left, right, or vertical discharge; integral ceiling fire damper.
   B. Fabrication: Aluminum extrusions with factory clear lacquer finish.
   C. Color: As indicated.
   D. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket, mitered end border.
   E. Plenum: Integral, galvanized steel, insulated.

2.05 CEILING PLAQUE DIFFUSER
   A. Type: Square diffuser to discharge air in 360 degree pattern.
   B. Frame:
      1. Surface.
      2. Snap-in.
      4. Invert T-bar.
      5. Narrow T.

2.06 CEILING EGG CRATE EXHAUST AND RETURN GRILLES
   A. Type: Egg crate style face consisting of 1/2 by 1/2 by 1/2 inch (13 by 13 by 13 mm), 1/2 by 1/2 by 1 inch (13 by 13 by 25 mm), and 1 by 1 by 1 inch (25 by 25 by 25 mm) grid core.
   B. Fabrication: Grid core consists of aluminum with mill aluminum finish.
   C. Color: As indicated.
   D. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting.
   E. Frame: Channel lay-in frame for suspended grid ceilings.

2.07 WALL SUPPLY REGISTERS/GRILLES
   A. Type: Streamlined and individually adjustable blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing with spring or other device to set blades, vertical face, double deflection.
   B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket.
   C. Fabrication: Steel with 20 gage, 0.0359 inch (0.91 mm) minimum frames and 22 gage, 0.0299 inch (0.76 mm) minimum blades, steel and aluminum with 20 gage, 0.0359 inch (0.91 mm) minimum frame, or aluminum extrusions, with factory baked enamel finish.
   D. Color: As indicated.

2.08 HIGH PERFORMANCE OUTSIDE AIR DIFFUSERS
   A. By Warren Technology.
   B. Ceiling diffusers shall be Valid Air High Performance Diffusers, manufactured in the USA by Warren Technology.
C. Face: Diffuser face shall be constructed of a corrosion proof, scratch resistant, white thermoplastic plate affixed to an aluminum backplate. Diffuser shall be 2’ x 2’ square with 8-way throw, unless otherwise noted.

D. Sizes: Diffuser shall be available in size 2’ x 2’. The flow rates for a given dimple jet depth shall be directly proportional to the face area of the diffuser. Noise Criteria (NC) levels shall be consistent for all sizes for a given flow rate per unit face area.

E. Supply Jets: High induction dimple jets shall be formed into the face of the diffuser, capable of producing an airstream parallel to the ceiling at full flow throughout the entire design range. Dimple jets shall be sized to optimize room air induction and entrainment for a variety of design cfm capacities.

F. Throw Patterns: Dimple jets shall be arranged in a variety of patterns which result in 3-way (in a corner) horizontal throws.

G. Plenum: Diffuser plenum shall be made from 0.0030 inch thickness aluminum with side inlet on wedge shape or top inlet on square shape.

H. Mounting Frames: Standard unit shall be suitable for bar mounting without requiring any special brackets.

2.09 LOUVERS

A. Manufacturers:
   1. Ruskin Company; ______: www.ruskin.com/#sle.
   2. Carnes

B. Type: 6 inch (150 mm) deep with blades on 45 degree slope with center baffle and return bend, heavy channel frame, 1/2 inch (13 mm) square mesh screen over exhaust and 1/2 inch (13 mm) square mesh screen over intake.

C. Fabrication: 12 gage thick galvanized steel welded assembly, with factory baked enamel finish.
   1. Intake louvers shall be selected with a free area face velocity no greater than 60% of the water intake velocity and less than 0.1" pressure drop. Shop drawings shall specifically indicate deviations of free area velocity above this amount.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.

C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.

D. Install diffusers to ductwork with air tight connection.

E. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

F. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 9123.

G. Pitch ductwork to drain out louver where applicable.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Disposable panel filters.
B. Extended surface high efficiency media filters.
C. High efficiency particulate air (HEPA) filters.
D. Filter frames and housings.
E. Filter gauges.

1.02 REFERENCE STANDARDS

1.03 EXTRA MATERIALS
A. See Section 230010 - GENERAL PROVISIONS, for additional provisions.
B. Provide one set of disposable panel filters to be installed prior to turning project over to owner.

PART 2 PRODUCTS

2.01 FILTER MANUFACTURERS

2.02 DISPOSABLE PANEL FILTERS
A. Media: UL 900 Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.
   1. Nominal Size: 12 by 24 inches (300 by 600 mm).
   2. Thickness: 2 inch (50 mm).
B. Holding Frames: 20 gage, 0.0359 inch (0.91 mm) minimum galvanized steel frame with expanded metal grid on outlet side and steel rod grid on inlet side, hinged with pull and retaining handles.

2.03 EXTENDED SURFACE HIGH EFFICIENCY MEDIA FILTERS
A. Media: Pleated, water-resistant glass fiber with aluminum separators; in 16 gage, 0.0598 inch (1.52 mm) steel holding frame with corrosion resistant coating.
   1. Nominal Size: 24 by 24 by 24 inches (____ by ____ by ____ mm) deep.
B. Minimum Efficiency Reporting Value (MERV): 13, when tested in accordance with ASHRAE Std 52.2.
C. Performance Rating, per ASHRAE Std 52.2:
   1. MIL-STD-282 Test 0.3 Micron Dioctyl Phthalate Smoke (DOP) Efficiency: 99 percent.
   2. Recommended Final Resistance: 1 inch WG (___ PA).
   3. Locations indicated on drawings.

2.04 HIGH EFFICIENCY PARTICULATE AIR (HEPA) FILTERS
A. Media: UL 586, pleated, water-resistant glass fiber with separators of aluminum:
3. Face Gasket: Neoprene expanded rubber.
4. Nominal Size: 24 by 24 by 12 inches (610 by 610 by 300 mm) deep.

B. Performance Rating:
1. MIL-STD-282 Test 0.3 Micron Dioctyl Phthalate Smoke (DOP) Efficiency: 99.97 percent.

2.05 FILTER FRAMES AND HOUSINGS

A. General: Fabricate filter frames and supporting structures of 16 gage, 0.0598 inch (1.52 mm) galvanized steel or extruded aluminum T-section construction with necessary gasketing between frames and walls.

2.06 FILTER GAUGES

A. Manufacturers:

B. Direct Reading Dial: 3-1/2 inch (90 mm) diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0-2.0 inch WG (0-500 Pa), 2 percent of full scale accuracy.

C. Accessories: Static pressure tips with integral compression fittings, 1/4 inch (6 mm) aluminum tubing, 2-way or 3-way vent valves.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.
B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
C. Install filter gauge static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.
D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.
E. Provide filter gauges on filter banks, installed with separate static pressure tips upstream and downstream of filters.

END OF SECTION
SECTION 23 6427
AIR COOLED WATER CHILLERS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Design and construction of air-cooled chiller
B. Starters with disconnect switches
C. System control panel
D. Refrigerant charge, oil, and like start-up materials
E. Testing, start-up and instruction
F. Manufacturer’s field services for start-up and instruction.
G. Electrical power connections.

1.02 RELATED REQUIREMENTS
A. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
B. Section 23 0548 - Vibration and Seismic Controls for HVAC: Placement of vibration isolators.
C. Section 23 0993 - Sequence of Operations for HVAC Controls.
D. Section 23 2300 - Refrigerant Piping.
E. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.
F. Section 23 8216 - Air Coils.

1.03 REFERENCE STANDARDS
B. AHRI 365 I-P - Performance Rating of Commercial and Industrial Unitary Air-Conditioning Condensing Units; 2009.
E. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

1.04 SUBMITTALS
A. See Section 23 0010 - GENERAL PROVISIONS, for submittal procedures.
B. Product Data: Provide rated capacities, weights specialties and accessories, electrical nameplate data, and wiring diagrams. Include equipment served by condensing units in submittal, or submit at same time, to ensure capacities are complementary.
C. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Include schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system.
D. Design Data: Indicate pipe and equipment sizing.
E. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.
F. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
G. Operation and Maintenance Data: Include start-up instructions, maintenance instructions, parts lists, controls, and accessories.

H. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 23 0010 - GENERAL PROVISIONS, for additional provisions.
   2. Extra Lubricating Oil: One complete change.

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

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.07 WARRANTY
   A. See Section 23 0010 - GENERAL PROVISIONS, for additional warranty requirements.
   B. Provide a five year parts and labor warranty to include coverage for refrigerant compressors.

PART 2 PRODUCTS

2.01 SCOPE
   A. The requirements of this Section shall conform to the general provisions of the Contract, including General and Supplementary Conditions, Conditions of the Contract, and Contract Drawings.
   B. Provide microprocessor-controlled, multiple-scroll compressor, air-cooled, liquid chillers of the scheduled capacities as shown and indicated on the drawings, including but not limited to:
      1. Chiller package with zero ozone depletion potential Refrigerant R-410A
      2. Electrical power and control connections
      3. Chilled water connections
      4. Manufacturer start-up
      5. Charge of refrigerant and oil.

2.02 MANUFACTURERS
   A. Carrier, a part of UTC Building and Industrial Systems, a unit of United Technologies Corp: www.carrier.com.

2.03 CHILLER MATERIALS AND COMPONENTS
   A. General: Install and commission, as shown on the schedules and plans, factory as-sembled, charged, and tested air cooled scroll compressor chillers as specified herein. Chiller shall be designed, selected, and constructed using a refrigerant with Flam- mability rating of “1”, as defined by ANSI/ASHRAE STANDARD 34 Number Designa-tion and Safety Classification of Refrigerants. Chiller shall include not less than two refrigerant circuits above 50 tons (200 kW), scroll compressors, direct-expansion type evaporator, air-cooled condenser, refrigerant, lubrication system, interconnecting wir-ing, safety and operating controls including capacity controller, control center, motor starting components, and special features as specified herein or required for safe, automatic operation.
   B. Cabinet: External structural members shall be constructed of heavy gauge, galvanized steel coated with baked on powder paint which, when subject to ASTM B117, 1000 hour, 5% salt spray test, yields minimum ASTM 1654 rating of “6”.

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AIR COOLED WATER CHILLERS

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C. Operating Characteristics: Provide low and high ambient temperature control options as required to ensure unit is capable of operation from 30°F to 115°F (-1°C to 46°C) ambient temperature. [Optional: -10°F to 125°F (-23°C to 52°C) ambient.]

D. Service Isolation valves: Discharge (ball type) isolation valves factory installed per refrigerant circuit.

E. Includes a system high-pressure relief valve in compliance with ASHRAE15.

F. Pressure Transducers and Readout Capability
   1. Discharge Pressure Transducers: Permits unit to sense and display discharge pressure.
   2. Suction Pressure Transducers: Permits unit to sense and display suction pressure.
   3. High Ambient Control: Allows units to operate when the ambient temperature is above 115°F (46°C). Includes discharge pressure transducers.

2.04 COMPRESSORS
   A. Compressors: Shall be hermetic, scroll-type, including:
      1. Compliant design for axial and radial sealing.
      2. Refrigerant flow through the compressor with 100% suction cooled motor.
      3. Large suction side free volume and oil sump to provide liquid handling capability.
      4. Compressor crankcase heaters to provide extra liquid migration protection.
      5. Annular discharge check valve and reverse vent assembly to provide low-pressure drop, silent shutdown and reverse rotation protection.
      6. Initial oil charge.
      7. Oil level sight glass.
      8. Vibration isolator mounts for compressors.

2.05 REFRIGERANT CIRCUIT COMPONENTS
   A. Each refrigerant circuit shall include: a discharge service ball type isolation valve, high side pressure relief, liquid line shutoff valve with charging port, low side pressure relief device, filter-drier, solenoid valve, sight glass with moisture indicator, thermostatic expansion valves [Option: electronic expansion valves], and flexible, closed-cell foam insulated suction line and suction pressure transducer.

2.06 HEAT EXCHANGERS
   A. Evaporator:
      1. Evaporator shall be brazed-plate stainless steel construction capable of refrigerant working pressure of 450 psig (3103 kPa) and liquid side pressure of 150 psig (1034 kPa).
      2. Brazed plate heat exchangers shall be UL listed.
      3. Exterior surfaces shall be covered with 3.4 in. (19 mm), flexible, closed cell insulation, thermal conductivity of 0.26k ([BTU/ HR-Ft2 -°F]/in.) maximum.
      4. Water nozzles shall be provided with grooves for field provided ANSI/AWWA C-606 mechanical couplings.
      5. Evaporator shall include vent and drain fittings and thermostatically controlled heat- ers to protect to -20°F (-29°C) ambient in off-cycle.
      6. A 20 mesh, serviceable wye-strainer and mechanical couplings shall be provided for field installation on evaporator inlet prior to startup.
      7. Evaporator shall be provided with piping extension kit and mechanical couplings to extend liquid connection from evaporator to edge of unit. Thermal dispersion type flow switch shall be factory installed in the evaporator outlet pipe extension and wired to the unit control panel. Extension kit nozzle connections shall be ANSI/AWWA C-606 (grooved) Extension kit pipe insulation and heat trace to be field provided (if required).

   B. Air Cooled Condenser:
1. Coils: Condenser coils shall be constructed of a single material to avoid galvanic corrosion due to dissimilar metals. Coils and headers are brazed as one piece. Integral sub cooling is included. Coils shall be designed for a design working pressure of 650 PSIG (45 bar). Condenser coil shall be washable with potable water under 100 psi (7 bar) pressure.

2. Low Sound Fans: Shall be dynamically and statically balanced, direct drive, corrosion resistant glass fiber reinforced composite blades molded into a low noise, full-airfoil cross section, providing vertical air discharge and low sound. Each fan shall be provided in an individual compartment to prevent crossflow during fan cycling. Guards of heavy gauge, PVC (polyvinyl chloride) coated or galvanized steel shall be factory installed.

3. Fan Motors: High efficiency, direct drive, 6 pole, 3 phase, insulation class “F”, current protected, Totally Enclosed Air-Over (TEAO), rigid mounted, with double sealed, permanently lubricated, ball bearings.

2.07 CONTROLS
A. General: Automatic start, stop, operating, and protection sequences across the range of scheduled conditions and transients.

B. Power/Control Enclosure: Rain and dust tight NEMA 3R powder painted steel cabinet with hinged, latched, and gasket sealed door.

C. Microprocessor Control Center:
1. Automatic control of compressor start/stop, anti-coincidence and anti-recycle timers, automatic pumpdown at system shutdown, condenser fans, evaporator pump, evaporator heater, unit alarm contacts, and chiller operation from 0°F to 125°F (-18°C to 52°C) ambient. Automatic reset to normal chiller operation after power failure.

2. Remote water temperature reset via 0-10 VDC or 4-20 mA input signal or up to two steps of demand (load) limiting.

3. Software stored in non-volatile memory, with programmed setpoints retained in lithium battery-backed real-time-clock (RTC) memory for minimum 5 years.

4. Forty character liquid crystal display, descriptions in English (or Spanish, French, Italian, or German), numeric data in English (or Metric) units. Sealed keypad with sections for Setpoints, Display/Print, Entry, Unit Options & clock, and On/Off Switch.

5. Programmable Setpoints (within Manufacturer limits): display language; chilled liquid temperature setpoint and range, remote reset temperature range, daily schedule/holiday for start/stop, manual override for servicing, low and high ambient cut-outs, low liquid temperature cut-out, low suction pressure cut-out, high discharge pressure cut-out, anti-recycle timer (compressor start cycle time), and anti-coincident timer (delay compressor starts).

6. Display Data: Return and leaving liquid temperatures, low leaving liquid temperature cut-out setting, low ambient temperature cut-out setting, outdoor air temperature, English or metric data, suction pressure cut-out setting, each system suction pressure, discharge pressure (optional), liquid temperature reset via a 4-20 milliamp or 0-10 VDC input, anti-recycle timer status for each compressor, anti-coincident system start timer condition, compressor run status, no cooling load condition, day, date and time, daily start/stop times, holiday status, automatic or manual system lead/lag control, lead system definition, compressor starts/operating hours (each), status of hot gas valves, evaporator heater and fan operation, run permissive status, number of compressors running, liquid solenoid valve status, load & unload timer status, water pump status.

7. System Safeties: Shall cause individual compressor systems to perform auto shut down; manual reset required after the third trip in 90 minutes. System Safeties include: high discharge pressure, low suction pressure, high pressure switch, and motor protector. Compressor motor protector shall protect against damage due to high input current or thermal overload of windings.

8. Unit Safeties: Shall be automatic reset and cause compressors to shut down if low ambient, low leaving chilled liquid temperature, under voltage, and flow switch operation.

9. Alarm Contacts: Low ambient, low leaving chilled liquid temperature, low voltage, low battery, and (per compressor circuit): high discharge pressure, and low suction pressure.
10. BAS Communications: YORKtalk 2, BACnet MS/TP, Modbus and N2 communica- tion capabilities are standard. (Option: LON communication via ELink Microgate- way)

D. Manufacturer shall provide any controls not listed above, necessary for automatic chiller operation. Mechanical Contractor shall provide field control wiring necessary to interface sensors to the chiller control system.

2.08 POWER CONNECTION AND DISTRIBUTION

A. Power Panels:
   1. NEMA 3R raintight, powder painted steel cabinets with hinged, latched, and gasket sealed outer doors. Provide main power connections, control power connections, compressor and fan motor start contactors, current overloads, and factory wiring.
   2. Power supply shall enter unit at a single location, be 3 phase of scheduled voltage, and connect to individual terminal blocks per compressor. Separate disconnecting means and/or external branch circuit protection (by Contractor) required per appli- cable local or national codes.

B. Compressor, control and fan motor power wiring shall be located in an enclosed panel or routed through liquid tight conduit.

2.09 ACCESSORIES AND OPTIONS

A. Microprocessor controlled, Factory installed Across-the-Line type compressor motor starters as standard.

B. Outdoor Ambient Temperature Control
   1. Low Ambient Control: Permits unit operation to 0°F ambient. Standard unit controls to 30°F ambient.
   2. Low Ambient Control with Variable Speed Fans: Permits unit operation to -10°F ambient. Standard unit controls to 30°F ambient.
   3. High Ambient Control: Permits unit operation above 115°F ambient.

C. Power Supply Connections:
   1. Single Point Power Supply: Single point Terminal Block for field connection and in- terconnecting wiring to the compressors. Separate external protection for the incoming power wiring, which must comply with the National Electric Code and/or local codes.
   2. Single Point or Multiple Point Disconnect: Single or Dual point Non-Fused Discon- nects and lockable external handle (in compliance with Article 440-14 of N.E.C.) can be supplied to isolate the unit power voltage for servicing. Separate external fusing must be supplied, by others, in the incoming power wiring, which must comply with the National Electric Code (CE) and/or local codes.
   3. Single Point Circuit Breaker: Single point Terminal Block with Circuit Breaker and lockable external handle (in compliance with Article 440-14 of N.E.C.) can be supplied to isolate power voltage for servicing. Incoming power wiring must comply with the National Electric Code and/or local codes.

D. Control Power Transformer: Converts unit power voltage to 120-1-60 (500 VA capac- ity). Factory-mounting includes primary and secondary wiring between the transformer and the control panel.

E. Power Factor Correction Capacitors: Provided to correct unit compressor factors to a 0.90-0.95.

F. Condenser Coil Environmental Protection:
   1. Environment Guard Premium - Microchannel condenser coils coated with an electro-deposited and baked flexible epoxy coating that is finished with a polyurethane UV resistant top-coat.
   2. Environment Guard Basic - Microchannel condenser coils treated with immersion bath-applied chemical treatment.
   3. Microchannel condenser shall be provided with a 5-year warranty against cor- rosion damage.

G. Protective Chiller Panels (Factory or Field Mounted)
1. Louvered Panels (condenser coils only): painted steel as per remainder of unit cabinet, over external condenser coil faces.

2. Wire Panels (full unit): Heavy gauge, welded wire-mesh, coated to resist corrosion, to protect condenser coils from incidental damage and restrict unauthorized access to internal components.

3. Louvered Panels (full unit): painted steel as per remainder of unit cabinet, to protect condenser coils from incidental damage, visually screen internal components, and prevent unauthorized access to internal components.

4. Louvered/Wire Panels: louvered steel panels on external condenser coils painted as per remainder of unit cabinet. Heavy gauge, welded wire-mesh, coated to resist corrosion, around base of machine to restrict unauthorized access.

5. End Louver (hail guard): louvered steel panels on external condenser coil faces located at the ends of the chiller.

H. Thermal Dispersion Flow Switch (Factory installed and wired in piping extension kit): normally open, 30 Bar pressure rating, stainless steel 316L construction, IP67, -4°F to 158°F ambient rating. Not available on units with remote evaporator.

I. Evaporator options:
   1. Provide 1-1/2 inch evaporator insulation in lieu of standard 3/4 inch.

J. Hot Gas By-Pass: Permits continuous, stable operation at capacities below the minimum step of unloading to as low as 5% capacity (depending on both the unit & operating conditions) by introducing an artificial load on the evaporator. Hot gas by-pass is installed on only one refrigerant circuit.

K. Thermal Storage: leaving chilled liquid setpoint range for charge cycle from 25°F to 20°F minimum, with automatic reset of the leaving brine temperature up to 40°F above the setpoint.

L. Low Temperature Process Glycol: leaving chilled liquid setpoint range 10°F to 50°F (-12°C to 10°C)

M. Chicago Code Relief Valves to meet Chicago Code requirements.

N. Sound Reduction (Factory installed):
   1. Ultra Quiet - Low speed, reduced noise fans
   2. Compressor Acoustic Sound Blankets

O. Vibration Isolation (Field installed):
   1. Elastomeric Isolators.
   2. 1 Inch Deflection Spring Isolators: level adjustable, spring and cage type isolators for mounting under the unit base rails.
   3. 2 Inch Deflection Restrained Spring Isolators: level adjustable, restrained mounts in rugged welded steel housing with vertical and horizontal limit stops. Housings shall be designed to withstand a minimum 1.0g accelerated force in all directions to 2 inches (50.8 mm).

2.10 OUTDOOR AMBIENT TEMPERATURE CONTROL

A. Low Ambient Control: Permits unit operation to 0°F ambient. Standard unit controls to 30°F ambient.

B. Low Ambient Control with Variable Speed Fans: Permits unit operation to -10°F ambient. Standard unit controls to 30°F ambient.

C. High Ambient Control: Permits unit operation above 115°F ambient.

2.11 POWER SUPPLY CONNECTIONS:

A. Single Point Power Supply: Single point Terminal Block for field connection and interconnecting wiring to the compressors. Separate external protection must be supplied, by others, in the incoming power wiring, which must comply with the National Electric Code and/or local codes.
PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's installation instructions.
B. Complete structural, mechanical, and electrical connections in accordance with manufacturer's installation instructions.
C. General: rig and install in full accordance with manufacturer's requirements, project drawings, and contract documents.
D. Location: locate chiller as indicated on drawings, including cleaning and service maintenance clearance per manufacturer instructions. Adjust and level chiller on support structure.
E. Components: installing contractor shall provide and install all auxiliary devices and accessories for fully operational chiller.
F. Electrical: coordinate electrical requirements and connections for all power feeds with electrical contractor (Division 16).
G. Controls: coordinate all control requirements and connections with controls contractor.
H. Finish: installing contractor shall paint damaged and abraded factory finish with touch-up paint matching factory finish.
I. Install chiller package on concrete foundations, sole plates and sub-base. Align, level, grout, and bolt in place.
J. Arrange piping for easy dismantling to permit tube cleaning.
K. Provide auxiliary water piping necessary for oil-cooling units and purge condensers.
L. Refrigerant Piping: Provide refrigerant hot-gas and liquid piping for remote condenser units in accordance with the manufacturer's requirements and the drawings.
M. Provide pressure-relief discharge piping from relief valve to outdoors. Provide stainless-steel flexible connector at the refrigeration machine as detailed on the drawings. Discharge shall be at least 15 feet above grade, and 20 feet away from building opening. Provide size recommended by chiller manufacturer, terminated with gooseneck facing down.
N. If no factory-mounted oil cooler chilled-water-piping circuit is provided, provide field piping in accordance with manufacturing recommendations, including valves, filters and drains.
O. Connect purge-unit discharge piping into main system pressure-relief piping upstream of flexible connector.
P. Before units are started, pump new grease into bearing housing to force out old grease and provide adequate lubrication.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:
B. Provide service of a factory-trained service engineer to supervise testing, evacuation, hydration, charging of unit, and start-up; make necessary adjustments; and instruct the University's operator on the care, operation and maintenance of the system.
C. Provide five 8-hour days of service for the first unit, and two 8-hour days for each additional unit.
D. Notify the University at least 24 hours in advance of field tests to allow University Representative to witness the tests.
E. Operational Control Tests:
   1. Demonstrate proper functioning of the entire operational control of the chiller. Verify proper operation as specified in part 2 of this section, including oil pumps, liquid-line solenoid valves, crankcase heaters, thermal-expansion valves, chilled-water and condenser water flow switches, and adjustable temperature controllers.
   2. Demonstrate chiller capacity control by varying the chiller load. The capacity range to be tested shall be from no-load to full-load and back to no-load. The chiller shall demonstrate
stable operation without excess vibration or noise. Verify each step of the multi-step control (cylinder unloading and/or compressor staging).

F. Safety Control Tests:
   1. Demonstrate proper functioning of safety cutouts in accordance with safety control requirements of part 2 of this section.
   2. Demonstrate that manual resetting is required to restart compressors for safety cutouts.
   3. Demonstrate proper operation of interlocking between chillers and condenser-water pumps, and between chillers and chilled-water pumps.
   4. Simulate variables to activate safety control actions.
   5. All safety control tests shall be verified by electric signals at the compressor motor starters or actual stopping of the compressors.

G. Running and Warning Indicators Test:
   1. Demonstrate proper functioning of indicating lights.
   2. Testing of running and warning indicators may be performed concurrently with safety control tests.

H. Site Tests:
   1. Pressure Test: After assembly of the complete unit on the job, pressure test the unit with a mixture of refrigerant and air, and test connections and welds with an electronic leak-detector torch and make refrigerant-tight. The complete unit shall be dehydrated by producing a vacuum to 0.3 inch Hg absolute and maintained for four hours. At the end of this period, stop the pump. The vacuum shall be maintained in the refrigeration unit for a period of 24 hours without gaining more than 0.1 inch Hg absolute pressure.
   2. Provide sufficient refrigerant and dry nitrogen for pressure testing under manufacturer’s supervision.
   3. Provide instruments required for conducting tests.

3.03 DEMONSTRATION
   A. Schedule operation and maintenance instruction period with the University Representative. Submit operation and maintenance manuals in advance of instruction period.
   B. Provide connection to refrigeration piping system and evaporators. Refer to Section 23 2300. Comply with ASHRAE Std 15.

END OF SECTION
SECTION 23 7313
CENTRAL-STATION AIR-HANDLING UNITS

PART 2 PRODUCTS

1.01 CASING CONSTRUCTION

A. Full Perimeter Base Rail:
   2. Provide base rail of sufficient height to raise unit for external trapping of condensate drain pans.

B. Casing:
   1. Construct of one piece, insulated, double wall panels.
   2. Provide mid-span, no through metal, internal thermal break.
   3. Construct outer panels of galvanized steel and inner panels of galvanized steel.
   4. Casing Air Pressure Performance Requirements:
      a. Able to withstand up to 8 inches w.g. (2 kPa) positive or negative static pressure.
      b. Not to exceed 0.0042 inches per inch (0.0042 mm/mm) deflection at 1.5 times design static pressure up to a maximum of plus 8 inches w.g. (2 kPa) in positive pressure sections and minus 8 inches w.g. (2 kPa) in negative pressure sections.

C. Access Doors:
   1. Construction, thermal and air pressure performance same as casing.
   2. Provide surface mounted handles on hinged, swing doors.

D. Outside Air and Exhaust Air Weather Hood:
   1. Fabricate from same material as casing outer panel.
   2. Extend hood past perimeter of unit casing opening so as not to instruct airflow path.
   3. Paint hoods with same finish as external surface of outdoor units.
   4. Provide inlet hood for each fresh air damper with a sine wave moisture eliminator to prevent entrainment of water into the unit from outside air.
   5. Provide exhaust hoods for each exhaust air opening.
   6. Size each hood for 100 percent of nominal fresh air damper capacities.
   7. Protect each hood with bird screen to prevent nesting at intake or exhaust air flow paths.

E. Unit Flooring: Construct with sufficient strength to support expected people and equipment loads associated with maintenance activities.

F. Casing Leakage: Seal joints and provide airtight access doors so that air leakage does not exceed one percent of design flow at the specified casing pressure.

G. Insulation:
   1. Provide minimum thermal thickness of 12 R (2.29 RSI) throughout.
   2. Completely fill panel cavities in each direction to prevent voids and settling.
   3. Comply with NFPA 90A.

H. Drain Pan Construction:
   1. Provide cooling coil and humidifier sections with an insulated, double wall, galvanized steel drain pan complying with ASHRAE Std 62.1 for indoor air quality and sufficiently sized to collect all condensate.
   2. Slope in two planes to promote positive drainage and eliminate stagnate water conditions.
   3. Locate outlet of sufficient diameter at lowest point of pan to prevent overflow at normal operating conditions.
   4. Provide threaded drain connections constructed of drain pan material, extended sufficient distance beyond the base to accommodate field installed, condensate drain trapping.

I. Bottom Inlet Units: Provide steel or aluminum walking grate on structural supports.

J. Louvers: Stationary, of galvanized steel, 4 inch (100 mm) deep with plenum, nylon bearings, 1/2 inch (13 mm) mesh, 0.04 inch (1.0 mm) galvanized wire bird screen in aluminum frame, and bearing AMCA Certified Ratings Seal in accordance with AMCA 500-L. Furnish adjustable louvers with hollow vinyl bulb edging on blades and foam side stops to limit leakage to
maximum 2 percent at 4 inch wg (1 kPa) differential pressure when sized for 2000 fpm (10 m/s) face velocity.

K. Marine Lights:
1. Provide factory-mounted, water- and dust-resistant LED fixture(s) where indicated on drawings, with the following characteristics:
   a. Non-ferrous metal housing.
   b. Glass or polycarbonate lens.
   c. Factory wired to a single switch within factory provided service module.
   d. Instant on white light with minimum 8000 hour service life.
2. Provide factory installed service module including GFCI receptacle independent from load side; designed to receive power from field supplied 120 volt source.

L. Finish:
1. Outdoor Units:
   a. Coat external surface of unit casing with primer and minimum 1.5 mil, enamel paint finish.
   b. Comply with salt spray test in accordance with ASTM B177/B177M.
   c. Color: Manufacturer's standard color.

1.02 FAN SECTION
A. Type: Forward curved, single width, single inlet, centrifugal plug type fan, in compliance with AMCA 99. Refer to Section 23 3413.
B. Performance Ratings: Determined in accordance with AMCA 210 and labeled with AMCA Certified Rating Seal.
C. Sound Ratings: AMCA 301; tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.
D. Bearings: Self-aligning, grease lubricated, with lubrication fittings extended to exterior of casing with plastic tube and grease fitting rigidly attached to casing.
E. External Motor Junction Box: Factory mount NEMA 4 external junction box and connect to extended motor leads from internally mounted motors.
F. Motor Wiring Conduit: Factory wire fan motor wiring to the unit mounted starter-disconnect, variable frequency drive, and external motor junction box.
G. Fan Accessories:
H. Flexible Duct Connections:
1. For separating fan, coil, and adjacent sections.
I. Drives:
2. Bearings: Heavy duty pillow block type, ball bearings, with ABMA STD 9, L-10 life at 50,000 hours.
3. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
4. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
5. Belt Guard: Fabricate to SMACNA (DCS); 0.106 inch (2.6 mm) thick, 3/4 inch (20 mm) diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
1.03 COIL SECTION

A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.

B. Drain Pans: 24 inch (600 mm) downstream of coil and down spouts for cooling coil banks more than one coil high.

C. Eliminators: Three break of galvanized steel, mounted over drain pan.

D. Air Coils:
   1. Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.

E. Fabrication:
   1. Tubes: 5/8 inch (16 mm) OD seamless copper expanded into fins, brazed joints.
   2. Fins: Aluminum.
   3. Casing: Die formed channel frame of galvanized steel.

F. Water Heating Coils:
   1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
   2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

G. Water Cooling Coils:
   1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
   2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.

1.04 FILTER AND AIR CLEANER SECTION

A. General: Provide filter sections with filter racks, minimum of one access door for filter removal, and filter block-offs to prevent air bypass.

B. Throwaway Filters:
   1. Media: 2 inch (50 mm) fiberglass with rigid supporting mesh across the leaving face, capable of operating up to a maximum of 500 fpm (2.54 m/s) without loss of efficiency and holding capacity.
   2. Frame: Rigid.
   3. Minimum Efficiency Reporting Value: 5 MERV when tested in accordance with ASHRAE Std 52.2.

C. Differential Pressure Gauge:
   1. Provide factory installed dial type differential pressure gauge, flush mounted with casing outer wall, and fully piped to both sides of each filter to indicate status.
   2. Maintain plus/minus 5 percent accuracy within operating limits of 20 degrees F (minus 6.7 degrees C) to 120 degrees F (48.9 degrees C).

1.05 DAMPER SECTION

A. Mixing Section: Provide a functional section to support the damper assembly for modulating the volume of outdoor, return, exhaust, and _________ air.

B. Damper Blades:
   1. Double-skin airfoil design with metal, compressible jamb seals and extruded-vinyl blade-edge seals on each blade.
   2. Self-lubricating stainless steel or synthetic sleeve bearings.
   3. Comply with ASHRAE Std 90.1 I-P for rated maximum leakage rate.
   4. Provide leakage testing and pressure ratings in compliance with AMCA 500-D test methods.
   5. Arrange in parallel or opposed-blade configuration.

C. Barometric Relief Dampers:
   1. Frame: Roll formed galvanized steel.
   2. Blades: Roll formed galvanized steel.
4. Material:

1.06 TOTAL ENERGY RECOVERY WHEEL SECTION

A. Certified in accordance with AHRI 1060 I-P and UL 1812 for mechanical, electrical, and fire safety.
B. Wheel Construction:
   1. Dessicant Properties:
      a. Factory coated.
      b. Washable using standard detergent or alkaline based coil cleaner.
      c. Resistant to high levels of humidity.
   2. Construct housing of stainless steel, aluminum, galvanized steel, or ____________.
   3. Factory set adjustable diameter seals and self-adjusting perimeter seals.
   4. Permanently sealed and lubricated wheel bearings.
   5. Motor:
      a. Thermally protected.
      b. Factory mounted.
C. Maintenance and Access Features:
   1. Access doors upstream and downstream of the wheel cassette.
   2. Removable wheel segments to facilitate maintenance and cleaning.
   3. Adequate space for cleaning, service, and maintenance.
D. Controls:
   1. Wheel Control: Damper control of recovery capacity to 40 percent of initial total recovery capacity.
   2. Frost Prevention Control: Provide outside air bypass, return air preheat, variable speed, or ____________ method.

1.07 DESICCANT WHEEL

A. Comply with UL 1812 for ducted heat recovery ventilators and UL 1995 for heating and cooling equipment.
B. Wheel Construction:
   1. Dessicant Properties:
      a. Synthetic matrix with Type III desiccant.
      b. Immune to water and high humidity.
   2. Structurally reinforced with spoke system to minimize wheel deflection.
   3. Diameter and perimeter seals.
   4. Provide direct, belt, or ______ drive motor with permanently lubricated ball bearings.
   5. Wheel shaft with grease fittings for periodic lubrication.
C. Maintenance and Access Features:
   1. Cleanable wheel matrix.
   2. Access doors upstream and downstream of the wheel cassette.
   3. Adequate space for cleaning, service, and maintenance.

