NEW HEALTH CLINIC FOR
FALLON PARK
ELEMENTARY
SCHOOL

Roanoke, Virginia  24013
June 12, 2020
Comm. No. 16046.03
SECTION 00 0110

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END OF SECTION
PART 1 GENERAL

1.01 PROJECT
A. Project Name: New Clinic for Fallon Park Elementary School
B. Owner's Name: Roanoke City Public Schools.
C. Architect's Name: Hughes Associates Architects & Engineers.
D. The Project consists of the construction of a new 1,622 square foot clinic addition to the existing school building. School to remain in operation during construction.

1.02 CONTRACT DESCRIPTION
A. Contract Type: A single prime contract based on a Stipulated Price.

1.03 DESCRIPTION OF ALTERATIONS WORK
A. Scope of demolition and removal work is indicated on drawings and specified in Section 02 4100.
B. Scope of alterations work is indicated on drawings.
C. Plumbing: Alter existing system and add new construction, keeping existing in operation.
D. HVAC: Alter existing system and add new construction, keeping existing in operation.
E. Electrical Power and Lighting: Alter existing system and add new construction, keeping existing in operation.
F. Fire Suppression Sprinklers: Alter existing system and add new construction, keeping existing in operation.
G. Fire Alarm: Alter existing system and add new construction, keeping existing in operation.
H. Telephone: Alter existing system and add new construction, keeping existing in operation.

1.04 WORK BY OWNER
A. Items noted NIC (Not in Contract) will be supplied and installed by Owner before Substantial Completion. Some items include:
   1. Movable cabinets.
   2. Furnishings.
   3. Small equipment.
   4. Artwork.
B. Owner will supply and install the following:
   1. IT servers, server racks and head-in equipment.
   2. Touch screen tv's.
   3. Medical Equipment.

1.05 OWNER OCCUPANCY
A. Owner intends to continue to occupy the site and portions of the existing building during the entire construction period.
B. Owner intends to occupy the Project upon Substantial Completion.
C. Owner intends to occupy the site prior to the completion date for the conduct of normal operations.
D. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
E. Schedule the Work to accommodate Owner occupancy, including ceasing noisy or disruptive work during preparation and testing periods for SOL and other examinations as required by Owner.
1.06 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Refer to Roanoke City Public Schools Request for Qualifications and Request for Proposals for conditions and requirements not listed herein.
   1. Construction Operations: Limited to areas noted on Drawings.
   2. Arrange use of site and premises to allow:
      a. Owner occupancy.
      b. Work by Others.
      c. Work by Owner.
      d. Use of site and premises by the public.
      e. Use of site and premises by the public.
      f. School bus and delivery truck traffic.
      g. Safe passage of students and faculty to and from the school, modular classrooms, and playground.

B. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

C. Existing building spaces may not be used for storage.

D. Time Restrictions:
   1. Limit conduct of especially noisy exterior work to times when school is not in session.

E. Utility Outages and Shutdown:
   1. Limit disruption of utility services to hours the building is unoccupied.
   2. Do not disrupt or shut down life safety systems, including but not limited to fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
   3. Do not disrupt or shut down data networks, without 7 days notice to Owner.
   4. Prevent accidental disruption of utility services to other facilities.

1.07 ASBESTOS DISCLOSURE STATEMENT

A. An inspection to identify asbestos-containing materials has been conducted and is included as Additional Information to Bidders in Appendix B of the Project Manual. Asbestos identified by this report may have been removed. Should the Contractor access any material suspected of containing asbestos still in place, or not identified by these reports, he shall stop work in the immediate area and notify the Owner. The cost for additional asbestos inspections and mitigation will be paid by the Owner.

B. The Architect assumes no responsibility for the adequacy or accuracy of the asbestos reports.

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 SECTION INCLUDES
   A. Procedures for preparation and submittal of applications for progress payments.
   B. Documentation of changes in Contract Sum and Contract Time.
   C. Change procedures.
   D. Correlation of Contractor submittals based on changes.
   E. Procedures for preparation and submittal of application for final payment.

1.02 SCHEDULE OF VALUES
   A. Electronic media printout including equivalent information will be considered in lieu of standard
      form specified; submit draft to Architect for approval.
   B. Forms filled out by hand will not be accepted.
   C. Submit Schedule of Values in duplicate within 15 days after date established in Notice to
      Proceed.
   D. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number
      and title of the specification section.
   E. Include in each line item, the amount of Allowances specified in this section.
   F. Include separately from each line item, a direct proportional amount of Contractor's overhead
      and profit.
   G. Revise schedule to list approved Change Orders, with each Application For Payment.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS
   A. Payment Period: Submit at intervals stipulated in the Agreement.
   B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement, no exceptions.
   C. Forms filled out by hand will not be accepted.
   D. Execute certification by signature of authorized officer.
   E. 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.
   F. List each authorized Change Order as a separate line item, listing Change Order number and
      dollar amount as for an original item of work.
   G. List each authorized Contingency Expenditure as a separate line item.
   H. Submit three copies of each Application for Payment.
   I. Include the following with the application:
      1. Transmittal letter as specified for submittals in Section 01 3000.
      2. Construction progress schedule, revised and current as specified in Section 01 3000.
      3. Affidavits attesting to off-site stored products.
   J. When Architect requires substantiating information, submit data justifying dollar amounts in
      question. Provide one copy of data with cover letter for each copy of submittal. Show
      application number and date, and line item by number and description.

1.04 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 Sum 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.
   1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
   2. Promptly execute the change.

D. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change. Contractor shall prepare and submit a fixed price quotation within 15 days.

E. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 01 6000.

F. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
   1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
   2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
   3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
   4. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.

G. Substantiation of Costs: Provide full information required for evaluation.
   1. On request, provide the following data:
      a. Quantities of products, labor, and equipment.
      b. Taxes, insurance, and bonds.
      c. Overhead and profit.
      d. Justification for any change in Contract Time.
      e. Credit for deletions from Contract, similarly documented.
   2. Support each claim for additional costs with additional information:
      a. Origin and date of claim.
      b. Dates and times work was performed, and by whom.
      c. Time records and wage rates paid.
      d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
   3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

H. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

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

J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

K. Promptly enter changes in Project Record Documents.

1.05 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:
1. All closeout procedures specified in Section 01 7000.

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

END OF SECTION
SECTION 01 2100
ALLOWANCES

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Contingency allowance.

1.02 RELATED REQUIREMENTS
A. Section 01 2000 - Price and Payment Procedures: Additional payment and modification procedures.

1.03 CONTINGENCY ALLOWANCE
A. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in forms authorizing expenditure of funds from this Contingency Allowance.
B. Funds will be drawn from the Contingency Allowance only by written Contingency Allowance Expenditure Authorization (CAEA)
C. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

1.04 ALLOWANCES SCHEDULE
A. Contingency Allowance: Include the stipulated sum/price of $50,000 for use upon Owner's instructions.
B. Western Virginia Water Authority: No permits or fees required
C. City of Roanoke Land Disturbance Application Grading Fee: Include the stipulated sum of $150.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION
SECTION 01 2200
UNIT PRICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Measurement and payment criteria applicable to Work performed under a unit price payment method.
B. Defect assessment and non-payment for rejected work.

1.02 COSTS INCLUDED

A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.03 UNIT QUANTITIES SPECIFIED

A. Quantities indicated in the Proposal Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.04 MEASUREMENT OF QUANTITIES

A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.
B. Take all measurements and compute quantities. Measurements and quantities will be verified by Architect or Third-Party Testing Agency employed by Owner.
C. Assist by providing necessary equipment, workers, and survey personnel as required.
D. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
E. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
F. Measurement by Area: Measured by square dimension using mean length and width or radius.
G. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.
H. Perform surveys required to determine quantities, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.

1.05 PAYMENT

A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.
B. Payment will not be made for any of the following:
   1. Products wasted or disposed of in a manner that is not acceptable.
   2. Products determined as unacceptable before or after placement.
   3. Products not completely unloaded from the transporting vehicle.
   4. Products placed beyond the lines and levels of the required Work.
   5. Products remaining on hand after completion of the Work.

1.06 DEFECT ASSESSMENT

A. Replace Work, or portions of the Work, not conforming to specified requirements.
B. If, in the opinion of Owner, it is not practical to remove and replace the Work, Owner will direct one of the following remedies:
   1. The defective Work may remain, but the unit price will be adjusted to a new unit price at the discretion of Owner.
2. The defective Work will be partially repaired to the instructions of the Owner, and the unit price will be adjusted to a new unit price at the discretion of Owner.

C. The individual specification sections may modify these options or may identify a specific formula or percentage price reduction.

D. The authority of Owner to assess the defect and identify payment adjustment is final.

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

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittal procedures, coordination.

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
      a. Unavailability.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to provide same or equivalent maintenance service and source of replacement parts, if applicable.
   4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   5. Waives claims for additional costs or time extension that may subsequently become apparent.

B. A Substitution Request for specified installer constitutes a representation that the submitter:
   1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.

C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
   1. Note explicitly any non-compliant characteristics.

D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. No specific form is required. Contractor's Substitution Request documentation must include the following:
      a. Project Information:
         1) Official project name and number.
      b. Substitution Request Information:
         1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
         2) Indication of whether the substitution is for cause or convenience.
         3) Issue date.
         4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
         5) Description of Substitution.
6) Reason why the specified item cannot be provided.
7) Differences between proposed substitution and specified item.
8) Description of how proposed substitution affects other parts of work.

  c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:

  1) Physical characteristics.
  2) In-service performance.
  3) Expected durability.
  4) Visual effect.
  5) Warranties.
  6) Other salient features and requirements.
  7) Include, as appropriate or requested, the following types of documentation:

     (a) Product Data:
     (b) Samples.
     (c) Certificates, test, reports or similar qualification data.
     (d) Drawings, when required to show impact on adjacent construction elements.

d. Impact of Substitution:

  1) Savings to Owner for accepting substitution.
  2) Change to Contract Time due to accepting substitution.

E. Limit each request to a single proposed substitution item.

  1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES AFTER BIDDING PHASE

A. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

B. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

  1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
  2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
  3. Bear the costs engendered by proposed substitution of:

     a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
     b. Other unanticipated project considerations.

C. Substitutions will not be considered under one or more of the following circumstances:

  1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.

3.03 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.

  1. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.04 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive,
Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.05 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. Include completed Substitution Request Forms as part of the Project record.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. General administrative requirements.
B. Preconstruction meeting.
C. Site mobilization meeting.
D. Progress meetings.
E. Construction progress schedule.
F. Submittals for review, information, and project closeout.
G. Number of copies of submittals.
H. Submittal procedures.

1.02 RELATED REQUIREMENTS
A. Section 00 7200 - General Conditions: Dates for applications for payment.
B. Section 00 7300 - Supplementary Conditions: Duties of the Construction Manager.
C. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements.
D. Section 01 7800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS
A. Conform to requirements of Section 01 7000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
B. Make the following types of submittals to Architect:
   1. Requests for Interpretation (RFI).
   2. Requests for substitution.
   3. Shop drawings, product data, and samples.
   4. Test and inspection reports.
   5. Design data.
   6. Manufacturer's instructions and field reports.
   7. Applications for payment and change order requests.
   8. Progress schedules.
   9. Coordination drawings.
   10. Correction Punch List and Final Correction Punch List for Substantial Completion.
   11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING
A. Schedule meeting after Notice of Award. This meeting may be combined with the Site Mobilization meeting.
B. Attendance Required:
   1. Owner.
   3. Contractor.
C. Agenda:
   1. Distribution of Contract Documents.
   2. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
3. Designation of personnel representing the parties to Contract, Owner and Architect.
4. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
5. Scheduling/sequencing.
6. Site security and temporary barricades and barriers.
D. Record minutes and distribute copies within two days after meeting to participants, with one copy to Architect, Owner, participants, and those affected by decisions made.

3.02 SITE MOBILIZATION MEETING
A. Schedule meeting at the Project site prior to Contractor occupancy.
B. Attendance Required:
   1. Contractor.
   2. Owner.
   3. Architect.
   4. Contractor's superintendent.
   5. Major subcontractors.
C. Agenda:
   1. Use of premises by Owner and Contractor.
   2. Owner's requirements and occupancy prior to completion.
   3. Construction facilities and controls provided by Owner.
   4. Temporary utilities provided by Owner.
   5. Survey and building layout.
   7. Schedules.
   8. Application for payment procedures.
   9. Procedures for testing.
   11. Requirements for start-up of equipment.
   12. Inspection and acceptance of equipment put into service during construction period.
D. Record minutes and distribute copies within two days after meeting to participants, with one copy to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS
A. Schedule and administer meetings throughout progress of the Work at minimum bi-weekly intervals.
B. 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. Agenda:
   1. Review minutes of previous meetings.
   2. Review of work progress.
   3. Field observations, problems, and decisions.
   4. Identification of problems that impede, or will impede, planned progress.
   5. Review of submittals schedule and status of submittals.
   6. Review of off-site fabrication and delivery schedules.
   7. Maintenance of progress schedule.
   8. Corrective measures to regain projected schedules.
   9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to work.

E. Contractor to record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE
A. If preliminary schedule requires revision after review, submit revised schedule within 10 days of submission of first schedule.
B. Within 10 days after joint review, submit complete schedule.
C. Submit updated schedule with each Application for Payment.

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 for aesthetic, color, or finish selection.
D. 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.

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

3.07 SUBMITTALS FOR PROJECT CLOSEOUT
A. Submit Correction Punch List for Substantial Completion.
B. Submit Final Correction Punch List for Substantial Completion.
C. When the following are specified in individual sections, submit them at project closeout in conformance to requirements of Section 01 7800 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   4. Other types as indicated.
D. Submit for Owner's benefit during and after project completion.

3.08 NUMBER OF COPIES OF SUBMITTALS
A. Documents: At the Contractor's option; contractor may 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. Documents for Review (If not submitted electronically)
1. Small Size Sheets, Not Larger Than 8-1/2 x 11 inches: Submit two copies (three copies if the document pertains to Mechanical, Electrical, Plumbing or Structural work); the Contractor shall make his own copies from original returned by Hughes Associates Architects and Engineers after making his own file copy.

2. Larger Sheets, Not Larger Than 36 x 48 inches: Submit the number of opaque reproductions that Contractor requires, plus one copy that will be retained by the Hughes Associates Architects and Engineers.

3. Documents for Information: Submit two copies.
   a. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.

3.09 SUBMITTAL PROCEDURES
   A. General Requirements:
   B. Transmit each submittal with approved form.

END OF SECTION
SECTION 01 4000
QUALITY REQUIREMENTS

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Submittals.
B. Quality assurance.
C. References and standards.
D. Control of installation.
E. Mock-ups.
F. Tolerances.
G. Manufacturers' field services.
H. Defect Assessment.

1.02 RELATED REQUIREMENTS
A. Document 00 3100 - Available Project Information: Soil investigation data.
B. Document 00 7200 - General Conditions: Inspections and approvals required by public authorities.
C. Section 01 3000 - Administrative Requirements: Submittal procedures.
D. Section 01 4216 - Definitions.
E. Section 01 4533 - Inspections and Tests
F. Section 01 6000 - Product Requirements: Requirements for material and product quality.

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
C. 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.
D. 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.
E. Erection Drawings: Submit drawings 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.
   2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

1.04 REFERENCES AND STANDARDS
A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
B. Conform to reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
C. Obtain copies of standards where required by product specification sections.
D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

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. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
C. Integrated Exterior Mock-ups: construct integrated exterior mock-up as indicated on Drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.
D. Notify Architect fifteen (15) working days in advance of dates and times when mock-ups will be constructed.
E. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.
F. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
G. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
H. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
I. Accepted mock-ups shall be a comparison standard for the remaining Work.
J. 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 TOLERANCES
   A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
   B. Comply with manufacturers' tolerances. Should manufacturers’ tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
   C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 MANUFACTURERS’ FIELD SERVICES
   A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.
   B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.05 DEFECT ASSESSMENT
   A. Replace Work or portions of the Work not conforming to specified requirements.
   B. If, in the opinion of Owner, it is not practical to remove and replace the Work, Owner will direct an appropriate remedy or adjust payment.

END OF SECTION
SECTION 01 4216
DEFINITIONS

PART 1 GENERAL
1.01 SUMMARY
A. This section supplements the definitions contained in the General Conditions.
B. Other definitions are included in individual specification sections.

1.02 DEFINITIONS
A. Furnish: To supply, deliver, unload, and inspect for damage.
B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
D. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.
E. Provide: To furnish and install.
F. Supply: Same as Furnish.

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

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Inspections and tests.
B. Testing services incidental to special inspections.
C. Submittals.

1.02 RELATED REQUIREMENTS
A. Document 00 3100 - Available Project Information: Soil investigation data.
B. Section 01 3000 - Administrative Requirements: Submittal procedures.
C. Section 01 4000 - Quality Requirements.

1.03 DEFINITIONS
A. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
B. National Institute of Standards and Technology (NIST).
C. Special Inspection:
   1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved contract documents and the referenced standards.
   2. Special inspections are separate from and independent of tests and inspections conducted by Owner or Contractor for the purposes of quality assurance and contract administration.

1.04 REFERENCE STANDARDS
A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency shall:
   1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.

3. Submit certification that Special Inspection Agency is acceptable to AHJ.

C. Testing Agency Qualifications: Prior to the start of work, the Testing Agency shall:
   1. Submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
   3. Submit certification that Testing Agency is acceptable to AHJ.

D. Special Inspection Reports: After each special inspection, Special Inspector shall promptly submit electronic copies of report; one to Architect, one to Structural Engineer and one to the AHJ.

E. Special Inspection Reports: After each special inspection, Special Inspector shall promptly submit electronic copies of report.
   1. Recipients
      a. Architect
      b. Design Professional in Responsible Charge
      c. Structural Engineer of Record
      d. Owner's Representative
      e. Contractor's Project Manager
      f. Contractor's On-site Superintendent
      g. Vendor or Manufacturer of product being tested or inspected.
      h. AHJ
   2. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of Special Inspector.
      d. Date and time of special inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of special inspection.
      h. Date of special inspection.
      i. Results of special inspection.
      j. Conformance with Contract Documents.
   4. Final Special Inspection Report: Document special inspections and correction of discrepancies prior to the start of the work.

F. Test Reports: After each test or inspection, promptly submit [electronic] copies of report to same recipients designated to receive Inspection Reports.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of test or inspection.
      h. Date of test or inspection.
      i. Results of test or inspection.
      j. Conformance with Contract Documents.
1.06 SPECIAL INSPECTION AGENCY
   A. Owner or Architect will employ services of a Special Inspection Agency to perform inspections and associated testing and sampling in accordance with ASTM E329 and required by the building code.
   B. The Special Inspection Agency may employ and pay for services of an independent testing agency to perform testing and sampling associated with special inspections and required by the building code.
   C. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.07 TESTING AND INSPECTION AGENCIES
   A. Owner or Architect may employ services of an independent testing agency to perform additional testing and sampling associated with special inspections but not required by the building code.
   B. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.08 QUALITY ASSURANCE
   A. Special Inspection Agency Qualifications:
      1. Independent firm specializing in performing testing and inspections of the type specified in this section.
   B. Testing Agency Qualifications:
      1. Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL
   A. Frequency of Special Inspections: Special Inspections are indicated as continuous or periodic.
      1. Continuous Special Inspection: Special Inspection Agency shall be present in the area where the work is being performed and observe the work at all times the work is in progress.
      2. Periodic Special Inspection: Special Inspection Agency shall be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

3.02 SPECIAL INSPECTIONS FOR STEEL CONSTRUCTION
   A. Structural Steel: Comply with quality assurance inspection requirements of ICC (IBC).
   B. High-Strength Bolt, Nut and Washer Material:
      1. Verify identification markings conform to ASTM standards specified in the approved contract and to AISC 360, Section A3.3; periodic.
      2. Submit manufacturer's certificates of compliance; periodic.
   C. High-Strength Bolting Installation: Verify items listed below comply with AISC 360, Section M2.5.
      1. Snug tight joints; periodic.
   D. Structural Steel and Cold Formed Steel Deck Material:
      1. Structural Steel: Verify identification markings conform to AISC 360, Section M3.5; periodic.
      2. Other Steel: Verify identification markings conform to ASTM standards specified in the approved contract documents; periodic.
      3. Submit manufacturer's certificates of compliance and test reports; periodic.
   E. Weld Filler Material:
      1. Verify identification markings conform to AWS standards specified in the approved contract documents and to AISC 360, Section A3.5; periodic.
2. Submit manufacturer's certificates of compliance; periodic.