1.08 CONTROLS

A. Combination Starter-Disconnects:
   1. Mount starter-disconnect on fan section externally in a NEMA 1 enclosure within a dedicated controls section or housed fan section.
   2. Include circuit breaker disconnect with through-the-door interlocking handle for externally mounted starters, spring loaded, and designed to rest only in the full and lockable ON or OFF state.
B. Combination VFD - Disconnects:
   1. Provide factory mounted, combination VFD - disconnect for each fan motor.
C. Factory Installed Direct Digital Control (DDC) System:
1. Factory engineer and test each component.
2. Provide fully functional control system to operate in either stand-alone mode or as part of the building automation system (BAS) via single pair of twisted wires tie-in.
3. DDC Controller:
   a. Dedicated, field programmable DDC controller with appropriate point capabilities.
4. Control Options:
   a. Electronic End Devices:
      1) Accommodate integration into existing building systems.
      2) Wire to standard point locations of unit mounted DDC controller or terminal block for remote controller.
   b. Mixing Section Spring Return Damper Actuators:
      1) Outdoor Air Damper: Normally closed.
      2) Return Air Damper: Normally open.
   c. Air Flow Measurement Stations: 2 to 10 VDC signal corresponding to CFM for controlling and documenting airflow.
   d. Fan Discharge Temperature and Temperature Averaging Sensors: Suitable for integration into the BAS system.
   e. Low Limit Switches:
      1) Factory wire to momentary push-button reset circuit.
      2) Provide separate low limit for each coil in a coil stack.
   f. Airflow Switches: Pipe to both filter sides to indicate fan status.
D. Factory Provided Controls for Field Installation:
   1. Control valves.
   2. Space and outdoor air temperature sensors.

1.09 ROOF MOUNTING CURB
A. Roof Vibration Isolation Mounting Curb: 14 inches (350 mm) high galvanized steel, channel frame with gaskets and nailer strips.
B. Include roof curb accessories for each roof mounted unit.

PART 3 EXECUTION
2.01 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Bolt sections together with gaskets.
C. Provide fixed sheaves required for final air balance.
D. Make connections to coils with unions or flanges.
E. Hydronic Coils:
   1. Hydronic Coils: Connect water supply to leaving air side of coil (counterflow arrangement).
   2. Provide shut-off valve on supply line and lockshield balancing valve with memory stop on return line.
   3. Locate water supply at bottom of supply header and return water connection at top.
   4. Provide manual air vents at high points complete with stop valve.
   5. Ensure water coils are drainable and provide drain connection at low points.
F. Cooling Coils:
   1. Pipe drain and overflow to nearest floor drain.

2.02 SYSTEM STARTUP
A. Provide manufacturer's field representative to perform systems startup.
B. Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.

2.03 CLOSEOUT ACTIVITIES
A. Demonstration: Demonstrate operation of system to Owner's personnel.
1. Use operation and maintenance data as reference during demonstration.
2. Briefly describe function, operation, and maintenance of each component.

B. Training: Train Owner's personnel on operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.

END OF SECTION
SECTION 26 0030
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Preconstruction meeting.
B. Progress meetings.
C. Construction progress schedule.
D. Coordination drawings.
E. Submittals for review, information, and project closeout.
F. Submittal procedures.

1.02 RELATED SECTIONS
A. Division 01 - General Requirements
B. Section 26 0032 - Product Requirements.
C. Section 26 0035 - Execution Requirements: Additional coordination requirements.

1.03 PROJECT COORDINATION
A. Project Coordinator: Construction Manager/General Contractor.
B. Refer to Division 01 - All Sections.
C. Cooperate with the Construction Manager/General Contractor in allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.
D. During construction, coordinate use of site and facilities through the Construction Manager.
E. Comply with specified procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
F. Comply with instructions of the Construction Manager/General Contractor for use of temporary utilities and construction facilities.
G. Coordinate field engineering and layout work under instructions of the Construction Manager/General Contractor.
H. Make the following types of submittals to Architect through the Construction Manager/General Contractor.
   1. Requests for interpretation/information.
   2. Requests for substitution.
   3. Shop drawings, product data, and samples. (See Also 26 0032)
   4. Test and inspection reports.
   5. Manufacturer's instructions and field reports.
   6. Applications for payment and change order requests.
   7. Progress schedules.
   8. Coordination drawings.
   10. As-built Record Drawings.
   11. Operation and Maintenance Manuals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING
A. Architect will schedule a meeting after Notice of Award.
B. Contractor shall attend if requested by Construction Manager/General Contractor or required by Division 01.
C. Refer to Division 01 for additional requirements.

3.02 REFER TO DIVISION 01 - ADMINISTRATIVE REQUIREMENTS, FOR ADDITIONAL REQUIREMENTS ON THE FOLLOWING:

A. Pre-Construction Meeting.
B. Progress Meetings.
C. Construction Progress Schedule.
D. Submittals for Review.(See also 26 0032)
E. Submittals for Information.
F. Submittals for Project Closeout.
G. Number of Copies of Submittals.
H. Submittal Procedures.

3.03 THE REQUIREMENTS OF DIVISION 01 SHALL APPLY TO ALL SECTIONS OF DIVISION 26, 27 &28.

3.04 COORDINATION DRAWINGS

A. Provide information required by Project Coordinator for preparation of coordination drawings.
B. Review drawings prior to submission to Architect.

3.05 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.
B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
C. Samples will be reviewed only for aesthetic, color, or finish selection.
D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below.

3.06 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Certificates.
   2. Test reports.
   3. Inspection reports.
   4. Manufacturer’s instructions.
   5. Manufacturer’s field reports.
   6. Other types indicated.

3.07 SUBMITTALS FOR PROJECT CLOSEOUT

A. When the following are specified in individual sections, submit them at project closeout:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   5. Test reports.
   6. Cerifications.
   7. Other items as indicated.

3.08 NUMBER OF COPIES OF SUBMITTALS

A. Quantity of submitted items shall be as outlined in Division 01.
3.09 SUBMITTAL PROCEDURES

A. Contractor shall submit in accordance with Division 01 requirements.

B. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

C. 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.

D. Deliver submittals through the proper channels as outlined in Division 01

E. Schedule submittals to expedite the Project, and coordinate submission of related items.

F. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.

G. Provide space for Contractor and Architect review stamps.

H. When revised for resubmission, identify all changes made since previous submission.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.
B. Transportation, handling, storage and protection.
C. Product option requirements.
D. Substitution limitations and procedures.
E. Spare parts and maintenance materials.

1.02 RELATED SECTIONS

A. General Requirements: Division 01 - All Divisions.
B. Electrical: Division 26 - All Sections.
C. Communications: Division 27 - All Sections.
D. Electronic Safety and Security: Division 28 - All Sections.

1.03 SUBMITTALS

A. Product Data Submittals: Submit manufacturer’s standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers’ standard data to provide information specific to this Project.
B. Shop Drawing Submittals: Prepared specifically for this Project.
C. Submit shop drawings and product data as required by various sections of Divisions 26, 27 and 28, in accordance with Division 01. Make submittals to Architect via the General Contractor. Do not submit directly to the Engineer.
D. Indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

PART 2 PRODUCTS

2.01 PRODUCTS

A. All products provided by the Contractor for this project shall be new, and shall be UL Listed where applicable.
B. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
C. Provide interchangeable components of the same manufacture for components being replaced.
D. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Size terminal lugs to NFPA 70, include lugs for terminal box.

2.02 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
B. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Provide spare parts, maintenance, and extra products of types and in quantities specified in individual specification sections.
B. Deliver to Project site; obtain receipt prior to final payment.
PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES

A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section and Division 01.

B. All product substitutions shall be by Addendum, or with written approval only.

C. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

D. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

E. A request for substitution constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Will provide the same warranty for the substitution as for the specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.
   5. Will reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.

F. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

G. Substitution Submittal Procedure:
   1. Submit two copies of request for substitution for consideration. Limit each request to one proposed substitution.
   2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
   3. Architect will notify Contractor in writing of decision to accept or reject request.

3.02 OWNER-SUPPLIED PRODUCTS

A. Owner’s Responsibilities (Unless Otherwise Noted Elsewhere):
   1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
   2. Arrange and pay for product delivery to site.
   3. On delivery, inspect products jointly with Contractor.
   4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for manufacturers’ warranties, inspections, and service.

B. Contractor’s Responsibilities (Unless Otherwise Noted Elsewhere):
   1. Review Owner reviewed shop drawings, product data, and samples.
   2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
   3. Handle, store, install and finish products.
   4. Provide electrical connections to equipment according to manufacturer’s instructions, and Contract Documents.
   5. Repair or replace items damaged by this Contractor.

3.03 TRANSPORTATION AND HANDLING

A. Transport and handle products in accordance with manufacturer’s instructions. All transportation costs shall be by this Contractor.

B. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

3.04 STORAGE AND PROTECTION

A. Store and protect products in accordance with manufacturers' instructions.

B. Store with seals and labels intact and legible.

C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

D. For exterior storage of fabricated products, place on sloped supports above ground.

E. Provide off-site storage and protection when site does not permit on-site storage or protection. Certificate of Insurance is required for off-site storage.

F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

G. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

H. 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
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Examination, preparation, and general installation procedures.
B. Laying out of work.
C. Temporary lighting and power
D. Cutting and patching.
E. Progress cleaning.
F. Protection of installed work.
G. Starting systems.
H. Demonstration and installation.
I. Adjusting.
J. Final cleaning.
K. Closeout procedures, except payment procedures.
L. Project record documents.
M. Operation and maintenance data for equipment and systems.
N. Operation and maintenance manuals.
O. Warranties and bonds.
P. Maintenance service.

1.02 RELATED SECTIONS
A. Division 01 - General Requirements - All Sections.
B. Electrical: Division 26 - All Sections.
C. Communications: Division 27 - All Sections.
D. Electronic Safety and Security: Division 28 - All Sections.

1.03 SUBMITTALS
A. Cutting and Patching: Submit written request in advance of cutting or alteration which affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   5. Work of Owner or separate Contractor.
   6. Include in request:
      a. Identification of Project.
      b. Location and description of affected work.
      c. Necessity for cutting or alteration.
      d. Description of proposed work and Products to be used.
      e. Effect on work of Owner or separate Contractor.
      f. Written permission of affected separate Contractor.
      g. Date and time work will be executed.

1.04 PROJECT CONDITIONS
A. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
B. Protect site from puddling or running water.
C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

E. Erosion and Sediment Control: Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
   4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

F. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

1.05 COORDINATION

A. Coordinate with Construction Manager/General Contractor and Owner to complete work in proper sequence.

B. Coordinate work of alterations and renovations to expedite completion sequentially and to accommodate occupancy requirements.

C. 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.

D. Verify utility requirements and characteristics of 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.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

H. 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.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new 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. Verify that utility services are available, of the correct characteristics, and in the correct locations.

D. 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. Protect work of other trades.

3.02 PREPARATION
A. Remove debris and abandoned items from area and from concealed spaces.
B. Close openings in exterior surfaces to protect existing work and salvage items from weather and extremes of temperature and humidity. Insulate ducts and piping to prevent condensation in exposed areas.
C. Prepare surfaces and remove surface finishes to provide for proper installation of new work and finishes.
D. Clean substrate surfaces prior to applying next material or substance.
E. Seal cracks or openings of substrate prior to applying next material or substance.
F. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 GENERAL INSTALLATION REQUIREMENTS
A. Install Products as specified in individual sections.
B. Make neat transitions. Patch work to match adjacent work in texture and appearance.
C. All ceiling mounted devices (i.e. smoke detectors, speakers, light fixtures, etc.) shall be installed centered in ceiling tiles (Unless otherwise noted). Coordinate with ceiling installer.

3.04 EXISTING UTILITIES
A. The plans indicate as accurately as possible the location, type and sizes of existing utilities at the site. It is the Contractor's responsibility to have all utilities located prior to starting work. Contractor shall contact appropriate utility companies and Call-One for locating utilities prior to commencement of any work.
B. This contractor shall protect all utilities affected by his work, and shall repair any damage caused by his forces at no cost to Owner, whether shown on the Drawings or not.
C. Owners of all underground facilities shall be notified at least 3 business days prior to excavation.

3.05 LAYING OUT THE WORK
A. Verify locations of survey control points prior to starting work.
B. Promptly notify Architect of any discrepancies discovered.
C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
F. Utilize recognized engineering survey practices.
G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means.
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.
H. Periodically verify layouts by same means.
I. Maintain a complete and accurate log of control and survey work as it progresses.

3.06 TEMPORARY LIGHTING AND POWER
A. Comply with Division 01.
B. Provide all temporary facilities required to supply construction power and light. Install and maintain facilities in a manner that will protect the public and workmen. Comply with all applicable laws and regulations.

C. Upon completion of work, remove all temporary facilities from the project site.

D. The Electrical Contractor shall provide power and lighting for construction as outlined in the General Requirements and/or Special Conditions. Electrical Contractor shall coordinate with the Construction Manager/General Contractor to ensure all costs for temporary power and all electrical usage is paid for as part of this contract. The Contractors are responsible for any charges related to temporary power and its usage.

3.07 CUTTING AND PATCHING

A. Execute cutting and patching including excavation and fill to complete the work, to uncover work to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit Products together to integrate with other work.

B. Execute work by methods to avoid damage to other work, and which will provide appropriate surfaces to receive patching and finishing.

C. Cut rigid materials using masonry saw or core drill. Pneumatic or electric impact-type tools not allowed without prior approval.

D. Restore work with new Products in accordance with requirements of Contract Documents.

E. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

F. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 26 0050, to full thickness of the penetrated element.

3.08 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition per OSHA standards.

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 rubbish from site periodically and dispose off-site.

3.09 PROTECTION OF INSTALLED WORK

A. Protect installed work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage.

C. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

D. 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.

E. Prohibit traffic from landscaped areas.

3.10 STARTING SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect and owner seven days prior to start-up of each item.
C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Provide written test results to owner with all data.

3.11 DEMONSTRATION AND INSTRUCTION

A. Demonstrate operation and maintenance of Products to Owner's personnel prior to date of final inspection.

B. Demonstrate operation and maintenance of Products to Owner's representative at a scheduled time with the owner.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.

D. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of owner personnel.

E. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

3.12 ADJUSTING

A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

3.13 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.
   1. Clean areas to be occupied by Owner prior to final completion and before Owner occupancy.

B. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

C. Remove waste and surplus materials, rubbish, and construction facilities from the site.

3.14 CLOSEOUT PROCEDURES

A. Refer to Division 01 Requirements.

B. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect and Owner.

C. Notify Architect when work is considered ready for Substantial Completion.

D. Correct items of work listed in executed Certificates of Substantial Completion and comply with requirements for access to Owner occupied areas.

E. Notify Architect when work is considered finally complete.

F. Complete items of work determined by Architect's final inspection.

3.15 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
5. Reviewed shop drawings, product data, and samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

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. Manufacturer's name and product model and number.
   2. Changes made by Addenda and modifications.
F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   2. Field changes of dimension and detail.
   3. Details not on original Contract drawings.

3.16 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. 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.
C. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions.
D. Include manufacturer's printed operation and maintenance instructions for each component.
E. Include sequence of operation by controls manufacturer.
F. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
G. Provide control diagrams by controls manufacturer as installed (as-builts).
H. Additional Requirements: As specified in individual product specification sections.

3.17 OPERATION AND MAINTENANCE MANUALS
A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
B. Prepare data in the form of an instructional manual.
C. Binders: Commercial quality, 8-1/2 x 11 inch (216 x 280 mm) three D side ring binders with durable plastic covers; 3 inch (75 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 Contractor Name; identify Architect and Engineer Firms names; identify subject matter of contents.
E. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.
F. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
H. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.

I. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. Significant design criteria.
      b. List of equipment.
      c. Parts list for each component.
      d. Operating instructions.
      e. Maintenance instructions for equipment and systems.
      f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
   3. Part 3: Project documents and certificates, including the following:
      a. Shop drawings and product data.
      b. Certificates.
      c. Photocopies of warranties and bonds.

3.18 WARRANTIES AND BONDS
   A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within ten 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 the 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. Contractor shall warrant all work, including materials and labor, for a period not less than one (1) year from the date of Substantial Completion. Manufacturer warranties greater than one (1) year shall be identified and included in the Operation and maintenance Manuals.
   F. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.
   G. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

3.19 MAINTENANCE SERVICE
   A. Furnish service and maintenance of components indicated in specification sections during the warranty period.
   B. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
   C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
   D. Maintenance service shall not be assigned or transferred to any agent or Subcontractor without prior written consent of the Owner.

END OF SECTION
SECTION 26 0050
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Firestopping materials.
   B. Firestopping of all penetrations and interruptions to fire rated assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED SECTIONS
   A. Section 26 0035 - Execution Requirements: Cutting and patching.
   B. Section 26 0519 - Low-Voltage Power Conductors and Cables.
   C. Section 26 0534 - Conduit.

1.03 REFERENCES

1.04 SUBMITTALS
   A. No submittals are required for this section.

1.05 QUALITY ASSURANCE
   A. Fire Testing: Provide firestopping assemblies of designs which provide the specified fire ratings when tested in accordance with ASTM E 814 and ASTM E 119.

1.06 ENVIRONMENTAL REQUIREMENTS
   A. Comply with firestopping manufacturer’s recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.
   B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 FIRESTOPPING ASSEMBLIES

2.02 MATERIALS
   A. Elastomeric Silicone Firestopping: Single component silicone elastomeric compound and compatible silicone sealant; conforming to the following:
      1. Durability and Longevity: Permanent.
      2. Color: Per Manufacturer.
      3. Manufacturers:
         a. 3M Product CP25WB+.
   B. Foam Firestopping: Single component foam compound; conforming to the following:
      1. Durability and Longevity: Permanent.
      2. Color: Per Manufacturer.
   C. Fibered Compound Firestopping: Formulated compound mixed with incombustible non-asbestos fibers; conforming to the following:
      1. Durability and Longevity: Permanent.
      2. Color: Per Manufacturer.
   D. Fiber Packing Material: Mineral fiber packing insulation; conforming to the following:
1. Durability and Longevity: Permanent.

E. Firestop Devices: Mechanical device with incombustible filler and sheet stainless steel jacket; conforming to the following:
   1. Durability and Longevity: Permanent.
   2. Manufacturers:
      a. EZ Pathway Products; Product EZ Path.

F. Intumescent Putty: Compound which expands on exposure to surface heat gain; conforming to the following:
   1. Potential Expansion: Minimum 1000 percent.
   2. Durability and Longevity: Permanent.
   3. Color: Per Manufacturer.
   4. Manufacturers:
      a. 3M Product MPS+.
      b. 3M Product MPP+.

G. Firestop Pillows: Formed mineral fiber pillows; conforming to the following:
   1. Durability and Longevity: Permanent.
   2. Manufacturers:
      a. 3M Product FB249.
      b. 3M Product FB269.
      c. 3M Product FB369.

H. Primers, Sleeves, Forms, and Accessories: Type required for tested assembly design.

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 matter which may affect bond of firestopping material.
   B. Remove incompatible materials which may 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.
   B. Do not cover installed firestopping until inspected by authority having jurisdiction.

3.04 CLEANING AND PROTECTION
   A. Clean adjacent surfaces of firestopping materials.
   B. Protect adjacent surfaces from damage by material installation.

END OF SECTION
PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Electrical demolition.

PART 2 PRODUCTS
2.01 MATERIALS AND EQUIPMENT
   A. Materials and equipment for patching and extending work: As specified in individual sections and drawings.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify field measurements and circuiting arrangements are as indicated on contract documents.
   B. Verify that abandoned wiring and equipment serve only abandoned facilities.
   C. Demolition drawings are based on casual field observation and existing record documents.
   D. Report discrepancies to Architect/Engineer before disturbing existing installation.
   E. Beginning of demolition means installer accepts existing conditions.
   F. An attempt has been made to show all devices and branch circuits. The electrical contractor shall visit the site to verify devices not shown, extent of conduit, boxes etc, & routings. All devices need to be removed in the demolition area unless noted on the drawings.
   G. Electrical Contractor shall refer to architectural drawings to familiarize himself with extent of alteration/remodeling work and more specifically note where new partitioning is being installed, where existing partitioning is being removed, where ceilings are being removed and or replaced, etc.
   H. If existing devices to be reused, provide all necessary conduit, wire, and terminations between devices and head end panels.
   I. If existing conduit is allowed to be reused it shall be supported per NEC and these specifications. Field verify the existing conditions prior to bidding.

3.02 PREPARATION
   A. Services to areas not within the demolition/remodel areas shall be maintained.
   B. Disconnect electrical systems in walls, floors, and ceilings to be removed.
   C. All required service and utility outages shall be scheduled in advance, and approved by School District in writing in advance.
   D. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
   E. Existing Electrical Services: Maintain existing systems in service.
   F. Existing Fire Alarm System: Fire Alarm System shall be removed in its entirety and replaced with new Voice Evacuation Fire Alarm System as Specified. Maintain existing system in service as long as possible.
      1. Notify Owner before partially or completely disabling system.
   G. Existing Telephone, Data, and Television Systems: Maintain existing systems in service.
   H. Existing Intercom System: Intercom System shall be removed in its entirety and replaced with new as Specified.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK
   A. Remove, relocate, and extend existing installations to accommodate new construction.
B. New ceilings are being provided as a part of this project. Electrical Contractor shall remove ALL existing ceiling mounted devices, including those not being replaced as a part of this project (i.e. wireless access points, classroom sound enhancement speakers, infrared dome receivers, etc.). Items not being replaced shall be protected during demolition and reinstalled and reconnecting in new ceilings.

C. Systems to be relocated, extended, or modified include, but are not limited to (not all may apply) telephone, data, fire alarm, PA, intercom, security, etc. All systems shall be re-tested to ensure functionality. Testing shall be by vendors for proper certifications of operation.

D. Remove abandoned wiring to source of supply.

E. If existing systems supporting/mounting methods are removed support/remount as required to meet the specifications for new.

F. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

G. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

L. Remove all surface mounted conduit/boxes and their associated wiring. Remove all concealed raceways, boxes and wiring from partitions being demolished. Remove all existing wiring/cabling from all existing concealed raceways in partitions that are to remain relating to demolished devices.

M. In remodeled/altered areas any feeders, conduits, branch circuits, signal and telephone circuits, etc. passing through the remodeled areas to serve (or be served from) existing adjacent, remote, or surrounding areas that are to remain, shall be retained and kept operational and shall be rerouted in all cases where they interfere with any new work or usage to be accomplished in the remodeled area.

N. Where devices are omitted from present branch circuits, the remaining devices shall be re-wired, if needed and as required, to remain on their respective circuits and in operating condition. Re feed from nearest panel or replacement panel. Where possible, electrical contractor may use existing branch circuit conduit, but new circuit wiring will need to be pulled. If existing circuiting is not available in the area of the electrical load, provide a new circuit from the panelboard servicing the area. Where practical, contractor will be allowed to reuse existing wiring, provided that it matches required color code. If contractor elects to exercise this option, he shall warrant used wire as new.

O. All wiring (power, lighting) not reused for remodeling areas, shall be completely removed back to associated panels. Empty boxes and conduits shall be removed beyond remodeled area (above ceiling).

P. Extend existing installations using existing materials where practical, and providing new materials and methods compatible with existing electrical installations. Refer to specific notes on the drawings.

Q. It is the intent of this project to remove as much exposed EMT conduit and reroute above new accessible ceilings or replace with Wiremold and paint to match adjacent surfaces for a more finished appearance. All wiring shall be new where EMT was removed and replaced with Wiremold.
3.04 SALVAGE ITEMS

A. The Owner shall have salvage rights for existing equipment and wire removed and not reused. If owner does not wish to keep this equipment, it shall become Contractor's property and be removed from the site, unless otherwise specified or shown.

B. Disposal of all electrical items (fluorescent lamps, fluorescent ballasts, HID lamps, HID ballasts, transformers, etc.) shall be done in full compliance with all applicable local, county, state, and federal requirements. This Contractor shall bear all costs (fees, permits, etc.) associated with these disposal requirements.

C. Check with owner prior to removal of all items.

D. Items shall not be damaged during removal.

E. Deliver to the Owner all salvage items to be retained by owner. Deliver to owner determined site within the city limits.

F. The Owner shall have the first choice to accept existing devices being removed. Do not relocate existing devices - provide new unless otherwise noted.

G. Salvage items to be returned to Owner shall be as specifically noted on the drawings.

H. All demolition materials not scheduled to be salvaged shall become the Contractor's property, and shall be removed from the site and legally disposed of by or through the contractor.

3.05 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment that remain or that are to be reused.

B. Electrical contractor shall be responsible for his own demolition, removal, capping, storing, abandoning, disconnecting, relocating and reconnection of existing electrical equipment and material. All cutting, patching, repairing, replacement and refinishing, shall match the existing construction as nearly as possible.

END OF SECTION
SECTION 26 0519
LOW-VOLTAGE POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.
B. Wire and cable for 600 volts and less.
C. Wiring connectors and connections.
D. Cable ties.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping.
B. Section 26 0505 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
C. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
D. Section 26 0553 - Identification for Electrical Systems.
E. Section 26 0534 - Conduit.
F. Section 26 0537 - Boxes.

1.03 REFERENCE STANDARDS

G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
H. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); 2012.
K. NEMA WC5 - Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
M. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
N. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
P. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
1.04 SUBMITTALS
A. There are no shop drawing submittals required for this section.
B. Samples of Actual Product Delivered: Submit one 18 inch (450 mm) length of cable assembly from each reel.
C. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.05 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.01 WIRING REQUIREMENTS
A. Dry Interior Locations: Use only building wire with Type THWN/THHN insulation in raceway.
B. Wet or Damp Interior Locations: Use only building wire with Type THWN insulation in raceway.
C. Exterior Locations: Use only building wire with Type THHN/THWN insulation in raceway, unless specifically noted otherwise.
D. Underground Installations: Use only building wire with Type THHN/THWN insulation in raceway.
E. Use stranded conductors for all feeder and branch circuits, regardless of size.
F. Use stranded conductors for control circuits.
G. Use conductor not smaller than 12 AWG for power and lighting circuits.
H. Use conductor not smaller than 14 AWG for control circuits.
I. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (25 m).
J. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 150 feet (____ m).
K. This contractor shall derate conductor ampacity in areas of high ambient temperature per the NEC.
L. All branch circuits served by a single pole breaker shall be provided with a separate, dedicated neutral conductor throughout. Shared neutrals on these circuits will not be allowed and multipole breakers for single phase loads are not allowed.
M. No more than three (3) branch circuits will be allowed in conduit homeruns. It is the Contractor's responsibility to increase wire sizes per NEC table T310.15(B)(3)(a) when more than three (3) current carrying conductors are installed in a common conduit.
N. All 20-amp branch circuits to be #10 stranded to first junction box.
O. Aluminum conductors are not allowed.
P. Metal-Clad (MC) Cabling is not allowed.

2.02 ALL CONDUCTORS AND CABLES
A. Provide products that comply with requirements of NFPA 70.
B. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.
C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
D. Comply with NEMA WC 70.
E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
G. Conductors for Grounding and Bonding: Also comply with Section 26 0526.
H. Aluminum conductors are not allowed.
I. Metal-Clad (MC) Cabling is not allowed.

J. Conductor Material:
   1. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
   2. Tinned Copper Conductors: Comply with ASTM B33.

K. Conductor Color Coding:
   1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
   2. Color Coding Method: Integrally colored insulation.
      a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
   3. Color Code:
      a. 208Y/120 V, 3 Phase, 4 Wire System:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.
         4) Neutral/Grounded: White.
      c. Isolated Ground, All Systems: Green with yellow stripe.
      d. Travelers for 3-Way and 4-Way Switching: Purple.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers: Anaconda, Cyprus Wire and Cable Company (Rome), General Electric Company, General Cable Company, Pirelli or approved equivalent.

B. Insulation:
   1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: NFPA 70, Type THHN/THWN.

E. Aluminum conductors are not allowed.

F. Metal-Clad (MC) Cabling is not allowed.

2.04 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Wiring Connectors for Terminations:
   1. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
   2. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.

C. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      c. NSI Industries LLC: www.nsiindustries.com/#sle.

D. Push-in Wire Connectors: Rated 600 V, 221 degrees F (105 degrees C).
   1. Manufacturers:
b. NSI Industries LLC: www.nsiindustries.com/#sle.
c. Wago Corporation: www.wago.us/#sle.

E. Mechanical Connectors: Provide bolted type or set-screw type.
   1. Manufacturers:

F. Compression Connectors: Provide circumferential type or hex type crimp configuration.
   1. Manufacturers:

2.05 WIRING ACCESSORIES

A. Cable Ties: Material and tensile strength rating suitable for application.

B. Splices and taps for conductor sizes No. 6 and larger, use approved gutter taps similar to O.Z.
   type PMX combination parallel gutter taps and covers.

C. Splices and taps for conductor sizes No. 8 and larger, use approved gutter taps similar to O.Z.
   type PMX combination parallel gutter taps and covers.

D. Where tapping of conductors is required, use minimum of two layers wrapped half lapped.
   Tape shall be a minimum of 150% of thickness of insulation. Tape shall be U.L. Listed 3M
   Scotch Brand 33+.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to
   accommodate conductors and cables in accordance with NFPA 70.

D. Verify that raceway installation is complete and supported.

E. Protect conductors from paint.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.

C. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other
      contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum
      pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not
      recommended by the manufacturer.

D. Paralleled Conductors: Install conductors of the same length and terminate in the same
   manner.
E. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

F. Terminate cables using suitable fittings.

G. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.

H. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

I. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
   5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
   6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

J. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

K. Insulate ends of spare conductors using vinyl insulating electrical tape.

L. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

M. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

N. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

O. All wire and cable shall be installed with conduit raceway system.

P. Conduits shall have a maximum fill in accordance with NEC requirements and wire and cable shall be installed within conduits as outlined in Section 26 0534 Conduit.

Q. Route wire and cable as required to meet NEC and project conditions.
   1. Wire and cable routing indicated is approximate unless dimensioned.
   2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
   3. Include wire and cable of lengths required to install connected devices within 10 ft (3000 mm) of location shown.

R. Use wiring methods indicated.

S. Pull all conductors into raceway at same time.

T. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

U. Protect exposed cable from damage.

V. Neatly train and lace wiring inside boxes, equipment, and panelboards.

W. Clean conductor surfaces before installing lugs and connectors.

X. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
Y. Identify and color code wire and cable under provisions of Section 26 0553. Identify each conductor with its circuit number or other designation indicated.

3.04 FIELD QUALITY CONTROL

A. Perform inspection, testing, and adjusting in accordance with Section 01 4000.
B. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
C. Correct deficiencies and replace damaged or defective conductors and cables.
D. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2.

END OF SECTION
SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Grounding and bonding requirements.
B. Conductors for grounding and bonding.
C. Connectors for grounding and bonding.

1.02 RELATED REQUIREMENTS
A. Section 26 0519 - LOW-VOLTAGE POWER CONDUCTORS AND CABLES: Additional requirements for conductors for grounding and bonding, including conductor color coding.
B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
C. Section 26 5600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.03 REFERENCE STANDARDS
A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Coordination:
   1. Verify exact locations of underground metal water service pipe entrances to building.
   2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.

1.05 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS
A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
D. Bonding and Equipment Grounding:
   1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical...
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.

E. Isolated Ground System:
1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.
3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other connections between isolated ground system and normal equipment ground system on the load side of this connection.

F. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
   a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
   b. Raceway Size: 3/4 inch (21 mm) unless otherwise indicated or required.
   c. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.
   d. Ground Bar Mounting Height: 18 inches (450 mm) above finished floor unless otherwise indicated.

2.02 GROUNDING AND BONDING COMPONENTS
A. General Requirements:
1. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
2. Provide products listed and labeled as complying with UL 467 where applicable.
B. Conductors for Grounding and Bonding, in addition to requirements of Section 26 0519:
1. Use insulated copper conductors unless otherwise indicated.
C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.
2.03 CONNECTORS AND ACCESSORIES

A. Mechanical Connectors (for indoor locations only): Bronze.
   1. Product: by O.Z. Gedney or equivalent.

B. Exothermic Connections:
   1. Product: by Cadweld or equivalent.

C. Wire: Stranded copper.

D. Grounding Electrode Conductor: Size to meet NFPA 70 requirements. Minimum #3/0 bare copper interconnecting ground conductors.

E. Motor shaft grounding:
   1. Provide field installed shaft grounding for all motors served by VFD's.
   2. Provide Aegis SGR or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as shown on the drawings.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.

C. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

D. Identify grounding and bonding system components in accordance with Section 26 0553.

E. Provide bonding to meet requirements described in Quality Assurance.

F. Bond together each metallic raceway (2" and larger), cable tray, pipe, duct and other metal object entering equipment enclosures. Use bare copper conductor, sized per NEC or as shown on plans (whichever is the most stringent).

G. Equipment Grounding Conductor: Provide separate, insulated copper equipment grounding conductor in all of the following runs listed below. Terminate each end on suitable lug, bus, or bushing. Where ground conductors are specified or required, conduit sizes shall be increased as necessary to meet the NEC conduit fill requirements.
   1. All new feeders.
   2. All raceways for receptacle circuits, including special power receptacles.
   3. All surface raceways and multi-outlet assemblies containing power receptacle devices (i.e. Wiremold).
   4. All feeds to light fixtures.
   5. All motor feeders and branch circuits.
6. All flexible metal conduit.
7. All non-metallic raceways containing power conductors.

H. Terminate each end of equipment ground conductors in an approved lug or bus or bushing.

I. In general, equipment ground conductors are not indicated on the plans. Where ground conductors are required, conduit sizes shall be increased as required to comply with NEC conduit fill requirements.

3.03 FIELD QUALITY CONTROL

A. Provide field inspection in accordance with Section 01 4000.
B. Perform inspections listed in NETA STD ATS, Section 7.13.
C. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION
SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Conduit and equipment supports.
B. Anchors and fasteners.
C. For communications cabling, see also specific sections.

1.02 RELATED REQUIREMENTS
A. Section 26 0534 - Conduit: Additional support and attachment requirements for conduits.
B. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
C. Section 26 5600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 REFERENCE STANDARDS
A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.

1.05 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MATERIALS
A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
B. Supports: Fabricated of structural steel or formed steel members; galvanized or painted, as required.
C. Anchors and Fasteners:
   1. Do not use powder-actuated anchors.
   2. Concrete Structural Elements: Use precast inserts, expansion anchors, or preset inserts.
   3. Steel Structural Elements: Use beam clamps, steel ramset fasteners, or welded fasteners.
   4. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
   5. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
   7. Sheet Metal: Use sheet metal screws.
D. Formed Steel Channel:
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

1. Product: Unistrut, or equivalent.

E. Steel Spring Clips:
   1. Product: Caddy, or equivalent.
   2. Use only in concealed locations (i.e. above ceilings, within walls, etc.)