F. Welding:
   1. Structural Steel and Cold Formed Steel Deck:
      b. Multipass Fillet Welds: Verify compliance with AWS D1.1/D1.1M; continuous.
      d. Plug and Slot Welds: Verify compliance with AWS D1.1/D1.1M; continuous.
      e. Single Pass Fillet Welds 5/16 inch or Greater: Verify compliance with AWS D1.1/D1.1M; continuous.
      f. Floor and Roof Deck Welds: Verify compliance with AWS D1.3/D1.3M; continuous.
   2. Reinforcing Steel: Verify items listed below comply with AWS D1.4/D1.4M and ACI 318, Section 3.5.2.
      a. Verification of weldability; periodic.
      b. Reinforcing steel resisting flexural and axial forces in intermediate and special moment frames as well as boundary elements of special structural walls of concrete and shear reinforcement; continuous.
      c. Shear reinforcement; continuous.
      d. Other reinforcing steel; periodic.

G. Steel Frame Joint Details: Verify compliance with approved contract documents.
   1. Details, bracing and stiffening; periodic.
   2. Member locations; periodic.
   3. Application of joint details at each connection; periodic.

3.03 SPECIAL INSPECTIONS FOR CONCRETE CONSTRUCTION

A. Reinforcing Steel, Including Prestressing of Tendons and Placement: Verify compliance with approved contract documents and ACI 318, Sections 3.5 and 7.1 through 7.7; periodic.

B. Reinforcing Steel Welding: Verify compliance with AWS D1.4/D1.4M and ACI 318, Section 3.5.2; periodic.

C. Design Mix: Verify plastic concrete complies with the design mix in approved contract documents and with ACI 318, Chapter 4 and 5.2; periodic.

D. Specified Curing Temperature and Techniques: Verify compliance with approved contract documents and ACI 318, Sections 5.11 through 5.13; periodic.

E. Concrete Strength in Situ: Verify concrete strength complies with approved contract documents and ACI 318, Section 6.2, for the following.

F. Formwork Shape, Location and Dimensions: Verify compliance with approved contract documents and ACI 318, Section 6.1.1; periodic.

3.04 SPECIAL INSPECTIONS FOR MASONRY CONSTRUCTION

A. Masonry Structures Subject to Special Inspection:
   1. Empirically designed masonry, glass unit masonry and masonry veneer in structures designated as "essential facilities".
   2. Engineered masonry in structures classified as "low hazard..." and "substantial hazard to human life in the event of failure".

B. Verify each item below complies with approved contract documents and the applicable articles of ACI 530/530.1/ERTA.
   1. Inspections and Approvals:
      a. Verify compliance with the required inspection provisions of the approved contract documents; periodic.
      b. Verify approval of submittals required by contract documents; periodic.
   2. Compressive Strength of Masonry: Verify compressive strength of masonry units prior to start of construction unless specifically exempted by code; periodic.

4. Joints and Accessories: When masonry construction begins, verify:
   a. Proportions of site prepared mortar; periodic.
   b. Construction of mortar joints; periodic.
   c. Location of reinforcement, connectors, prestressing tendons, anchorages, etc; periodic.

5. Structural Elements, Joints, Anchors, Protection: During masonry construction, verify:
   a. Size and location of structural elements; periodic.
   b. Type, size and location of anchors, including anchorage of masonry to structural members, frames or other construction; periodic.
   c. Size, grade and type of reinforcement, anchor bolts and prestressing tendons and anchorages; periodic.
   d. Welding of reinforcing bars; continuous.
   e. Preparation, construction and protection of masonry against hot weather above 90 degrees F and cold weather below 40 degrees F; periodic.

6. Grouting Preparation: Prior to grouting, verify:
   a. Grout space is clean; periodic.
   b. Correct placement of reinforcing, connectors, prestressing tendons and anchorages; periodic.
   c. Correctly proportioned site prepared grouts and prestressing grout for bonded tendons; periodic.
   d. Correctly constructed mortar joints; periodic.


3.05 SPECIAL INSPECTIONS FOR SOILS
   A. Materials and Placement: Verify each item below complies with approved construction documents and approved geotechnical report.
      1. Design bearing capacity of material below shallow foundations; periodic.
      2. Design depth of excavations and suitability of material at bottom of excavations; periodic.
      4. Subgrade, prior to placement of compacted fill; periodic.
   B. Testing: Classify and test excavated material; periodic.

3.06 OTHER SPECIAL INSPECTIONS
   A. Provide for special inspection of work that, in the opinion of the AHJ, is unusual in nature.

3.07 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES
   A. Special Inspection Agency shall:
      2. Perform specified sampling and testing of products in accordance with specified reference standards.
      3. Ascertain compliance of materials and products with requirements of Contract Documents.
      4. Promptly notify Architect and Contractor of observed irregularities or non-conformance of work or products.
      5. Perform additional tests and inspections required by Architect.
      6. Submit reports of all tests or inspections specified.
   B. Limits on Special Inspection Agency Authority:
      1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
      2. Agency may not approve or accept any portion of the work.
      3. Agency may not assume any duties of Contractor.
      4. Agency has no authority to stop the work.
C. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.

D. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

3.08 TESTING AGENCY DUTIES AND RESPONSIBILITIES

A. Testing Agency Duties:
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-conformance of work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Submit reports of all tests or inspections specified.

B. Limits on Testing or Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the work.

C. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.

D. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

3.09 CONTRACTOR DUTIES AND RESPONSIBILITIES

A. Contractor Responsibilities, General:
   1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
   2. Cooperate with agency and laboratory personnel; provide access to the work.
   3. Provide incidental labor and facilities:
      a. To provide access to work to be tested or inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
      c. To facilitate tests or inspections.
      d. To provide storage and curing of test samples.
   4. Notify Architect and laboratory 48 hours prior to expected time for operations requiring testing or inspection services.
   5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

3.10 PAYMENT FOR INSPECTIONS AND TESTS

A. Required Inspections and Tests:
   1. Inspections and tests indicated to be performed by Owner's testing laboratory will be paid for by Owner.
   2. Inspections and tests indicated to be performed by Contractor and/or his suppliers shall be paid for by Contractor.

B. Retesting:
   1. When tests paid for by Owner indicate noncompliance with the Contract Documents, subsequent retesting occasioned by the noncompliance shall be performed by same testing agency, and costs thereof will be deducted by Owner from the Contract Sum. Refer to the General Conditions.

C. Code Compliance Testing:
1. Inspections and tests other than the special inspections listed at the end of this section, required by codes or ordinances, and which are made by a legally constituted authority, shall be responsibility of and shall be paid for by Contractor, unless otherwise provided in the Contract Documents.

3.11 CONTRACTOR'S QUALITY CONTROL TESTING
   A. Notwithstanding Owner's testing for quality assurance, Contractor is required to provide his own testing in order to control work in a manner which delivers the quality product specified. Contractor's testing is to control quality, and Owner's testing is to assure conformance to contract requirements.
   B. Inspecting and testing performed exclusively for Contractor's control of quality shall be the sole expense and responsibility of Contractor.

3.12 ASBESTOS AND LEAD DISCLOSURE STATEMENTS
   A. An inspection to identify asbestos-containing materials has been conducted and can be found as part of Appendix A to the Project Specifications. Some asbestos containing floor tile and mastic and window glazing identified by this report has been removed. Should the Contractor access any material suspected of containing asbestos still in place or not identified by these reports, he shall stop work in the immediate area and notify the Owner. The cost for additional asbestos inspections and possible removal will be paid by the Owner.
   B. Hughes Associates Architects & Engineers assumes no responsibility for the adequacy or accuracy of the asbestos reports contained in the Contract Documents.

END OF SECTION
SECTION 01 5813
PROJECT SIGNAGE

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Project identification sign.
B. Project informational signs.

PART 2 PRODUCTS
2.01 SIGN MATERIALS
A. Structure and Framing: New, wood, structurally adequate.
B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch thick, standard large sizes to minimize joints.
C. Rough Hardware: Galvanized.
D. Lettering: Exterior quality paint, colors as indicated in Project Manual Appendix C.
E. Lettering: Digitally printed on vinyl or painted with exterior quality paint.

2.02 PROJECT IDENTIFICATION SIGN
A. One painted or printed sign of construction, design, and content shown on Drawing in Project Manual Appendix C, location to be determined by Architect.

2.03 PROJECT INFORMATIONAL SIGNS
A. Painted informational signs of same colors and lettering as Project Identification sign, or standard products; size lettering to provide legibility at 100 foot distance.
B. Provide at each field office, storage shed, and directional signs to direct traffic into and within site. Relocate as Work progress requires.

PART 3 EXECUTION
3.01 INSTALLATION
A. Install project identification sign within 30 days after date fixed by Notice to Proceed.
B. Erect at location to be approved by Architect.
C. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
D. Install sign surface plumb and level, with butt joints. Anchor securely.
E. Paint exposed surfaces of sign, supports, and framing.

3.02 MAINTENANCE
A. Maintain signs and supports clean, repair deterioration and damage.

3.03 REMOVAL
A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.
B. Make arrangements with Architect to deliver sign to the Architect's office.

END OF SECTION
SECTION 01 6000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. General product requirements.
B. Re-use of existing products.
C. Transportation, handling, storage and protection.
D. Product option requirements.
E. Substitution limitations.
F. Procedures for Owner-supplied products.
G. Maintenance materials, including extra materials, spare parts, tools, and software.

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

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS
A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the Contract Documents.
B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

2.02 NEW PRODUCTS
A. Provide new products unless specifically required or permitted by the Contract Documents.
B. DO NOT USE products having any of the following characteristics:
   1. Made using or containing CFC's or HCFC's.

2.03 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.

2.04 MAINTENANCE MATERIALS
A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
B. Deliver and place in location as directed; obtain receipt prior to final payment.
PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS
   A. See Section 01 2500 - Substitution Procedures.

3.02 OWNER-SUPPLIED PRODUCTS
   A. See Section 01 1000 - Summary for identification of Owner-supplied products.
   B. Owner's Responsibilities:
      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.
   C. Contractor's Responsibilities:
      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. Repair or replace items damaged after receipt.