F. Conduit Straps:
   1. Product: Steel City, or equivalent.
   2. Cadmium plated steel, one or two hole type, to hold conduit tight to surface.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
C. Rigidly weld support members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
D. Install surface-mounted cabinets and panelboards with minimum of four anchors.
E. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1 inch (25 mm) off wall.
F. All supports shall be securely positioned to the structure, not equipment or ceiling tile supports. Coordinate structure load capabilities with General Contractor.
G. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION
SECTION 26 0534
CONDUIT

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Conduit, fittings and conduit bodies.

1.02 RELATED REQUIREMENTS
A. Section 07 9200 - Joint Sealants.
B. Section 26 0050 - Firestopping.
C. Section 26 0526 - Grounding and Bonding for Electrical Systems.
D. Section 26 0529 - Hangers and Supports for Electrical Systems.
E. Section 26 0553 - Identification for Electrical Systems.
F. Section 26 0537 - Boxes.

1.03 REFERENCE STANDARDS
A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
B. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC); 2005.
C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC); 2005.
D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
G. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; 2005.
H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.
I. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2015.
J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS
A. There are no shop drawing submittals required for this section.
B. Samples of Materials Actually Delivered to Site:
C. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches (51 mm).

1.05 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Accept conduit on site. Inspect for damage.
B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
C. Protect PVC conduit from sunlight.
PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

D. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

E. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

F. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

G. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

H. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

I. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.

J. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

K. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
   1. Maximum Length: 6 feet (1.8 m).

L. Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit.
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.

2.02 CONDUIT REQUIREMENTS

A. Conduit Size: Comply with NFPA 70.
   1. Minimum Size: 3/4 inch (19 mm) for circuit homeruns, and for runs with more than the equivalent of three single circuits served with single pole breakers and #12 AWG conductors. 1/2" conduit may be used for all other runs with the equivalent of 7 #12 AWG conductors or less.
   2. Minimum conduit size for runs supplying a single communications outlet shall be 1" or larger as noted on the plans or in Division 27.

B. Underground Installations:
   1. More than 5 Feet (1.5 Meters) from Foundation Wall: Use thickwall non-metallic conduit.
   2. Through foundation walls and five feet either side: Use plastic coated rigid steel conduit.
   3. Where conduits turn up from under slab or from underground: Use plastic coated rigid steel conduit until above slab or grade.
   4. Under Slab on Grade: Use thickwall non-metallic conduit.
   5. Minimum Size: 3/4 inch (19 mm).
   6. Other locations shall be Schedule 40 PVC.

C. Outdoor Locations Exposed Above Grade: Use rigid steel conduit or intermediate metal conduit.

D. In Slab Above Grade (precast wall panels): Conduits shall not be routed in concrete floor topping.
1. Use rigid steel conduit or intermediate metal conduit with appropriate protective coating.

E. Wet and Damp Locations: Use rigid steel conduit or intermediate metal conduit.
   1. Liquid tight conduit with liquid tight fittings shall be used for final connection to equipment in kitchens, wells, sump pits, transformer connections, underfloor in computer/server rooms and other areas of moisture content.

F. Dry Locations:
   2. Exposed: Use electrical metallic tubing.
   3. Flexible metal conduit shall be used for connections to motors, fixed appliances, equipment subject to vibration, and recessed luminaires where required.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)
   A. Manufacturers:
   B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

2.04 INTERMEDIATE METAL CONDUIT (IMC)
   A. Manufacturers:
   B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

2.05 METAL CONDUIT
   A. Manufacturers: Republic Steel Company, Youngstown, Triangle, Allied, Wheatland, or approved equivalent.
   B. Rigid Steel Conduit: ANSI C80.1.
   C. Intermediate Metal Conduit (IMC): Rigid steel.
   D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.
   E. All connectors shall have insulated throats.

2.06 PVC COATED METAL CONDUIT
   A. Manufacturers: Allied, Robroy Industries or approved equivalent.
   B. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil (0.05 mm) thick.
   C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.
   D. All connectors shall have insulated throats.

2.07 FLEXIBLE METAL CONDUIT
   A. Description: Interlocked steel construction.
   B. Fittings: NEMA FB 1.
   C. All connectors shall have insulated throats.

2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT
   A. Manufacturers: Anaconda, Liquatite, or Electri-Flex or approved equivalent.
   B. Description: Interlocked steel construction with PVC jacket.
   C. Fittings: NEMA FB 1.
   D. All connectors shall have insulated throats.
2.09 ELECTRICAL METALLIC TUBING (EMT)
A. Description: ANSI C80.3; galvanized tubing.
B. Fittings and Conduit Bodies: NEMA FB 1; steel set screw type, except that compression type steel fittings shall be used in wet or damp locations.
C. All connectors shall have insulated throats.

2.10 NONMETALLIC CONDUIT
A. Manufacturers: Carlon, Triangle, Johns-Manville or approved equivalent.
B. Description: NEMA TC 2; Schedule 40 PVC (unless noted or specified elsewhere).
C. Fittings and Conduit Bodies: NEMA TC 3.

2.11 ACCESSORIES
A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil (0.51 mm).
B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force (890 N).

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that field measurements are as shown on drawings.
B. Verify that mounting surfaces are ready to receive conduits.
C. Verify that conditions are satisfactory for installation prior to starting work.
D. Verify routing and termination locations of conduit prior to rough-in.
E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION
A. Install products in accordance with manufacturer’s instructions.
B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.
C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.
E. Install intermediate metal conduit (IMC) in accordance with NECA 101.
F. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.
G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
H. Conduit Routing:
   1. When conduit destination is indicated and routing is not shown, determine exact routing required.
   2. Conceal all conduits unless specifically indicated to be exposed.
   3. Conduits in the following areas may be exposed, unless otherwise indicated:
      a. Electrical rooms.
      b. Mechanical equipment rooms.
      c. Within joists in areas with no ceiling.
   4. Unless otherwise approved, do not route conduits exposed:
      a. Across floors.
      b. Across roofs.
c. Across top of parapet walls.
d. Across building exterior surfaces.

5. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.

6. Arrange conduit to maintain adequate headroom, clearances, and access.
7. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
8. Route conduits above water and drain piping where possible.
9. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
10. Maintain minimum clearance of 6 inches (150 mm) between conduits and piping for other systems.
11. Maintain minimum clearance of 12 inches (300 mm) between conduits and hot surfaces. This includes, but is not limited to:
   a. Heaters.
   b. Hot water piping.
   c. Flues.
12. Group parallel conduits in the same area together on a common rack.

I. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

J. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

K. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and...
maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.

8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

L. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
   1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
   2. Where conduits are subject to earth movement by settlement or frost.

M. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
   1. Where conduits pass from outdoors into conditioned interior spaces.
   2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

N. Provide (2) two 1" spare conduits with pull strings over all hard surface ceilings for future use.

O. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches (300 mm) at each end.

P. Provide grounding and bonding in accordance with Section 26 0526.

3.03 FIELD QUALITY CONTROL
A. See Section 01 4000 - Quality Requirements, for additional requirements.
B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
D. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING
A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION
A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.
B. At contractor's option, existing conduit in remodeled areas may be reused for new branch circuits and feeders where practical, and as noted on the plans. Existing conduits shall meet all requirements for new conduit as specified herein, and shall be warranted as new by the contractor.
C. Install conduit securely, in a neat and workmanlike manner, as specified in NECA 1.
D. Install steel conduit as specified in NECA 101.
E. Install nonmetallic conduit in accordance with manufacturer's instructions.
   1. For all nonmetallic conduit runs 2 inch trade size and larger, all sweeps shall be of galvanized rigid construction. If sweeps are underground, sweeps shall be PVC coated.
F. Arrange supports to prevent misalignment during wiring installation.
G. Support conduit using method approved for installation. All conduit shall be supported from structural members of the building, and not from ceiling support wires, ducts, pipes, or the like.
H. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
I. Fasten conduit supports to building structure and surfaces under provisions of Section 26 0529.
J. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
K. Arrange conduit to maintain headroom and present neat appearance.
L. Route exposed conduit parallel and perpendicular to walls.
M. Route conduit under slab, and underground from point-to-point.
N. No conduit shall be run within concrete slabs unless specifically noted otherwise.
O. Maintain adequate clearance between conduit and piping.
P. Maintain 12 inch (300 mm) clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).
Q. Cut conduit square using saw or pipe cutter; de-burr cut ends.
R. Bring conduit to shoulder of fittings; fasten securely.
S. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
T. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations.
U. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one shot bender to fabricate bends in metal conduit larger than 2 inch (50 mm) size. Runs that require more than three 90 degree bends shall be brought to the attention of the Engineer.
V. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
W. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.
X. Provide conduit seals where raceway enters the building from underground. Seal in accordance with NEC requirements.
Y. Provide suitable pull string in each empty conduit except sleeves and nipples.
Z. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
AA. All conduits to cable trays shall be bonded to the cable tray.
AB. Where conduits pass through exterior walls or roofs, Contractor shall seal penetrations with materials outlined in Section 07 9200.
AC. Where conduits pass through smoke or fire rated walls Contractor shall seal penetrations with appropriate smoke and/or fire rated materials as outlined in Section 26 0050.

3.06 INTERFACE WITH OTHER PRODUCTS
A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 26 0050.
B. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation.

END OF SECTION
SECTION 26 0535
SURFACE METALLIC RACEWAYS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Surface Metallic Raceways.
   B. Fittings.
   C. Device Brackets and Plates.
   D. Cover Brackets and Face Plates.
   E. Wireways.

1.02 RELATED SECTIONS
   A. Section 26 0526 - Grounding and Bonding.
   B. Section 26 2726 - Wiring Devices.
   C. Section 27 1020 - Voice/Data System - CAT 6A.

1.03 REFERENCES
   C. UL 5 - Surface Metal Raceways and Fittings; Underwriters Laboratories Inc.; 2004.
   D. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Underwriters Laboratories Inc.; 1996.

1.04 SYSTEM DESCRIPTION
   A. System components listed by Underwriter's Laboratories, Inc.:
      1. Metal components: Conforming to specifications of UL 5.
      2. Plastic components: Exhibiting non-flammable, self-extinguishing characteristics when tested in accordance with UL 94, V-O.

1.05 SUBMITTALS
   A. See Division 01 and 26 0032 - Product Requirements, for submittal procedures.
   B. Product Data: Manufacturer's descriptive literature for each system component specified in this section.
   C. Shop Drawings: Indicate raceway layouts, each system component required for complete system, raceway lengths, device types, locations; identify all circuits.
   D. Closeout Submittals: If variations from approved shop drawings occur during installation of raceway system, submit final as-built drawings indicating such variations.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Store products of this section in manufacturer's unopened packaging until installation.
   B. Maintain storage area conditions for products of this section in accordance with manufacturer's instructions until installation.

PART 2 PRODUCTS

2.01 COMPONENTS
   A. Surface Metallic Raceways: (TO BE USED ONLY WHERE SPECIFICALLY INDICATED ON PLANS OR WITH PRIOR APPROVAL FOR OTHER AREAS)
      1. Manufacturer:
         a. The Wiremold Company; 60 Woodlawn Street, West Hartford CT 06133-2500; ASD.
            Tel. (800) 621-0049, Fax. (203) 232-2062.
b. Panduit.
c. Pre-bid approved equivalent.

B. Locations requiring power or data, but not both:
   2. Product description: Provide Surface Metallic Raceway equal to this product as minimum. Provide larger size as needed if extra capacity is needed to meet wire/cable fill requirements identified by code. Provide all accessories such as covers, elbows, fittings, boxes, etc to make a complete system. Provide shop drawings on all components that will be used.
   3. Finish: Gray polyester topcoat over ivory primer, capable of being field-painted.
   4. Fittings:
      a. Factory-formed units to complete indicated configuration of raceway systems, including, but not limited to, the following:
         1) External corner units.
         2) Internal corner units.
         3) Flat units.
         4) Blank end units.
         5) Elbows.
         6) Couplings: One per raceway joint location.
         7) Wire clips: One for every 2 linear feet (609 mm) of indicated raceway configuration.
      b. Material: Same material and metal thickness as linear raceway components.
      c. Finish: Matching linear raceway components.
   5. Device Brackets and Plates:
      a. Factory-formed brackets and plates allowing installation of indicated power, data, and communications devices, both single-gang and two-gang, either vertically or horizontally in raceways.
      b. Finish: Color matching linear raceway components.
   6. Cover Brackets and Face Plates:
      a. Plastic device mounting brackets and trim plates allowing installation of indicated power, data, and communications devices horizontally in raceways; trim cover sized to overlap device cut-out in raceway, concealing seams.
      b. Finish: Color matching linear raceway components.

C. Locations requiring power and data at same location:
   2. Product description: Two-piece system of galvanized steel, nominal 0.050 inch (1.27 mm) metal thickness, having total assembled cross-section dimension 4.75 inches (120 mm) high by 1.75 inches (44 mm) deep, having cross-section area 7.5 square inches (4838 sq mm), consisting of base, snap-on cover, and removable longitudinal barrier, dividing raceway interior into two equal spaces. Provide all accessories such as covers, elbows, fittings, boxes, etc to make a complete system.
   3. Finish: Gray polyester topcoat over ivory primer, capable of being field-painted.
   4. Fittings:
      a. Factory-formed units to complete indicated configuration of raceway systems, including, but not limited to, the following:
         1) External corner units.
         2) Internal corner units.
         3) Flat units.
         4) Blank end units.
         5) Elbows.
         6) Couplings: One per raceway joint location.
         7) Wire clips: One for every 2 linear feet (609 mm) of indicated raceway configuration.
8) Replacement longitudinal barrier: One section for every 8 linear feet (2438 mm) of indicated raceway configuration.

b. Material: Same material and metal thickness as linear raceway components.

c. Finish: Matching linear raceway components.

5. Device Brackets and Plates:

a. Factory-formed brackets and plates allowing installation of indicated power, data, and communications devices, both single-gang and two-gang, either vertically or horizontally in raceways.

b. Finish: Color matching linear raceway components.

6. Cover Brackets and Face Plates:

a. Plastic device mounting brackets and trim plates allowing installation of indicated power, data, and communications devices horizontally in raceways; trim cover sized to overlap device cut-out in raceway, concealing seams.

b. Finish: Color matching linear raceway components.

D. Devices:

1. Electrical devices shall be as specified in Section 26 2726 - Wiring Devices.

2. Communication devices shall be as specified in Section 27 1020 - [Voice/Data System - CAT 6A].

E. Wireway: General purpose type wireway.

1. Manufacturers:


   c. Pre-bid approved equivalent.

2. Manufacturer's standard knockouts.

3. Size: 6X6 inches; length as required.


5. Fittings: Lay-in type with removable top, bottom, and side; captive screws.

6. Finish: Rust inhibiting primer coating with gray enamel finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify that substrates are prepared to receive products specified in this section.

3.02 INSTALLATION

A. Install components of raceway system in accordance with shop drawings and manufacturer's installation instructions.

B. Installation of electrical devices, and wiring of electrical devices, is specified in Section 26 2726.

C. Install raceways securely, in a neat and workmanlike manner, as specified in NECA 1.

D. Use flat-head screws, clips, and straps to fasten raceway channel to surfaces. Mount plumb and level.

E. Use suitable insulating bushings and inserts at connections to raceway system, at outlets and corner fittings.

F. Close ends of wireway and unused conduit openings.

G. Ground and bond raceway and wireway under provisions of section 260526.

END OF SECTION
SECTION 26 0537
BOXES

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Wall and ceiling outlet boxes.
   B. Pull and junction boxes.

1.02 RELATED REQUIREMENTS
   A. Section 26 0032 - Product Requirements.
   B. Section 26 0050 - Firestopping.
   C. Section 26 0526 - Grounding and Bonding.
   D. Section 26 2726 - Wiring Devices: Wall plates in finished areas and floor box service fittings.
   E. Section 31 2316 - Excavation.

1.03 REFERENCE STANDARDS
   A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
   B. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
   C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
   D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS
   A. See Division 01 and Section 26 0030 for submittal procedures.
   B. Project Record Documents: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents. Also record actual locations of floor boxes on project record documents.

1.05 QUALITY ASSURANCE
   A. Conform to requirements of NFPA 70.
   B. Products: Provide products listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

PART 2 PRODUCTS
2.01 OUTLET BOXES
   A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
   B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.
   C. Wall Plates for Finished Areas: As specified in Section 26 2726 and Section 27 1020 based on system served.

2.02 PULL AND JUNCTION BOXES
   A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
   B. Hinged Enclosures: As specified in Section 26 2716.

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verify that mounting surfaces are ready to receive boxes.
   B. Verify that conditions are satisfactory for installation prior to starting work.
3.02 INSTALLATION

A. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.
B. Install in locations as shown on Drawings and approved by owner, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.
C. Coordinate installation of outlet boxes for equipment connected under Section 26 2717.
D. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
E. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
   1. Adjust box locations up to 10 feet (3 m) if required to accommodate intended purpose, without adjustment in contract amount.
F. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726.
G. Maintain headroom and present neat mechanical appearance.
H. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
I. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 12 inches (____ mm) from ceiling access panel or from removable recessed luminaire.
J. Install boxes to preserve fire resistance rating of partitions and other elements.
K. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
L. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
M. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
N. Use flush mounting outlet boxes in finished areas.
O. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening at nearest mortar joint.
P. DO NOT INSTALL FLUSH MOUNTING BOX BACK-TO-BACK IN WALLS; PROVIDE MINIMUM 12 INCHES HORIZONTAL SEPARATION. PROVIDE MINIMUM 24 INCHES HORIZONTAL SEPARATION IN ACOUSTIC RATED WALLS.
Q. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
R. Properly support boxes with approved methods.
S. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
T. Use properly supported, adjustable steel channel fasteners for hung ceiling outlet box.
U. Do not fasten boxes to ceiling support wires.
V. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches (305 mm) of box.
W. Use gang box where more than one device is mounted together. Do not use sectional boxes.
X. Use 4" square box with plaster ring for single device outlets.
Y. Use cast outlet box, FD type, in exterior locations and wet locations.
Z. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.03 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.
B. Install knockout closures in unused box openings.

3.04 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.
B. Clean exposed surfaces and restore finish.
3.05 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Electrical identification requirements.
   B. Nameplates and labels.
   C. Wire and cable markers.
   D. Field-painted identification of conduit.

1.02 RELATED REQUIREMENTS
   A. Section 26 0519 - LOW-VOLTAGE POWER CONDUCTORS AND CABLES: Color coding for power conductors and cables 600 V and less.
   B. Section 26 2726 - Wiring Devices: Device and wallplate finishes; factory pre-marked wallplates.
   C. Section 26 0534 - Conduit.

1.03 REFERENCE STANDARDS
   A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 QUALITY ASSURANCE
   A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

2.02 NAMEPLATES AND LABELS
   A. Contractor MUST coordinate face-plate/ block labeling scheme with owner. Owner will provide additional labeling information to contractor after contract is awarded.
   B. Face-plates and punchdown blocks must be machine labeled.
   C. Nameplates: Engraved three-layer laminated plastic, black letters on white background.
   D. Equipment to have Nameplates include:
      1. Switchboards, panelboards, distribution panels, transfer switches, transformers, equipment disconnects, special system control panels, motors, motor starters, pushbutton stations, pilot lights, special lighting or control switches, special receptacles, junction boxes, communication system pull boxes and junction boxes, and empty conduits provided for future use.
      2. Normal use light switches, receptacles, and conduit will not require identification unless specifically noted otherwise.
   E. Letter Size:
      1. Use 1/8 inch (3 mm) letters for identifying individual equipment and loads.
      2. Use 1/4 inch (6 mm) letters for identifying grouped equipment.
   F. Labels: Embossed adhesive tape, with 3/16 inch (5 mm) white letters on black background. Use only for identification of individual wall switches and receptacles and control device stations.

2.03 JUNCTION BOX COVERPLATE COLOR CODING
   A. Junction box coverplates shall be color-coded to indicate function.
      1. Normal circuit homerun coverplates - - WHITE.
      2. Video/Surveillance box coverplates - - YELLOW.
      3. Wireless Computer Access box coverplates - - GREEN.
      4. Fire alarm box coverplates - - RED.
      5. Telephone and Data box coverplates - - BLUE
6. Audio Enhancement/ Intercom box coverplates - - WHITE.
7. Cable TV box coverplates - - BLACK/WHITE.

B. External surface of coverplate may be painted in unfinished spaces, and above accessible ceilings. The inside surface of the coverplate shall be painted for boxes located in finished spaces.

C. In addition to color coding, the voltage, panel designation, and circuit number of the homerun shall be stenciled on to the box cover.

2.04 WIRE AND CABLE MARKERS

A. Description: Vinyl cloth type self-adhesive wire markers.
B. Description: tape type color coded wire markers on feeder cables #4 and larger. Branch circuit wire and cable #6 and smaller shall be factory color coded by integral pigmentation.

C. Locations: Each conductor at panelboard gutters, pull boxes, and junction boxes for each load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer’s instructions.
B. Degrease and clean surfaces to receive nameplates and labels.

3.02 INSTALLATION

A. Equipment to be identified with nameplates shall include, but not limited to, switchboards, panelboards, distribution panels, transfer switches, special system control panels, motors, motor starters, equipment disconnects, pushbuttons stations, pilot lights, special lighting or control switches, special receptacles, junction boxes, communication pull boxes and j-boxes, series rated overcurrent devices, and empty conduits provided for future use.

B. Install nameplates and labels parallel to equipment lines.

C. Secure nameplates to equipment front using screws.

D. Secure nameplates to inside surface of door on panelboard that is recessed in finished locations.

E. Voice/Data, sound, and intercom Systems: [Legibly and permanently label all j-boxes]. Permanent black marker shall be acceptable as the permanent marking means.

F. All J-boxes shall be legibly and permanently marked to indicate the circuit numbers, panel, and voltage associated with the conductors in the j-box.

G. Identify feeder and branch circuit conductors using the following colors.
   1. 208/120 Volt System: Phase A - black, phase B - red, phase C - blue, neutral - white, equipment ground - green, switchleg - purple.

H. Each EXISTING panelboard shall be provided with a NEW neatly typed directory with plastic protector and laminated map of area served.

END OF SECTION
SECTION 26 0919
ENCLOSED CONTACTORS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. General purpose contactors.
   B. Emergency lighting transfer relays.
   C. Lighting control contactors.

1.02 RELATED REQUIREMENTS
   A. Section 26 0526 - Grounding and Bonding.
   B. Section 26 0529 - Hangers and Supports for Electrical Systems.
   C. Section 26 0553 - Identification for Electrical Systems: Engraved nameplates.
   D. Section 26 5100 - Interior Lighting
   E. Section 26 5600 - Exterior Lighting

1.03 REFERENCE STANDARDS
   C. General purpose contactors.

1.04 SUBMITTALS
   A. See Division 01 and Section 26 0030 for submittal procedures.
   B. Product Data: Provide dimensions, size, voltage ratings and current ratings.

1.05 QUALITY ASSURANCE
   A. Conform to requirements of NFPA 70.
   B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 GENERAL PURPOSE CONTACTORS
   A. Description: NEMA ICS 2, AC general purpose magnetic contactor.
   B. Coil operating voltage: 120 volts, 60 Hertz, voltage as scheduled or as needed.
   C. Poles: As required to match circuit configuration and control function.
   D. Enclosure: NEMA ICS 6, Type 1.
   E. Accessories:
      1. Selector Switch: ON/OFF/AUTOMATIC.
      2. Indicating Light: RED.
      3. Auxiliary Contacts: Two, field convertible.

2.02 LIGHTING CONTACTORS
   A. Lighting contactors shall be equal to GE CR460 series for up to 30A or CR360 series for amperages over 30A.
   B. Description: NEMA ICS 2, magnetic lighting contactor.
   C. Configuration: Electrically held.
   D. Coil operating voltage: 120 volts, 60 Hertz, voltage as scheduled or needed.
   E. Poles: As required to match circuit configuration and control function.
   F. Contact Rating: 600VAC, 30A current rating.
G. Enclosure: NEMA ICS 6, Type 1.

H. Accessories:
   1. Selector Switch: ON/OFF/AUTOMATIC.
   2. Indicating Light: RED.
   3. Auxiliary Contacts: Two, field convertible.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install enclosed contactors where indicated, in accordance with manufacturer's instructions.
B. Install enclosed contactors plumb. Provide supports in accordance with Section 26 0529.
C. Provide engraved plastic nameplates; refer to Section 26 0553 for product requirements and location.

END OF SECTION
SECTION 26 2716
CABINETS AND ENCLOSURES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Hinged cover enclosures.
B. Cabinets.
C. Terminal blocks.

1.02 RELATED REQUIREMENTS
A. Section 26 0526 - Grounding and Bonding.
B. Section 26 0529 - Hangers and Supports for Electrical Systems.

1.03 REFERENCE STANDARDS
A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
B. PART 1 GENERAL
C. NEMA ICS 4 - Application Guideline for Terminal Blocks; 2015.
D. SECTION INCLUDES

1.04 SUBMITTALS
A. See Division 01 and Section 26 0030 for submittal procedures.
B. Product Data: Provide manufacturer's standard data for enclosures and cabinets.
C. Cabinet Keys: Deliver to Owner in accordance with Section 01 6000 for maintenance materials.

1.05 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 HINGED COVER ENCLOSURES
A. Construction: NEMA 250, Type 1 (3R where installed outdoors or exposed to moisture) steel enclosure.
B. Covers: Continuous hinge, held closed by flush latch operable by screwdriver.
C. Provide interior plywood panel for mounting terminal blocks and electrical components; finish with white enamel.
D. Enclosure Finish: Manufacturer's standard enamel.

2.02 CABINETS
A. Boxes: Galvanized steel.
B. Backboard: Provide 3/4 inch (19 mm) thick plywood backboard for mounting terminal blocks and electrical components. Paint matte white.
C. Fronts: Steel, surface type with screw cover front, door with concealed hinge, and flush lock. Finish with gray baked enamel.
D. Provide metal barriers to form separate compartments wiring of different systems and voltages.
E. Keys: Provide two of each different key.

2.03 TERMINAL BLOCKS
A. Terminal Blocks: NEMA ICS 4.
B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
C. Provide ground bus terminal block, with each connector bonded to enclosure.

PART 3 EXECUTION

3.01 INSTALLATION
   A. Install securely, in a neat and workmanlike manner, as specified in NECA 1.
   B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner under the provisions of Section 26 0529.
   C. Install cabinet fronts plumb.

3.02 CLEANING
   A. Clean electrical parts to remove conductive and harmful materials.
   B. Remove dirt and debris from enclosure.
   C. Clean finishes and touch up damage.

   END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS
A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables (600 V and Less).
B. Section 26 0526 - Grounding and Bonding.
C. Section 26 0534 - Conduit.
D. Section 26 0537 - Boxes.
E. Section 26 0553 - Identification for Electrical Systems.
F. Section 26 2726 - Wiring Devices.
G. Section 26 2818 - Enclosed Switches.
H. Section 31 2316 - Excavation.

1.03 REFERENCE STANDARDS
A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS
A. See Division 01 for submittal procedures.
B. Product Data: Provide wiring device manufacturer’s catalog information showing dimensions, configurations, and construction.

1.05 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 COORDINATION
A. Obtain and review shop drawings, product data, manufacturer’s wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
B. Determine connection locations and requirements.
C. Sequence rough-in of electrical connections to coordinate with installation of equipment.
D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 PRODUCTS

2.01 MATERIALS
A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
   1. Colors: Conform to NEMA WD 1.
   2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
   3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
B. Disconnect Switches: As specified in Section 26 2818 and in individual equipment sections.
C. Wiring Devices: As specified in Section 26 2726.
D. Flexible Conduit: As specified in Section 26 0534.
E. Wire and Cable: As specified in Section 26 0519.
F. Boxes: As specified in Section 26 0537.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS
A. Make electrical connections in accordance with equipment manufacturer’s instructions.
B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
D. Provide receptacle outlet to accommodate connection with attachment plug.
E. Provide cord and cap where field-supplied attachment plug is required.
F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
H. Install terminal block jumpers to complete equipment wiring requirements.
I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION
SECTION 26 2726
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall switches.
B. Wall dimmers.
C. Occupancy sensors.
D. Receptacles.
E. Wall plates.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables (600 V and Less).
B. Section 26 0526 - Grounding and Bonding.
C. Section 26 0534 - Conduit.
D. Section 26 0537 - Boxes.
E. Section 26 0553 - Identification for Electrical Systems: Labels for wiring devices.

1.03 REFERENCE STANDARDS

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.
C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
D. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
E. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
G. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Division 01 and Section 26 0030 for submittal procedures.
B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
C. Operation and Maintenance Data:
   1. GFI Receptacles: Include information on status indicators and testing procedures and intervals.
D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.
PART 2 PRODUCTS

2.01 ALL WIRING DEVICES

A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

B. Finishes:
   1. Wiring Devices Installed in Finished Spaces: White with stainless steel wall plates.
   2. Wiring Devices Installed in Unfinished Spaces: White with galvanized steel wall plate unless otherwise indicated.
   3. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover unless otherwise indicated.
   4. All ceiling mounted occupancy sensors shall be White.

2.02 WALL SWITCHES

A. All Wall Switches: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
   1. Wiring Provisions: Switches shall be wired using "Plug Tail" connector. Contractor to provide "Plug Tail" connector as appropriate for every wall switch.

B. Locking Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed switch actuator and maintained contacts; all switches shall be toggle-keyed, using a fork-type key, and all switches shall be keyed alike; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

C. Manufacturers: Pass & Seymour.

D. Wall Switches: NEMA WD 1, Heavy Duty, AC only general-use snap switch.
   1. Body and Handle: White plastic with toggle handle.
   2. Indicator Light: Lighted handle type switch; red handle. (where indicated on drawings).
   3. Ratings:
      a. Voltage: 120 - 277 volts, AC.

E. Switches:
   1. Product: Pass & Seymour No. PS20AC Series, or equivalent.

F. Indicator Switches:
   1. Product: Pass & Seymour No. PS20AC1-RPL.

G. Keyed Lock Switches:

H. Occupancy Sensor Wall Switch Style:
   1. Dual Circuit Occupancy Sensor Switch: Sensor Switch #WSD-PDT-2P or equivalent by Hubbell or Wattstopper.
   2. Single Circuit Occupancy Sensor Switch: Sensor Switch #WSD-PDT or equivalent by Hubbell or Wattstopper.
   3. Provide with dimming capability where indicated with "DOS".

I. Occupancy Sensor Ceiling Mounted:
   1. Product: Sensor Switch #CMR-PDT or equivalent by Hubbell or Wattstopper.
   2. Provide power packs and other accessories as required to accommodate intended operation.

2.03 WALL DIMMERS

A. Wall Dimmers: NEMA WD 1; Semiconductor dimmer for LED fixture, _______ type as required to be compatible with LED Fixtures.
   1. Voltage: 120 or 277 volts, as required.
   2. Product: Legrand #RH4FBL3PTC or equivalent.
2.04 RECEPTACLES

A. All Receptacles: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
   1. Wiring Provisions: Receptacles shall be wired using “Plug Tail” connector. Contractor to provide “Plug Tail” connector as appropriate for every receptacle.
   2. NEMA configurations specified are according to NEMA WD 6.
   3. Provide labeling of receptacles as outlined in Section 26 0553.

B. Manufacturers: Pass & Seymour.

C. Receptacles: Heavy duty, complying with NEMA WD 6 and WD 1.

D. Convenience Receptacles: Type 5 - 20, rated 20A at 125V.
   1. Product: Pass & Seymour No. PT5362A-W
   2. Shall be Tamper Resistant in ALL Public Spaces. PTTR5362W

E. GFCI Receptacles: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements. ALL GFCI receptacles shall be readily accessible, provide faceless receptacle in an accessible location if receptacle is obstructed by equipment. White.
   1. GFCI receptacles shall have 20A feed-through rating, and 20A device face rating at 125V.
   2. Product: Pass & Seymour No. PT2094-W.
   3. Shall be Tamper Resistant in ALL Public Spaces. PT2094TRW

F. Special purpose receptacles, as noted or shown on the drawings.

2.05 WALL PLATES

A. All Wall Plates: Comply with UL 514D.
   1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
   2. Size: Standard; Stainless Steel.
   3. Screws: Metal with slotted heads finished to match wall plate finish.

B. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

C. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

D. In-Use Weatherproof Cover Plates: Self-closing, and weatherproof with cord and plug inserted into the device. Product: Hubbell WP26MH or approved equivalent.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
B. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of wiring devices provided under this section.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. Provide GFI receptacles with integral GFI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

I. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

J. Install wiring devices plumb and level with mounting yoke held rigidly in place.

K. Install wall switches with OFF position down.

L. Do not share neutral conductor on branch circuits utilizing wall dimmers.

M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

N. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

P. Install receptacles with grounding pole oriented to the bottom.

Q. Connect wiring device grounding terminal to outlet box with bonding jumper, except where equipment grounding conductor is present.

R. Connect wiring devices by wrapping conductor around screw terminal.

S. Use jumbo size plates for outlets installed in masonry walls.

T. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

U. Install protective rings on active flush cover service fittings.

V. For all wall switch occupancy sensors, set time delay to 5 minutes during construction; change delay to automatic (learning) mode following substantial completion.

W. For single circuit wall switch occupancy sensors, set device to manual "on," automatic "off" (occupant required to press button to turn lights on, but the lights will automatically turn off once vacancy is detected).

**3.04 INTERFACE WITH OTHER PRODUCTS**

A. Coordinate locations of outlet boxes provided under Section 26 0537 to obtain mounting heights specified or indicated on drawings.

B. Install wall switch 48 inches (1.2 m) above finished floor.

C. Install convenience receptacle 18 inches (450 mm) above finished floor or as indicated on plans.

D. Install convenience receptacle 6 inches (150 mm) above counter.
E. Install wall dimmers 48 inches (1.2 m) above finished floor.
F. Install telephone and data jacks outlets 18 inches (450 mm) above finished floor or as indicated on plans.
G. Install telephone jack for all wall telephone and intercom outlets at 48 inches (___ m) above finished floor.
H. Heights above are to the center of the box.

3.05 FIELD QUALITY CONTROL
A. Perform field inspection, testing, and adjusting in accordance with Section 01 4000.
B. Inspect each wiring device for damage and defects.
C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
D. Operate each wall switch with circuit energized and verify proper operation.
E. Verify that each receptacle device is energized.
F. Test each receptacle to verify operation and proper polarity.
G. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
H. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.06 ADJUSTING
A. Adjust devices and wall plates to be flush and level.
B. Adjust devices and boxes as required to assure that device coverplates seat firmly to wall surface.

3.07 CLEANING
A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION
SECTION 26 2813
FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fuses.

1.02 REFERENCE STANDARDS
A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 RELATED SECTIONS
A. Section 26 2413 - Switchboards.
B. Section 26 2818 - Enclosed Switches.

1.04 SUBMITTALS
A. See Division 01 and Section 26 0030 for submittal procedures.
B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

1.05 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 MAINTENANCE MATERIALS
A. See Section 16032 - Product Requirements, for additional provisions.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Cooper Bussmann, Inc: www.cooperbussmann.com/#sle.
B. Littelfuse, Inc: www.littelfuse.com/#sle.

2.02 FIRES
A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.
B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
C. Provide fuses of the same type, rating, and manufacturer within the same switch.
D. Comply with UL 248-1.
E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
F. Voltage Rating: Suitable for circuit voltage.
G. Power Load Feeder Switches: Class RK1 (time delay).
H. Motor Load Feeder Switches: Class RK1 (time delay).
I. Motor Branch Circuits: Class RK5.