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

3.04 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. Provide off-site storage and protection when site does not permit on-site storage or protection.
G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

H. Comply with manufacturer's warranty conditions, if any.

I. Do not store products directly on the ground.

J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

K. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

L. Prevent contact with material that may cause corrosion, discoloration, or staining.

M. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

N. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION
SECTION 01 7000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.
B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.
C. Pre-installation meetings.
D. Cutting and patching.
E. Surveying for laying out the work.
F. Cleaning and protection.
G. Starting of systems and equipment.
H. Demonstration and instruction of Owner personnel.
I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
J. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
B. Section 01 3000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
C. Section 01 4000 - Quality Requirements: Testing and inspection procedures.
D. Section 01 5000 - Temporary Facilities and Controls: Temporary exterior enclosures.
E. Section 01 5000 - Temporary Facilities and Controls: Temporary interior partitions.
F. Section 01 5100 - Temporary Utilities: Temporary heating, cooling, and ventilating facilities.
G. Section 01 5713 - Temporary Erosion and Sediment Control: Additional erosion and sedimentation control requirements.
H. Section 07 8400 - Firestopping.

1.03 REFERENCE STANDARDS


1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Cutting and Patching: Submit written request in advance of cutting or alteration that 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.
C. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.05 PROJECT CONDITIONS

A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
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 and over adjacent property.
   1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
   2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

E. Erosion and Sediment Control: Plan and execute work 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. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

F. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
   1. At All Times: Excessively noisy tools and operations will not be tolerated inside the building at any time of day except when the building is unoccupied by school personnel; excessively noisy includes jackhammers.
   2. Outdoors: Limit conduct of especially noisy exterior work to 3 pm to 8 pm.
   3. Indoors: Limit conduct of especially noisy interior work to the hours of 6 pm to 7 am.

G. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

H. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

I. 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. Comply with federal, state, and local regulations.

1.06 COORDINATION

A. See Section 01 1000 for occupancy-related requirements.

B. 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.

C. Notify affected utility companies and comply with their requirements.

D. 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.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

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.
B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

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

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

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

3.04 LAYING OUT THE WORK
A. Verify locations of survey control points prior to starting work.
B. Promptly notify Architect of any discrepancies discovered.
C. Contractor shall locate and protect survey control and reference points.
D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
E. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
F. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

G. Utilize recognized engineering survey practices.

H. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.

I. 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.

J. Periodically verify layouts by same means.

K. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

A. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.

B. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

F. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
   1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
   2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.

D. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.
   2. Relocate items indicated on drawings.
   3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
   4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
E. Services (including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and Alarm Systems): Remove, relocate, and extend existing systems to accommodate new construction.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
   3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
      a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
      b. See Section 01 1000 for other limitations on outages and required notifications.
      c. Provide temporary connections as required to maintain existing systems in service.
   4. Verify that abandoned services serve only abandoned facilities.
   5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

F. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.

G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
   1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
   2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
   3. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
   4. Trim existing wood doors as necessary to clear new floor finish. Refinish trim as required.

H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

I. Refinish existing surfaces as indicated:
   1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
   2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

J. Clean existing systems and equipment.

K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

L. Do not begin new construction in alterations areas before demolition is complete.

M. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.
B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-conforming work.

D. Execute cutting and patching to complete the work, to uncover work in order 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.

E. Execute work by methods that avoid damage to other work and that will provide appropriate
surfaces to receive patching and finishing. In existing work, minimize damage and restore to
original condition.

F. Employ skilled and experienced installer to perform cutting for weather exposed and moisture
resistant elements, and sight exposed surfaces.

G. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior
approval.

H. Restore work with new products in accordance with requirements of Contract Documents.

I. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

J. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids
with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated
element.

K. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous
      surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire
      unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other
      imperfections due to patching work. If defects are due to condition of substrate, repair
      substrate prior to repairing finish.

L. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest
intersection or natural break. For an assembly, refinish entire unit.

M. Make neat transitions. Patch work to match adjacent work in texture and appearance. Where
new work abuts or aligns with existing, perform a smooth and even transition.

N. Patch or replace surfaces that are damaged, lifted, discolored, or showing other imperfections
due to patching work. Repair substrate prior to patching finish. Finish patches to produce
uniform finish and texture over entire area. When finish cannot be matched, refinish entire
surface to nearest intersections.

3.08 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly
condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed
or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning
to eliminate dust.
D. Collect and remove waste materials, debris, and trash/rubbish from site weekly and dispose off-site; do not burn or bury.

### 3.09 PROTECTION OF INSTALLED WORK

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

### 3.10 SYSTEM STARTUP

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 that 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. Submit a written report that equipment or system has been properly installed and is functioning correctly.

### 3.11 DEMONSTRATION AND INSTRUCTION

A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of owner personnel.
D. 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.
E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

### 3.12 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.
B. Testing, adjusting, and balancing HVAC systems: See Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.
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 before Owner occupancy.
B. Use cleaning materials that are nonhazardous.
C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces.
D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
F. Replace filters of operating equipment.
G. Clean debris from roofs, scuppers, overflow drains, area drains, and drainage systems.
H. Clean site; sweep paved areas, rake clean landscaped surfaces.
I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES
A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect and Owner.
B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
E. Owner will occupy portions of the building as specified in Section 01 1000.
F. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
G. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
H. Accompany Project Coordinator on Contractor's preliminary final inspection.
I. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
J. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.15 MAINTENANCE
A. Provide service and maintenance of components indicated in specification sections.
B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than three years from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION
SECTION 01 7800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Project Record Documents.
B. Operation and Maintenance Data.
C. Warranties and bonds.

1.02 RELATED REQUIREMENTS
A. Section 00 7200 - General Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
B. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
C. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.
D. Individual Product Sections: Specific requirements for operation and maintenance data.
E. Individual Product Sections: Warranties required for specific products or Work.

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

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS
A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. 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. Changes made by Addenda and modifications.

F. Record Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

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

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Additional information as specified in individual product specification sections.

D. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

E. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

D. 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.
E. 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.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide control diagrams by controls manufacturer as installed.

K. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

L. Include test and balancing reports.

M. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

D. Prepare data in the form of an instructional manual.

E. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

F. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

G. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

H. 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.

I. 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.

J. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.

K. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

L. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.

M. 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 Architect, 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. Air and water balance reports.
   c. Certificates.
   d. Photocopies of warranties and bonds.

N. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

O. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect, Consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

3.06 WARRANTIES AND BONDS

A. Contractor shall provide minimum three (3) year material and labor warranty on all workmanship and products. Warranties noted in Contract Documents to exceed three years shall be provided for the greater length of warranty.

B. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner’s permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

C. Verify that documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Retain warranties and bonds until time specified for submittal.

F. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

END OF SECTION
SECTION 02 4100
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS
A. Section 00 3100 - Available Project Information: Existing building survey conducted by Owner; information about known hazardous materials.
B. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.
C. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
D. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; temporary bracing and shoring.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Site Plan: Showing:
   1. Areas for temporary construction and field offices.
C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SCOPE
A. Remove portions of the existing building as indicated on the Drawings.
B. Remove indicated pavements, base materials, curbs, sidewalks, fences and gates as indicated and as required to accomplish new work.
C. Remove portion of existing building where indicated in the Construction Documents.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS
A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Comply with applicable requirements of NFPA 241.
   3. Use of explosives is not permitted.
   4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   5. Provide, erect, and maintain temporary barriers and security devices.
   6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   8. Do not close or obstruct roadways or sidewalks without permit.
9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
10. Do not work within the VDOT right of way if needed, without maintenance of traffic controls, as required by the VDOT Land Use Permit.
11. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from Owner.
C. Protect existing structures and other elements that are not to be removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

D. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

E. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

F. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Copies of available existing building drawings will be made available electronically.
   2. Verify that construction and utility arrangements are as indicated.
   4. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Maintain weatherproof and secure exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.

C. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.

D. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch as specified for patching new work.

3.04 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.
B. Remove from site all materials not to be reused on site; do not burn or bury.
C. Leave site in clean condition, ready for subsequent work.
D. Clean up spillage and wind-blown debris from public and private lands.

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

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Concrete formwork.
B. Floors and slabs on grade.
C. Concrete foundations.
D. Concrete reinforcement.
E. Joint devices associated with concrete work.
F. Concrete curing.

1.02 RELATED REQUIREMENTS
A. Section 07 9200 - Joint Sealants: Products and installation for sealants for saw cut joints and isolation joints in slabs.
B. Section 07 9513 - Expansion Joint Cover Assemblies.
C. Section - Joint Sealers: Sealants for saw cut joints and isolation joints in slabs.
D. Section 32 1313 - Concrete Paving: Sidewalks, curbs and gutters.

1.03 REFERENCE STANDARDS
C. ACI 301 - Specifications for Structural Concrete; 2016.
D. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).
E. ACI 302.2R-06 Guideline for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
I. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).
J. ACI 347R - Guide to Formwork for Concrete; 2014.


Y. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.


AF. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting; 2015.


AH. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011.

AI. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.

AJ. ASTM F1869- Standard Test Method for Measuring Moisture Evaporation Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.


1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
   1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.

C. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.

D. Test Reports: Submit report for each test or series of tests specified.

E. Manufacturer’s Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.

B. Follow recommendations of ACI 305R when concreting during hot weather.
C. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

A. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
   1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
   2. Earth Cuts: Do not use earth cuts as forms for vertical surfaces. Natural rock formations that maintain a stable vertical edge may be used as side forms.
   3. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.

2.02 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
   1. Type: Deformed billet-steel bars.
   2. Finish: Unfinished, unless otherwise indicated.
B. Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain type.
   1. Form: Coiled rolls.
C. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
   3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
   1. Acquire cement for entire project from same source.
C. Fly Ash: ASTM C618, Class C or F.
D. Calcined Pozzolan: ASTM C618, Class N.
E. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.
F. Water: Clean and not detrimental to concrete.

2.04 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
B. Air Entrainment Admixture: ASTM C260/C260M.
C. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
E. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.
F. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
G. Accelerating Admixture: ASTM C494/C494M Type C.
H. Retarding Admixture: ASTM C494/C494M Type B.
I. Water Reducing Admixture: ASTM C494/C494M Type A.

2.05 ACCESSORY MATERIALS

A. Underslab Vapor Retarder: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E1745, Class A; stated by manufacturer as
suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.

1. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.

2. Manufacturers:
   b. Substitutions: See Section 01 6000 - Product Requirements.

B. Chemical Hardener: Fluosilicate solution designed for densification of cured concrete slabs.

C. Non-Shrink Cementitious Grout: ASTM C1107/C1107M; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.

D. Moisture-Retaining Cover: ASTM C 171; regular curing paper, white curing paper, or white burlap-polyethylene sheet.

E. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Grout: Comply with ASTM C1107/C1107M.
   2. Minimum Compressive Strength at 48 Hours, ASTM C109/C109M: 2,000 pounds per square inch.
   3. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
   5. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
   6. Flowable Products:
      d. Substitutions: See Section 01 6000 - Product Requirements.
   7. Low-Slump, Dry Pack Products:
      d. Substitutions: See Section 01 6000 - Product Requirements.

F. Non-Shrink Epoxy Grout: Moisture-insensitive, two-part; consisting of epoxy resin, non-metallic aggregate, and activator.
   1. Composition: High solids content material exhibiting positive expansion when tested in accordance with ASTM C827/C827M.
      b. Minimum Height Change: Plus 1 percent.
   2. Minimum Compressive Strength at 7 days, ASTM C579: 12,000 pounds per square inch.
   3. Minimum Compressive Strength at 7 days, ASTM D695: 12,000 pounds per square inch.

2.06 BONDING AND JOINTING PRODUCTS

A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.
   1. Manufacturers:
      b. Substitutions: See Section 01 6000 - Product Requirements.

B. Epoxy Bonding System:
   1. Manufacturers:
b. Substitutions: See Section 01 6000 - Product Requirements.

C. Waterproofing Admixture Slurry: Slurry coat of Portland cement, sand, and crystalline
waterproofing additive, mixed with water in proportions recommended by manufacturer to
achieve waterproofing at cold joints in concrete.
1. Manufacturers:
   c. Xypex Chemical Corporation; XYPEX Concentrate:  www.xypex.com/#sle.
   d. Substitutions: See Section 01 6000 - Product Requirements.

D. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top
section that will form 1/2 inch deep sealant pocket after removal.
1. Material: Closed-cell, non-absorbent, compressible polyethylene or polymer foam in sheet
form.
2. Manufacturers:
   a. W. R. Meadows, Inc; Deck-O-Foam Joint Filler with pre-scored top strip:
      www.wrmeadows.com/#sle.
   b. Substitutions: See Section 01 6000 - Product Requirements.

E. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to
provide straight route for shrinkage cracking.
1. Manufacturers:

F. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel,
with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6
inches on center; ribbed steel stakes for setting.
1. Provide removable plastic cap strip that forms wedge-shaped joint for sealant installation.
2. Height: To suit slab thickness.

2.07 CURING MATERIALS
A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss
caused by high temperature, low humidity, and high winds; intended for application immediately
after concrete placement.

B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming
compound; complying with ASTM C309.
1. Application: Use at areas where resilient flooring is to be installed.
2. Manufacturers:
   b. Substitutions: See Section 01 6000 - Product Requirements.

C. Moisture-Retaining Sheet: ASTM C171.
1. Curing paper, regular.
2. Polyethylene film, clear, minimum nominal thickness of 0.0040 inch.
3. White-burlap-polyethylene sheet, weighing not less than 10 ounces per linear yard, 40
   inches wide.

D. Polyethylene Film: ASTM D2103, 4 mil thick, clear.

E. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN
A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
   1. Replace as much Portland cement as possible with fly ash, ground granulated blast
      furnace slag, silica fume, or rice hull ash as is consistent with ACI recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis
   of field experience or trial mixtures, as specified in ACI 301.
   1. For trial mixtures method, employ independent testing agency acceptable to Architect for
      preparing and reporting proposed mix designs.
C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

D. Normal Weight Concrete:
   1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
   2. Fly Ash Content: Maximum 25 percent of cementitious materials by weight.
   3. Calcined Pozzolan Content: Maximum 25 percent of cementitious materials by weight.
   4. Silica Fume Content: Maximum 15 percent of cementitious materials by weight.
   5. Water-Cement Ratio: Maximum 40 percent by weight.
   6. Total Air Content: 3 percent, determined in accordance with ASTM C173/C173M.
   7. Maximum Slump: 3-5 inches.
   8. Maximum Aggregate Size: .75-1.25 inch.

2.09 MIXING
A. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION
A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
B. Verify that forms are clean and free of rust before applying release agent.
C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in accordance with bonding agent manufacturer's instructions.
   1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
   2. Use latex bonding agent only for non-load-bearing applications.
E. Where new concrete with integral waterproofing is to be bonded to previously placed concrete, prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions. Saturate cold joint surface with clean water, and remove excess water before application of coat of waterproofing admixture slurry. Apply slurry coat uniformly with semi-stiff bristle brush at rate recommended by waterproofing manufacturer.
F. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
G. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
   1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS
A. Fabricate and handle epoxy-coated reinforcing in accordance with ASTM D3963/D3963M.
B. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
C. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.
D. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 PLACING CONCRETE
A. Place concrete in accordance with ACI 304R.
B. Place concrete for floor slabs in accordance with ACI 302.1R.
C. Notify Architect not less than 24 hours prior to commencement of placement operations.
D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
E. Ensure reinforcement, inserts, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.05 SLAB JOINTING
A. Locate joints as indicated on drawings.
B. Anchor joint fillers and devices to prevent movement during concrete placement.
C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
   1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.
D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.
E. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

3.06 FLOOR FLATNESS AND LEVELNESS TOLERANCES
A. Maximum Variation of Surface Flatness:
   1. Exposed Concrete Floors: 1/4 inch in 10 feet.
B. Correct the slab surface if tolerances are less than specified.
C. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.07 CONCRETE FINISHING
A. Repair surface defects, including tie holes, immediately after removing formwork.
B. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
   1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
C. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
   1. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
   2. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.
      a. Chemical Hardener: See Section 03 3511.
D. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

3.08 CURING AND PROTECTION

A. Comply with requirements of ACI 308R, without the use of topically applied curing compounds for concrete to be polished. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than 7 days.
   2. High early strength concrete: Not less than 4 days.

C. Surfaces Not in Contact with Forms:
   1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer’s satisfaction.
   2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water-fog spray or saturated burlap.
      a. Spraying: Spray water over floor slab areas and maintain wet.
      b. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
   3. Final Curing: Begin after initial curing but before surface is dry.
      a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.
      b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.09 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.

E. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.

F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.10 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.11 PROTECTION
   A. Do not permit traffic over unprotected concrete floor surface until fully cured.

3.12 SCHEDULE - CONCRETE TYPES AND FINISHES
   A. Refer to structural drawings for concrete psi, 28 day concrete.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Concrete Block.
   B. Clay Facing Brick.
   C. Common Brick.
   D. Mortar and Grout.
   E. Reinforcement and Anchorage.
   F. Flashings.
   G. Accessories.

1.02 RELATED REQUIREMENTS
   A. Section 05 5000 - Metal Fabrications: Loose steel lintels.
   B. Section 07 9200 - Joint Sealers: Backing rod and sealant at control and expansion joints.

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

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data for mortar and masonry accessories.
   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.

1.05 QUALITY ASSURANCE
   A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the contract documents.
   B. Fire Rated Assemblies: Conform to applicable code for UL (FRD) Assembly No. see drawings.
   C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of experience.

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.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS
   A. Concrete Block: Comply with referenced standards and as follows:
      1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depth of 8 inches.
      2. Load-Bearing Units: ASTM C90, normal weight.
         a. Hollow block, as indicated.
         b. Exposed Faces: Manufacturer's standard color and texture.
      3. Bond Beam Units:
         a. Reinforced as indicated on structural drawings.
         b. Locations: As indicated on drawings; at joist bearing locations; and at top of concrete masonry walls.
2.02 BRICK UNITS
   A. General: Brick to match existing school building.
   B. Manufacturers:
      1. Basis of Design: Belden Brick; www.beldenbrick.com
      2. Substitutions: Not permitted.
   C. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.
      3. Special shapes: Molded units as required by conditions indicated, unless standard units
         can be sawn to produce equivalent effect.
      4. Watertable Shape: Belden No. 9.7 Sloped Stretcher Nominal Size 8" x 4" x 8"
   D. Building (Common) Brick: ASTM C62, Grade SW; solid units.

2.03 MORTAR AND GROUT MATERIALS
   A. Masonry Cement: ASTM C91/C91M, Type N.
   B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color
      sample.
      1. Not more than 0.60 percent alkali.
   C. Hydrated Lime: ASTM C207, Type S.
   D. Mortar Aggregate: ASTM C144.
   E. Grout Aggregate: ASTM C404.
   F. Water: Clean and potable.
   G. Accelerating Admixture: Nonchloride type for use in cold weather.
   H. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.

2.04 REINFORCEMENT AND ANCHORAGE
   A. Manufacturers:
      4. Substitutions: See Section 01 6000 - Product Requirements.
   B. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi), deformed billet bars; galvanized.
   C. Single Wythe Joint Reinforcement: Ladder type; ASTM A 82/A 82M steel wire, mill galvanized
      to ASTM A 641/A 641M, Class 3; 3/16 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. Reinforcing to be as indicated on drawings or at a maximum of 16" o.c.
   D. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and
      building frame, sized to provide not more than 1 inch and not less than 1/2 inch of mortar
      coverage from masonry face.
   E. Two-Piece Wall Ties: Formed steel wire, 0.1875 inch thick, adjustable, hot dip galvanized to
      ASTM A 153/A 153M, Class B, sized to provide not more than 1 inch and not less than 1/2 inch
      of mortar coverage from masonry face and to allow vertical adjustment of up to 1-1/4 in.
   F. 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.

G. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.

2.05 FLASHINGS

A. Plastic Flashings: Sheet polyolefin laminated to polypropylene; 40 mil thick.
   1. Manufacturers:
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.06 ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
   1. Manufacturers:
      c. WIRE-BOND: www.wirebond.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.
   1. Manufacturers:
      b. WIRE-BOND: www.wirebond.com/#sle.
      c. Substitutions: See Section 01 6000 - Product Requirements.

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.
   1. Full-Height Airspace Maintenance and Drainage Material: Mesh panels, fitted between masonry ties.
      a. Manufacturers:
         2) CavClear/Archovations, Inc; CavClear Masonry Mat: www.cavclear.com/#sle.


E. Nailing Strips: Softwood lumber, preservative treated for moisture resistance, dovetail shape, sized to masonry joints.

F. Termination Bars: Stainless steel; compatible with membrane and adhesives.

G. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.

H. Weeps:
   1. Type: Molded PVC grilles, insect resistant.

I. Cavity Vents:
   1. Type: Molded PVC grilles, insect resistant.

J. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials and as recommended by brick manufacturer.