2.03 SPARE FIRES
A. Provide one spare fuse for each three fuses of each amp rating installed with a minimum of three spares for each amp rating used.
PART 3 EXECUTION

3.01 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.
B. Install fuses with label oriented such that manufacturer, type, and size are easily read.
C. Provide identification nameplate for spare fuse cabinet in accordance with Section 26 0553.

END OF SECTION
SECTION 26 2818
ENCLOSED SWITCHES

PART 1  GENERAL

1.01  SECTION INCLUDES
A.  Fusible switches.
B.  Nonfusible switches.

1.02  RELATED REQUIREMENTS
A.  Section 26 0526 - Grounding and Bonding for Electrical Systems.
B.  Section 26 0529 - Hangers and Supports for Electrical Systems.
C.  Section 26 2813 - Fuses.

1.03  REFERENCE STANDARDS
A.  NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
B.  NECA (INST) - NECA Standard of Installation; National Electrical Contractors Association; 1993.
C.  NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association; 2002 (R2007).
D.  NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
F.  NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04  SUBMITTALS
A.  See Division 01 and Section 26 0030 for submittal procedures.
B.  Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
C.  Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
D.  Project Record Documents: Record actual locations of enclosed switches.
E.  Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1.  See Section 01 6000 - Product Requirements, for additional provisions.

1.05  QUALITY ASSURANCE
A.  Conform to requirements of NFPA 70.

PART 2  PRODUCTS

2.01  MANUFACTURERS
A.  Same manufacturer as panelboards.

2.02  COMPONENTS
A.  Fusible Switch Assemblies: NEMA KS 1, Type HD (heavy-duty) enclosed load interrupter knife switch.
   1.  Externally operable handle interlocked to prevent opening front cover with switch in ON position.
   2.  Handle lockable in OFF position.
   3.  Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.
B.  Nonfusible Switch Assemblies: NEMA KS 1, Type HD (heavy-duty) enclosed load interrupter knife switch.
1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
2. Handle lockable in OFF position.

C. Enclosures: NEMA KS 1.
   1. Interior Dry Locations: Type 1.
   2. Exterior or Wet Locations: Type 3R.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that field measurements are as shown on the drawings.
   B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
   C. Verify that mounting surfaces are ready to receive enclosed safety switches.
   D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION
   A. All disconnect switches shown on drawings shall be considered fused unless specifically noted as non-fused.
   B. Install enclosed switches in accordance with manufacturer’s instructions.
   C. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA 1.
   D. Arrange equipment to provide minimum clearances in accordance with manufacturer’s instructions and NFPA 70.
   E. Provide required supports in accordance with Section 26 0529.
   F. Install enclosed switches plumb.
   G. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.
   H. Provide grounding and bonding in accordance with Section 26 0526.
   I. Install fuses in fusible disconnect switches, with fuse nameplates visible from the front.
   J. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.03 FIELD QUALITY CONTROL
   A. Perform field inspection and adjusting in accordance with Section 01 4000.
   B. Inspect and test in accordance with NETA STD ATS, except Section 4.
   C. Perform inspections and tests listed in NETA STD ATS, Section 7.5.1.1.
   D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 CLEANING
   A. Clean dirt and debris from switch enclosures and components according to manufacturer’s instructions.
   B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Manual motor controllers.
   B. Magnetic motor controllers.
   C. Combination magnetic motor controllers and disconnects.

1.02 RELATED REQUIREMENTS
   A. Section 26 0526 - Grounding and Bonding.
   B. Section 26 0529 - Hangers and Supports for Electrical Systems.
   C. Section 26 0553 - Identification for Electrical Systems: Engraved nameplates.
   D. Section 26 2813 - Fuses.

1.03 REFERENCE STANDARDS
   A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
   B. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches; National Electrical Manufacturers Association; 1993.
   F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
   H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS
   A. See Division 01 and Section 26 0030 for submittal procedures.
   B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
   C. Maintenance Data: Replacement parts list for controllers.

1.05 QUALITY ASSURANCE
   A. Conform to requirements of NFPA 70.
   B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles (160 km) of Project.
   C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Same as panelboards or Allen-Bradley.
2.02 MANUAL CONTROLLERS
A. Manual Motor Controllers: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller with overload element, red pilot light, and toggle operator. 120V manual starters (MTS) for motors 1/2 HP and less shall be Square D, Class 2510 or equivalent.
B. Enclosures: NEMA ICS 6, Type 1.

2.03 AUTOMATIC CONTROLLERS
A. Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
B. For motors 25 HP or larger contractor shall provide a soft start drive equal to Square D series ATS46 solid state reduced voltage starter rated for horsepower of motor.
C. Two-Speed Controllers: Include integral time delay transition between FAST and SLOW speeds.
D. Coil Operating Voltage: 24 volts, 60 Hertz. (Electrical Contractor shall coordinate with DDC controls contractor before ordering.)
E. Overload Relays: NEMA ICS 2; bimetal.
F. Enclosures: NEMA ICS 6, Type as required to meet conditions of installation.

2.04 VARIABLE FREQUENCY DRIVES
A. Variable frequency drives (VFD's) are being provided as indicated on Motor and Starter schedule. Coordinate requirements with Mechanical Contractor.
   1. Where VFD's are noted to be supplied by the Mechanical Contractor with equipment the Electrical Contractor shall ensure they are installed and wired properly.
   2. Provide motor shaft grounding of all motors served by VFD's in accordance with Section 26 0526 Grounding and Bonding. This is required of all VFD's whether supplied by the Electrical Contractor or not.
   3. Where VFD's are noted to be supplied by the Electrical Contractor they shall meet the requirements of Section 26 2923.

2.05 ACCESSORIES FOR ALL AUTOMATIC CONTROLLERS
A. Auxiliary Contacts: NEMA ICS 2, 2 field convertible contacts in addition to seal-in contact.
B. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty oiltight type. Provide red RUN and green OFF LED lights.
C. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
D. Pushbuttons: Recessed type.
E. Indicating Lights: Transformer, LED type.
F. Selector Switches: Rotary type. Cover mounted HOA.
G. Control Power Transformers: 24 volt secondary, 120V primary or as needed. Provide fused primary, secondary, and bond unfused leg of secondary to enclosure.

2.06 DISCONNECTS
A. Combination Controllers: Combine motor controllers with over-current protective device and disconnect in common enclosure. Obtain IEC Class 2 coordinated component protection.
B. Motor Circuit Protector: Circuit breakers with integral instantaneous magnetic trip in each pole; UL listed. Shall be provided in all combination controllers.

PART 3 EXECUTION
3.01 INSTALLATION
A. Install enclosed controllers where indicated, in accordance with manufacturer's instructions.
B. Install securely, in a neat and workmanlike manner, as specified in NECA 1.
C. Provide supports in accordance with Section 26 0529.
D. Height: 5 ft (1500 mm) to operating handle.
E. Provide fuses for fusible switches; refer to Section 26 2813 for product requirements.
F. Select and install overload heater elements in motor controllers to match installed motor characteristics.
G. Identify enclosed controllers in accordance with Section 26 0553.
H. Provide engraved plastic nameplates; refer to Section 26 0553 for identification requirements and location. Shall identify motor served, horsepower of motor, and voltage/phase rating.

3.02 FIELD QUALITY CONTROL
A. Perform field inspection and testing in accordance with Section 01 4000.
B. Perform inspections and tests listed in NETA STD ATS, Section 7.16.1.

END OF SECTION
SECTION 26 5100
INTERIOR LIGHTING

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Interior luminaires.
B. Exit signs.
C. LED emergency power supply units.
D. Luminaire accessories.

1.02 RELATED REQUIREMENTS
A. Section 260519 - Low-Voltage Power Conductors and Cables (600V and Less).
B. Section 260526 - Grounding and Bonding for Electrical Systems.
C. Section 260534 - Conduit.
D. Section 26 0537 - Boxes.
E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
F. Section 26 0919 - Enclosed Contactors: Lighting contactors.
G. Section 26 2726 - Wiring Devices: Manual wall switches and wall dimmers.

1.03 REFERENCE STANDARDS
E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
H. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2002.
I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Coordination:
   1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.

3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.

4. Notify Architect/Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Division 1 and Section 260030 for submittal procedures.

B. Utility Incentive Program: Contractor shall coordinate with Owner and Rocky Mountain Power and provide all necessary documentation for Owner to receive all available lighting incentives.
   1. Coordinate Pre-Construction Inspection with RMP.
   2. Coordinate Post-Construction Inspection with RMP.

C. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

D. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:
      a. Include estimated useful life, calculated based on IES LM-80 test data.
      b. Include IES LM-79 test report upon request.
      c. Color temperature
      d. Color rendering index (CRI)
      e. Input wattage
      f. Lumen output
      g. Lumens per watt rating
   2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IESNA LM-63 standard format upon request.
   3. Drivers: Include wiring diagrams.
   4. LED Emergency Power Supply Unit: Associated lumen output.

E. Where LEDs are to be interfaced with dimmer switches, Contractor to ensure dimmer switches and fixtures are compatible with switches.

F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

1.06 QUALITY ASSURANCE

A. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

B. Conform to requirements of NFPA 70 and NFPA 101.

C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 WARRANTY

A. Provide five year manufacturer warranty for all LED luminaires, including drivers.

B. Provide three year full warranty for batteries for emergency lighting units.

C. Provide five year full warranty for batteries for self-powered exit signs.

1.08 EXTRA MATERIALS

A. See Section 016000 - Product Requirements, for additional provisions.
B. Furnish the following quantities of spare fixtures:
   1. 4 Type A2; 4 Type A4; 4 Type B2; 1 Type G.

PART 2 PRODUCTS

2.01 LUMINAIRES
   A. Furnish products as indicated in Schedule included on the Drawings.
   B. All luminaires shall be provided with a disconnecting means meeting the requirements of the NEC.
   C. All LED luminaires shall be DLC qualified or accepted by Rocky Mountain Power's incentive program.

2.02 EXIT SIGNS
   A. All Exit Signs: Internally illuminated with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924. Universal mounting kit.
      1. Number of Faces: Single or double as indicated or as required for the installed location.
      2. Directional Arrows: As indicated or as required for the installed location.

PART 3 EXECUTION

3.01 INSTALLATION
   A. Install products according to manufacturer's instructions.
   B. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA 500 (commercial lighting).
   C. Install suspended luminaires and exit signs using pendants supported from swivel hangers or by chain as indicated in schedule. Provide pendant length or chain required to suspend luminaire at indicated height.
   D. Support luminaires independent of ceiling frame.
   E. Many of the fluminaires in this project are shown to be installed in layin ceilings. All of the fixtures shall be provided with support connected directly from building structure.
   F. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
   G. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
   H. Install recessed luminaires to permit removal from below.
   I. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
   J. Install clips to secure recessed grid-supported luminaires in place.
   K. Install wall mounted luminaires, emergency lighting units, and exit signs at height as indicated on Drawings.
   L. Install accessories furnished with each luminaire.
   M. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire; use flexible conduit.
   N. Connect luminaires and exit signs to branch circuit outlets provided under Section 260537 as indicated.
   O. Bond products and metal accessories to branch circuit equipment grounding conductor.

3.02 FIELD QUALITY CONTROL
   A. See Section 01 4000 - Quality Requirements, for additional requirements.
   B. Inspect each product for damage and defects.
   C. Operate each luminaire after installation and connection to verify proper operation.
D. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
E. Correct wiring deficiencies and repair or replace damaged or defective products.

3.03 ADJUSTING
A. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.
B. Aim and adjust luminaires as directed by manufacturer and Engineer.

3.04 CLEANING
A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.
B. Clean electrical parts to remove conductive and deleterious materials.
C. Remove dirt and debris from enclosures.
D. Clean photometric control surfaces as recommended by manufacturer.
E. Clean finishes and touch up damage.

3.05 CLOSEOUT ACTIVITIES
A. Contractor shall coordinate with Owner and Rocky Mountain Power and provide all necessary documentation for Owner to receive all available lighting incentives.
   1. Coordinate Post-Construction Inspection with RMP.

3.06 SCHEDULE - SEE DRAWINGS

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Exterior luminaires and accessories.
   B. Lamps.

1.02 RELATED REQUIREMENTS
   A. Section 26 0537 - Boxes.
   B. Section 26 0919 - Enclosed Contactors: Lighting contactors.
   C. Section 26 0519 - Low-Voltage Power Conductors and Cables (600V and Less).
   D. Section 26 0526 - Grounding and Bonding for Electrical Systems.
   E. Section 26 0534 - Conduit.
   F. Section 26 2726 - Wiring Devices

1.03 REFERENCE STANDARDS
   A. ANSI C78.379 - American National Standard for Electric Lamps -- Reflector Lamps --
      Classification of Beam Patterns; 2006.
   B. ANSI C82.1 - American National Standard for Lamp Ballast - Line Frequency Fluorescent Lamp
      Ballast; 2004.
   C. ANSI C82.4 - American National Standard for Ballasts for High-Intensity-Discharge and
      Low-Pressure Sodium Lamps (Multiple-Supply Type); 2002.
   D. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric
      Data and Related Information; 2002 (Reaffirmed 2008).
   E. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State
      Lighting Products; 2008.
   F. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED
      Packages, Arrays, and Modules; Illuminating Engineering Society; 2015.
   G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
   I. IESNA RP-20 - Lighting for Parking Facilities; Illuminating Engineering Society of North
      America; 1985.
   J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having
      Jurisdiction, Including All Applicable Amendments and Supplements.
   L. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition,
      Including All Revisions.

1.04 SUBMITTALS
   A. See Division 1 and Section 26 0030 for submittal procedures.
   B. Utility Incentive Program: Contractor shall coordinate with Owner and Rocky Mountain Power
      and provide all necessary documentation for Owner to receive all available lighting incentives.
      1. Coordinate Pre-Construction Inspection with RMP.
      2. Coordinate Post-Construction Inspection with RMP.
   C. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard
      product of the manufacturer.
   D. Product Data: Provide manufacturer's standard catalog pages and data sheets including
      detailed information on luminaire construction, dimensions, ratings, finishes, mounting
requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:
   a. Include estimated useful life, calculated based on IES LM-80 test data.
   b. Include IES LM-79 test report upon request.
   c. Color temperature
   d. Color rendering index (CRI)
   e. Input wattage
   f. Lumen output
   g. Lumens per watt rating

2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IESNA LM-63 standard format upon request.

3. LED Emergency Power Supply Unit: Associated lumen output.

4. Drivers: Include wiring diagrams.

E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70 and NFPA 101.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.06 WARRANTY

A. Provide five year manufacturer warranty for all LED luminaires, including drivers.

B. Provide three year full warranty for batteries for emergency lighting units.

1.07 EXTRA MATERIALS

A. See Section 016000 - Product Requirements, for additional provisions.

B. Furnish the following quantities of spare fixtures:
   1. 1 Type W; 1 Type WE.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

2.02 LUMINAIRE

A. Furnish products as indicated in Schedules included on the Drawings.

B. All LED luminaires shell be DLC qualified or accepted by Rocky Mountain Power's incentive program.

C. Provide products that comply with requirements of NFPA 70.

D. Provide products that are listed and labeled as complying with UL 1598, where applicable.

E. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

F. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
G. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

H. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

I. LED Luminaires:
   1. Components: UL 8750 recognized or listed as applicable.
   2. Tested in accordance with IES LM-79 and IES LM-80.
   3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data or as required in Light Fixture Schedule.

2.03 LAMPS
   A. Lamp Types: As specified for each luminaire.

PART 3 EXECUTION

3.01 INSTALLATION
   A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.
   B. Install products according to manufacturer's instructions.
   C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA/IESNA 501 (exterior lighting).
   D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
   E. Install accessories furnished with each luminaire.
   F. Bond products and metal accessories to branch circuit equipment grounding conductor.

3.02 FIELD QUALITY CONTROL
   A. Inspect each product for damage and defects.
   B. Perform field inspection, testing, and adjusting in accordance with manufacturer's instructions.
   C. Operate each luminaire after installation and connection to verify proper operation.
   D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.03 ADJUSTING
   A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

3.04 CLEANING
   A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.
   B. Clean electrical parts to remove conductive and deleterious materials.
   C. Remove dirt and debris from enclosure.
   D. Clean photometric control surfaces as recommended by manufacturer.
   E. Clean finishes and touch up damage.

3.05 CLOSEOUT ACTIVITIES
   A. Replace luminaires that have failed at Substantial Completion. Replacement shall not come from Owner spare stock.
   B. Contractor shall coordinate with Owner and Rocky Mountain Power and provide all necessary documentation for Owner to receive all available lighting incentives.

3.06 SCHEDULE - SEE DRAWINGS

END OF SECTION
SECTION 27 1020
VOICE/DATA SYSTEMS - CAT 6A

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Installation of a conduit, cable and outlet system for telecommunications wiring that complies with TIA/EIA 568. All racks, routers, switches, termination blocks, cables, terminations etc. to be installed by this contractor.
B. Voice Systems.
C. Data Systems
D. Voice/Data wiring, termination and outlets.

1.02 RELATED SECTIONS
A. Section 26 0534 - Conduit.
B. Section 26 0535 - Surface Raceways.
C. Section 26 0537 - Boxes.
D. Section 26 2726 - Wiring Devices.

1.03 REFERENCES
A. Category 6a requirements are found in the following American National Standards Institute (ANSI), the Electronics Industries Association/Telecommunications Industry (EIA/TIA) Standards and Technical Systems Bulletins (TSB):

1.04 SUBMITTALS
A. See Division 01 and Section 26 0030 for submittal procedures.
B. Submit communication closet layout per communication standards and per provided layout.
C. Product data:
   1. NOTE: All components shall be as specified, or be 100% compatible (ie. completely interchangeable, etc.).
   2. Materials list of items proposed to be provided under this section.
   3. Manufacturer's specifications and other data needed to provide compliance with the specified requirements.
   4. Manufacturer's recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the work.
D. Submit information on the labeling scheme that will be used. MUST be coordinated with the owner.
E. Shop Drawings: Show details of each cable type, outlets, terminal blocks, accessories, and related equipment.
F. Project Record Documents: Record actual locations and sizes of pathways and outlets.
1.05 QUALITY ASSURANCE
A. Work shall be installed in accordance with the manufacturer’s recommendations of the equipment to be supplied and installed under this contract. Installations and materials shall be in accordance with latest edition of the Uniform Building Code (UBC), National Electrical Code (NEC), and Building Industry Consulting Service International (BICSI).
B. Installer Qualifications: Company specializing in installing similar systems, with minimum three years documented experience.
C. Products: Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.
D. Whenever conflicts between referenced standards are encountered, the more stringent will apply.

1.06 COORDINATION
A. Sequence, coordinate and schedule installation of material and equipment with other trades and building occupants. Avoid unexpected interruptions with building occupants and other contractors.

1.07 QUALIFICATIONS
A. Manufacturer: Systimax.
B. Installer: Personnel installing and terminating the Cabling system shall be trained for voice and data installations, and testing work. All installers/testers shall provide proof of training. Training must be from a nationally recognized organization and must be able to maintain system warranties of materials being installed. Proof of training shall be submitted to Owner for review prior to start of work.

1.08 SYSTEM DESCRIPTION
A. Conduits, cable trays, backboards, racks, termination blocks, cables, and outlet to form raceway and wiring systems for voice and data.
B. Provide voice/data wiring from existing communication racks, see plans to each outlet, using wire and cable as specified. Telecommunications cabling will terminate on blocks in the appropriate communication rack in the telecommunications room. Termination of cabling shall be in accordance with detail on plans, and shall be coordinated and terminated as approved by the Owner.
C. System Components: Products of single manufacturer unless otherwise specified.
D. Wiring configuration at all jack locations shall be per the EIA/TIA 568B standard. Cabling and connections shall be tested per TIA/EIA standards. All telecommunications cabling shall be category 6A compliant. Horizontal cabling shall be 4 pair minimum 23 ga., plenum rated.
E. Telecommunication work shall be in accordance with the latest BICSI Telecommunication Distribution Methods Manual. This manual shall be on site for reference at all times telecommunication work is in progress. All cable shall be color coded per BICSI Standards.
F. Labeling scheme shall be coordinated, reviewed and approved by the Owner before implementation.
G. Total station wire length to each workstation area shall be a maximum of 90 meters (295 feet).
H. Combination Voice/Data Outlets shall include three (3) RJ-45/8wire modular jacks rated CAT 6A. Each jack shall be fed by its own CAT 6A 4 pair cable. One of these jacks will be voice and Two will be data. All cables will be terminated at new patch panels in the existing rack in the Work Room 203 or Gym Stage.
I. All Ceiling WAP’s outlets shall consist of (2) data RJ-45/8wire modular jacks rated CAT 6A unless otherwise noted. Each jack shall be fed by its own CAT 6A 4 pair cable. All cables will be terminated at new patch panels in the existing rack in the Work Room 203 or Gym Stage.
J. All Projector outlets shall consist of (1) data RJ-45/8wire modular jacks rated CAT 6A unless otherwise noted. Each jack shall be fed by its own CAT 6A 4 pair cable. All cables will be terminated at new patch panels in the existing rack in the Work Room 203 or Gym Stage.

K. All Security Drops shall consist of (2) data RJ-45/8wire modular jacks rated CAT 6A unless otherwise noted. Each jack shall be fed by its own CAT 6A 4 pair cable. All cables will be terminated at new patch panels in the existing rack in the Work Room 203 or Gym Stage.

L. Furnish all network equipment as specified.

M. Provide dedicated building ground at all terminal locations.

PART 2 PRODUCTS

2.01 SERVICE AND PATHWAYS

A. Horizontal Pathway: Conform to TIA/EIA-569-A, using raceway, racks, and backboards as indicated.

B. Any wall mounted telephone (except wall phone), data or combinations telephone/data outlet to be provided with Arlington Industries, Inc ((800)233-4717 or www.aifittings.com) Low Voltage Mounting Bracket model LVH1K or equal and a 1 inch conduit to new rack.

C. Any Wall Phone outlet to be provided 4-11/16 inch by 4-11/16 inch dual device "deep" 2-1/8 inch style junction box (42 cubic inches) with a single gang mud ring.

2.02 COMPONENTS

A. NOTE: All components shall be as specified, or shall be 100% compatible (ie. completely interchangeable, etc.).

B. Manufacturers: Systimax, ICC.

C. Voice/Data Outlet: Each outlet will contain three (3) Systimax GigaSpeed XL MGS600 jacks.

D. Modular Faceplates:
   1. Systimax M-Series "LE".
      a. Single with studs: For use with wall mounted telephone.
      c. Number of Holes as required for application.
      d. Provide blank covers for unused openings; color to match faceplate.
      e. Provide Kroy lettered labels for top and bottom of label holder.

E. RJ45 Wall Jack: Systimax MGS600.
   1. Color:
      a. Data - Blue.
      c. WAP - Green.

F. Rack Mounted Patch Panels:
   1. Provide 48 Port CAT 6A patch panels equal to Systimax 360 GigaSpeed X10D F/UTP.
   2. Provide with Rack Mounting Kit.
   3. Provide with Labeling Kit.
   4. Provide quantity of panels and accessories to provide a minimum of 25% spares beyond quantity required for cabling identified on drawings.

G. Wire Management:
   1. Wall Mounted Equipment Racks
      a. Use Existing in Gym Stage.
   2. Floor Mounted Closet Equipment Racks
      a. Use Existing in Work Room 203.

2.03 VOICE/DATA SYSTEM CABLING (COPPER) - ALSO APPLIES TO VIDEO SURVEILLANCE CABLING:

A. Horizontal Station Cable:
1. UL Listed Category 6a, plenum rated.
   a. Unshielded, twisted pairs.
   b. Conductors: Copper.
   c. Insulation type: CMP.
   f. Wire size: 23 AWG.
   g. Number of pairs: 4.

B. Patch Cord Assembly - Closet:
1. UL Listed - Systimax patch cords.
   a. Unshielded, twisted pairs.
   b. Conductors: 4 pair, copper.
   c. Supply one closet cable for every data jack in the building.

C. Voice/Data Labeling
1. Label both ends of each connection.
2. Labeling scheme shall be coordinated, reviewed and approved by the Owner before implementation.
3. System Descriptive Letters:
   a. Data - "D"
   b. Voice - "V"
   c. All Ceiling Drops - "C"
   d. Security - "S"

PART 3 EXECUTION

3.01 INSTALLATION

A. RACEWAY INSTALLATION
1. Provide complete conduit system as specified in 2.01.
2. Bond all voice and/or data conduits and cable tray together and to building grounding system.
3. All voice and data wiring shall be installed in raceway, conduit, or cable tray.
4. Provide voice/data labels on all ends and in pull boxes.
5. Conduit size:
   a. One voice/data outlet: 1 inch.
   b. Two voice/data outlets: 1 inch.
   c. Three voice/data outlets: 1 1/4 inch.
6. Support raceways and cabinets under the provisions of Section 26 0534.
7. Raceway shall be limited to 40% fill, with three or more conductors. Fill shall be limited to 30% for raceways with less than three conductors. No conduit smaller than 1" shall be allowed. No more than 180 degrees in bends shall be allowed, unless noted otherwise.

B. EQUIPMENT INSTALLATION
1. Plan equipment backboard arrangements. Arrangements shall be uniform and well organized.
2. Use commercially available wire management products to route wiring across backboards.
3. All cables shall be bonded with bond clamps (in buildings), and grounded to an NEC approved ground.
4. Provide a #6 cu ground tied to the grounding system.

C. VOICE/DATA WIRE AND CABLE INSTALLATION
1. Plan cable installation so no voice or data cable run is longer than 300 feet.
2. Install in accordance with manufacturer's installation guidelines.
3. Punch wiring in accordance with TIA-568B.
4. The finished installation shall meet the most current Category 6a system installation standards.
5. Maintain pair twists to termination index strip.
6. Replace all cabling that fails Field Quality Control Testing. (It is permissible to only reterminate cable if terminations are cause of failure).
7. Ground cabling as per NEC and TIA/EIA-607.
8. Cable runs shall follow building lines discreetly in a neat and workman like manner, parallel and consistent throughout. No shortcuts or diagonal runs shall be allowed.
9. 
D. FIELD QUALITY CONTROL
1. Testing Equipment; Microtest Omnisnanner or equivalent.
   a. With flash ROM for standard upgrades.
   b. Use current ROM upgrade for testing, including Avaya 2091 for all gigaspeed Cat. 6a connections.
   c. Maintain ROM updates throughout project.
   d. Capable of testing;
      1) NEXT (Near End Cross Talk)
      2) Attenuation
      3) ACR (Attenuation to Cross Talk Ratio).
      4) Length of cable; 4% or 2 feet whichever is greater.
      5) Impedance.
      6) Loop Resistance.
      7) Capacitance.
      8) Measure Wire Map.
      9) Capable of indicating pass or failure of testing.
      10) Capable of providing hard copy printout results.
2. Voice/Data Wiring System Testing:
   a. All testing to be conducted under observation of Owner's representative.
   b. Notify Owner's representative at least 48 hours before commencing testing.
   c. All testing to be conducted using data rates introduced at intervals up to 100 Gbps as recommended by test equipment manufacturer.
   d. Perform testing on all four pairs of wire per cable.
   e. Label each cable test recorded on test equipment identical to the markings on the cable.
   f. Deliver Omnisnanner to Owner's representative immediately after testing, to allow downloading of test results.
   g. Provide one electronic and one paper copy of results to Owner.
3. Frequency of testing:
   a. Test 100% of the cables installed. Conduct testing after terminations have been made at wall jack and block.
   b. Retest all cables required to be reinstalled or reterminated.
4. Support raceways, backboards, and cabinets under the provisions of Section 26 0035.
E. Install wire and cable in accordance with manufacturer's instructions and in accordance with TIA/EIA-568.
F. Finish paint termination backboards with durable gray enamel prior to installation of equipment.
G. Provide a #6 cu ground tied to the grounding system per the NEC and the telephone utility.
H. All requirements shall be coordinated with the Utility. This Contractor is responsible for all charges from the Utility.
I. Install pullwire in each empty telephone conduit over 10 feet (3 m) in length or containing a bend.

END OF SECTION
SECTION 27 5123
EDUCATIONAL INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

PART 1 - GENERAL

1.01 1.01 GENERAL REQUIREMENTS

A. The conditions of the General Contract (General, Supplementary, and other Conditions) and the General Requirements are hereby made a part of this Section.

B. All bids shall be based on the equipment as specified herein. The catalog numbers and model designations are that of the CH1000 Life Safety Communication System. The specifying authority must approve any alternate system.

C. Contractors who want to submit alternate equipment shall provide the specifying authority with the appropriate documentation at least 15 business days prior to bid opening. The submitted documentation must provide a feature by feature comparison identifying how the proposed equipment meets the operation and functionality of the system described in this specification. The contractor shall provide adequate and complete submittal information prior to bid date. Submittal documentation shall include, but is not limited to, specification sheets, working drawings, shop drawings, and system demonstration. The alternate supplier-contractor must also provide a list of six installations identical to the system proposed.

D. Final approval of the alternate system shall be determined at the time of job completion. Failure to provide the "precise functional equivalent" shall result in the removal of the alternate system at the contractor's expense.

E. The contractor for this work shall be held to have read all bidding requirements, the general requirements of Division 1, contract proposal forms and complete the execution of this work. The contractor shall be bound by all conditions and requirements therein.

F. The contractor shall be responsible for providing a complete functional system including all necessary components whether included in this specification or not.

G. In preparing the bid, the contractor should consider that no claim will be made against the owner for any costs incurred by the contractor for any equipment demonstrations that the owner requests.

1.02 1.02 SCOPE OF WORK

A. Furnish and install all equipment, accessories, and materials in accordance with these specifications and drawings to provide a complete and operating school communications system including, but not limited to:

1. Administrative Display Phone with integrated 280x128 supertwist graphic LCD display configured with 14 lines by 16 characters.
2. Call Switches
3. Call initiation switches capable of placing normal, urgent, or emergency calls
4. Built-in Master Clock with unlimited events, 64 schedules (including Daylight Savings Time), that can be assigned to any of the 64 time zones
5. One Ethernet interface port for the system for LAN/WAN access for district-wide all-calls and remote management

B. The system can connect to the Public Switched Telephone Network (PSTN) via analog CO trunks, or SIP trunks.

1. Telephone service with public utilities shall be arranged by the owner in conjunction with the equipment supplier. The equipment supplier shall generate a one-page document that provides the owner with information concerning the number of outside lines (minimum of 8 and a maximum of 1,125 per school).

1.03 1.03 SUBMITTALS

A. Specification sheets on all items including cable types

B. Shop drawings that detail the integrated electronic communications network system including, but not limited to, the following:
1. Port wiring arrangement
C. Wiring diagrams showing typical connections for all equipment
D. Numbered Certificate of Completion for installation, programming, and service training, which identifies the installing technician(s) as having successfully completed the technical training course(s) provided by the system manufacturer

1.04 QUALITY ASSURANCE
A. All items of equipment shall be designed by the manufacturer to function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.
B. The contractor shall be an established communications and electronics contractor who currently maintains and for at least five years has had a locally run and operated business. The contractor shall be a duly authorized distributor of the equipment supplied with full manufacturer's warranty privileges.
C. The contractor shall show satisfactory evidence, upon request, that he or she maintains a fully equipped service organization that is capable of furnishing adequate inspection and service to the system. The contractor shall maintain at his or her facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.

1.05 SINGLE SOURCE RESPONSIBILITY
A. Except where specifically noted otherwise, all equipment supplied shall be the standard product of a single manufacturer of known reputation and with a minimum of 10 years’ experience in the industry. The supplying contractor shall have attended the manufacturer's installation and service school. A certificate of this training shall be provided with the contractor's submittal.

1.06 SAFETY/COMPLIANCE TESTING
A. The communications system shall bear the label of a Nationally Recognized Testing Laboratory (NRTL), such as TUV or UL, and shall be listed by their re-examination service. All work must be completed in strict accordance with all applicable electrical codes under direction of a qualified and factory approved distributor to the approval of the owner.

B. The system is to be designed and configured for maximum ease of service and repair.

1.07 IN-SERVICE TRAINING
A. The contractor shall provide a minimum of eight hours of in-service training with this system. These sessions shall be broken into segments that facilitate the training of individuals in the operation of this system. Operators Manuals and Users Guides shall be provided at the time of this training.

1.08 WIRING
A. System wiring, and equipment installation shall be in accordance with good engineering practices as established by the EIA and the NEC/CSA. Wiring shall meet all state and local electrical codes. All wiring shall test free from all grounds and shorts.
B. All communication system wiring shall be labeled at both ends of the cable. All labeling shall be based on the room numbers as indicated in the architectural graphics package.

1.09 PROTECTION
A. The contractor shall provide all necessary transient protection on the AC power feed and on all Port-lines leaving or entering the building.
B. The contractor shall note in his system drawings the type and location of these protection devices as well as all wiring information. Such devices are not to be installed above the ceiling.

1.10 SERVICE AND MAINTENANCE
A. The contractor shall provide a five-year equipment hardware warranty of the installed system against defects in material and workmanship. All materials shall be provided at no expense to
the owner during normal working hours. The warranty period shall begin on the date of acceptance by the owner/engineer.

B. The contractor shall, at the owner's request, make available a maintenance contract offering continuing factory authorized service of this system after the initial warranty period.

C. The system manufacturer shall maintain engineering and service departments that are capable of rendering advice regarding installation and final adjustment of the system.

PART 2 - EQUIPMENT SPECIFICATION

2.01 MANUFACTURERS

A. Subject to compliance with requirements specifications, provide the following system:
1. CH1000(LT) manufactured by CareHawk Inc., Kitchener, Ontario; and Longwood, FL.

B. Other Approved Manufacturers:
1. Telecenter VoIP manufactured by Rauland-Borg Corp
2. Three Sixty

C. The intent is to establish a standard of quality, function, and features. It is the responsibility of the bidder to ensure that the proposed product meets or exceeds every standard set forth in these specifications.

D. The functions and features specified are vital to the operation of this facility; therefore, inclusion in the list of acceptable manufacturers does not release the contractor from strict compliance with the requirements of this specification.

2.02 EQUIPMENT

A. SYSTEM EQUIPMENT

1. CH1000(LT) (Central Cabinet)
   a. Wall Mount Cabinet. Shall include the following components:
   b. CC200 Central Controller Card
   c. MI100(LT) Main Interface Card
   d. TC2 Telephone Interface Card(s)
   e. AC1 Admin Interface Card(s)
   f. 5 Volt/12 Volt Power Supply
   g. DAF250C 300-Watt Class D Amplifier(s)
   h. IA5 Intercom Amplifier Card(s)
   i. CH1000C (Central Client Cabinet)
      1) Wall Mount Cabinet. Shall include the following components:
      2) CC200 Central Controller Card
      3) MI100C Main Interface Card
      4) RAC2 Remote Access Card(s)
      5) 5 Volt/12 Volt Power Supply
      6) DAF250C 300-Watt Class D Amplifier(s)
      7) IA5 Intercom Amplifier Card(s)
   j. SS16/SS32 Remote Switching Cards
      1) Option add-ons include
      2) ACA16 Audible Call Assurance Card
      3) OC16 Output Contact Card
      4) CR16 Camera Routing Card
   k. IP/Analog Telephone Equipment
      1) VTM VoIP Telephone Expansion Module
      2) VG2/VG4 2 or 4 Port FXO Telephone Gateway
      3) VFS16/VFS32 16 or 32 Port FXS Telephone Gateway
   l. Program Sources
      1) MP100 Media Player
   m. Port Equipment
      1) AP1-B Administrative Display Console
2.03 COMPONENTS AND DESCRIPTIONS

A. The CH1000(LT) intercom must support the existing 25V speakers and wire as well as a distributed cable infrastructure. Systems shall not be deemed acceptable if they do not allow the reuse of existing equipment or are not backwards compatible.