2.07 MORTAR AND GROUT MIXES

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
   1. Masonry below grade and in contact with earth: Type S.
   2. Exterior, loadbearing masonry: Type N.
   3. Exterior, non-loadbearing masonry: Type N.
   4. Interior, loadbearing masonry: Type N.
   5. Interior, non-loadbearing masonry: Type O.
B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
   1. Grout Strength at 28 Days: Minimum 2,500 psi

D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

E. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

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

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

3.03 COLD AND HOT WEATHER REQUIREMENTS
   A. Maintain materials and surrounding air temperature to minimum 40 degrees F 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.

3.04 COURSING
   A. Establish lines, levels, and coursing indicated. Protect from displacement.
   B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
   C. Concrete Masonry Units:
      1. Bond: Running.
      2. Coursing: One unit and one mortar joint to equal 8 inches.
   D. Brick Units:
      1. Bond: Running.
      2. Coursing: Two units and two mortar joints to equal 8 inches.

3.05 PLACING AND BONDING
   A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
   B. Lay hollow masonry units with face shell bedding on head and bed joints.
   C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
   D. Remove excess mortar and mortar smears as work progresses.
   E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
   F. Interlock intersections and external corners.
   G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
J. Isolate masonry partitions from vertical structural framing members with a control joint.
K. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.06 WEEPS/CAVITY VENTS
A. Install weeps in veneer and cavity walls at 24 inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.
B. Install cavity vents in veneer and cavity walls at 32 inches on center horizontally below shelf angles and lintels and near top of walls.

3.07 CAVITY MORTAR CONTROL
A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
C. Install cavity mortar control panels continuously throughout full height of exterior masonry cavities during construction of exterior wythe, complying with manufacturer's installation instructions. Verify that airspace width is no more than 3/8 inch greater than panel thickness. Install horizontally between joint reinforcement. Stagger end joints in adjacent rows. Fit to perimeter construction and penetrations without voids.
D. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.08 REINFORCEMENT AND ANCHORAGE - GENERAL
A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches 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. Lap joint reinforcement ends minimum 6 inches.
E. Reinforce joint corners and intersections with strap anchors 16 inches on center.
F. 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 24 inches horizontally and 16 inches vertically.

3.09 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY
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. Lap joint reinforcement ends minimum 6 inches.

3.10 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. Lap joint reinforcement ends minimum 6 inches.
E. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

F. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.11 REINFORCEMENT AND ANCHORAGES - CAVITY WALL MASONRY
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 openings.
C. Place continuous joint reinforcement in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6 inches.
E. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Space anchors at maximum of 24 inches horizontally and 16 inches vertically.

3.12 REINFORCEMENT AND ANCHORAGES - MULTIPLE WYTHE UNIT MASONRY
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. Lap joint reinforcement ends minimum 6 inches.
E. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Space anchors at maximum of 24 inches horizontally and 16 inches vertically.

3.13 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 6 inches, minimum, into adjacent masonry or turn up at least 8 inches, minimum, 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 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.14 LINTELS
A. Install loose steel lintels over openings.
B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
   1. Openings to 42 inches: Place two, No. 3 reinforcing bars 1 inch from bottom web.
   2. Openings from 42 inches to 78 inches: Place two, No. 5 reinforcing bars 1 inch from bottom web.
   3. Do not splice reinforcing bars.
   4. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
   5. Place and consolidate grout fill without displacing reinforcing.
3.15 GROUTED COMPONENTS
   A. Reinforce bond beams with 2, No. 5 bars, 1 inch from bottom web.
   B. Lap splices minimum 24 bar diameters.
   C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
   D. Place and consolidate grout fill without displacing reinforcing.
   E. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening. See additional notes on structural drawings.

3.16 CONTROL AND EXPANSION JOINTS
   A. Do not continue horizontal joint reinforcement through control or expansion joints.
   B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer’s instructions.
   C. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.
   D. Size control joint in accordance with Section 079005 Joint Sealers for sealant performance.

3.17 BUILT-IN WORK
   A. As work progresses, install built-in metal door frames, wood nailing strips, anchor bolts, and plates 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 frames in adjacent mortar joints. Fill frame voids solid with grout.
   D. Do not build into masonry construction organic materials that are subject to deterioration.

3.18 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.
   F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.19 CUTTING AND FITTING
   A. Cut and fit for chases, pipes, conduit, sleeves, and and electrical device boxes. 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.

3.20 PARGING
   A. Dampen masonry walls prior to parging.
   B. Scarify each parging coat to ensure full bond to subsequent coat.
   C. Parge masonry walls in two uniform coats of mortar to a total thickness of 3/4 inch.
   D. Steel trowel surface smooth and flat with a maximum surface variation of 1/8 inch per foot.
   E. Strike top edge of parging at 45 degrees.

3.21 FIELD QUALITY CONTROL
   A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
3.22 CLEANING
A. Remove excess mortar and mortar droppings.
B. Replace defective mortar. Match adjacent work.
C. Clean soiled surfaces with detergent-based masonry cleaner, specifically designed for removal of dirt and mortar without damage to colored mortar or masonry surface. Neither muriatic acid nor high pressure water shall be used.
D. Use non-metallic tools in cleaning operations.
E. Clean walls daily during installation using stiff brushes. Remove green mortar with burlap or dry cloth. Do not allow excess mortar to harden on finished surfaces.
F. Final cleaning shall be with bucket and brush, and flushed with clean water.

3.23 PROTECTION
A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.
B. Securely cover tops of masonry elements with waterproof sheet material at end of each work day and when masonry work is not underway, until building is dried in.
C. At brick at grade install a layer of wood chip mulch or straw to a distance of 2 feet from wall to protect wall from mud splatter until final landscaping is established.

END OF SECTION
SECTION 05 1200
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Structural steel framing members.
B. Base plates, shear stud connectors and expansion joint plates.
C. Grouting under base plates.

1.02 RELATED REQUIREMENTS
A. Section 05 2100 - Steel Joist Framing.
B. Section 05 3100 - Steel Decking: Support framing for small openings in deck.
C. Section 05 5000 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings:
   1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
   2. Connections not detailed.
   3. Indicate cambers and loads.
   4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.04 QUALITY ASSURANCE
A. Fabricate structural steel members in accordance with AISC (MAN) “Steel Construction Manual.”
B. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

PART 2 PRODUCTS

2.01 MATERIALS
A. Steel Angles and Plates: ASTM A36/A36M.
B. Steel W Shapes and Tees: ASTM A992/A992M.
C. Rolled Steel Structural Shapes: ASTM A992/A992M.
D. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.
E. Steel Bars: ASTM A108.
F. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153/A153M, Class C.
G. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.
H. Unheaded Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563 or ASTM A563M nuts and ASTM F436/F436M Type 1 washers.
J. Welding Materials: AWS D1.1/D1.1M, type required for materials being welded.
K. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
   2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
L. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.
M. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION
   A. Shop fabricate to greatest extent possible.
   B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
   C. Fabricate connections for bolt, nut, and washer connectors.
   D. Develop required camber for members.

2.03 FINISH
   A. Shop prime structural steel members. Do not prime surfaces that will be field welded, in contact with concrete, or high strength bolted.

2.04 SOURCE QUALITY CONTROL
   A. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
   B. Welded Connections: Visually inspect all shop-welded connections.

PART 3 EXECUTION

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

3.02 ERECTION
   A. Erect structural steel in compliance with AISC 303.
   B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
   C. Field weld components and shear studs indicated on shop drawings.
   D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".
   E. Do not field cut or alter structural members without approval of Architect.
   F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
   G. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.03 TOLERANCES
   A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
   B. Maximum Offset From True Alignment: 1/4 inch.
3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

END OF SECTION
SECTION 05 2100
STEEL JOIST FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Open web steel joists and shear stud connectors, with bridging, attached seats and anchors.
B. Loose bearing members, such as plates or angles, and anchor bolts for site placement.
C. Supplementary framing for floor and roof openings greater than 18 inches.

1.02 RELATED REQUIREMENTS
A. Section 05 1200 - Structural Steel Framing: Grouting base plates and bearing plates.
   Superstructure framing.
B. Section 05 1200 - Structural Steel Framing: Superstructure framing.
C. Section 05 3100 - Steel Decking: Bearing plates and angles.
D. Section 05 3100 - Steel Decking: Support framing for openings less than 18 inches in decking.
E. Section 05 5000 - Metal Fabrications: Non-framing steel fabrications attached to joists.

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments.
C. Welders' Certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.
D. Manufacturer's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.04 QUALITY ASSURANCE
A. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
B. Perform Work, including that for headers and other supplementary framing, in accordance with SJI (SPEC) Standard Specifications Load Tables and SJI Technical Digest No. 9.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Transport, handle, store, and protect products to SJI requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Steel Joists:
   1. Canam Group Inc: www.canam-steeljoists.ws
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS
A. Open Web Joists: Types as indicated on drawings:
   1. Provide bottom and top chord extensions as indicated.
   2. Minimum End Bearing on Steel Supports: As shown on the drawings.
   3. Minimum End Bearing onConcrete or Masonry Supports: As shown on drawings.
   4. Finish: Shop primed.
C. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.
D. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A 36/A 36M.
E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION
A. Frame special sized openings in joist web framing as detailed.

2.04 FINISH
A. Shop prime joists as specified.
   1. Galvanize steel ledge angles.
   2. Leave other steel members unprimed.
B. Prepare surfaces to be finished in accordance with SSPC-SP 2.
C. Galvanizing: Provide minimum 1.7 oz/sq ft galvanized coating to ASTM A123/A123M requirements.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify existing conditions prior to beginning work.

3.02 ERECTION
A. Erect joists with correct bearing on supports.
B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.
C. Coordinate the placement of anchors for securing loose bearing members furnished as part of the work of this section.
D. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.
E. Position and field weld joist chord extensions and wall attachments as detailed.
F. Install supplementary framing for floor and roof openings greater than 18 inches.
G. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.
H. Do not field cut or alter structural members without approval of joist manufacturer.
I. After erection, prime welds, damaged shop primer, and surfaces not shop primed, except surfaces specified not to be primed.

3.03 TOLERANCES
A. Maximum Variation From Plumb: 1/4 inch.
B. Maximum Offset From True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL
A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

END OF SECTION
SECTION 05 3100
STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Roof deck.
B. Metal form deck.
C. Supplementary framing for openings up to and including 18 inches.
D. Bearing plates and angles.

1.02 RELATED REQUIREMENTS
A. Section 03 3000 - Cast-in-Place Concrete: Concrete topping over metal deck.
B. Section 05 1200 - Structural Steel Framing: Support framing for openings larger than 18 inches and shear stud connectors.
C. Section 05 1200 - Structural Steel Framing: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.
D. Section 05 2100 - Steel Joist Framing: Support framing for openings larger than 18 inches and shear stud connectors.

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.
I. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; Factory Mutual System; 2006.
N. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
C. Certificates: Certify that products furnished meet or exceed specified requirements.
D. Submit manufacturer's installation instructions.
E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
F. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE
A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
B. Installer Qualifications: Company specializing in performing the work of this Section with minimum three (3) years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Cut plastic wrap to encourage ventilation.
B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Steel Deck:
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 STEEL DECK
A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.
   1. Calculate to structural working stress design and structural properties specified.
B. Roof Deck: Non-composite type, fluted steel sheet:
   2. Minimum Base Metal Thickness: 22 gage, 0.0299 inch.
   3. Nominal Height: 1-1/2 inch.
   4. Profile: Fluted; SDI WR.
   5. Formed Sheet Width: 36 inch.
   7. End Joints: Lapped, mechanically fastened.
C. Metal Form Deck: Corrugated sheet steel:
   2. Nominal Height: 9/16 inch.
   3. Formed Sheet Width: 32 inch.
   5. End Joints: Lapped, mechanically fastened.

2.03 ACCESSORY MATERIALS
A. Bearing Plates and Angles: ASTM A36/A36M steel, unfinished.
B. Welding Materials: AWS D1.1/D1.1M.
C. Fasteners: Galvanized hardened steel, self tapping.
D. Powder Actuated Mechanical Fasteners: Steel; with knurled shank and forged ballistic point. Comply with applicable requirements of ICC-ES AC70.
   1. Design Requirements: Provide number and type of fasteners that comply with the applicable requirements of SDI (DM) design method for roof deck and floor deck applications and ICC-ES AC43.
      a. Hardness: Rockwell C 54.5, minimum.
      b. Tensile Strength: 285 kips per square inch, minimum.
      c. Shear Strength: 175 kips per square inch, minimum.
      d. Washers:
         1) Steel Bar Joist Framing Applications: 0.472 inch diameter, minimum.
         2) Exposed Roof Deck Applications: 0.591 inch diameter, minimum.
      e. Corrosion Resistance:
         1) Steel Bar Joist Framing Applications: ASTM B633, SC1, Type III zinc electroplate.
         2) Exposed Roof Deck Applications: Provide manufacturer's standard stainless steel sealing caps with bonded neoprene washer over each fastener.
   3. Products:
      e. Substitutions: See Section 01 6000 - Product Requirements.
E. Mechanical Sidelap Connectors: Steel; hex washer head undercut with reverse serrations and self-piercing or stitch point at center.
   1. Design Requirements: Provide number and type of fasteners that comply with the applicable requirements of SDI design method for roof deck and floor deck applications.
      a. Hardness: Vickers Surface Hardness 450 HV0.3, minimum.
      b. Corrosion Resistance:
         1) Fasteners for Steel Roof Decks Protected with Waterproofing Membrane: ASTM B 633, SC1, Type III zinc electroplate.
         2) Fasteners for Exposed Steel Roof Deck Application: Manufacturer's standard stainless steel with bonded neoprene washer.
   3. Fastener Manufacturers:
      e. Substitutions: See Section 01 6000 - Product Requirements.
F. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.
G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.
I. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

2.04 FABRICATED DECK ACCESSORIES
A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gage, 0.0299 inch thick sheet steel; of profile and size as indicated; finished same as deck.
PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION
   A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
   B. On steel supports provide minimum 1-1/2 inch bearing.
   C. Fasten deck to steel support members at ends and intermediate supports at 12 inches on center maximum, parallel with the deck flute and at each transverse flute using methods specified.
      1. Welding: Use fusion welds through weld washers.
   D. Clinch lock seam side laps.
   E. At mechanically fastened male/female side laps fasten at 24 inches on center maximum.
   F. Drive mechanical sidelap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.
   G. Weld deck in accordance with AWS D1.3/D1.3M.
   H. At deck openings from 6 inches to 18 inches in size, provide 2 by 2 by 1/4 inch steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld to deck at each flute.
   I. Where deck (other than cellular deck electrical raceway) changes direction, install 6 inch minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.
   J. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.
   K. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.
   L. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

END OF SECTION
SECTION 05 4000
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Formed steel stud exterior wall and interior wall framing.

1.02 RELATED REQUIREMENTS
A. Section 07 2400: Exterior Insulation and Finish Systems.
B. Section 04 2001 - Masonry Veneer: Veneer masonry supported by wall stud metal framing.
C. Section 05 3100 - Steel Decking.
D. Section 06 1000 - Rough Carpentry: Wood blocking and miscellaneous framing.
E. Section - Gypsum Board Assemblies: Lightweight, non-load bearing metal stud framing.

1.03 REFERENCE STANDARDS
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
D. ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities and insulation.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention.

1.06 QUALITY ASSURANCE
A. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Metal Framing:
   3. Substitutions: See Section 01 6000 - Product Requirements.
B. Framing Connectors and Accessories:
   1. Same manufacturer as metal framing.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FRAMING SYSTEM
A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

2.03 FRAMING MATERIALS
A. Studs and Track: ASTM C955; studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.
   1. Gage and Depth: As indicated on drawings.
   2. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.
   3. Provide components fabricated from ASTM A1008/A1008M, Designation SS (structural steel).

2.04 ACCESSORIES
A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.05 FASTENERS
A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
B. Anchorage Devices: Powder actuated.
C. Welding: In conformance with AWS D1.1/D1.1M.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that substrate surfaces are ready to receive work.
B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION OF STUDS
A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.
B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches on center.
C. Place studs at 16 inches on center; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using clip and tie method.
D. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
E. Install load bearing studs full length in one piece. Splicing of studs is not permitted.
F. Install load bearing studs, brace, and reinforce to develop full strength and achieve design requirements.
G. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
H. Install intermediate studs above and below openings to align with wall stud spacing.
I. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
J. Attach cross studs to studs for attachment of fixtures anchored to walls.
K. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
L. Touch-up field welds and damaged galvanized surfaces with primer.

END OF SECTION
SECTION 05 5000
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Shop fabricated steel items, including:
   1. Roof ladder

1.02 RELATED REQUIREMENTS
A. Section 04 2000 - Unit Masonry: Placement of metal fabrications in masonry.
B. Section 05 3100 - Steel Decking: Bearing plates for metal deck bearing, including anchorage.
C. Section 09 9113 - Exterior Painting: Paint finish.

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. 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.
C. Welders’ Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL
A. Steel Sections: ASTM A36/A36M.
B. Plates: ASTM A283/A283M.
C. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
D. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 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.

2.03 FABRICATED ITEMS
A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; galvanized finish. Fabricate as indicated on drawings.
B. Channels and Plates Not Attached to Structural Framing: For support of metal decking, joists, and masonry, prime paint finish.

C. Lintels: As detailed, prime paint finish.

D. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.

E. Lintels: As detailed; prime paint finish.

2.04 FINISHES - STEEL

A. Prime paint steel items.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: One coat.

2.05 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 INSTALLATION -GENERAL

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain approval prior to site cutting or making adjustments not scheduled.

D. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.03 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
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Rough opening framing for doors, windows, and roof openings.
B. Roofing nailers.
C. Preservative treated wood materials.
D. Communications and electrical room mounting boards.
E. Concealed wood blocking, nailers, and supports.
F. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS
A. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.

1.03 REFERENCE STANDARDS
F. PS 1 - Structural Plywood; 2009.
H. SPIB (GR) - Grading Rules; 2014.

1.04 DELIVERY, STORAGE, AND HANDLING
A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS
A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Southern Pine, unless otherwise indicated.
   2. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.
B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS
A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
B. Sizes: Nominal sizes as indicated on drawings, S4S.
C. Moisture Content: Kiln-dry or MC15.
D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS
1. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
2. Edges: Square.
3. Glass Mat Faced Products:
   c. Substitutions: See Section 01 6000 - Product Requirements.

B. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.04 ACCESSORIES
A. Fasteners and Anchors:
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length to achieve full penetration of sheathing substrate.
   3. Anchors: Toggle bolt type for anchorage to hollow masonry.
B. Water-Resistive Barrier: As specified in Section 07 2500.

2.05 FACTORY WOOD TREATMENT
A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.
B. Preservative Treatment:
      a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
      b. Treat lumber exposed to weather.
      c. Treat lumber in contact with roofing, flashing, or waterproofing.
      d. Treat lumber in contact with masonry or concrete.
      e. Treat lumber less than 8 inches above grade.

PART 3 EXECUTION
3.01 PREPARATION
A. Coordinate installation of rough carpentry members specified in other sections.

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

3.03 BLOCKING, NAILERS, AND SUPPORTS
A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

F. Provide the following specific non-structural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.
   3. Handrails.
   4. Grab bars.
   5. Towel and bath accessories.
   6. Wall-mounted door stops.

3.04 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at all roof openings except where specifically indicated otherwise. Form corners by alternating lapping side members.

3.05 INSTALLATION OF CONSTRUCTION PANELS

A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
   1. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.

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

3.06 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.

B. Allow preservative to dry prior to erecting members.

3.07 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.08 CLEANING

A. Waste Disposal: Comply with the requirements of Section 01 7419 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION
SECTION 06 4100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Specially fabricated cabinet units.
B. Cabinet hardware.
C. Factory finishing.
D. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS
A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
B. Section 12 3600 - Countertops.