B. CH1000(LT)

1. The CH1000(LT) facility shall have a minimum of one central cabinet and a maximum of up to 7 networked central cabinets. A combined maximum of 256 CH1000(LT) audio points can be installed in a single CH1000(LT).

2. The processor software shall be upgradeable via CH1000(LT) Settings. After rebooting the central, the software upgrade is complete. If for some reason the newly installed software does not boot properly, the system shall allow for a manual revert to the previous working software load.

3. The VTM VoIP telephone module shall be configured to act as a VoIP Call Manager for facility point-to-point calls.

4. The system shall facilitate the playing of pre-recorded audio files repetitively until stopped by the CH1000(LT) Assistant User, an Administrative Display Phone AP1-B, or a dry contact closure.

5. A built-in Master Clock with battery backup shall be included to automatically control class change or other signals. The Master Program Clock shall have unlimited events that may be programmed into any of the unlimited time schedules. The schedules shall be calendar based and allow for programming years in advance. Systems that rely on an external master clock shall not be considered equivalent.

6. Network Time Synchronization. The system shall be capable of periodic update/synchronization of the processor’s time with a Network Time Server running NTP via the school’s LAN network. Systems that do not provide Network Time Synchronization will not be deemed equivalent.

C. CH1000(LT) Settings & Calendar

1. The CH1000(LT) uses a PC-based programming tool. Systems that do not use Ethernet communications for programing are not deemed equal. Systems that do not separate scheduling functions in to a separate tool shall not be deemed equal.

2. Only Facilities Technicians shall have access to Settings.

3. Users shall have access to Calendar with all the scheduling functions.

D. Administrative Display Phone

1. Administrative Display Phones shall be CareHawk Model AP1-B. The administrative telephone display LCD screen shows the time of day and date, and the Port numbers and call-in priority of Classroom stations that have called that room. Two arrow keys are used to scroll the display and to answer normal and emergency calls. The LCD display shall turn
red on any emergency call. Administrative phones can use display menus to activate zone
pages, alarm signals, and external functions; select program sources; and distribute or
cancel a program to any or all speakers or zones.

2. Administrative Display Phones shall be able to dial and have the option of dialing either the
loudspeaker or phone at each room location. The system shall automatically switch from
phone-to-intercom communication to phone-to-phone communication when the STEL or
STELVP-1 classroom phone on the receiving end of the call is lifted.

3. Administrative Display Phones shall have the ability to manually override the active
schedule in the facility. Systems that do not have the ability to override the schedule via the
administrative phone are not equal.

E. Classroom Phone
1. Classroom phones shall be one of the following CareHawk Model(s)
   a. STEL Analog Phone - Basic (Desk or Wall)
   b. STELVP-1 VoIP Display Phone (Desk or Wall)
   c. When a classroom phone goes off-hook and dials the 3- to 6-digit number of the
desired room (preceded by an # if calling a telephone instead of loudspeaker). The
call is routed to any room (admin/Classroom). The classroom phone shall be capable
of the following features depending on how the VTM is configured:
   1) Emergency Call involves going off-hook and waiting for the programmed timeout
to expire. The call is then switched to the assigned Admin Phone as an
emergency. Systems that do not provide this feature are not equivalent.
   2) Tone Distribution
   3) Program Distribution
   4) Conference Calling
   5) Transfer Call
   6) Dial Administrative Display Phone, dial the room number to call to the speaker,
or dial the classroom phone number preceded with #. The call shall be routed to
the Administrative Display Phone showing the architectural number that is
calling.
   7) Emergency All-Call shall be broadcasted to all the ports in the facility.
   8) Place Outside Call
   9) Zone/All-Page
   10) Call Waiting Tone, and it shall be possible to feed the call waiting tone to the
Administrative Phone during a conversation.

F. STELVP-1 VoIP Display Phone - (Desk or Wall)
1. The classroom VoIP phone shall be capable of the following features:
   a. Speed dials
   b. Missed call logging
   c. Ethernet pass through jack
   d. PoE
   e. Tone Distribution
   f. Audio Program On/Off
   g. Emergency All-Call shall be broadcasted to all the ports in the facility.
   h. Place Outside Call
   i. Zone/All-Page

G. Classroom Call Stations
1. Call Stations shall be CareHawk Model:
   a. CS100 Silicon Green Call-in Switch with RJ45 breakout
   b. CS35 Silicon Green Call-in Switch
   c. CS45 Rocker Style Call-in Switch with privacy
   d. CS25 Rocker Style Call-in Switch
   e. Shall be capable of Normal and Emergency Calls.
f. Normal Call involves pressing the Call Switch once. The call is then switched to the Administrative Display Phone. This requires the display of the architectural number on the Administrative Display Phone.

g. Emergency Call involves pressing the call switch at 2 times. The call is then switched to the Administrative Display Phone. This requires the display of the architectural number on the Administrative Display Phone and the LCD color to change to red.

h. Emergency call escalation - If the emergency call is unanswered by the Administrative Display Phone and the emergency call escalation programmed, the emergency call will be forwarded to all the other Administrative phones. Systems that do not provide emergency call escalation will not be considered equal.

2.04 2.04 SYSTEM PARAMETERS

A. The communication system shall be a CareHawk CH1000(LT) and shall provide a comprehensive communication network between administrative areas and Classroom locations throughout the facility. Non-volatile removable memory shall store the programming and operating system. A system that uses a battery to maintain system configuration information or is does not have removable memory shall not be acceptable.

B. The system shall contain natively RS232, RS485, USB, and Ethernet ports for communication to any third-party system. Systems that do not contain all the above communication ports or require additional equipment shall not be considered.

C. The system shall contain no moving parts. Systems that contain moving parts including cooling fans shall not be deemed equal.

D. The system shall provide no less than the following features and functions:

1. Telephonic communication (complete with DTMF signaling, dial tone, ringing and busy signals, and data display).

2. Amplified-voice communication with loudspeakers shall use CAT 3, CAT 5(e), or CAT 6 cable. A system that uses shielded wire shall not be acceptable.

3. System amplifiers shall be Class D only.

4. The system shall be capable of using two wire conductors for a speaker and call button referred from herein as a 2-wire circuit. It shall be possible to mix 2-wire and standard 4-wire circuits on the same switching/line card with the use of a AD2W16 two wire adapter. Systems that cannot mix 2-wire and 4-wire circuits on the same switching/line card shall not be considered. Systems that require more than two conductors or require shielded cable shall not be considered.

5. The system shall be available in the following configurations:

a. CH1000LT Wall/Rack mountable in a custom enclosure. Port capacity shall be from 16 to 64 ports + 4 Admin phone ports. Optionally the VTM VoIP telephone module shall integrate with the CH1000LT. The VTM shall provide unlimited classroom telephone ports and SIP/POTS lines.

b. CH1000 Wall/Rack mountable in a custom enclosure. Port capacity shall be from 16 to 256 ports + 8 Admin phone ports. Optionally the VTM VoIP telephone module shall integrate with the CH1000. The VTM shall provide unlimited classroom telephone ports and SIP/POTS lines.

c. The previously listed system configurations represent a single node in the CH1000(LT). Each node can be combined with up to 7 additional CH1000C Client systems for a total single facility capacity of up to 2,048 ports.

d. The system shall consist of any combination of the following: 8 Administrative Display Phones, Classroom VoIP Phones, and Analog Phones.

1) Classrooms shall consist of wall- or ceiling-mounted loudspeakers with call-in switches.

2) Classroom phone shall consist of VoIP phones, display phones, or DTMF dialing 2500 analog-style telephone sets.

3) All Administrative and classroom phones shall display caller-ID. The System shall support caller-ID for all ports regardless of type. Systems that do not use call-ID shall not be considered.
4) Administrative Display Phones shall be DTMF-dialing digital telephone sets with a 14x16 character LCD display panel. They shall be equipped with a standard 12-key push-button dialing keypad. Phones requiring external LCD displays shall not be accepted as an equal.

e. The system shall be a global switching system, providing up unlimited unrestricted simultaneous private telephone paths per VTM. The system must also provide up to 2 amplified intercom paths per facility. Amplified-voice intercom channels shall provide voice-activated switching. Systems requiring the use of a push-to-talk switch on administrative telephones shall not be acceptable. There shall be an automatic level control for return speech during amplified-voice communications. The intercom amplifier shall also provide control over the switch sensitivity and delay times of the VOX circuitry.

f. The system shall provide 911 Dial-Through. The 911 Dial-Through is available to any port that can dial.

g. It is of highest importance that emergency calls from classrooms receive prompt attention. Therefore, it is important that there be an alternate destination in case the emergency call does not get answered at the primary location. To this end:

1) Classroom-generated Emergency calls shall be treated as the highest system priority. Therefore, all Emergency calls shall annunciate at the top of the call queue of their respective Administrative Display Phone. Should that emergency call go unanswered for the programmed number of seconds, the call is re-routed to all Administrative Display Phones. Administrative Display Phones shall ring the distinctive Emergency ring.

2) Should the original Administrative Display Phone be engaged in a non-emergency conversation, its conversation shall be indicated with an alert tone.

3) Systems failing to escalate unanswered Emergency calls to all the Administrative Display Phone shall not be deemed as equal.

h. There shall be a System-Wide Facility Emergency All-Call feature. The Emergency All-Call shall be accessed from Administrative Phones or by the activation of an external contact closure that shall give the third-party audio program input emergency status. The Emergency All-Call function shall have the highest system priority and shall override all other loudspeaker-related functions including Time Tones, Normal All-Call or Zone Pages, or Audio Distribution.

1) Emergencies calls are to be treated with the highest level of concern. Systems that do not treat Emergency-All-Call page from an administrative console with the highest priority shall not be deemed as equal.

2) When a user picks up the receiver and presses the “Emergency Page” button an emergency page will commence. In this way, the user shall not be required to memorize complicated key sequences to access emergency functions.

3) The Emergency All-Call shall capture complete system priority and shall be transmitted over all speakers in the facility. It shall also activate an external relay, which can be used to automatically override volume controls and other sound systems.

4) Systems without Emergency All-Call or systems with All-Call that cannot be activated by external means or that do not capture complete system priority or activate an external relay shall not be acceptable.

i. There shall be at least 100 user tone slots available for pre-recorded tones/announcements. Any number of these can be dedicated Emergency Alarm Tones. Each may be accessed by dialing the appropriate number from the designated Administrative Display Phone, via Tone Alerts PC software, by a dedicated panic button, via Assistant PC based admin console, or via any authorized PBX/Cell phone. Systems using external alarm generators or having less than 100 pre-recorded tones/announcements shall not be acceptable.

j. There shall be six (6) general purpose inputs available at the central cabinet. CH1000(LT) Decisions software shall be used to configure system inputs. It shall be
possible to configure an input to trigger a tone, an output, a time sync, a program source, and/or a camera output. Systems that do not support inputs shall not be deemed equal.

k. There shall be five (5) open collector outputs and two (2) relay supported dry contacts that are configured from CH1000(LT) Decisions software. It shall be possible to toggle an output via an Administrative Display Console by dialing a code. These outputs remain set until toggled later. Systems that require the user to remember complicated dialing schemes or that prompt the user via cryptic commands shall not be deemed equal.

1) The system shall be capable of being programmed for security contact relays for use with magnetic locks, motion detectors, cameras, or any low-voltage, dry contact creating device. Systems using security stations for control of external functions shall not be acceptable.

l. There shall be a program source interface, which shall accept up to two program inputs. Systems requiring an external program source interface shall not be acceptable.

m. The base system shall support the use of up to eight (8) TC2 FXS telephone interface cards for use with a PBX. The circuitry shall interface with the FXO ports of an external telephone system or CO lines and shall provide facilities for up to 8 ports per facility. This option shall also provide the ability to make outside line calls from Administrative Display Console.

n. The system shall provide for field-programmable three-, four-, five-, or six-digit alphanumeric architectural room numbers.

o. There shall be an automatic level control for return speech during amplified-voice communications.

p. Each room loudspeaker shall be assignable to any one, any combination, or all of 64 Multi-purpose zones per facility. Systems with less than 64 Multi-purpose zones shall not be acceptable.

q. There shall be unlimited Time-Signaling Schedules with unlimited user-programmed events per facility. Each event shall sound one of the user-selected tones or external audio. It shall be possible to assign each schedule to a day in an unlimited calendar or to manually change schedules from an authorized CH1000(LT) Calendar software, via the web browser, Assistant software or the Administrative Display Console. Systems that do not provide unlimited time-signaling schedules or a choice of 100-time tones plus external audio shall not be acceptable.

r. An internal program clock (with battery backup) shall be included, allowing for unlimited user-programmed events per facility. It shall be possible to synchronize the internal program clock with an external master clock or an internet time based time server. Systems that do not provide an internal program clock and/or cannot synchronize with an external master clock or to a time server are not equal.

1) The built-in Master Clock corrects time by accessing the network's Network Time Server.

2) The CH1000(LT) Processor can adjust the Daylight Savings Time automatically.

3) Each event shall be able to be directed to any one of the 64 multi-purpose time-signaling zones.

4) Each event shall sound one of 100 user-selected tones or external audio. Each event may use a different custom tone to send the gymnasium, shop classes, and pool (if necessary) a separate time tone to indicate "clean up." Minutes later, the entire facility can receive the same time tone to indicate class change.

5) Each of the 100 Distinct Time Tone Signals may be manually activated by selected Administrative Display Phones or by an authorized CH1000(LT) Assistant software or by Tone Alerts software.

(a) Upon the user picks up the receiver and presses "Tones" menu, a menu shall appear on the display prompting the user to enter the tone number. In this way, the user shall not be required to memorize complicated key sequences to access manual time-tone functions.
b. Systems that do not provide unlimited time signaling schedules or do not provide automatic activation of schedules shall not be acceptable.

s. There shall be a zone-page/all-page feature that is accessible by STELVP-1/STEL Phones and Administrative Phones.
   1) There shall be automatic muting of the loudspeaker in the area where a page is originating.
   2) There shall be a pre-announce tone signal at any loudspeaker selected for voice paging.

t. There shall be a voice-intercom feature that is accessible by STELVP-1/STEL Phones and all Administrative Display Phones.
   1) There shall be a privacy tone every 15 seconds to signal that any loudspeaker selected for amplified-voice intercom is in progress.
   2) There shall be a pre-announce tone signal at any loudspeaker selected for voice-intercom communication.
   3) Privacy and pre-announce tone signals shall be capable of being disabled during system initialization.
   4) There shall be an automatic switchover to private telephone communication should the person at the loudspeaker pick up his analog or VoIP phone handset.

u. There shall be telephonic features, which are accessible by all STELVP-1/STEL Phones, and Administrative Display Phones.
   1) There shall be an audible ring signal announcing that a call has been placed to that phone.
   2) When the user picks up the receiver and dials a # (pound) followed by a room number the system shall connect the caller to the loudspeaker in the room. There should be no confusion as to type of conversation whether speaker/intercom or telephonic to be established.
   3) It shall not be possible to tie up communication channels by leaving an Administrative display phone or STELVP-1/STEL off hook when nothing is dialed. Systems that tie up system resources based only on an off hook condition shall not be deemed equal.

v. Each Classroom call station shall be programmable for one of two call-in types, as follows:
   1) Normal/Emergency
   2) Emergency
      (a) Classroom Call Stations programmed for access Normal / Emergency shall be able to initiate an emergency call by pressing the call button twice within two seconds. STELVP-1/STEL classroom telephones shall support off hook duress. When the handset is knocked off hook for a programable number of seconds an emergency level call is placed. Systems, which require additional switches and/or conductors to initiate an emergency call, shall not be acceptable.
         (1) Emergency Calls-ins Classroom Call Switch Stations shall jump to the top of the call-in queue and alert the Administrative Display Phone via a distinctive ring and the LCD flashing red. If the Administrative display phone is busy the user shall be alerted via the earpiece. Systems which interrupt calls shall not be acceptable.
         (2) Normal calls shall be logged into queue for the designated Administrative Display Phones.
         (3) Each queue shall first be sorted by call priority (emergency calls, and then normal calls). Calls are sorted within each priority level on a first-in, first-out basis. When a call is answered, it shall automatically be removed from the queue. Systems that do not sort calls according to priority and order received shall not be acceptable. The display shall simultaneously show up to four Classroom Call Switch Station Calls
pending. Additional calls shall be indicated viewable by scrolling the display.

(4) It shall be possible to answer any incoming call simply by picking up the handset while it is ringing. It shall not be necessary to hit any buttons to answer a call unless the call has dropped into the queue.

w. Administrative Display Phones shall be equipped with a 14x16 character alphanumeric display panel.

1) Administrative Display Phones shall receive dial tone upon going off-hook. Outgoing calls are made by dialing the desired port number. Incoming calls can be directed to the telephone via call groups.

2) The display shall normally show the time of day and day of week, the current time, and the numbers of up to four stations calling in along with the call-in status of each station (normal or emergency). When dialing from the Administrative Display Phone, the display shall indicate the room number being dialed.

3) The display shall also provide user-friendly menu selections to assist the operator when paging and distributing program material. Displays shall be in English or French. Systems that require the operator to memorize long lists of operating symbols or control codes shall not be acceptable.

4) Program selection and its distribution or cancellation shall be accomplished from a designated Administrative Display Phone with the assistance of the menu display system. Distribution and cancellation shall be to any one or combination of speakers, any zone(s), or all zones. It shall be possible to provide two program channels at the same time.

5) It shall be possible, via an Administrative Display Phone, to manually initiate any of 100 tones. The tones shall be separate and distinctly different.

6) Each Administrative Display Phone shall maintain a unique queue of all stations calling that phone.

x. System programming shall be from an authorized CH1000(LT) Settings software. All system programming data shall be stored in nonvolatile removable memory of at least 1Gb.

1) Diagnostics shall be built into the CH1000(LT) Central controller and be accessible via a web browser and be accessible only by authorized personnel. Diagnostics shall show all activity in real time with a 30-day log of all events. Systems that do not provide real time activity shall not be deemed equal.

2) All programming and data access shall be through an Ethernet connection. Systems that do not have a built in Ethernet port shall not be deemed equal.

2.05 2.05 SPEAKERS

A. The SPL-12-RTRJ 1’ X 2’ lay in Ceiling Speaker is part of the CH1000 series Security Communications Systems. The SPL-12-RTRJ is a complete loudspeaker assembly, with 8” frame, perforated steel baffle and integral back box. One 24” white “T” bar is supplied to finish cut tile edge. The SPL-12-RTRJ material and construction permits use where ceiling plenum is part of the sir handling system. Two RJ45 jacks are provided on the rear of the unit to allow for daisy chaining of multiple speakers. The SPL-12-RTRJ interfaces with a SS16/SS32 Security Switching Card audio port.

B. The SPL-12-RTRJ 2’ X 2’ lay in Ceiling Speaker is part of the CH1000 series Security Communications Systems. The SPL-12-RTRJ is a complete loudspeaker assembly, with 8” frame, perforated steel baffle and integral back box. One 24” white “T” bar is supplied to finish cut tile edge. The SPL-12-RTRJ material and construction permits use where ceiling plenum is part of the sir handling system. Two RJ45 jacks are provided on the rear of the unit to allow for daisy chaining of multiple speakers. The SPL-12-RTRJ interfaces with a SS16/SS32 Security Switching Card audio port.

C. The SOLUTION 1 loudspeaker shall be an interior grade, ceiling tile mount, complete loudspeaker assembly consisting of a 22 gage perforated steel baffle, fastened to a Factory
installed loudspeaker and transformer, steel support bridge and steel UL Listed back can. Finish of the baffle shall be white baked epoxy hybrid.

1. The loudspeaker shall be 8” O.D., the transducer voice coil shall be 19 mm (0.75 in) O.D.; the loudspeaker cone shall be constructed of molded paper fiber.

2. The loudspeaker assembly shall be equipped with an integral dual voltage line transformer for either 25V or 70.7V systems. Five tap levels shall be available at 5W, 2.5W, 1.25W, 0.63W and 0.31W. Tap selection is by selecting and energizing color coded wire pigtail leads on the rear of the enclosure.

3. Performance measurement and specification of a typical production unit shall conform to EIA 426A standards:

4. Sensitivity (SPL at 1m [3.3 ft] with 2.83V input, averaged from 100 Hz to 10 kHz) shall be at least 92 dB-SPL.

5. Usable frequency response shall extend from 65 Hz to 17 kHz (10 dB below rated sensitivity) with no external equalization.

6. Rated power for nominal 8-Ohm unit shall be at least 12 W continuous pink noise.

7. The loudspeaker assembly shall have a nominal conical polar coverage pattern of 90 degrees.

2.06 (AT -6 DB POINT), AVERAGED 500 HZ TO 10 KHZ.

A. The complete loudspeaker assembly, shall weigh no more than 5 kg (11 lb).

1. The SOLUTION 2 loudspeaker shall be an interior grade, ceiling tile mount, complete loudspeaker assembly consisting of a 22 gage perforated steel baffle, fastened to a Factory installed loudspeaker and transformer, steel support bridge and steel UL Listed back can. Finish of the baffle shall be white baked epoxy hybrid. The loudspeaker assembly includes a screwdriver/ knob volume control mounted in the center of the steel baffle.

a. The loudspeaker shall be 8” O.D., the transducer voice coil shall be 19 mm (0.75 in) O.D.; the loudspeaker cone shall be constructed of molded paper fiber.

b. The loudspeaker assembly shall be equipped with an integral dual voltage line transformer for either 25V or 70.7V systems. Five tap levels shall be available at 5W, 2.5W, 1.25W, 0.63W and 0.31W. Tap selection is by selecting and energizing color coded wire pigtails leads on the rear of the enclosure.

c. Performance measurement and specification of a typical production unit shall conform to EIA 426A standards:

d. Sensitivity (SPL at 1m [3.3 ft] with 2.83V input, averaged from 100 Hz to 10 kHz) shall be at least 92 dB-SPL.

e. Usable frequency response shall extend from 65 Hz to 17 kHz (10 dB below rated sensitivity) with no external equalization.

f. Rated power for nominal 8-Ohm unit shall be at least 12 W continuous pink noise.

g. The loudspeaker assembly shall have a nominal conical polar coverage pattern of 90 degrees.

2.07 (AT -6 DB POINT), AVERAGED 500 HZ TO 10 KHZ.

A. The complete loudspeaker assembly, shall weigh no more than 5 kg (11 lb).

1. The QH16T loudspeaker shall be a double re-entrant trumpet type, consisting of a single compression-type transducer, installed in Factory assembled integral metal enclosure with integral metal projector bell. The loudspeaker will be furnished complete with adjustable, universal metal mounting flange. Finish: Tan enamel.

a. The transducer voice coil shall be 25 mm (1.0 in) in diameter; the diaphragm shall be weather resistant phenolic composite.

b. The loudspeaker assembly shall be equipped with an integral dual voltage line transformer for either 25V or 70.7V systems. Tap selection is by selector switch; four tap levels shall be available for 70.7V operation at 16W, 8W, 4W and 2W. Five tap levels shall be available for 25V operation at 16W, 8W, 4W and 2W and 1W. Audio connection to the loudspeaker is by binding head screw in an integral weather-resistant compartment.
c. Performance measurement and specification of a typical production unit shall conform to EIA 426A standards
d. Sensitivity (SPL at 1m [3.3 ft] with 2.83V input, averaged from 100 Hz to 10 kHz) shall be at least 110 dB-SPL.
e. Usable frequency response shall extend from 300 Hz to 15 kHz (10 dB below rated sensitivity) with no external equalization.
f. Rated power for nominal 8 ohm unit shall be at least 16 W continuous pink noise.
g. The loudspeaker shall have a nominal conical polar coverage pattern of 110 degrees (at -6 dB point), averaged 500 Hz to 10 kHz.
h. Overall trumpet bell diameter shall not exceed 225 mm (8.88 in), front to rear dimension shall not exceed 235 mm (9.19 in), the integral mounting flange shall be no smaller than 80mm (3.13 in).
i. The loudspeaker shall weigh no more than 4.5 kg (10 lb).

PART 3 - EXECUTION
3.01 3.01 EXAMINATION
3.02 EXAMINE CONDITIONS WITH THE INSTALLER PRESENT FOR COMPLIANCE WITH REQUIREMENTS AND OTHER CONDITIONS AFFECTING THE PERFORMANCE OF THE INTEGRATED TELECOMMUNICATIONS/TIME/AUDIO/MEDIA SYSTEM.
A. Do not proceed until unsatisfactory conditions have been corrected.
3.03 3.02 INSTALLATION
A. The installation, adjustment, testing, and final connection of all conduit, wiring, boxes, cabinets, etc., shall conform to local electrical requirements and shall be sized and installed in accordance with the manufacturer’s approved shop drawings.
B. Low-voltage wiring may be run exposed above ceiling areas where they are easily accessible.
C. The contractor shall install a new rack console at the location shown on plans.
1. Solder each speaker line; splice and tape each individual wire.
2. Connect remote slave clocks to master clock in console.
D. All classroom phones shall be wall-mounted.
1. Mount at 54" AFF.
2. Conceal all wiring.
3. Verify exact location with Architect.
E. All Administrative Phones shall be desk- or counter-mounted.
1. Verify exact location with the architect.
F. Tie-wrap speaker and telephone lines that run above ceiling and are not in the conduit to the ceiling joist with a maximum spacing of 8' between supports. No wires shall be laid on top of ceiling tile.
G. Connect field cable to each speaker transformer using UL butt splices for 22 AWG wire.
H. Terminate field wiring on the wall adjacent to the system using Telco 66 type blocks. Provide neat cross connect system for wiring. Wiring is to be labeled to indicate final architectural room number that it services on the Telco block.
I. Label the system in numerical order with speaker/phone combinations first and speaker/outside horn combinations last. Labeling and order shall reflect final Architectural room numbers posted outside the rooms. Use three, four, five, or six digit dialing extensions.
J. Provide a minimum of eight hours of operational and programming instruction to school personnel.
K. Provide a technician to standby and assist in system operation on the first school day following installation of the Multicom System.
L. Mark and label all telephone outlets and/or sets with the graphic room numbers. Label all demarks IDF and MDF points with destination point numbers. Rooms with more than one outlet shall be marked XXX-1, XXX-2, XXX-3, etc., where XXX is the room number.
M. No graphic room number shall exceed the sequence from 000001 through 899999.
   1. All outside speakers shall be on a separate page zone and time zone.
   2. All hallway speakers shall be tapped at 1 watt maximum.
   3. All outside horns shall be tapped at 3.75 watts maximum.
   4. All classroom speakers shall be tapped at ½ watt maximum.
   5. Large rooms, such as cafeterias, shall be tapped at 2 watts maximum.

3.04 3.03 GROUNDING

A. Provide equipment grounding connections for Integrated Telecommunications/Time/Audio/Media System as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to ensure permanent and effective grounds.

B. Ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize the greatest extent possible ground loops, common mode returns, noise pickup, cross talk, and other impairments.

C. Provide all necessary transient protection on the AC power feed and on all audio lines leaving or entering the building.

D. Note in the drawing, the type and locations of these protection devices as well as all wiring information.

E. Furnish and install a dedicated, isolated earth ground from the central equipment rack and bond to the incoming electrical service ground buss bar.

PART 4 - EXECUTION

4.01 4.01 DIVISION OF WORK

A. While all work included under this specification is the complete responsibility of the contractor, the following division of actual work listed shall occur.

   1. The conduit, outlets, terminal cabinets, etc., which form part of the rough-in work shall be furnished and installed completely by the electrical contractor. The balance of the system, including installation of speakers and equipment, making all connections, etc., shall be performed by the manufacturer's authorized representative. The entire responsibility of the system, its operation, function, testing, and complete maintenance for one year after final acceptance of the project by the owner shall also be the responsibility of the manufacturer's authorized representative.

4.02 EQUIPMENT MANUFACTURER'S REPRESENTATIVE

A. All work described herein to be done by the manufacturer's authorized representative shall be provided by a documented factory authorized representative of the basic line of equipment to be used.

B. As further qualification for bidding and participating in the work under this specification, the manufacturer's representative shall hold a valid C-10 Contractor's License issued by the Contractor's State License Board of [your state]. The manufacturer's representative shall have completed at least 10 projects of equal scope, giving satisfactory performance, and shall have been in the business of furnishing and installing sound systems of this type for at least 5 years. The manufacturer's representative shall be capable of being bonded to ensure the owner of performance and satisfactory service during the guarantee period.

C. The manufacturer's representative shall provide a letter with submittals from the manufacturer of all major equipment stating that the manufacturer's representative is an authorized distributor. This letter shall also state that the manufacturer guarantees service performance for the life of the equipment and that there will always be an authorized distributor assigned to service the area in which the system has been installed.

D. The contractor shall furnish a letter from the manufacturer of the equipment that certifies that the equipment has been installed according to factory intended practices, that all the components used in the system are compatible, and that all new portions of the systems are
operating satisfactorily. Further, the contractor shall furnish a written guarantee, guaranteeing all parts for a period of five years after final acceptance of the project by the owner.

4.03 4.03 INSTALLATION

A. Plug disconnect: All major equipment components shall be fully pluggable by means of multi-pin receptacles and matching plugs to provide for ease of maintenance and service.

B. Protection of cables: Cables within terminal cabinets, equipment racks, etc., shall be grouped and bundled (harnessed) as to type and shall be laced with No. 12 cord waxed linen lacing twine or T & B "Ty-Rap" cable. Edge protection material shall be installed on edges of holes, lips of ducts, or any other point where cables or harnesses cross a metallic edge.

C. Cable identification: Cable conductors shall be color-coded, and each cable shall be individually identified. Each cable identification shall have a unique number located approximately 1 1/2" from cable connection at both ends of the cable. Numbers shall be approximately 1/4" in height. These unique numbers shall appear on the As-Built Drawings.

D. Instructions: Provide complete "in service" instructions of system operation to school personnel. Assist in programming of telephone system.

4.04 4.04 DOCUMENTATION

A. Provide the following directly to the Supervisor of Technology Service:

B. A printed copy of all field programming for all system components

C. One copy of all diagnostic software with a copy of field program for each unit

D. One copy of all service manuals, parts list, and internal wiring diagrams of each system component

E. One copy of all field wiring runs, location, and end designation of the system

END OF SECTION
SECTION 27 5130
CLASSROOM SOUND REINFORCEMENT SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Speakers.
   B. Input equipment.
   C. Speaker system cable.

1.02 REFERENCES

1.03 SYSTEM DESCRIPTION
   A. All-in-one classroom audio system equal to Lightspeed TOPCAT.
      1. All-in-one unit with integrated infrared sensor/receiver, amplifier, and speakers.
      2. Two-way hybrid speaker system with exciter technology sound panel and low frequency cone driver.
      3. Two IR channels with independent volume controls.
      4. Pendant-style classroom microphone with audio input.
      5. Four wireless audio inputs from wireless Media Connector.
      6. One wireless audio output to the Media Connector.
      7. Optional PageFirst emergency page priority.
      8. In-Ceiling mounted.
      9. Cross over technology to deliver high speech intelligibility and full range sound with even distribution throughout the classroom.

1.04 SUBMITTALS
   A. See Division 1 and Section 26 0030 for submittal procedures.
   B. Shop Drawings: Indicate electrical characteristics and connection requirements. Indicate component interconnecting wiring, and wiring diagrams of field wiring to speakers.
   C. Product Data: Provide data showing electrical characteristics and connection requirements for each component.
   D. Operation Data: Include instructions for adjusting, operating, and extending the system.

1.05 QUALITY ASSURANCE
   A. Conform to requirements of NFPA 70 and Federal Communications Commission.
   B. Products: Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Lightspeed

2.02 COMPONENTS
   A. Overall System:
      1. Power output: 20 Watts rms
      2. Acoustic Frequency response: 60 Hz to 18 kHz -10dB
      3. AC Power Input: 100-240V ~ 50/60Hz 1.5A
      4. DC Power Input: 24V/2.5A
      5. Dimensions (W x D x H): 24" x 24" x 4" (Removable side spacers to fit international ceiling grids) (595mm x 595mm x 101mm)
      6. Weight: 22 lbs (10 kg)
      7. Controls:
         a. (2) IR microphone volume controls
8. Connections:
   a. (1) AC Power input
   b. (1) Optional DC Power Input
   c. (1) Optional Page mute (PageFirst™) input (Euro-block)

B. Integrated Infrared Sensor/Receiver:
   1. Total Diodes: 32
   2. Reception Coverage: up to 1600 square feet
   3. Signal-to-noise: >77 dB
   4. Image and Spurious Rejection: >70 dB
   5. Total Harmonic Distortion: <1%, 1 kHz
   6. Standard sub-carrier frequencies: 2.06/2.54 MHz
   7. Alternative sub-carrier frequencies: 3.20/3.70 MHz
   8. Receiver Sensitivity: 6 µV for 60 dB S/N
   9. Reception Selectivity: ±40 kHz

C. Integrated 2-Way Hybrid Speaker System:
   1. Description: exciter technology sound panel plus low frequency cone driver
   2. Integrated cross-over circuit
   3. Panel Size: 16" x 8"
   4. Cone Driver Size: 5.25"
   5. Overall Frequency Response: 60 Hz to 18 kHz -10dB
   6. Impedance: 8 Ohms
   7. Power Handling: 25 W

D. The in-ceiling classroom audio system shall use bi-directional DECT wireless transmission technology to integrate with other audio sources in the classroom.

E. The in-ceiling classroom audio system shall use bi-directional DECT wireless transmission to send a mixed audio output to a receiver/transmitter located at a convenient/student accessible location in the classroom.

F. The all-in-one system must contain a Page mute function (PageFirst™) that passively detects the audio signal of a page coming through the PA system without compromising system performance or voiding warranties. As an audio signal is sent to the PA speaker, the PageFirst™ detects that signal and immediately mutes the REDCAT Media.

G. The all-in-one audio system shall be manufactured using lead-free processes and free of other materials harmful to the environment (RoHS compliant).

H. The all-in-one audio system shall be manufactured in the USA.

I. The all-in-one system shall be UL Listed as an Audio/Video Apparatus and suitable for use in air handling spaces (UL 2043).

J. The receiver/amplifier shall be CE certified.

K. Wireless Media Connector
   1. Description: Integrates with classroom audio sources to send the audio wirelessly to the all-in-one system in the ceiling.
   2. (1) Power switch with LED
   3. (1) Registration switch with Registration LED and linked LED
   4. Audio Inputs: (4) 3.5mm stereo jacks connect to classroom audio sources.
   5. Audio Output: (1) 3.5mm jack with volume control
   6. Audio frequency response: 80 Hz to 7 kHz ±3 dB
   7. Audio distortion: <1%
   8. DC Power Input: 5V/1.0 Amp
   9. Mounting: table-top or wall
   10. Dimensions (W x D x H): 8.75”x 5.375”x 2.0” (22.2 cm x 13.7 cm x 5.1cm)

L. Pendant-Style IR Microphone / Transmitter with Volume Control
1. Description: the pendant-style infrared microphone/transmitter shall contain microphone volume control on the unit allowing teachers to adjust volume level from anywhere in the classroom. The microphone must be capable of being worn around a teacher’s neck as a hands-free microphone via the lavaliere cord or to be used as a handheld student pass-around microphone. The transmitter must be rechargeable via cradle charger and must have alkaline charge protection.
2. Equal to Lightspeed Redmike VC
3. Standard sub-carrier frequencies: 2.06/2.54 MHz
   a. Alternative sub-carrier frequencies: 3.20/3.70 MHz
4. Audio distortion: <1%
5. Integrated microphone type: uni-directional electret
6. Input jack for audio source or optional external microphone: 3.5mm
7. Microphone input impedance: 2.2k Ohms
8. Volume control range: 0 dB (total range = 16 dB)
9. Volume control level: 9 levels (2 dB change per level)
10. Alkaline Charge Protection: Yes
11. Battery Charger: cradle charger (charges two transmitters)
12. Cradle Charger input: mini DC jack
13. Cradle Charger Output Jack: 3.5mm DC output jack for LT-71 or HM-70 transmitters
14. Battery Power: One (1) AA NiMH Lightspeed rechargeable battery (Part# BA-NH2A27)
15. Dimensions: 3.5” (h) x 0.9” (w) x 1.0” (d)
16. Weight (with battery): 2.1 oz.
17. The pendant-style transmitter shall be manufactured using lead-free processes and free of other materials harmful to the environment (RoHS compliant).
18. The pendant-style transmitter shall be CE certified.

2.03 WIRE AND CABLE
   A. Plenum Cable for Speaker Circuits: Shall be purchased with speakers.

PART 3 EXECUTION

3.01 INTEGRATING WITH OTHER AUDIO SOURCES
   A. The wireless Media Connector must have four audio inputs to allow other audio sources to be wirelessly transmitted and played through the system. Computers, DVD/BLUERAY’s, TV’s, CD’s, MP3’s etc. may be connected into the Media Connector using appropriate patch cords. The Media Connector must also receive audio back from the system to output the mixed audio signal of both microphone channels and multimedia for recording purposes and interface with assistive listening devices.

3.02 INSTALLATION
   A. Install in accordance with manufacturer’s instructions.
   B. Support cables above accessible ceilings to keep them from resting on ceiling tiles. Use spring metal clips or plastic cable ties to support cables from structure for ceiling suspension system. Include bridle rings or drive rings.
   C. Use suitable cable fittings and connectors.
   D. OWNER PERSONNEL TRAINING
      1. Owner’s Instruction: user-training will be performed by the manufacturer’s local representative. The training will include a video on the research and benefits of classroom amplification, system operation, simple troubleshooting guidelines, and incorporating the classroom amplification into teaching styles. The manufacturer will also provide additional training in trouble-shooting techniques and product return procedures to one specified person per campus.
      2. Provide local classroom facilities.

END OF SECTION
SECTION 28 1300
ACCESS CONTROL

PART 1  GENERAL

1.01  SECTION INCLUDES

A.  Security access devices.
B.  Access control panel.

1.02  RELATED REQUIREMENTS

A.  Section 08 7100 - Door Hardware.
B.  Section 26 0519 - LOW-VOLTAGE POWER CONDUCTORS AND CABLES (600 V and Less).

1.03  REFERENCES

A.  NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04  SYSTEM DESCRIPTION

A.  Security Access System:  Control access to building and selected areas using a door security system.
B.  The work consists of providing and installing prescribed systems and equipment, in accordance with the Owner's directives and needs. The Contractor shall design, install, and configure systems to provide the exact function described herein and will be held to the operational criteria. Contractor shall be responsible for providing and installing a complete and fully operational system, with the intended features and capabilities, whether or not all required parts, components, systems or accessories are specified in the construction documents. Contractor shall provide all required parts, components, systems, materials and accessories needed for a complete and working system, without additional cost to the owner.
C.  Controllers shall be located in IT Room(s) or as coordinated with the Owner, with connections to the network and wiring to all accessories and equipment
D.  Interface with the Intrusion Detection System as required
E.  Furnish all labor, materials, tools, equipment, and services for all Access Control Equipment, as indicated, in accord with provisions of Contract Documents. Final terminations and system commissioning to be performed by a factory certified technician.
1.  Items include but are not limited to the following:
2.  Reader Controller
3.  Reader Interface
4.  Access Control and Alarm Monitoring software
5.  Power Supply
6.  Card Reader and Credentials
7.  Wiring, switches, and ancillary equipment
8.  Panic button for building lockdown
9.  Interface with ADA operated doors, including wiring and accessories as required such that presentation of credentials (reader) allows a actuation within 10 seconds
10. Although such work is not specifically indicated, provide and install supplementary or miscellaneous items, appurtenances and devices incidental to, or necessary for, a sound, secure and complete installation.
11. Training on operation and software of the access control system.

1.05  SUBMITTALS

A.  See Section 26 0030 - Administrative Requirements, for submittal procedures.
B.  Shop Drawings:  Provide system wiring diagram showing each device and wiring connection required.
C.  Product Data:  Provide electrical characteristics and connection requirements.
D. Submit data consisting of shop drawings and catalog cut sheets complete with technical data necessary to evaluate the material and equipment. Include dimension, wiring and block diagrams, performance data, ratings, control sequences, and other descriptive data necessary to describe the item proposed and its operating characteristics. Included a complete technical specification for the submitted equipment, noting differences and adherences to the specifications.
   1. Coordinate with other trades in submittal of shop drawings.
   2. Provide an operational narrative of each component/system. See Section Door Hardware specifications for operational description.
   3. Submit to Owner a complete listing of proposed devices, indicating interconnection equipment locations and specifying terminal/connector termination locations. Submit a complete set of proposed drawings, identifying equipment locations, types of cabling, numbers of conductors, raceway locations, and termination points of each conductor.

E. Qualification Data: For system supplier. Compliance with this Section shall include letters of certification. Certifications shall be submitted for approval with and be incorporated with submittal. Submittals will not be considered without the certifications.

F. Warranty Documentation: Provide copies of manufacturers' warranties for all system components and applicable equipment. Include statement of labor warranty from the manufacturer, Security Contractor, and/or 3rd party entity.

G. Record Documentation:
   1. Submit a copy of a signed agreement between the Security Contractor and the Owner stipulation that the license of all software and operation systems residing on the server and workstations shall become the sole property of the Owner.
   2. Submit to Owner upon completion of Work, all passwords used to access all aspects of the operating system software and database utilized by the system. Documentation shall include the name and position of anyone who has knowledge or record of these passwords.
   3. Substantial Design Closeout Documentation
   4. Operation and Maintenance Manual Data: Submit data in accordance with Division 1 and this Section for all equipment specified in this Section. Include complete set of supplier's operating instructions, installation instructions, and troubleshooting guide. Include final listing of doors, locations and normal status in MS Excel format.
   5. Prior to Substantial Completion, provide schematic drawings depicting type and location of interface equipment/components, number of cables and conductors, raceway locations, types of connectors, circuit requirements and type and dimensions of enclosures.
   6. The Security Contractor shall provide documentation of any specialized tools required by the End User in order to perform routine maintenance.

1.06 QUALITY ASSURANCE
   A. Conform to requirements of NFPA 70.
   B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 200 miles of Project.
      1. System supplier must be certified by the equipment manufacturer for installing, supporting and servicing the products to be furnished. Certification shall be submitted on the equipment manufacturer's letterhead.
   C. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and indicated.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING
   A. Acceptance: Upon delivery to the site, Contractor shall inspect all products and materials for any damage. Acceptance of the units constitutes that the inspection has occurred and no damaged or unacceptable products were found, and any damage or unacceptable products would be the responsibility of the Contractor.
B. Store product in temperature and humidity controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F (10 and 30 deg C), and not more than 80 percent relative humidity, non-condensing.

1.08 WARRANTY

A. All work and system components shall be covered by a one (1) year 'in field' warranty against defects in materials and workmanship, commencing with substantial completion of the project, unless otherwise directed by owner or their representative. During system warranty period, system updates are to be made available to owner at no charge to owner. During warranty period, provide twenty-four (24) hour toll-free technical support.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Security Access System:
1. Vanderbilt SMS System, complete with Communication Interface Module (CIM), software, transaction and alarm monitoring, and all accessories as required to meet Owner's requirements.
2. The contractor shall furnish and install all hardware, software, devices and components to meet the performance and functional requirements described in these contract documents. Include all items required, whether or not individually specified, to ensure a completely operational integrated Security Protection system. The contractor must complete all database entry (unless directed otherwise by owner or their representative), and provide the owner with training on cardholder entry, as well as all system programming. No additional costs shall be allowed to make the system operational or to meet specifications.
3. System Software:
b. Access Control & Alarm monitoring software includes in base package:
c. Transaction & Alarm monitoring / routing
d. Cardholder management (includes special access needs)
e. Unlimited card holder capacity
f. Unlimited card reader capacity
g. Unlimited alarm capacity
h. Unlimited operator capacity
i. Manage online and off line locks/readers
j. Complete Auditing/Reporting capabilities
k. Auto scheduling of predefined reports
l. Enrollment reader capable
m. Elevator Control
n. Unless otherwise specified by owner, server shall be provided by the Security Contractor. Minimum requirements are MS Windows Server 2008 R2 Operating System, network card, DVD/CD-RW, 22" flat screen monitor, 104-key keyboard and mouse.
4. System Hardware:
a. Reader Controllers: models VSRC &. VRCNX-R - as manufactured by Vanderbilt Industries.
   1) The reader controllers shall be independently programmed, intelligent devices, which shall be able to make decisions and store transactions at the local level. The system shall provide reader controllers for one read head or up to 16 reader capacity, and field configurable by standard system software. Capable of being fully networked into (TCP/IP LAN/WAN) network connectivity. Downstream communication shall be done through RS-485. Enclosure to be lockable NEMA rated 20"x 20" x 4".
2) Downstream communication via RS-485 connects directly to the following devices:
   (a) VRINX. (reader interface)
   (b) VIONX-8. (input / output board)
   (c) Schlage AD Series locks.
   (d) Schlage wireless PIM400-485-SMS
   (e) Scalable for the following:
       (1) 1 door controller: VSRC
       (2) 16 door controller: VRCNX-R
   (f) Specifications:
       (1) Up to 16 input device channels
       (2) Up to 16 supervised or non-supervised inputs
       (3) Up to 16 SP/DT relays
       (4) Flashable Firmware
       (5) 64 MB RAM for ID capability
       (6) Power requirements 24 VAC @ 14 amps
       (7) UL Listed for UL294
       (8) RoHS compliant

b. Reader Interface: model. VRINX - as manufactured by Vanderbilt Industries.
   1) Each reader in the system shall have a dedicated reader interface panel able to connect
      to the controller via RS-485 protocol, able to support proximity, smart card, magnetic
      stripe, biometric, bar code, and Wiegand technologies. The reader interface panel shall have
      two form "C" SP/DP 1 amp relay outputs, four supervised or unsupervised contact inputs.
   2) Specifications:
      (a) Enclosure Dimensions - 8 ¼"H x 7 ½"W x 3 ½"D
      (b) Power requirements - 14-24 VDC
      (c) Max. Current req. - 120 mA (without read head)
      (d) Operating Temperature - 0° to 49° C or 32° to 120° F
      (e) Cable spec. - 18 AWG 2 conductor stranded, shielded, twisted for data to VRCNX-R &
         18 AWG 2 conductor stranded, shielded, twisted for power, & 18 AWG 6 conductor for read
         heads.
      (f) Cable distance - with RS-485 4,000 ft. for data to VRCNX-R; 500 ft. for power & 500 ft.
         for read head.
      (g) Operating humidity - 10% to 90% (non-condensing)
      (h) UL Listed for UL294.
      (i) RoHS compliant

c. Smart Reader Controller: model. VSRC - as manufactured by Vanderbilt Industries.
   1) Each smart reader controller shall operate on Linux operating system compatible
      with Vanderbilt Industries Security Management software version 5.3.5 and higher. It shall
      communicate via TCP/IP protocol and is able to be connected to a variety of different
      read head technologies. Controller to have 64 Mb flash memory and 64 Mb RAM with two form
      "C" SP/DT 1A relays and include four supervised or unsupervised input contacts for connection
      of request to exit or door position switches. It shall be capable of being fully networked and
      includes tamperproof switch within the enclosure. Requires UL listed 294 power supply for
      operation. Controller shall have selectable jumper for connection with Clock/data, and Wiegand
      or serial (RS232 or RS485).
   2) Downstream communication via RS-485 with option for RS-232 and connects
      directly to the following devices:
      (a) One reader.
      (b) Eight AD300 hardwired locks.
      (c) One PIM400-485-SMS to support sixteen AD400 wireless locks.
      (d) Specifications:
          (1) Dimensions - 8 ¼"H x 7 ½"W x 3 ½"D
(2) Power input - 20 - 32 VDC powered locally.
(3) Max. Current req. - 100 mA (without read head)
(4) Operating Temperature - 0° to 49° C or 32° to 120° F
(5) Cable spec. - Network protocol 10 BaseT ethernet & 18 AWG 2 conductor stranded, shielded, twisted for power, & 18 AWG 6 conductor for read heads & 18 AWG 2 conductor (RS485) for AD series devices.
(e) Cable distance - 500 ft for power & 500 ft. for read head & up to 4000 ft in total for RS 485 for AD series devices
(f) Operating humidity - 10% to 90% (non-condensing)
(g) UL Listed for UL294.
d. Expansion Board: model VONX-8 - as manufactured by Vanderbilt Industries. Each expansion board shall have eight SP/DT relay outputs and communicates directly to any VRCNX-R.
1) SRC via RS485 protocol. It shall have 16Kb flash memory and 1Kb RAM with two serial ports for either RS232 or RS485. The board shall be equipped with eight supervised or unsupervised contact inputs and eight form “C” SP/DT 1 A relay outputs.
2) Specifications:
   (a) Dimensions - 8 ¼”H x 7 ½”W x 3 ½”D
   (b) Power input - 14 - 24 VDC powered locally.
   (c) Max. Current req. - 100 mA
   (d) Operating Temperature - 0° to 49° C or 32° to 120° F
   (e) Cable spec. - 18awg/2 conductor, stranded, shielded, and twisted
   (f) (RS485 data only)
   (g) Cable distance - with RS-485 4,000 ft. or data to VRCNX-R & 500 ft for power
   (h) UL Listed for UL294.
   (i) RoHS compliant
5. Power Supplies:
a. SMS-3APS as mfg. by Vanderbilt Industries.
   1) Having LED’s indicators show good AC power and DC on.
   2) Electronic power limited short circuit protection.
   3) Thermal regulator for preventing overheating.
   4) Output ON/OFF service switch.
   5) No switch over or voltage drop when input power fails.
   6) Specification:
      (a) Power input - 85-260VAC
      (b) Power output - 24VDC @ 3A
      (c) Enclosure dimension - 14.0” x 9.0” x 3.5”
      (d) Operating temperature - 14° to 95°F (-20° to 35°C)
      (e) UL Exit device trim listed for UL294. Lockset and capable of handling new and existing access control software and credential reading technology.
b. SMS-5APS as mfg. by Vanderbilt Industries
   1) Having LED’s indicators show good AC power and DC on.
   2) Electronic power limited short circuit protection.
   3) Thermal regulator for preventing overheating.
   4) Output ON/OFF service switch.
   5) No switch over or voltage drop when input power fails.
   6) Lockset and exit device to be modular in design, to have the ability to change credential reader without being removed from door.
   7) Locking escutcheon, security lever trim and to be non-handed, operate independently of non-locking levers for extended life cycles. Handing to be field reversible.
8) Lockset and Exit Device Trim to have the following standard status switches:
Lock/Unlock Status (Clutch Position), Request-to-Exit Switch, Request to Enter Switch, Door Position Switch, Deadbolt Position, Interior Cover Tamper Guard

9) Should power be lost to device, Lockset and Exit Device Trim to have the ability to be field configured to manage access control in one of the three field configurable methods, Fail locked (secured), Fail unlocked (unsecured), and Fail As-Is.

10) Lockset and Exit Device Trim to have real-time communication with access control system, such that all events at Lockset and Exit Device Trim are communicated real-time to network control software.

11) Lockset and Exit Device Trim to have visual tri-colored LED to indicate operational systems status, system error conditions and low power conditions along with audible feedback that can be enabled or disabled.

12) Credential reader capabilities include 13.56 MHz Smart card, 125 kHz proximity card, magnetic card and/or keypad.

13) Specifications:
(a) Power input - 85-264VAC
(b) Power output - 12 or 24VDC @ 5A required
(c) Enclosure dimension - 14.0" x 14.0" x 4.75"
(d) Operating temperature - 14° to 95°F (-20° to 35°C)
(e) UL Data: 24AWG, 4 conductor shielded (Belden 9843, 9841 or equivalent)
(f) DC Power: 18 AWG, 2 conductor, (Belden 8760 or equivalent)
(g) RS485 communication interface

 SMS-20APS as mfg. by Vanderbilt Industries.

1) Having LED's indicate AC power and DC on.
2) Electronic power limited short circuit protection.
3) Thermal regulator for preventing overheating.
4) Output ON/OFF service switch.
5) No switch over or voltage drop when input power fails.
6) Lockset and exit device to be modular in design, to have the ability to change credential reader without being removed from door.
7) Locking escutcheon, security lever trim and to be non-handed, operate independently of non-locking levers for extended life cycles. Handing to be field reversible.
8) Lockset and Exit Device Trim to have the following standard status switches:
Lock/Unlock Status (Clutch Position), Request-to-Exit Switch, Request to Enter Switch, Door Position Switch, Deadbolt Position, Interior Cover Tamper Guard

9) Should power be lost to device, Lockset and Exit Device Trim to have the ability to be field configured to manage access control in one of the three field configurable methods, Fail locked (secured), Fail unlocked (unsecured), and Fail As-Is.

10) Lockset and Exit Device Trim to have real-time communication with access control system, such that all events at Lockset and Exit Device Trim are communicated real-time to network control software.

11) Lockset and Exit Device Trim to have visual tri-colored LED to indicate operational systems status, system error conditions and low power conditions along with audible feedback that can be enabled or disabled.

12) Credential reader capabilities include 13.56 MHz Smart card, 125 kHz proximity card, magnetic card and/or keypad.

13) Specifications:
(a) Powered by four AA batteries with option for eight AA batteries or a 12V or 24VDC power supply
(b) Data: Wireless 900 MHz spread spectrum, direct sequence, 10 channels transmission with AES-128 bit encryption
(c) PIM-400 communication interface required
d. PIM400-485-SMS:
1) PIM400-485 is required to integrate access control panels via RS485 protocols without the need of reader interface modules. Supports up to sixteen AD-400 wireless access control devices.
2) Optional credential reader capabilities include 13.56 MHz Smart card, 125 kHz proximity card, and magnetic card
3) Specifications:
   (a) Power input - 12VDC to 24VDC
   (b) Power consumption - up to 250mA
   (c) Operating temperature - -31°F to 151°F (-35°C to 66°C)
   (d) Operating Humidity - 0-100% condensing

PART 3 EXECUTION
3.01 INSTALLATION
A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. PREPARATION
      a. Coordinate exact location of panic button for building lockdown with Owner prior to rough-in.
      b. Furnish or coordinate any inserts required for building into concrete, masonry, and other work, to support and attach work of this section. Furnish or coordinate in ample time to comply with schedule of work into which inserts are built.
      c. Verify that power and outlets are in correct locations.
      d. Verify that building structure is properly prepared for mounting, attachment and support of equipment.
      e. Prior to installation of systems components and devices, verify all required preparations have been properly performed and that substrates are acceptable for installation.
      f. Verify all rough-ins and field dimensions.
      g. Report in writing to the Architect any prevailing conditions that will adversely affect satisfactory execution of Work in this Section.
         1) Owner or their representative reserves the right to review proposed methods of construction/installation, reject proposed methods, and have the installation done in a satisfactory method at the Contractor's cost.
   2. INSTALLATION OF SYSTEM
      a. Install work will be in accordance with manufacturer's recommendations, instructions and final Shop Drawings. All control panels and power supplies should be installed so as to allow easy access for service in the future.
      b. Anchor components securely in place, plumb, level, and accurately aligned. Provide separators and isolators to prevent corrosion and electrolytic deterioration.
      c. For card readers that are located in equipment traffic areas, and that are exposed to damage due to collision or impact from forklifts, or manually moved carts, carriers, or other equipment used by the Owner, provide protective bollards, railings, coverings etc. to ensure that all card readers installed are properly protected from such damage.
      d. Provide fastenings, plates, and other incidental items required for complete and operational installation.
      e. Provide interface with Intrusion Detection System as required. Coordinate with Owner.
      f. Provide required electrical work in accordance with code requirements.
g. Create and deliver final as built Shop Drawings

3. SYSTEM SOFTWARE
   a. Develop, install, and test software and databases for the complete and proper operation of systems involved. Assign software license to Owner and assign
   b. Develop, install, and test software and databases for the complete and proper operation of systems involved. Assign software license to Owner and assign

4. SYSTEM PROGRAMMING
   a. The Contractor shall work with the owner to ensure that the new components will be properly programmed into the new and/or existing system.
   b. Coordination required is as follows, unless directed otherwise by owner or their representative;
      1) Personal/staff information.
      2) Access time for all personal/staff.
      3) Definitions of openings for staff access.
      4) Holiday definition.
      5) Special access privileges.
      6) Lock down conditions.

5. SITE QUALITY CONTROL
   a. The Contractor shall develop a Final Test and Acceptance (FTA) Plan. The plan shall identify each new system component provided, intent of test, method or methods of test and expected results. Each component listed in the plan shall include space for test part signatures, brief comments, time of test and pass/fail check boxes. The FTA plan shall be submitted to the owner's representative 30 days prior to the scheduled final test.
   b. Provide authorized manufacturer's supervision of final testing of each system.
      1) On-Site Testing: Manufacturer trained and authorized Systems Integrator shall functionally test each component in the system after installation to verify proper operation and confirm that the wiring and dressing conform to the wiring documentation.
      2) Each system shall test free from interference, opens, grounds, and short circuits.

6. OWNER PERSONNEL TRAINING
   a. On Site Operator training: instruct operating staff in proper operation, including hands-on training.
      1) Minimum of eight (8), man-hours covering the operations for each system installed. Training sessions shall be provided to supervisors, staff utilizing systems and equipment provided under this section, maintenance personnel and any other personnel designated by the owner. Security Contractor should prepare to provide operator training for up to ten (10) personnel.
      2) Security contractor shall be prepared to provide training sessions on all work shifts, including day, evening and night shifts.
      3) On Site Administrator training: instruct owner-designated security system administrators for each system installed.
         (a) Minimum of eight (8), man-hours of training for each owner-designated individual. Training to cover all administrative and management functions, features and controls for each system.
      4) Review in detail all information in the operations and maintenance manuals for each system provided.
      5) Prior to administering the above training, the contractor(s) shall prepare an outline of the training, identifying the goals and expectations of the course and detailing what students are expected to learn.
      6) Training courses shall be videotaped for subsequent training use by the Owner.

7. CLEANING AND WASTE MANAGEMENT
   a. Cleaning and Touchup: Immediately after installation, including the completion of wiring and testing, clean all work and touchup all damaged factory finishes.

8. PROTECTION
a. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured during periods when a qualified operator in the employ of Contractor is not present.

b. Protection: Provide protective covers, fenders, and barriers as necessary to maintain Work of this Section in same condition as installed until time of Substantial Completion.

9.

D. Install in accordance with manufacturer's instructions.

E. Install wiring in conduit per the manufacturers recommendations.

**END OF SECTION**
SECTION 28 1600
INTRUSION DETECTION

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Intrusion detection devices.

1.02 RELATED REQUIREMENTS
A. Section 08 7100 - Door Hardware.
B. Section 28 1300 - Access Control: For interface with intrusion detection system.
C. Section 28 2300 - Video Surveillance: For interface with intrusion detection system.
D. Section 26 0519 - LOW-VOLTAGE POWER CONDUCTORS AND CABLES (600 V and Less).

1.03 REFERENCE STANDARDS
A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Coordination:
1. Coordinate compatibility of devices for the installed locations with work provided under other sections or by others.
   a. Doors: See appropriate Division 8 sections.
2. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
B. Preinstallation Meeting: Conduct meeting with facility representative and other related equipment manufacturers to discuss intrusion detection system interface requirements.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate system wiring diagram showing each device and wiring connection required.
C. Product Data: Provide electrical characteristics and connection requirements.
D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
E. Project Record Documents: Record actual locations of initiating devices, signaling appliances, and end-of-line devices.
F. Operation Data: Operating instructions.
G. Maintenance Data: Maintenance and repair procedures.

1.06 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and indicated.

1.07 WARRANTY
A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide minimum two year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
PART 2 PRODUCTS

2.01 INTRUSION DETECTION SYSTEM REQUIREMENTS

A. Provide new intrusion detection system consisting of all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Initiating Device Requirements:
   1. Protected Premises: Entire Building.
   2. Provide magnetic contacts to monitor opened/closed position for:
      a. All perimeter doors.

C. Alarm Notification and Reporting Requirements:
   1. Transmit alarm report to listed remote central station under contract with facility.

D. Interface with Other Systems:
   1. Provide products compatible with other systems requiring interface with intrusion detection system.
   2. Interface with access control system as specified in Section 28 1300.
   3. Interface with video surveillance system as specified in Section 28 2300.

2.02 INITIATING DEVICES

A. General Requirements:
   1. Provide devices suitable for intended application and location to be installed.

B. Contacts:
   1. Listed and labeled as complying with UL 634.
   2. Magnetic Contacts: Encapsulated reed switch(es) and separate magnet; designed to monitor opened/closed position of doors.
      a. Use standard security contacts (not balanced magnetic type) unless otherwise indicated.

2.03 ACCESSORIES

A. Provide components as required for connection of alarm control unit to devices and other systems indicated.

B. Provide cables as required for connections between system components.

PART 3 EXECUTION

3.01 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1.

B. Install products in accordance with manufacturer's instructions.

C. Wiring Method: Unless otherwise indicated, use wiring in conduit.
   1. Conduit: Comply with Section 26 0534.

D. Provide grounding and bonding in accordance with Section 26 0526.

E. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

F. Identify system wiring and components in accordance with Section 26 0553.

G. Install in accordance with manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

A. Prepare and start system in accordance with manufacturer's instructions.

B. Inspection and testing to include, at a minimum:
   1. Test each initiating device for proper response by alarm control unit.
   2. Test for proper operation of output relays.
   3. Test for proper operation of communication interfaces and central station reporting.
   4. Test for proper interface with other systems.
C. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.
D. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.03 CLEANING
A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.04 MANUFACTURER SERVICES
A. Provide the services of the manufacturer’s technical representative to prepare and start systems.
B. Include services of technician to supervise installation, adjustments, final connections, system testing, and Owner training.

3.05 CLOSEOUT ACTIVITIES
A. Demonstrate normal and abnormal modes of operation, and required responses to each.
B. Provide 6 hours of instruction in three 2 hour blocks. The dates and times are to be coordinated with the Owner.

3.06 PROTECTION
A. Protect installed system components from subsequent construction operations.

3.07 MAINTENANCE
A. Provide service and maintenance of intrusion detection system for one year from Date of Substantial Completion.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Video surveillance system requirements.
B. Video recording and viewing equipment.
C. Cameras.
D. Accessories.
E. Control equipment.

1.02 RELATED REQUIREMENTS

A. Section 26 0534 - Conduit
B. Section 27 1020 - Voice /Data Systems

1.03 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SYSTEM DESCRIPTION

A. This section includes the Video Surveillance System (VSS) as shown on the drawings. The work under this section consists of furnishing all materials and equipment, performing labor and services necessary for the installation of the VSS.

B. Scope of Project: This project consists of the removal of the existing Video Surveillance System in its entirety and the installation of a new Video Surveillance System in the existing Fort Caspar Academy School. This system shall be able to operate as a standalone system but shall also be able to be networked by way of WAN system. The system will be an IP based system that will operate on a Panasonic WV-ASM300 video management software or pre-approved equivalent. The Servers and Storage systems shall be sized to accommodate 25% added growth capabilities. The system is based on maximum resolution per camera and 5 frames per second per camera recording continuously using H.265 Codec compression per camera and an archive storage retention of 14 days minimum. Any substitute system will be required to provide similar performance and storage capacity to meet this criteria. The Contractor shall also provide all networking cables (Cat 6a) and terminations as specified in Section 271020 - Cabling for Voice/Data Systems - Cat 6a. The Contractor shall also provide all PoE switches necessary for each camera. These switches shall be installed in the existing rack within the existing MDF as indicated. This Contractor will still be responsible for final connections of cameras and providing a complete and operational system that can be viewed locally and across the WAN at other remote locations with appropriate password protected access. Video from all cameras will need to be able to be viewed at several locations. The Contractor shall also provide any necessary updates required at the existing client workstation. This Contractor shall ensure that this workstation is fully operational and able to display all of the cameras in various arrays on the existing video monitors. The video will need to be able to be displayed in various arrays depending on the video monitor screen sizes and shall be able to be user defined.

C. Capacity:

1.05 SUBMITTALS

A. See Section 26 0030 - Administrative Requirements, for submittal procedures.
B. Provide Shop Drawings, complete with additional information as follows:
   1. Complete one-line risers and point-to-point wiring diagrams prepared especially for this installation.
   2. Cable layout drawings of the system, indicating size and number of all conductors.
3. Certificate of acceptance of qualifications of installing Contractor to install, test, and maintain manufacturer's equipment.
4. Contractor's qualifications.

C. Product Data: Provide showing electrical characteristics and connection requirements for each component.

D. Design Data:
   1. Standby battery/UPS calculations.
   2. Video storage capacity calculations.

E. Certify that proposed system design and components meet or exceed specified requirements.

F. Operation Data: Instructions for starting and operating system.

G. Maintenance Data: Routine trouble shooting procedures.

1.06 WARRANTY

A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance of system or certificate of substantial completion (whichever is later). The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

B. Warranty shall include necessary repairs or loaner replacement assuring complete restoration of operation within 48 hours from time service call is requested.

C. All electronic equipment including cameras furnished under this contract shall have a minimum of a five (5) year factory warranty from the manufacturer.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 50 miles of Casper, WY.

C. Approved Installers: Comtronix, API
   1. Other installers shall provide evidence of conformance to the following qualification requirements when submitting for pre-qualification. Pre-qualification submittal package shall be submitted for approval no later than ten (10) days prior to the bid date. Any additionally approved installers shall be listed in an addendum.
      a. Manufacturer's representative for the equipment specified.
      b. Licensed as a Low Voltage Contractor in the State of Wyoming.
      c. Factory training certificate for the specified equipment.
      d. Provide three (3) references of security systems of similar size and type as that specified herein. References shall be the operating personnel and Owner's contract administrator for each project. The supplied references shall be generally positive with respect to engineering practices, installation practices, completion timeliness, and warranty satisfaction. The contractor shall furnish photographs illustrating installation practices consistent with those specified herein.
      e. Letter stating that all specifications will be strictly adhered to.

D. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.01 VIDEO MANAGEMENT SYSTEM SOFTWARE OVERVIEW

A. The Video Management System (VMS) software shall have features for viewing live and recorded video from IP cameras and video encoders connected to a local and wide area network (WAN). The VMS software shall have a Client-Server based architecture that can be configured as a standalone VMS system with the client software running on the server hardware and/or the client running on any network connected TCP/IP PC workstation. Multiple client
workstations shall be capable of simultaneously viewing live and/or recorded video from a single or multiple servers. Multiple servers shall also be able to simultaneously provide live and/or recorded video to a single or multiple workstation(s). Included in the cost of the software are an unlimited number of client software applications.

B. IP Camera and Encoder Support
   1. The VMS software shall have an open architecture supporting IP cameras and encoders from multiple manufacturers providing best of breed solutions from low cost entry level features to high resolution megapixel features. A minimum of five (5) IP camera manufacturers must be supported from leading companies such as ACTi, Arecont Vision, Axis, IQinvision, Panasonic, Sony, and Vivotek.

C. VMS Client Server Architecture
   1. The VMS software shall be based on a client/server architecture. A client/server architecture provides a scalable platform, whereby each computer on a network is a client, server, or both a client/server simultaneously.

D. VMS Client Software
   1. A client is a computer system that accesses a (remote) service on another computer by a TCP/IP network. The VMS client software displays and searches live and recorded video, audio and alarms, and administers the VMS server configurations.

E. There shall be one VMS client application that shall be installed in two different configurations depending upon requirements. The VMS client shall have the same features, functions, and user interface in either configuration. The first client installation configuration is referred to as a Local Client, meaning the client resides on the same system that is "local" to the server. The second installation is referred to as a Remote Client, meaning it is installed on a different computer that is "remote" from the server and is connected to the server through a local or wide area network. All interaction (viewing live or recorded video and administration) with the server shall be performed through either the Local or Remote Client.

F. When configuring a server with full administrative privileges with either a Local or Remote Client, all administration and configuration functions shall be identical. By having full administration and configuration features from a Remote Client, customers and installers shall save time and money by not being required to administer features where the server hardware is physically located.

G. At no time during the administration and configuration of any feature of a server from either a Local or Remote Client shall video recording be required to be disabled.

H. The VMS client software shall operate on any of the following operating systems:
   1. Microsoft Windows 8 (all versions)
   2. Microsoft Windows 10 (all versions)

I. Any combination of VMS client applications running on any of the above listed operating systems shall be able to connect to view and retrieve live or recorded video from any of the server applications running on any of the operating systems listed. As an example, a VMS client running on Microsoft Windows 7 shall be able to simultaneously connect to four (4) different VMS servers all running with a different operating system, one each running on Server 2003, XP, Vista, and Linux respectively.

J. Client Browser
   1. A browser based client shall have a feature to connect to a VMS server to display live video. The client browser shall display video on a PC, Mac, Linux PC, PDA, iPhone, & CEL phone using the following browsers:
      a. Internet Explorer
   2. The client browser shall also connect with non-Java script browsers and shall be compliant with HTML 4.0 (www.w3.org).

K. VMS Client on Multiple Monitors
   1. The VMS software shall have the capability to run multiple client applications simultaneously on one PC workstation with multiple monitors. Up to four VGA monitors
shall be configured on a single PC workstation with one client application running on each VGA monitor. As decompressing video is CPU-intensive, the PC workstation shall have multiple processors, one for each VMS client application. The HP PT453A Display Adaptor shall be used to support up to four VGA monitors. This is an NVidia Quadro-based board that shall have been tested running the VMS client with VGA and DVI monitors up to 1920x1200 resolutions.

L. Standalone Client/Server
1. A client and server can simultaneously reside and operate on one computer and communicate to each other through a TCP/IP loop back interface. A loopback address is a special IP address (127.0.0.1) that is designed for the client and server software to communicate with each other on the same computer. By combining the functionality of the VMS client and server software on one system, administrators can deploy both standalone and network configurations that can scale as required. The administrator shall have the added benefit of configuring and administering the VMS server with identical features either locally or remotely.

M. IP Camera Based Motion Detection
1. Motion based video recording with the VMS server software shall be based on using the motion detection alarm (also known as a flag) generated by the IP camera. The motion detection feature of the IP camera shall generate an alarm whenever movement occurs in the image. The VMS server software reads the alarm from the IP camera to determine if motion occurred, then records video. The benefits of using IP camera based motion detection vs. server (host processor) based motion detection include:
   a. Reduced server processor speed requirements
   b. Reduced server memory requirements
   c. Reduced processor heat
   d. Reduced CPU processor usage
   e. Increased IP camera connectivity
   f. Increased IP camera throughput

2.02 VIDEO MANAGEMENT SYSTEM SOFTWARE FEATURES

A. Operating Modes
1. The VMS software shall have three main modes of operation depicted by three icons. Clicking on any of these icons below shall change the mode of operation:
   a. Live Display Mode Icon: allows users the ability to view live video
   b. Search Mode Icon: allows users the ability to search for recorded video
   c. Setup Mode Icon: allows administrators and power users the ability to configure systems

B. Live Display Mode Features
1. A live display mode shall have features for users to view live video. The live display mode shall have the following features to navigate and view live video:
   a. Layout Icons - shall have features to organize your camera video view panel in the following patterns:
      1) 1 camera (full screen) layout
      2) 4 camera (2x2) layout
      3) 9 camera (3x3) layout
      4) 12 camera (4x3) layout
      5) 16 camera (4x4) layout
      6) 20 camera (5x4) layout
      7) 30 camera (6x5) layout
      8) 48 camera (8x6) layout
   2. Navigation Tree - shall display cameras, alarms, monitor & audio icons that are connected to the VMS server.
   3. Navigation Pane - shall display a hierarchy of cameras, audio input, and serial port input icons organized by cameras (cameras connected to servers), groups (logical grouping of
cameras), and views (saved live display layouts). Clicking on navigation pane bars shall switch the navigation tree into the desired navigation tree display.

4. Video View Panel - shall display video of cameras. Cameras can be dragged from the navigation tree into the view panel and live video will be displayed. If there are multiple video view panels in a layout (example: 4 camera (2x2) layout), video can be moved (switched) by dragging video from one view panel to another panel.

5. About Icon - shall provide information about the version number of the client software you are using.

6. Help Icon - shall provide context sensitive documentation from the online user's manual specific to the screen you are viewing.

7. Show/Hide Navigation Tree Icon - extends the display by hiding the Navigation Tree.

8. Full Screen Icon - shall enlarge the video display area by hiding the title and task bars.

9. Date and Time - shall display the current date and time.

C. Auto Replay of Recorded Video from Live Display Mode
1. The VMS software shall replay recorded video from the Live Display Mode by right clicking in the appropriate video view panel and selecting Replay. You will have the option of reviewing video in increments of 5 or 30 seconds or 1, 5, or 15 minutes. Once you select the desired video replay increment, the replay window will open and begin downloading the recorded video. A scrub bar will track the progress of the download. The total number of frames in the video segment as well as the number that have been downloaded will also be displayed in the status bar. If you wish to stop the download, click the Stop Download button at the bottom of the window.

D. Virtual Matrix Switching
1. The VMS software shall activate virtual matrix switching by right clicking in one of the live video panels and selecting Event Monitor from a drop down dialog menu and then selecting a profile you wish to view. A virtual matrix switching shall automatically show video as it is triggered. For example, if you have a series of entrances, each time an entrance is triggered the video panel will switch to the camera displaying the most recent motion as it occurs. Virtual matrix switching shall be stopped by right clicking in the active video panel and disabling the active event monitoring profile.

E. Event Monitoring
1. The VMS software shall activate event monitoring by right clicking in one of the live video panels and selecting Event Monitor from a drop down dialog menu and then selecting a profile you wish to view. An event monitoring profile shall bring up a list of events which the user can click on to view giving more control. If you configured your profile for Event Monitoring mode, and Event Monitoring box will appear just below the active video panel. Once a video event takes place, it will be automatically listed in the box. Using the same entrance example as above, instead of the video panel automatically switching to the camera displaying the most recent door opening, the event would be added to a list in the Event Monitoring box. You then could click on the item to display the video. Event Monitoring shall be stopped by right clicking in the active video panel and disabling the active event monitoring profile.

F. Viewing Logical Camera Groups
1. The VMS software shall have a feature for viewing logical groups of cameras. The VMS software shall also have a feature creating camera groups. This will enable efficient viewing of cameras in logical order as chosen by the user. Once the camera groups are set up, cameras in those groups may be selected by clicking the Group button in the Navigation Pane.

G. Creating, Saving, and Accessing Views
1. The VMS software shall have a feature to organize your cameras into preset views. Once views are saved, they shall be accessible via the Navigation Pane. The VMS software shall have the ability to create and organize views into folders.

H. Video Tours
1. The VMS software shall have the capability to automatically cycle through two or more saved views to create a video tour. Once saved, the tour shall be activated by clicking on the saved tour icon in the View Navigation Pane.

I. Search Mode Overview
1. The VMS software shall have features to search for and playback recorded video, audio, and events from a VMS server. The system must be capable of performing searches on multiple cameras based on a given criteria. The VMS search software shall have the following features:
   a. Input Selection Tree - select the camera(s), audio input(s), or text data to search
   b. Navigation Pane
   c. Video Time Line
   d. Camera Selection List
   e. Video Cursor
   f. Recorded Bar
   g. Video Playback Controls:
      1) Reverse fast (double) speed
      2) Reverse normal speed
      3) Stop
      4) Forward normal speed
      5) Forward fast speed
      6) Forward one frame at a time
      7) Backward one frame at a time
   h. Calendar
   i. Start Search Time
   j. Export

J. Multi Camera Search and Playback
1. In addition to searching and playing back recorded video from a single camera, the VMS software shall have the capability to search for and playback multiple cameras simultaneously. All video recording shall be played back and displayed in a synchronized multi camera layout as the video was recorded.

K. Audio Search and Playback - the VMS software shall have a feature search and playback audio in synchronization with video.

L. The VMS software shall have the capability to export video and audio files in standalone (*.exe) format (includes executable player with the video and audio data), AVI files (*.avi), and PS files (*.ps).

M. The VMS software shall also have the capability to copy, save, and print images.

N. The VMS software shall have features for adding and setting up IP cameras on the system.

O. The VMS software shall have features to configure an email server and message profile that will send an email message whenever an event occurs.

P. The VMS software shall have features to connect different types of events such as an input triggers to a desired action such as recording video or triggering an alarm.

Q. The VMS software shall have features to add or delete users to and from the VMS server.

2.03 NETWORK VIDEO RECORDER HARDWARE FEATURES

A. The NVR shall be capable of simultaneously recording, displaying, and playing back digitized video from IP cameras and analog cameras through the use of a video encoder.

B. The NVR shall support recording resolutions from CIF to 9 megapixel and shall be user selectable. MJPEG, H.254, and H.265 video compression format shall be user selectable depending on the IP camera configured to the IP Server. Video recording shall be available at up to 60 images per second per input channel depending on IP camera type selected.

C. Each NVR shall have a 1Gbit 1000Base TX RJ-45 Ethernet connection for networking to Remote PC Clients. Multiple servers shall be accessible by multiple clients located anywhere
on the network. Each server shall record video, audio, and text while displaying live video or playback video. In the event that there is no client actively attached to the server, the server shall continue to record video and audio, monitor events, and all other server functions.

D. Recorded video shall be triggered by the motion detection sensor of the IP camera, an external input device, or in continuous record mode.

E. Each NVR shall have the ability to link specific events in an "if-then" scenario. Linked events types shall include video motion, video loss, input trigger, POS port, POS profile and temperature. Sources of these events shall be any camera connected to the specific server. Action from these events shall include record video, record audio, enable output trigger, output video, and notify (send email).

F. A Raid 5 option shall be available consisting of a 4U chassis and eight hot swappable hard drives. The Raid 5 option shall be internal to the server and shall provide notification of a drive failure to the administrator.

G. Provide NVR with enough storage capacity to store recorded images from all cameras plus 25% spare, at 5 FPS/camera for minimum of 14 days.

2.04 NVR SPECIFICATION AND MODEL NUMBER

A. Rackmount RAID5 IP Server shall have the following specifications:
   1. Dimensions (L x W x H): (14.57” x 16.54” x 3.46”) (37 x 42 x 8.8 cm)
   2. Weight: 15.40 - 22.10 lbs. (7.0 - 10.0 kg)
   3. Input Voltage: 120 VAC
   4. Power Consumption: 72 watts
   5. Recording Resolution: CIF to 9 megapixel
   6. Compression: MJPEG, H.264, or H.265 by camera or encoder
   7. Network Connections: 2x 10BASE-T/100BASE-TX/1000BASE-TX (RJ-45)
   8. USB 3.0 Ports: 2
   9. Hard Drive Storage: 4 HDD slots
   10. Video Output: 2-HDMI, 1-BNC
   11. Keyboard & Mouse: 2-mouse connection port USB2.0
   12. Operating Temperature: 41° -113°F (5° - 45°C)
   13. Relative Humidity: 5 - 90% RH (non-condensing)

B. Provide external hard disk storage capacity as required to meet the minimum design parameters.

C. Approved Product: Panasonic WJ-NX300K Series.

2.05 CERTIFICATIONS

A. CE and FCC, Class A and B (all models)

2.06 IP CAMERAS

A. Interior:
   1. Fixed: Panasonic WV-S2231 2 Megapixel Super Dynamic Full HD Vandal Resistant Dome (Opaque) Network Camera or equivalent by Advidia or Milesight.
   2. 360-Degree: Panasonic WV-S4550L 5 Megapixel 360-Degree Super Dynamic Vandal Resistant Dome Network Camera or equivalent by Advidia or Milesight.

B. Exterior:
   1. 360-Degree: Panasonic WV-X4571L 9 Megapixel 360-Degree Super Dynamic Vandal Resistant Outdoor Dome Network Camera or equivalent by Advidia or Milesight.

2.07 POE SWITCHES

A. 10/100/1000 Network switches shall be POE based. Coordinate with owner for network switch requirements. All security systems may be attached to this network, so provide 4 extra ports per switch for additional security devices. Approved Manufacturer: HP 2530 series.
2.08 AUXILLIARY POWER SUPPLIES
   A. Shall be rack mounted, providing 24VAC-28VAC to 16 individually fused outputs.
   B. Approved products: Altronix #R2416UL.

2.09 UNINTERRUPTABLE POWER SUPPLIES
   A. Furnish and install a separate UPS system sized to provide power for the video surveillance system for 60 minutes in the event of a power outage.

2.10 MONITOR
   A. Contractor shall provide a new flat screen monitor, standard keyboard, and optical mouse to interface with the NVR. Provide a rack mounted tray to hold these items. Provide all cables necessary to make a complete and operating interface. The LCD monitor shall be at least 17” in size and carry the Energy Star label.

2.11 VIDEO RECORDING AND VIEWING EQUIPMENT
   A. Provide video recording and viewing equipment compatible with cameras to be connected.
   B. Software:
      1. Unless otherwise indicated, provide all software and licenses required for fully operational system.

2.12 CAMERAS
   A. Provide cameras and associated accessories suitable for operation under the service conditions at the installed location. Provide additional components (e.g. enclosures, heaters, blowers, etc.) as required.
   B. Where not factory-installed, provide additional components (e.g. lenses, mounting accessories, etc.) as necessary for complete installation.
   C. Camera Enclosures and Mounting Brackets:
      1. Where not factory-installed, provide accessory camera enclosures suitable for operation under the service conditions at the installed location.
      2. Where not factory-installed, provide accessory camera mounting brackets necessary for installation.

2.13 ACCESSORIES
   A. Provide CAT 6A wiring from each camera outlet location to security network switch in MDF 153 as shown on plans. Cable shall be installed and meet the requirements outlined in 27 1020 Voice/Data Systems - CAT 6A. Cable shall be yellow, confirm with Owner prior to ordering. Provide a 20’ service loop coiled above accessible ceiling space at each camera outlet location.
   B. Switches in telecom closets shall be furnished by Owner but installed by this Contractor.

PART 3 EXECUTION

3.01 INSTALLATION
   A. Install in accordance with manufacturer's instructions.
   B. Cameras shall be located as shown on contract documents. They shall be mounted at heights which will minimize potential damage or vandalism and which will allow clear view of area.

3.02 INTERFACE WITH OTHER PRODUCTS
   A. Interface installation of video surveillance with security cable television system.

3.03 FIELD QUALITY CONTROL
   A. Provide the services of manufacturer's technical representative to prepare and start systems and supervise final wiring connections and system adjustments.

3.04 ADJUSTING
   A. Adjust manual lens irises to meet lighting conditions.
3.05 CLOSEOUT ACTIVITIES
   A. Demonstrate system operation and provide four hours of instruction with manufacturer's training personnel.
   B. Conduct walking tour of project and briefly describe function, operation, and maintenance of each component.

3.06 MAINTENANCE
   A. Provide service and maintenance of system for one year from Date of Substantial Completion.

END OF SECTION
PART 1 GENERAL

1.01 DESCRIPTION:

A. This section of the specification includes the furnishing, installation, and connection of the microprocessor controlled, intelligent reporting fire alarm equipment with voice evacuation, required to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panel, auxiliary control devices, annunciators, and wiring as shown on the drawings and specified herein.

B. The fire alarm system shall comply with requirements of the current adopted NFPA Standard No. 72 for protected premises signaling systems except as modified and supplemented by this specification. The system field wiring shall be supervised either electrically or by software-directed polling of field devices.

C. The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

D. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).

E. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final check-out and to ensure the systems integrity.

F. The equipment supplier shall employ NICET (minimum Level III fire alarm technology) technician at their local office to prepare installation drawings and verify compliance with the specifications.

G. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

H. The system shall be capable of initiating a lockdown event and call out to local authorities via a push button at the reception and principal’s office and separate input at the FACP. During a lockdown event, local authorities shall be notified but the system shall not initiate an audible alarm within the building. However, the system shall be capable for the Owner to record a separate alarm and voice message at any point in the future for a lockdown event.

1.02 SCOPE:

A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings.

B. Basic Performance:
   1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on an NFPA Style 6 (Class A) Signaling Line Circuit (SLC).
   2. Initiation Device Circuits (IDC) shall be wired Class B (NFPA Style B).
   3. Notification Appliance Circuits (NAC) shall be wired Class B (NFPA Style Y), as part of an addressable device connected by the SLC Circuit.
   4. Built-in Speaker/Strobe Synchronization w/ selective silence.
   5. Digitized electronic signals shall employ check digits or multiple polling.
   6. A single ground or open on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
   7. Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.

C. BASIC SYSTEM FUNCTIONAL OPERATION
   1. When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:
      a. The system alarm LED shall flash.
      b. A local piezo electric signal in the control panel shall sound.
c. A backlit 80 character LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
d. History storage shall log the information associated with each new Fire Alarm Control Panel condition, along with the time and date of occurrence.
e. All notification devices such as, speaker/strobes, strobes, speakers, bells, etc. shall activate in all areas.
f. All control relays shall change state. I.E. all air handling equipment shall be shut down. Contractor to provide all relays, conduit and wire to ensure complete shutdown of all air handling equipment.
g. All magnetic door holders shall release.
h. System shall transmit appropriate signals to the digital communicator as to the location of the alarm input.
i. Transmit English wording location of the alarm to the main panel and remote annunciators.
j. System shall provide signal to door security system so as to initiate all applicable life safety functions of that system.
k. General fire alarm signaling shall include the use of a spoken alarm message that will be followed by a code 3 tone and then repeated until silenced.

1.03 RELATED SECTIONS:
A. Section 01 - GENERAL REQUIREMENTS.
B. Section 26 0050 - Firestopping.
C. Section 26 0519 - LOW VOLTAGE POWER CONDUCTORS AND CABLES. Requirements for power cables.
D. Section 26 0526 - Grounding and Bonding for Electrical Systems.
E. Section 26 0529 - Hangers and Supports for Electrical Systems.
F. Section 26 0534 - Conduit.
G. Section 26 0537 - Boxes.
H. Section 26 0553 - Identification for Electrical Systems.

1.04 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70, 72, 101 and the International Fire Code.
B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 SUBMITTALS:
A. Refer to Division 01 for Submittal Procedures.
B. General:
   1. Submittals shall be submitted to the Architect/Engineer for review, in accordance with General Requirements, and shall include NICET Certifications.
   2. All references to manufacturer’s model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent equipment (compatible UL Listed) from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.
C. Shop Drawings:
   1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
   2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts, and complete floor plan layouts, showing all existing and new equipment and device locations.
   3. Show annunciator layout, configurations, and terminations.
4. Provide standby battery capacity calculations.

D. Manuals:
   1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.
   2. Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.
   3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.
   4. Two weeks prior to substantial completion, submit (3) copies of final updated O & M Manuals.

E. Software Modifications
   1. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 8 hours.
   2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.

F. Certifications:
   1. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.
   2. Two weeks prior to final inspection, submit a final system test report, and a Letter of Certification from the local authorized equipment representative, stating that the system has been properly installed, adjusted, and tested, and is fully functional.

G. Contractor is responsible for engineer stamp and plan review fee with the State.

1.06 GUARANTY:
   A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

1.07 MAINTENANCE SERVICE:
   A. Maintenance Service Contract: Provide maintenance of fire alarm systems and equipment for a period of 12 months commencing with Substantial Completion using factory-authorized service representatives. During this period the Contractor shall perform as a minimum a semi-annual and annual maintenance and testing inspection.
   B. Basic Services: Systematic, routine maintenance visits on a quarterly basis at times coordinated with the Owner. In addition, respond to service calls within 24 hours of notification of system trouble. Adjust and replace defective parts and components with original manufacturer's replacement parts, components and supplies.
   C. Additional Services: Perform services within the above 12-month period not classified as routine maintenance or as warranty work as described in Division 1 Section "Warranties and Bonds" when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.
   D. Renewal of Maintenance Service Contract: No later than 60 days prior to the expiration of the maintenance services contract, deliver to the Owner a proposal to provide contract maintenance and repair services for an additional one-year term. Owner will be under no obligation to accept maintenance service contract renewal proposal.
E. All Maintenance Service Contracts shall include maintenance and testing on an annual basis for one full year. A preventive maintenance schedule shall be provided by the contractor that shall describe the protocol for preventive maintenance. The schedule shall include:
   1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, waterflow switches and all accessories of the fire alarm system.
   2. Each circuit in the fire alarm system shall be tested semiannually.
   3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72.

1.08 APPLICABLE PUBLICATIONS:
A. The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards.

B. National Fire Protection Association (NFPA) - USA:
   1. No. 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. Underwriters Laboratories Inc. (UL) - USA:
   3. No. 268A Smoke Detectors for Duct Applications.
   4. No. 521 Heat Detectors for Fire Protective
   5. No. 464 Audible Signaling Appliances.

D. International Building Code and International Fire Code; Most Recent Editions Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. International Mechanical Code; Most Recent Editions Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. Local and State Building Codes.

G. All requirements of the Authority Having Jurisdiction (AHJ).

H. ADA Americans With Disabilities Act

1.09 APPROVALS:
A. The system shall have proper listing and/or approval from the following nationally recognized agencies:
   1. UL Underwriters Laboratories Inc
   2. FM Factory Mutual

PART 2 PRODUCTS
2.01 APPROVED MANUFACTURERS:
A. FireLite - preferred by Owner
B. Notifier
C. Edwards System Technology (EST)
D. Siemens
E. Gamewell-FCI
F. Pre-Bid Approved Equal.

2.02 EQUIPMENT AND MATERIAL, GENERAL:
A. All equipment and components shall be new, and the manufacturer's current model.
B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place.

D. All new Fire Alarm System detectors and indicating appliances in the Gymnasium Areas shall be provided with wireguards.

2.03 CONDUIT AND WIRE:

A. Conduit:
   1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
   2. All wiring shall be installed in conduit. No Fire Alarm wiring shall be placed in the cable tray. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
   3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box, cable tray, or raceway containing these conductors, per NEC Article 760 55.
   4. Wiring for 24 volt DC control, alarm notification, emergency communication and similar power limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits.
   5. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
   6. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
   7. Conduit shall be 3/4 inch minimum.

B. Wire:
   1. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 16 AWG (1.02 mm) for Initiating Device Circuits and Signaling Line Circuits, and 14 AWG (1.63 mm) for Notification Appliance Circuits.
   2. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
   3. Wiring used for the multiplex communication circuit (SLC) shall support a minimum wiring distance of 10,000 feet.
   4. All field wiring shall be electrically supervised for open circuit and ground fault.
   5. The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLCs).
   6. Each cable terminated shall be tagged and labeled. Ideal brand (or equivalent) shall be used.
   7. Wiring shall be Plenum rated.

C. Terminal Boxes, Junction Boxes and Cabinets:
   1. All boxes and cabinets shall be UL listed for their use and purpose.
   2. Exact locations and sizes of all back boxes and conduit runs shall be verified with the equipment supplier prior to rough-in.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, heat, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

E. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes, utilize existing circuit as shown on the plans. All fire alarm panel components requiring 120VAC power may be connected to the same branch circuit.
F. The control panel cabinet shall be grounded securely to the electrical service grounding system.

2.04 MAIN FIRE ALARM CONTROL PANEL:

A. The FACP shall be equivalent to an Edwards System Technology (EST) EST3 with ANS microphone system to make live announcements in addition to making recorded messages and all associated equipment to provide a fully functional fire alarm system. Control panel shall be provided with cabinet and trim for surface and/or semi-recessed mounting. The FACP shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment:
1. Intelligent addressable smoke and thermal (heat) detectors,
2. Addressable modules,
3. Printer,
4. Annunciators, and
5. Other system controlled devices.

B. Operator Control
1. Acknowledge Switch:
   a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the 80-character LCD display to the next alarm or trouble condition.
   b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.
2. Alarm Silence Switch:
   a. Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.
3. Alarm Activate (Drill) Switch:
   a. The Alarm Activate switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset.
4. System Reset Switch:
   a. Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.
5. Lamp Test:
   a. The Lamp Test switch shall activate all system LEDs and light each segment of the liquid crystal display.

C. System Capacity and General Operation
1. The control panel shall provide, or be capable of expansion to 1000 intelligent/addressable devices.
2. The control panel shall include common alarm relay with Form C Contact.
3. The control panel shall include Trouble, Supervisory and Programable relays with Form A Contacts.
4. The fire alarm control panel shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.
5. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel. The system shall be fully programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
6. The system shall allow the programming of any input to activate any output or group of outputs. Systems which have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a laptop personal computer are not considered suitable substitutes.

7. The FACP shall provide the following features:
   a. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
   b. Detector sensitivity test, meeting requirements of NFPA 72, Chapter 10.
   c. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
   d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be 1 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot for ionization detectors. The system shall also include up to nine levels of prealarm, selected by detector, to indicate to maintenance personnel of impending alarms.
   e. The ability to display or print system reports.
   f. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.
   g. PAS presignal, meeting NFPA 72 6.8.1.2 requirements.
   h. Rapid manual station reporting (under 3 seconds).
   i. Non-alarm points for general (non-fire) control.
   j. Periodic detector test, conducted automatically by the software.
   k. Self optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its prealarm level to just above normal peaks.
   l. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
   m. Walk test, with a check for two detectors set to same address.
   n. Control-by-time for non-fire operations, with holiday schedules.
   o. Day/night automatic adjustment of detector sensitivity.
   p. Device blink control for sleeping areas.
   q. UL-1076 security monitor points.
   r. The FACP shall be capable of coding notification circuits in march time (120 PPM), temporal (NFPA 72 6.8.6.4), and California code. Main panel notification circuits (NAC 1,2,3 and 4) shall also support special two and three stage operations.

D. Central Microprocessor
   1. The microprocessor shall be a state-of-the-art, high speed, 16 bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage, non-volatile memory for building-specific program storage, and a "watch dog" timer circuit to detect and report microprocessor failure.
   2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.
   3. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year.
   4. A special program check function shall be provided to detect common operator errors.
   5. An auto-program (self-learn) function shall be provided to quickly install initial functions and make the system operational.
   6. For flexibility and to ensure program validity, an optional Windows(TM) based program utility shall be available. This program shall be used to off-line program the system with batch upload/download. This program shall also have a verification utility which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing.
of any system operating changes. This shall be in compliance with the NFPA 72
requirements for testing after system modification.

E. Display
1. The display shall provide all the controls and indicators used by the system operator and
may also be used to program all system operational parameters.
2. The display shall include status information and custom alphanumeric labels for all
intelligent detectors, addressable modules, internal panel circuits, and software zones.
3. The display shall include a back-lit alphanumeric Liquid Crystal Display (LCD). It shall also
provide a Light-Emitting Diode (LED) for each of the following system parameters: Alarm,
Supervisory, Disable/Test, Monitor, Trouble, Ground Fault, CPU Fail, Power, and Panel
Silenced.
4. Panel shall have a keypad that has the capability to command all system functions, entry
of any alphabetic or numeric information, and field programming. Two different password
levels shall be provided to prevent unauthorized system control or programming.
5. The display shall include the following operator control switches: ACKNOWLEDGE,
ALARM SILENCE, ALARM ACTIVATE (drill), SYSTEM RESET, and LAMP TEST.
6. The system shall support an optional battery ammeter/voltmeter display.

F. Signaling Line Circuits (SLC)
1. The system shall include SLCs. SLCs interface shall provide power to and communicate
with intelligent detectors (ionization, photoelectric or thermal) and intelligent modules
(monitors or control). Each SLC shall be capable of NFPA 72 Style 6 or Style 4 (Class A or
B) wiring. The system must be able to accommodate 250 intelligent detector and modules
without adding any components to the system.
2. The Loop Interface Board (LIB) shall receive analog information from all intelligent
detectors to be processed to determine whether normal, alarm, prealarm, or trouble
conditions exist for each detector. The software shall automatically maintain the detector's
desired sensitivity level by adjusting for the effects of environmental factors, including the
accumulation of dust in each detector. The analog information shall also be used for
automatic detector testing and for the automatic determination of detector maintenance
requirements.
3. The detector software shall meet NFPA 72, requirements and be certified by UL as a
calibrated sensitivity test instrument.
4. The detector software shall allow manual or automatic sensitivity adjustment.

G. Serial Interfaces
1. The system shall include two serial EIA-232 interfaces. Each interface shall be a means of
connecting UL Listed Electronic Data Processing (EDP) peripherals.
2. The EIA-232 interface shall be used to connect an UL-Listed 40 or 80 column printer.
Printers which are not UL-Listed are not considered acceptable substitutes.
3. The system shall include an EIA-485 port for the serial connection of optional annunciators
and remote LCD displays.
4. The EIA-485 interface may be used for network connection to a proprietary receiving unit.

H. Notification Appliance Circuit (NAC) Module
1. The Notification Appliance Circuit module shall provide four fully supervised Class A or B
(NFPA Style Z or Y) notification circuits. An expansion circuit board shall allow expansion
to eight circuits per module.
2. The notification circuit capacity shall be 3.0 amperes maximum per circuit and 6.0
amperes maximum per module.
3. The module shall not affect other module circuits in any way during a short circuit
condition.
4. The module shall provide eight green ON/OFF LEDs and eight yellow TROUBLE LEDs.
5. The module shall also provide a momentary switch per circuit that may be used to
manually turn the particular circuit on or off or to disable the circuit.
6. Each notification circuit shall include a custom label inserted to identify each circuits
location. Labels shall be created using a standard typewriter or wordprocessor.
7. The notification circuit module shall be provided with removable wiring terminal blocks for ease of installation and service. The terminal strips shall be UL listed for use with up to 12 AWG wire.
8. Each circuit shall be capable of, through system programming, deactivating upon depression of the signal silence switch.

I. Control Relay Module
1. The control relay module shall provide four Form-C auxiliary relay circuits rated at 5 amperes, 28 VDC. An expansion circuit board shall allow expansion to eight Form-C relays per module.
2. Each relay circuit shall be capable of being activated (change in state) by any initiating device or from any combination of initiating devices.
3. The expansion module shall provide 8 green ON/OFF LEDs and 8 yellow LEDs (indicates disabled status of the relay).
4. The module shall provide a momentary switch per relay circuit that may be used to manually turn the relay ON/OFF or to disable the relay.
5. Each relay circuit shall include a custom label inserted to identify its location. Labels shall be created using a standard typewriter or wordprocessor.
6. The control relay module shall be provided with removable wiring terminal blocks for ease of installation and service. The terminal blocks shall be UL listed for use with up to 12 AWG wire.

J. Enclosures:
1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.
3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be selected for either right or left hand hinging.

K. Power Supply:
1. The main power supply for the fire alarm control panel shall provide 6.0 amps of available power for the control panel and peripheral devices. If required, additional power supplies shall be provided to satisfy the system power requirements.
2. Provisions shall be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
3. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 60 AH or may be used with an external battery and charger systems.
4. The main power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:
   a. Ground Fault LED
   b. Battery Fail LED
   c. AC Power Fail LED
5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.
6. The main power supply shall provide a battery charger for 4 hours of standby using dual-rate charging techniques for fast battery recharge.
7. The main power supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
8. The main power supply shall provide meters to indicate battery voltage and charging current.
9. All circuits shall be power-limited, per 1995 UL864 requirements.
L. Field Charging Power Supply: The FCPS is a device designed for use as either a remote 24 volt power supply or used to power Notification Appliances.
   1. The FCPS shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24 volt power. It shall include an integral charger designed to charge 7.0 amp hour batteries and to support 24 hour standby.
   2. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (two Style Y or Z and two style Y) shall be available for connection to the Notification devices.
   3. The FCPS shall include an attractive surface mount backbox.
   4. The Field Charging Power Supply shall include the ability to delay the AC fail delay per 1993 NFPA requirements.
   5. The FCPS include power limited circuitry, per 1995 UL standards.

M. Audio Amplifiers:
   1. The audio amplifiers will provide audio power (@ 25 Volts RMS) for distribution to the speaker circuits.
   2. Multiple audio amplifiers may be mounted in the fire alarm control panel using additional cabinets if necessary.
   3. The audio amplifiers shall include an integral power supply, and shall provide the following controls and indicators:
      a. Normal Audio Level LED
      b. Incorrect Audio Level LED
      c. Brownout LED
      d. Battery Trouble LED
      e. Amplifier Trouble LED
      f. Audio Amplifier Gain Adjust
   4. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.
   5. All terminal blocks for the connection of field wiring shall have a removable plug-in and be hardwired to allow for ease of field wire installation in a cabinet or at a remote location.
   6. The amplifier shall include audio input and amplified output supervision, back-up input, and automatic switch-over to back up (if primary amplifier should fail).
   7. Amplifiers shall be backed up in groups (one amplifier backs up several primary amplifiers).

N. Prerecorded Voice - Audio Message Generator:
   1. The voice communication system shall be capable of transmitting a prerecorded voice message to all speakers in the building, or to any programmed group of speakers.
   2. Actuation of any alarm initiating device shall cause a pre-recorded message to sound over the speakers. The message shall be repeated four times.
   3. A built-in microphone shall be provided to allow paging through speaker circuits and shall have priority over the alarm message.
   4. The message generator shall provide an interface to allow paging through telephone circuits.
   5. The audio message generator shall have the following controls and indicators to allow for proper operator understanding and control.
      a. Audio Level Normal LED
      b. All Call LED
      c. On-Line LED
      d. Amplifier Trouble LED
      e. Speaker Trouble LED
      f. All Call Switch
      g. Local Speaker Volume Control
   6. The prerecorded message shall be stored on a non-volatile read only memory chip. The message shall be up to 24 seconds in length. An optional random access chip shall be
available for a field programmable message. This message shall be programmed through the system's microphone or downloaded via a cassette recorder. Systems which utilize prerecorded memory storage other than on ROM type memory chips are not suitable substitutes.

O. Specific System Operations
1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector.
3. Point Disable: Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.
4. Point Read: The system shall be able to display or print the following point status diagnostic functions:
   a. Device status
   b. Device type
   c. Custom device label
   d. View analog detector values
   e. Device zone assignments
   f. All program parameters
5. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system status.
6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 1000 events.
   a. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose.
   b. Each of these activations will be stored and time and date stamped with the actual time of the activation.
   c. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety.
   d. The history buffer shall use non-volatile memory.
7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display, and printed on the optional printer.
8. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation.
   a. Both pre-alarm levels shall be fully field adjustable.
   b. The first level shall give an audible indication at the panel.
   c. The second level shall give an audible indication and may also activate control relays.
   The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.
9. Software Zones: The FACP shall provide 99 software zones and 10 additional special function zones.
10. The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows:
   a. Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.
   b. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.
   c. Walk test shall be selectable on a per device/circuit basis. All devices and circuits which are not selected for walk test shall continue to provide fire protection and if an alarm is detected, will exit walk test and activate all programmed alarm functions.
d. All devices tested in walk test shall be recorded in the history buffer.

11. Waterflow Operation
   a. An alarm from a waterflow detection device shall activate the appropriate alarm message on the main panel display, turn on all programmed notification appliance circuits and shall not be affected by the signal silence switch.

12. Supervisory Operation
   a. An alarm from a supervisory device shall cause the appropriate indication on the 80 character display, light a common supervisory LED, but will not cause the system to enter the trouble mode.

13. Signal Silence Operation
   a. The FACP shall have the ability to program each output circuit (notification, relay, speaker etc) to deactivate upon depression of the signal silence switch.

14. Non-Alarm Input Operation
   a. Any addressable initiating device in the system may be used as a non-alarm input to monitor normally-open contact type devices. Non-alarm functions shall be a lower priority than fire alarm initiating devices.

2.05 SYSTEM COMPONENTS:

A. Provide control module, panic push button (located at Reception, coordinate exact location with Owner), and all interconnections as required to initiate a lockdown event. FACP shall call out to local authorities. Coordinate a separate lockdown recording with Owner.

B. Programmable Electronic Sounders/Strobe:
   1. Electronic sounders shall operate on 24 VDC nominal.
   2. Electronic sounders shall be field programmable without use of special tools, to provide a slow whoop, continuous, or interrupted tones with an output sound level of at least 90 dBA measured at 10 feet from the device.
   3. The maximum pulse duration shall be 2/10 of one second.
   4. Strobe intensity shall meet requirements of UL 1971.
   5. Flash rates shall meet the requirements of UL 1971.
   6. Shall be flush or surface mounted as show on plans.
   7. Shall be flush mounted in finished spaces and surface mounted in unfinished spaces.

C. Speakers:
   1. All speakers shall operate at 25 VRMS or with field selectable output taps from 0.5 to 2.0 watts.
   2. Speakers in corridors and public spaces shall produce a nominal sound output of 84 dBA at 10 feet (3m).
   3. Frequency response shall be a minimum of 40 Hz to 4000 Hz.
   4. The back of each speaker shall be sealed to protect speaker cone from damage and dust.

D. Strobe lights shall meet the requirements of the ADA, UL Standard 1971 and shall meet the following criteria:
   1. The maximum pulse duration shall be 2/10 of one second.
   2. Strobe intensity shall meet the requirements of UL 1971.
   3. The flash rate shall meet the requirements of UL 1971.

E. Speaker/Strobe Light Combination Devices:
   1. Shall meet the requirements for speakers outlined above.
   2. Shall meet the requirements for strobes outlined above.

F. Serially Connected Annunciator
   1. The annunciator shall communicate with the fire alarm control panel via a two wire EIA 485 (multi-drop) communications circuit.
   2. The annunciator shall require no more than four wires for operation. Annunciation shall include: intelligent addressable points, system software zones, control relays, and notification appliance circuits. The following operations shall also be provided:
      a. Up to 32 annunciators, each with up to 64 points, may be installed on the system.
b. The annunciator shall include a single electrical keyswitch to disable all switch functions.

c. The annunciator shall provide alarm and trouble resound, with flash for new conditions.

d. An optional repeater shall be available which allows the serial data to be repeated, supporting extended wire distances. A version shall also be available for connecting annunciators over a dual fiber optic pair.

G. Alphanumeric LCD Type Annunciator:
   1. The alphanumeric display annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text.
   2. The LCD annunciator shall display all alarm and trouble conditions in the system.
   3. An audible indication of alarm shall be integral to the alphanumeric display.
   4. The display shall be UL listed for fire alarm application.
   5. It shall be possible to connect up to 32 LCD displays and be capable of wiring distances up to 6,000 feet from the control panel.
   6. The annunciator shall connect to a separate, dedicated "terminal mode" EIA-485 interface. This is a two-wire loop connection and shall be capable of distances to 6,000 feet. Each terminal mode LCD display shall mimic the main control panel.
   7. The system shall allow a minimum of 32 terminal mode LCD annunciators. Up to 10 LCD annunciators shall be capable of the following system functions: Acknowledge, Signal Silence and Reset which shall be protected from unauthorized use by a keyswitch or password.

H. All interfaces and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL Standard 864.

I. Digital Alarm Communicator Transmitter (DACT). The DACT is an interface for communicating digital information between a fire alarm control panel and a UL-Listed central station.
   1. The DACT shall be interfaced with an IP bridge communicator that will allow for connection to the customer provided Ethernet 10/100 Based network (LAN or WAN). This bridge will allow use of the internet for remote alarm reporting. The IP bridge shall receive contact ID configured signals from the DACT and convert these analog signals into digital signals at the panel for transmission to a compatible receiver at the central station. All connections to the IP bridge shall be supervised and report to the host fire alarm panel through the DACT.
   2. The DACT shall be completely field programmable from a built-in keypad and 4 character red, seven segment display.
   3. The DACT shall be capable of transmitting events in at least 15 different formats. This ensures compatibility with existing and future transmission formats.
   4. Communication shall include vital system status such as:
      a. Independent Zone (Alarm, trouble, non-alarm, supervisory)
      b. Independent Addressable Device Status
      c. AC (Mains) Power Loss
      d. Low Battery and Earth Fault
      e. System Off Normal
      f. 12 and 24 Hour Test Signal
      g. Abnormal Test Signal (per UL requirements)
      h. EIA-485 Communications Failure
      i. Phone Line Failure
   5. The DACT shall support independent zone/point reporting when used in the Contact ID format.

J. Field Wiring Terminal Blocks
   1. All panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks which are permanently fixed are not acceptable.
K. Door Holders
1. Provide where shown on the plans.
2. All 120 volt power for door holds shall be independent of panel power.
3. Provide separate circuits for door holders as shown on the plans.
4. Wall mount door holders shall be 120VAC, flush wall mount, Notifier #DH154N.
5. Floor mount door holders shall be 120VAC, surface floor mount with flush floor box, Notifier #DH150N.
6. Provide all hardware and accessories for a complete installation.

2.06 SYSTEM COMPONENTS - ADDRESSABLE DEVICES:

A. Addressable Devices - General
1. Addressable devices shall use decade type address switches, numbered 0 to 15. Detectors that have expanded addressing will have decade switch numbered from 0 to 15 for the most significant digit to allow detector addressing from 1 to 159. The detectors and modules shall use FLASHSCAN technology, or equivalent.
2. Addressable devices which use a binary-coded address setting method, such as a DIP switch, are not an allowable substitute.
3. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel signaling line circuits.
4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs.
   a. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected.
   b. If required, the LED flash shall have the ability to be removed from the system program.
   c. An output connection shall also be provided in the base to connect an external remote alarm LED.
5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity shall be automatically adjusted by the panel on a time-of-day basis.
6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature.
8. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
11. Detectors shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LEDs shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
12. Addressable devices shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LED(s) shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.

13. A magnetic test switch shall be provided and supplied to the Owner, to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

B. Addressable Pull Box (Pre-signal manual station)
   1. Addressable pull boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
   2. Manual stations shall be 2-stage presignal type and constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, minimum 1.75" high.
   3. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
   4. Manual stations shall be equivalent to EST # SIGA-270P.

C. Intelligent Photoelectric Smoke Detectors (symbol - SD)
   1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.
   2. Intelligent photoelectric/thermal smoke detectors shall be equivalent to EST #SIGA-PS, complete with base.

D. Duct Smoke Detectors
   1. Photoelectric duct smoke detectors shall be a 24 VDC type with visual alarm and power indicators, DPDT relay and a RTS 451 remote test reset switch where shown on drawings.
   2. Each detector shall be installed upon the composite supply/return air duct(s), with properly sized air sampling tubes. For maintenance purposes it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing from cover.
   3. Each duct detector shall be provided with a Test Station (Edwards SD-TRK). Test Stations, shall be mounted such that they are easily accessible and testing can be performed without using ladders or other tools. Label each Test Station and Duct Detector with the name of the Mechanical Unit being monitored.
   4. Duct smoke detectors shall be equivalent to Edwards SIGA-SD, complete with sampling tubes and all accessories required for operation.

E. Intelligent Thermal Detectors
   1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.
   2. Intelligent thermal detectors shall be equivalent to Edwards SIGA-HRS, with base.

F. Universal Class A/B Module
   1. Addressable monitor module shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs. Provide as required.
   2. The monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.
   3. The IDC zone shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
   4. Modules shall be equivalent to Edwards SIGA-UM.
G. Signal Module
   1. Signal Module, upon command from the loop controller, shall connect supervised Class B signal circuits to their respective power inputs. The function of this module shall be determined by a selectable code.
   2. The module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.
   3. Modules shall be equivalent to EST #SIGA-CC1.

H. Synchronization Output Module
   1. Synchronization Output Module shall be used as a signal power riser selector to provide synchronization of fire alarm signals across multiple zones.
   2. The module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.
   3. Modules shall be equivalent to EST #SIGA-CC1S.

I. Waterflow/Tamper Module
   1. Waterflow/Tamper Module is a two circuit intelligent module. Circuit 1 is for Class B normally-open waterflow alarm switches. When the input contact is closed for approximately 16 seconds, an "alarm" signal is sent to the loop controller. Circuit 2 is for Class B normally open dry contact supervisory and tamper switches. When the input contact is closed, an "active" signal is sent to the loop controller. Conditions on both circuits are latched at the module.
   2. The monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.
   3. Modules shall be equivalent to EST #SIGA-WTM.

J. Addressable Control Module
   1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contact relay.
   2. The control module shall mount in a standard 4-inch square, 2-1/8 inch deep electrical box, or to a surface mounted backbox.
   3. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.
   4. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised, UL listed remote power supply.
   5. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.
   6. Addressable control module shall be equivalent to Edwards SIGA-CR.

K. Isolator Module
   1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.
   2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
   3. The isolator module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
   4. The isolator module shall mount in a standard 4-inch (101.6 mm) deep electrical box or in a surface mounted backbox. It shall provide a single LED that shall flash to indicate that
the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

5. Modules shall be equivalent to EST #SIGA-IM.

2.07 CONVENTIONAL INITIATING DEVICES:
   
   A. Conventional heat detectors shall be combination fixed temperature/rate-of-rise type devices, equivalent to Edwards System Technology Signautre II Series.
   
   B. All conventional detectors shall be integrated into the addressable fire alarm system via addressabel monitor modules as recommended by the system manufacturer. Provide all necessary materials to integrate.

2.08 BATTERIES:
   
   A. The batteries shall be 25 amp-hour sealed Gel Cell type, 12 volt nominal (number as required).
   
   B. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty four (24) hours plus 15 minutes of alarm upon a normal AC power failure.
   
   C. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.
   
   D. If necessary to meet standby requirements, external battery and charger systems may be used.

PART 3 EXECUTION

3.01 INSTALLATION:
   
   A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
   
   B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
   
   C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
   
   D. Manual pull stations shall be suitable for surface mounting or semiflush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.
   
   E. All ceiling mounted devices (i.e. smoke detectors) installed in accessible ceilings shall be centered in the ceiling tiles, and shall be connected with flexible metal conduit, as detailed on the drawings.
   
   F. Horn/strobes, speaker/strobes, and strobes shall be installed at 80 inches or 12 inches below the finished ceiling, whichever is lower.
   
   G. All provisions of the contract documents, including Division 1, Division 23, Division 26, Division 27 and Division 28 shall apply to the work specified in this section.
   
   H. The following work shall be performed by factory trained personnel (NICET level 2) in the direct employ of the Fire Alarm equipment supplier:
      1. Connections of all annunciators and digital communicators.
      2. All connections at FACP.

3.02 TEST:
   
   A. The service of a competent, factory certified technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72.
      1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
      2. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
      3. Verify activation of all waterflow switches.
4. Open initiating device circuits and verify that the trouble signal actuates.
5. Open and short signaling line circuits and verify that the trouble signal actuates.
6. Open and short notification appliance circuits and verify that trouble signal actuates.
7. Ground all circuits and verify response of trouble signals.
8. Check presence and audibility of tone at all alarm notification devices.
9. Verify function of all strobes.
10. Verify shut down of all air handling equipment upon alarm.
11. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
12. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
13. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addresses or grouped devices, sensitivity monitoring, verification, functionality and the like.
14. A copy of the completed test report, as required by NFPA 72, shall be submitted for approval before final inspection and before final acceptance will be made of the building. Copies of this report shall also be included in the O&M manuals provided upon completion of the job.

3.03 FINAL INSPECTION:
   A. At the final inspection, a factory trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.
   B. The technician on site shall be NICET Level 2 Certified in Fire Alarm Systems.

3.04 INSTRUCTION:
   A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.
   B. The contractor and/or the systems manufacturer’s representatives shall provide a typewritten "Sequence of Operation."

3.05 CERTIFICATION:
   A. Provide a Letter of Certification from the authorized and certified factory representative of the manufacturer that the system has been thoroughly tested and is fully operational.
   B. The letter shall substantially contain the following:
      1. "We the undersigned, having been selected as the fire alarm contractor and installer, do hereby certify that the systems are installed in accordance with the manufacturer's recommended procedures. The system has been thoroughly tested and is completely and fully operational. It has been demonstrated to the local Fire Marshall and was accepted as complete and acceptable to him.

END OF SECTION
Geotechnical Engineering Evaluation

Proposed Additions to Park Elementary School
140 West 9th Street
Casper, Wyoming

Prepared for:

GSG Architecture
Tim Schenk
606 South David Street
Casper, Wyoming 82601

Prepared by:

Environmental & Civil Solutions, LLC
111 West 2nd Street, Suite 600
Casper, Wyoming 82601

August 22, 2019
PURPOSE AND SCOPE OF STUDY

This report presents the results of a geotechnical engineering study for the proposed additions to Park Elementary School located at 140 West 9th Street in Casper, Wyoming. This study was conducted for the purpose of developing foundation, site grading, and pavement recommendations for the proposed additions and new parking areas. This study was conducted in accordance with the Work Order between GSG Architecture and ECS Engineers (ECS) and our proposal dated May 10, 2019.

The field exploration program consisted of drilling three exploratory borings within the breezeway addition and the classroom addition footprints to obtain information on the subsurface conditions. The exploratory borings were located generally as shown on the attached Location of Exploratory Borings, Figure 1. Samples of the soil obtained during the field exploration were tested to determine physical and engineering characteristics and analyzed to develop earthwork and construction design recommendations. The results of the field exploration and laboratory testing are presented herein.

This report has been prepared to summarize the data obtained during this study, and to present conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. A discussion of geotechnical engineering considerations related to construction is included in this report.

PROPOSED CONSTRUCTION

We understand that three additions are planned for the existing Park Elementary School. The main addition will be located north of the classroom wing and will add four new classrooms. This addition will be two stories and will have plan dimensions of approximately 42 ft by 71 ft. A second addition will be located on the north side of the existing breezeway which connects the gymnasium to the classroom wing. This addition will be one story and will have a footprint area of approximately 1,700 sf. A third small addition will be located at the southwest corner for new office space. This addition will be one story and will have plan dimensions of approximately 11 by 15 ft. The type of construction will likely be steel framing with masonry veneer. Structural loads are expected to range from 2,000 to 3,000 pounds per lineal foot for walls for the single level additions and 3,000 to 4,000 pounds per lineal foot for the two story addition. Finished floor
Elevations for the additions will generally match the existing finished floor elevations. The breezeway addition will require stepping or sloping to match the different finished floor elevations between the gymnasium and the classroom wing.

Site improvements will include additional parking. A row of diagonal parking will be added along David Street and a row of diagonal parking will be added along 8th Street on the south side. Initial plans call for closing 8th Street to the general public and reserving its use for Park School and the NCSD bus hub. We expect only asphalt pavement will be considered.

SITE CONDITIONS

At the time of our field exploration the site of the proposed project was occupied by the existing Park Elementary School. The school grounds are bounded by 9th street to the south, David Street to the west, Center Street to the east, and 8th Street to the north. The existing building is generally “L” shaped and located on the southern portion of the site. The classroom wing is located along the western portion of the site and parallels David Street. The classroom addition is currently used as concrete sidewalk and gravel playground. The breezeway addition is paved with concrete and asphalt and a small storage shed is located within or near the proposed footprint. The office addition is currently a sidewalk. Parking is currently located along the west side of the classroom wing and extends from 8th Street to 9th Street. The topography of the site slopes slightly downward to the north with an elevation difference of approximately 5 ft across the entire site. Surrounding development includes residential, some commercial, and the school district bus hub to the north.

Based on a structural drawing of the existing classroom wing provided by GSG Architecture, the school was supported by spread footings extending to the sand stratum. A note on the drawing stated that foundation bearing elevation is 39.0’ and top of floor slab elevation is 47.32’. This implies that the stem walls are 7 ft in height and that the footings were placed on the sand stratum.

FIELD EXPLORATION

ECS Engineers conducted the field exploration on August 5, 2019. Three borings were drilled to depths of 16.5 ft. Boring B-1 was drilled within the breezeway addition and borings B-2 and B-3
were drilled within the classroom addition. The approximate boring locations are shown on Figure 1. ECS established the boring locations in the field referencing on site features.

ECS contracted Henderson Drilling to perform the drilling services. The drill crew advanced the borings through the on-site soils with a CME 75 truck mounted drill rig using 3.25 inch inside diameter hollow-stem auger. An ECS field engineer logged the borings. Auger refusal was not encountered within any of the borings.

Samples of the subsurface soils were obtained using 1½ inch inside diameter split barrel samplers. The samplers were driven into the various strata using a 140 lb hammer falling 30 inches. The total number of blows required to advance the standard split barrel samplers each of three successive 6 inch increments is recorded and the sum of the second and third 6 inch increments is recorded as the penetration resistance value (SPT or N value). This testing is performed in general accordance with ASTM D1586, Split Barrel Sampling. Penetration resistance values provide an indication of the relative density of granular soils or consistency of fine-grained soils. Depths at which the samples were obtained, and the penetration resistance values are shown on the attached exploratory boring logs.

The groundwater levels were measured within each boring at the time of drilling. The borings were backfilled with auger cuttings upon completion of drilling and groundwater measurements.

LABORATORY TESTING

Samples of soil obtained during the field exploration were observed and visually classified in accordance with ASTM D2487, which is based on the Unified Soil Classification System. Samples were selected for testing to determine the engineering and physical properties in general accordance with ASTM or other generally recognized procedures. The following table summarizes the tests performed for this project:

<table>
<thead>
<tr>
<th>Test</th>
<th>ASTM Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Moisture Content</td>
<td>D2216</td>
</tr>
<tr>
<td>Percent Passing No. 200 Sieve</td>
<td>D1140</td>
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<tr>
<td>Atterberg Limits</td>
<td>D4318</td>
</tr>
<tr>
<td>Sieve Analysis</td>
<td>D422</td>
</tr>
</tbody>
</table>
Results of all laboratory tests are summarized on the exploratory boring logs and presented on the table below. The laboratory data, along with the visual field logging information, were used to prepare the exploratory boring logs.

**SUBSURFACE CONDITIONS**

Based on the soil samples obtained from drilling, the subsurface conditions generally consist of 3 to 9 ft of lean clay overlying poorly graded sand with silt. The attached boring logs should be referenced for complete soil descriptions and classifications, stratum thicknesses, N values, and laboratory test results. A brief description of each soil type encountered follows:

**Lean Clay (CL)**

Lean clay was encountered below the asphalt in boring B-1 and below the playground gravel in borings B-2 and B-3. The lean clay extended to approximate depths of 3 ft in boring B-1, 6 ft in boring B-2, and 9 ft in boring B-3. The consistency of the lean clay is medium stiff to stiff as indicated by the N values ranging from 5 to 15. The clay is brown to dark brown in color and moist. Laboratory testing indicates that the lean clay has a moderate to significant compression potential upon loading and becoming wetted.

**Poorly Graded Sand with Silt (SP-SM)**

Poorly graded sand with silt was encountered below the lean clay in all three borings. The sand extended to the depths explored in all three borings, 16.5 ft. The relative density of the sand ranged from loose to dense as indicated by the N values ranging from 7 to 33. However, the stratum is mostly medium dense as the majority of N values ranged from 14 to 25. The sand is light brown in color and slightly moist. A summary of laboratory test results for a sample of the sand is presented in the table below.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Moisture Content</th>
<th>Liquid Limit</th>
<th>Plasticity Index</th>
<th>Percent Passing (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1 @ 7.5 ft</td>
<td>2.7%</td>
<td>NP</td>
<td>96</td>
<td>93</td>
</tr>
</tbody>
</table>
Groundwater

Groundwater was not encountered within the borings at the time of drilling. Numerous factors contribute to fluctuations of groundwater levels, and evaluation of such factors are beyond the scope of this study.

ENGINEERING ANALYSIS AND RECOMMENDATIONS

The recommended design and construction criteria presented below should be observed for the geotechnical engineering aspects of the project. The following construction details should be considered when preparing project documents.

Site Grading

The topography of the site slopes slightly downward to the north. The construction of the additions will require minor site grading. Fills ranging from 2 to 3 ft may be required to achieve the floor elevation for the classroom addition. Cuts and fills of 1 ft or less will be required for the other two additions.

Site Preparation

Prepare each addition site by following the general recommendations provided below.

1. Remove all topsoil, vegetation, organic matter, concrete, asphalt, and playground gravel from all construction areas and cut and fill areas.

2. Remove the lean clay in its entirety from all three addition footprints. The exact vertical and lateral extents of the lean clay within each addition footprint can only be determined at the time of foundation excavations. An ECS geotechnical engineer must inspect over-excavations to determine required over-excavation limits.

3. All fill and backfill should be approved by the geotechnical engineer. The lean clay and the poorly graded sand will be the soil types encountered within site grading and foundation excavations. The lean clay is suitable for re-use as new fill only for exterior
foundation wall backfill. It is not suitable for re-use as fill below floors slabs or below pavement areas. The poorly graded sand is suitable for re-use below floor slabs, below pavement sections, and as foundation wall backfill.

4. Structural fill will be required below foundations for the classroom addition and below floor slabs for all three additions. Structural fill will need to be imported and must be approved by the geotechnical engineer prior to importing. In general, structural fill should consist of a consistently graded granular material with a maximum particle size of 1.5 inches, 35 to 75% passing the No. 4 sieve, and 10 to 20% passing the No. 200 sieve.

5. Place imported fill and on-site soil fill required to obtain design grades in thin (8 inch thick maximum), uniform lifts and compact to the following minimum percentages of the maximum dry density as determined by ASTM D698 (Standard Proctor).

<table>
<thead>
<tr>
<th>Application</th>
<th>Compaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below Foundations</td>
<td>97</td>
</tr>
<tr>
<td>Building Pad (below floors)</td>
<td>97</td>
</tr>
<tr>
<td>Exterior Foundation Wall Backfill</td>
<td>95</td>
</tr>
<tr>
<td>Below Concrete Flatwork</td>
<td>95</td>
</tr>
<tr>
<td>Utility Trenches</td>
<td>95</td>
</tr>
<tr>
<td>Below Pavement Sections</td>
<td>95</td>
</tr>
<tr>
<td>Overlot Fill</td>
<td>90</td>
</tr>
</tbody>
</table>

Moisture condition and place imported fill material and on-site soil placed as new fill to within ±2% of the optimum moisture content of each soil as determined by ASTM D698.

**Excavations**

Based on the subsurface conditions encountered within the exploratory borings, the lean clay and the poorly graded sand will be encountered within the site grading excavations and foundation excavations and over-excavations. Conventional heavy-duty earth excavation equipment will be sufficient for anticipated cuts and foundation excavations.

Care must be taken not to cause construction related induced distress to the existing structure. Appropriately sized equipment for excavating, placing, and compacting fill must be used when working immediately adjacent to the existing building.
Based on a structural drawing of the existing classroom wing provided by GSG Architecture, the school was supported by spread footings extending to the sand stratum. A note on the drawing stated that foundation bearing elevation is 39.0’ and top of floor slab elevation is 47.32’. This implies that the stem walls are 7 to 8 ft in height. If this is the case over-excavations should not undermine existing footings. If this is not the case, over-excavations required for the classroom addition will extend below existing footings for the existing building. Over-excavations that extend below existing footings must be made in short segments, preferably about 10 ft in length and made perpendicular to the existing footings and backfilled with structural fill as soon as possible to help reduce the potential for soil loss below the existing footings.

It is the contractor’s responsibility to provide safe working conditions and safe temporary side slopes for all excavations. Based on the soil type encountered within the exploratory borings and for planning purposes use only, we estimate that the excavation sides will require slopes of 1 horizontal to 1 vertical or flatter to meet OSHA 29 CFR 1926, Subpart P requirements.

**Surface Drainage**

Observe the following drainage precautions during construction and maintain them at all times after the additions have been completed.

1. Slope the ground surface adjacent to exterior foundations to drain away from the foundations in all directions. We recommend a minimum slope of 5% in the first 10 ft for landscaped areas and 2.5% in the first 10 ft for pavement, concrete flatwork, or driveway areas.

2. Discharge roof downspouts and drains well beyond the limits of all foundation wall backfill, preferably a minimum of 10 ft. Maintain downspouts and drains over the life of the facility.

3. Keep landscaping that requires irrigation at least 5 ft from exterior walls.

**Foundations**

*Breezeway and Office Additions*

Approximately 3 ft of compressible lean clay was encountered within the breezeway addition. A boring was not drilled within the footprint of the office addition. However, we believe the lean clay will be relatively shallow in depth. The depth and condition of the lean clay stratum within the office addition footprint must be verified by the ECS geotechnical engineer during construction.
Based on the subsurface profile, spread footing are a suitable foundation type for the breezeway addition and the office addition and must be placed on the natural, undisturbed sand stratum.

**Classroom Addition**

Based on the presence of 6 to 9 ft of compressible lean clay, we recommend that the clay be entirely removed from below all new foundations. Placing foundations on compressible lean clay entails a significant risk of excessive differential movement potentially causing damage to foundations. The lean clay is not suitable for support of structural loads. If the existing footing extended to the sand stratum, undermining of existing footings should not occur. If the existing footings did not extend to the sand stratum, over-excavations will be required that extend below existing foundations. Underpinning can likely be avoided if over-excavations are made in relatively short segments and backfilled with structural fill to the existing bearing elevation as soon as possible. Over-excavations should be constructed at slopes of 1 horizontal to 1 vertical or flatter and should have a minimum bottom width of 4 ft.

Backfilling a relatively deep over-excavation could be made more effective by using a clean ¾ inch gravel for the lower portions. The advantages to using a clean gravel include less compactive effort, less moisture conditioning, and the requirement for compaction testing on the clean gravel would be eliminated. The gravel should be placed in 1.5 ft thick lifts and compacted until all noticeable vertical deflection has ceased or at least six passes of a vibratory compactor. We recommend the use of clean gravel as structural fill only if the existing footings do not extend as deep as indicated on the structural design drawing. If Grading “J” base or other approved structural fill is used, it must be compacted to 97% of the maximum dry density and within 2% of the optimum moisture content as determined by ASTM D698, Standard Proctor.

**Spread Footings**

As outlined above, spread footings are a suitable foundation type provided they are placed on the natural, undisturbed sand stratum or properly placed and compacted structural fill. Design footings using a maximum allowable bearing pressure of 3,000 psf.

Observe the design and construction criteria presented below for a spread footing foundation system.

1. We determined a footing depth and bearing pressure for the design of footings that should provide against bearing failure and excessive settlement. Based upon our experience and
analyses using one-dimensional settlement theory, we recommend that footings be designed using a maximum allowable bearing pressure of 3,000 psf for the properly placed structural fill. For footings designed using this bearing pressure, we estimate the total settlement for the footings will be 1 inch or less. We estimate differential settlement will be less than half the total settlement.

2. Place exterior footings or footings below unheated areas at least 42 inches below final exterior grade for frost protection.

3. Settlements that take place for the additions will be differential with respect to the existing building. The additions should be separated from the existing building as much as possible with construction joints that will allow for differential movement between the structures.

4. Footing sizes must be designed by a licensed Professional Engineer. For planning purposes, we recommend minimum footing widths of 18 inches for continuous footings and 24 inches for isolated pads.

5. Design and construct reinforcing for continuous footings and foundation walls to span an unsupported length of at least 10 ft.

6. Use Type II Portland cement in concrete in contact with the on-site soils.

7. A representative of the geotechnical engineer must observe the foundation excavations prior to concrete placement.

Floor Systems

We understand that the addition floors will consist of concrete slab-on-grade construction. The on-site lean clay in its existing condition is not suitable for support of concrete slab-on-grade floor construction. The floors should be supported on a zone of structural fill. The lean clay should be entirely removed and replaced with imported granular structural fill for all three additions. Compact fill placed below floor slabs to at least 97% of the maximum dry density and at a moisture content within ±2% of optimum moisture as determined by ASTM D698, Standard Proctor.

Observe the following recommendations for concrete slab-on-grade construction.

1. To reduce the effects of some differential movement, separate floor slabs from all bearing walls and columns with expansion joints, which allow unrestrained vertical movement.

2. Use floor slab control joints to reduce damage due to shrinkage cracking. Provide joints approximately 15 ft apart.
3. The requirements for slab reinforcement and thickness should be established by the designer based on experience and the intended use of the slab.

4. Place a 4-inch thick layer of free draining gravel beneath all concrete slab-on-grade floor slabs. This material should consist of minus 1½-inch size aggregate with less than 60% passing the No. 4 sieve, and less than 5% passing the No. 200 sieve.

**Pavement Design**

The primary purpose of a pavement section is the distribution of concentrated wheel loads to the subgrade in a manner such that the subgrade is not over-stressed. Performance of the pavement section is directly related to the strength of the subgrade soils and the characteristics of the traffic loading. For purposes of designing a pavement section, subgrade soils are represented by a soil support value for flexible pavements (asphaltic concrete). This representative value is empirically related to strength.

Pavement design procedures are based upon strength properties of the subgrade soils and pavement materials, along with the design traffic conditions (especially truck traffic). Subgrade strength decreases when the subgrade is wetted and is further reduced when saturated. Therefore, proper drainage, both surface and subsurface, is essential for adequate pavement performance.

Pavement requirements were analyzed for anticipated uses within the proposed new parking areas. We do not expect that traffic loads will vary from existing conditions. Traffic will consist of mostly light passenger vehicles. The pavement subgrade will consist of the lean clay. Therefore, a relatively low CBR value was assumed for these soils. The pavement section thickness design was made by using a subgrade modulus of 6,000 psi, which was correlated from an estimated CBR of 4. The analyses included using a 20-year design life and a reliability factor of 80%. In designing the pavement section, we used methods from the AASHTO Guide to Pavement Design (1993).

**Subgrade Preparation**

Minor cuts may be required to achieve rough subgrade elevation for the pavement areas. Prior to placement of the geotextile fabric, the subgrade should be scarified to a minimum depth of 9 inches, moisture conditioned to near optimum, and compacted. After compaction of the scarified
zone, the resulting subgrade should be proof-rolled with a loaded dump truck to inspect for loose or soft areas. If loose or soft areas are encountered, over-excavation of 1 to 2 ft will be required. An imported granular material (such as Grading J) should be used within the over-excavations, compacted to 95% of the maximum dry density as determined by ASTM D698. If fill is required to achieve the desired pavement subgrade elevations, it should be approved by the geotechnical engineer. Use fill beneath pavements consisting of the on-site soils or imported material approved by the geotechnical engineer. Compact fill below pavement sections to at least 95% of the maximum dry density and within ±2% of optimum moisture content as determined by ASTM D698.

**Recommended Pavement Section**

Based on our design calculations, anticipated traffic, and the field conditions, we recommend the pavement section shown below for new or re-constructed pavement areas and parking areas.

**FLEXIBLE SECTION - ASPHALTIC CONCRETE**

<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphaltic Concrete</td>
<td>4</td>
</tr>
<tr>
<td>Crushed Aggregate Base</td>
<td>6</td>
</tr>
<tr>
<td>Subbase</td>
<td>12</td>
</tr>
<tr>
<td>Woven Geotextile Fabric</td>
<td></td>
</tr>
</tbody>
</table>

The geotextile fabric should consist of Mirafi 500X, or equivalent. The crushed aggregate base course should consist of Grading W and should be compacted to at least 98% of the maximum dry density and within ±2% of optimum moisture content as determined by ASTM D698. The subbase should consist of Grading J material and should be compacted to at least 95% of the maximum dry density and within ±2% of optimum moisture content as determined by ASTM D698. The asphalt should have a minimum stability of 2,000 lb and should be placed to at least 96% Marshall density.

**Building Maintenance**

It is extremely critical that proper maintenance be performed over the life span of the new additions and the overall building. It is very important that positive site drainage be maintained to ensure overall performance of the foundations and floor systems as presented herein. Maintaining positive site drainage will require periodic maintenance to ensure roof gutters and roof downspouts are properly maintained and properly discharged away from the foundation in all
directions. All landscaping or surface re-grading must take into consideration the positive drainage recommendations presented herein. Changing the surface drainage could have a negative impact on surface flow.

LIMITATIONS

This study has been conducted in accordance with generally accepted geotechnical engineering practices in this area for use by the client for design purposes. The conclusions and recommendations submitted in this report are based upon the design data submitted to ECS Engineers, data obtained from the exploratory borings drilled at the locations indicated on Figure 1, and the proposed construction discussed in this report. The nature and extent of subsurface variations across the site may not become evident until construction. During construction, if fill, soil, bedrock or water conditions appear to be different from those described herein, this office must be advised at once so that we may re-evaluate the recommendations made.

This report has been prepared for the exclusive use by our client for design purposes. We are not responsible for technical interpretations by others of our exploratory information which has not been described or documented in this report. As the project evolves, we should provide continued consultation during construction to review and monitor the implementation of our recommendations, and to verify that the recommendations have been appropriately interpreted. Significant design changes may require additional analysis or modifications of the recommendations presented herein. We recommend on-site observation of excavations and foundation bearing strata by a representative of the geotechnical engineer. Have soil compaction tested during construction in the field by a qualified testing laboratory.

Attachments:
  Figure 1 – Boring Location Plan
  Exploratory Boring Logs
  Laboratory Test Results
CASPER, WY - PARK ELEMENTARY SCHOOL
FIGURE 1 - LOCATION OF EXPLORATORY BORINGS

PARK ELEMENTARY SCHOOL

B-3

B-2

B-1

Drawing Not To Scale

ECS
<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample Type</th>
<th>SPT Value</th>
<th>Moisture Content (%)</th>
<th>Dry Density (pcf)</th>
<th>Liquid Limit</th>
<th>Plasticity Index</th>
<th>Passing No. 200 (%)</th>
<th>Material Description</th>
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</thead>
<tbody>
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<td>6</td>
<td></td>
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<td>3 inches of asphalt</td>
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<td></td>
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<td></td>
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<td>Thin Asphalt</td>
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<td></td>
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<td></td>
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<td>0.25 to 3 ft</td>
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<td></td>
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<td>(SP), medium dense,</td>
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<td>Bottom of Boring 16.5 ft</td>
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</table>

Samplng Type Symbols:  ■ California Sampler  □ Split Barrel Sampler

- Groundwater at time of drilling
- Stabilized groundwater level

Project Name:  Park Elementary School Additions, Casper, Wyoming
Boring Number:  B-1
Driller:  Henderson Drilling
Logger:  Brian Chandler
Boring Location:  North of Breezeway, See Figure 1
Drill Date:  August 5, 2019
Drilling Equipment:  CME 75
Boring Diameter:  7 inches
Hammer Type:  Automatic
Ground Elevation:  5143.4
Groundwater:  Not encountered during drilling
<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Sample Type</th>
<th>SPT Value</th>
<th>Moisture Content (%)</th>
<th>Dry Density (pcf)</th>
<th>Liquid Limit</th>
<th>Plasticity Index</th>
<th>Passing No. 200 (%)</th>
<th>Lithology Symbol</th>
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<td></td>
<td>6</td>
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<td>0.25 to 6 ft Lean Clay (CL), medium stiff to stiff, brown, moist</td>
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<td>6 to 16.5 ft Poorly Graded Sand (SP), medium dense to dense, light brown, slightly moist</td>
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</tbody>
</table>

Sampler Type Symbols:  
- California Sampler  
- Split Barrel Sampler

Groundwater at time of drilling:  
- Stabilized groundwater level

Project Name: Park Elementary School Additions, Casper, Wyoming
Boring Number: B-2  
Driller: Henderson Drilling  
Logger: Brian Chandler
Boring Location: East Side of Proposed Classroom Add., See Figure 1
Drill Date: August 5, 2019
Drilling Equipment: CME 75  
Boring Diameter: 7 inches  
Hammer Type: Automatic
Ground Elevation: 5141.3
Groundwater: Not encountered during drilling

Log of Exploratory Boring B-2
Project Name:  Park Elementary School Additions, Casper, Wyoming
Boring Number:  B-3
Driller:  Henderson Drilling
Logger:  Brian Chandler
Boring Location:  West Side of Proposed Classroom Add., See Figure 1
Drill Date:  August 5, 2019
Drilling Equipment:  CME 75
Boring Diameter:  7 inches
Hammer Type:  Automatic
Ground Elevation:  5141.6
Groundwater:  Not encountered during drilling

<table>
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<th>Sample Type</th>
<th>SPT Value</th>
<th>Moisture Content (%)</th>
<th>Dry Density (pcf)</th>
<th>Liquid Limit</th>
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<th>Passing No. 200 (%)</th>
<th>Lithology Symbol</th>
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</tbody>
</table>

MATERIAL DESCRIPTION

3 inches of pea gravel
0.25 to 9 ft
Lean Clay (CL), medium stiff to stiff, brown, moist

9 to 16.5 ft
Poorly Graded Sand (SP), medium dense to dense, light brown, slightly moist

Bottom of Boring 16.5 ft

Sampler Type Symbols:  ☐ California Sampler ☐ Split Barrel Sampler

Groundwater at time of drilling ☐ Stabilized groundwater level

Project No.  190009
Log of Exploratory Boring B-3
Lean Clay (CL)

Park Elementary School Additions
One Dimensional Swell / Collapse
Boring B-1 at 5 ft

Water Added

Strain (%)

Stress (psf)