1.03 REFERENCE STANDARDS
A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
C. BHMA A156.9 - American National Standard for Cabinet Hardware; 2015.
D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
C. Product Data: Provide data for hardware accessories.
D. Submit color samples of manufacturer's full range of laminate colors for selection by Architect.
E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

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

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

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

PART 2 PRODUCTS

2.01 CABINETS
A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
B. Plastic Laminate Faced Cabinets: Custom grade.

2.02 WOOD-BASED COMPONENTS
A. Wood fabricated from old growth timber is not permitted.
2.03 LAMINATE MATERIALS
   A. Manufacturers:
      4. Substitutions:  See Section 01 6000 - Product Requirements.
   B. Thermally Fused Laminate (TFL):  Melamine resin, NEMA LD 3, Type VGL laminate panels.
   C. High Pressure Decorative Laminate (HPDL):  NEMA LD 3, types as recommended for specific applications.
   D. Provide specific types as follows:
      1. Horizontal Surfaces:  HGS, 0.048 inch nominal thickness, through color, color as selected, textured low gloss finish.
      2. Vertical Surfaces:  VGS, 0.028 inch nominal thickness, through color, color as selected, textured low gloss finish.
      3. Laminate Backer:  BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.04 COUNTERTOPS
   A. Countertops are specified in Section 12 3600.

2.05 ACCESSORIES
   A. Adhesive:  Type recommended by fabricator to suit application.
   B. Plastic Edge Banding:  Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
      1. Color:  As selected by Architect from manufacturer's standard range.
      2. Use at all exposed plywood edges.
      3. Use at all exposed shelf edges.
   C. Fasteners:  Size and type to suit application.
   D. Bolts, Nuts, Washers, Lags, Pins, and Screws:  Of size and type to suit application; chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
   E. Concealed Joint Fasteners:  Threaded steel.
   F. Grommets:  Standard plastic grommets for cut-outs, in color to blend with adjacent surface.

2.06 HARDWARE
   A. Hardware:  BHMA A156.9, types as recommended by fabricator for quality grade specified.
   B. Adjustable Shelf Supports:  Standard side-mounted system using multiple holes for pin supports and coordinated self rests, satin chrome finish, for nominal 1 inch spacing adjustments.
   C. Drawer and Door Pulls:  "U" shaped wire pull, steel with chrome finish, 4 inch centers.
   D. Cabinet Locks:  Keyed cylinder, two keys per lock, steel with chrome finish.
   E. Drawer Slides:
      1. Type:  Full extension with overtravel.
      2. Static Load Capacity:  Commercial grade.
      4. Stops:  Integral type.
      5. Features:  Provide self closing/stay closed type.
      6. Manufacturers:
         d. Substitutions:  See Section 01 6000 - Product Requirements.
F. Hinges: Semiconcealed self-closing type, steel with polished finish.
   1. Manufacturers:
      c. Substitutions: See Section 01 6000 - Product Requirements.

2.07 FABRICATION
A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit
   passage through building openings.
B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than
   one piece for any single length.
C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for
   cutting. Provide matching trim for scribing and site cutting.
D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with
   manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Locate
counter butt joints minimum 2 feet from sink cut-outs.
   1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
   2. Cap exposed plastic laminate finish edges with plastic trim.
E. Mechanically fasten backsplash to countertops as recommended by laminate manufacturer at
   16 inches on center.
F. Provide cutouts for plumbing fixtures, inserts, outlet boxes, and fixtures and fittings. Verify
   locations of cutouts from on-site dimensions. Prime paint cut edges.

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

3.02 INSTALLATION
A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements
   for grade indicated.
B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
C. Use fixture attachments in concealed locations for wall mounted components.
D. Use concealed joint fasteners to align and secure adjoining cabinet units and countertops.
E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not
   use additional overlay trim for this purpose.
F. Secure cabinets to floor using appropriate angles and anchorages.

3.03 ADJUSTING
A. Adjust moving or operating parts to function smoothly and correctly.

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

END OF SECTION
SECTION 06 6510
SOLID SURFACE FABRICATIONS

PART 1 — GENERAL
1.01 SECTION INCLUDES
A. Solid surface sills

1.02 DEFINITION
A. Solid surface is defined as nonporous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment.

1.03 SUBMITTALS
A. Product data: Indicate product description, fabrication information and compliance with specified performance requirements.
B. Shop drawings: show edge details and method of attachment for solid surface sills.
C. Samples:
   1. For each type of product indicated.
      a. Submit minimum 6-inch by 6-inch sample in specified gloss.
      b. Cut sample and seam together for representation of inconspicuous seam.
      c. Indicate full range of color and pattern variation.
   2. Approved samples will be retained as a standard for work.
D. Maintenance data:
   1. Submit manufacturer’s care and maintenance data, including repair and cleaning instructions.
      a. Maintenance kit for finishes shall be submitted.
   2. Include in project closeout documents.

1.04 QUALITY ASSURANCE
A. Qualifications:
   1. Shop that employs skilled workers who custom fabricate products similar to those required for this project and whose products have a record of successful in-service performance.
B. Fabricator/installer qualifications:
   1. Work of this section shall be by a certified fabricator/installer, certified in writing by the manufacturer.

1.05 DELIVERY, STORAGE AND HANDLING
A. Deliver no components to project site until areas are ready for installation.
B. Store components indoors prior to installation.
C. Handle materials to prevent damage to finished surfaces.
   1. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.06 WARRANTY
A. Provide manufacturer’s warranty against defects in materials.
   1. Warranty shall provide material and labor to repair or replace defective materials.
   2. Damage caused by physical or chemical abuse or damage from excessive heat will not be warranted.

1.07 MAINTENANCE
A. Provide maintenance requirements as specified by the manufacturer.

PART 2 — PRODUCTS
2.01 MANUFACTURERS
A. Manufacturers:
Subject to compliance with requirements, provide products by one of the following:
   a. Corian® surfaces from the DuPont company (basis of design).
   b. Substitutions: See Section 01 6000 – Product Requirements.

2.02 MATERIALS
   A. Solid polymer components
      1. Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.6, having minimum physical and performance properties specified.
      2. Superficial damage to a depth of 0.010 inch (.25 mm) shall be repairable by sanding and/or polishing.
   B. Thickness:
      1. 1/4 inch

2.03 ACCESSORIES
   A. Joint adhesive:
      1. Manufacturer’s standard one- or two-part adhesive kit to create inconspicuous, nonporous joints.
   B. Sealant:
      1. Manufacturer’s standard mildew-resistant silicone sealant in colors matching components.

2.04 FACTORY FABRICATION
   A. Shop assembly
      1. Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer’s printed instructions and technical bulletins.
      2. Form joints between components using manufacturer’s standard joint adhesive without conspicuous joints.
         a. Reinforce with strip of solid polymer material, 2” wide.
      3. Rout and finish component edges with clean, sharp returns.
         a. Rout cutouts, radii and contours to template.
         b. Smooth edges.
         c. Repair or reject defective and inaccurate work.
   B. Thermoforming:
      1. Comply with manufacturer’s data.
      2. Heat entire component.
         a. Material shall be uniform, between 275 and 325 degrees Fahrenheit during forming.
      3. Form pieces to shape prior to seaming and joining.
      4. Cut pieces to finished dimensions.
      5. Sand edges and remove nicks and scratches.

2.05 FINISHES
   A. Architect will select from the manufacturer’s standard color chart.
      1. Provide surfaces with a uniform finish.

PART 3 — EXECUTION

3.01 EXAMINATION
   A. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
   A. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
      1. Provide product in the largest pieces available.
2. Form field joints using manufacturer’s recommended adhesive, with joints inconspicuous in finished work.
3. Exposed joints/seams shall not be allowed.
4. Reinforce field joints with solid surface strips extending a minimum of 1 inch on either side of the seam with the strip being the same thickness as the top.
5. Cut and finish component edges with clean, sharp returns.
6. Rout radii and contours to template.
7. Carefully dress joints smooth, remove surface scratches and clean entire surface.

3.03 REPAIR
   A. Repair or replace damaged work which cannot be repaired to architect’s satisfaction.

3.04 CLEANING AND PROTECTION
   A. Keep components clean during installation.
   B. Remove adhesives, sealants and other stains.
SECTION 06 8316
FIBERGLASS REINFORCED PANELING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fiberglass reinforced plastic panels.
B. Trim.

1.02 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.

1.03 ENVIRONMENTAL REQUIREMENTS
A. Building should be fully enclosed prior to installation with sufficient heat (70 degrees) and ventilation consistent with good working conditions for finish work.

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

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Fiberglass Reinforced Plastic Panels:
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEMS
A. Wall Panels:
   1. Panel Size: 4 by 8 feet.
   2. Panel Thickness: 0.10 inch.
   5. Attachment Method: Adhesive only, with trim and sealant in joints.

2.03 MATERIALS
A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
   1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Scratch Resistance: Barcol hardness score greater than 35, when tested in accordance with ASTM D2583.
   4. Impact Strength: Greater than 6 ft lb force per inch, when tested in accordance with ASTM D256.
   5. Surface Characteristics and Cleanability: Provide products that are smooth, durable, and easily cleanable, in compliance with FDA Food Code, Chapter 6 - Physical Facilities.
   6. Chemical Cleanability: Excellent chemical resistance to common cleaners and detergents when tested in accordance with ISO 2812-1.
   7. Biological Resistance: Rating of 0, when tested in accordance with ISO 846.
B. Trim: PVC; color coordinating with panel.
C. Adhesive: Type recommended by panel manufacturer.
D. Sealant: Type recommended by panel manufacturer; clear.
PART 3 EXECUTION

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

3.02 INSTALLATION - WALLS
   A. Install panels above base in accordance with manufacturer's instructions.
   B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
   C. Pre-drill fastener holes in panels, 1/8 inch greater in diameter than fastener, spaced as indicated by panel manufacturer.
   D. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
   E. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
   F. Install panels with manufacturer's recommended gap for panel field and corner joints.
   G. Drive fasteners to provide snug fit, and do not over-tighten.
   H. Place trim on panel before fastening edges, as required.
   I. Fill channels in trim with sealant before attaching to panel.
   J. Install trim with adhesive and screws or nails, as required.
   K. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.
   L. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION
SECTION 07 1113
BITUMINOUS DAMPPROOFING

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Bituminous dampproofing.
B. Protection boards.
C. Drainage panels.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide properties of primer, bitumen, and mastics.
C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.04 FIELD CONDITIONS
A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Acceptable Manufacturers:
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BITUMINOUS DAMPPROOFING
A. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; without fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.
   1. Composition - Vertical Application: ASTM D1227 Type III or ASTM D1187/D1187M Type I.
   2. VOC Content: Not more than permitted by local, State, and federal regulations.
   3. Applied Thickness: 1/16 inch, minimum, wet film.

B. Primers, Mastics, and Related Materials: Type as recommended by dampproofing manufacturer.

2.03 ACCESSORIES
A. Drainage Panel: 1/4 inch thick formed plastic, hollowed sandwich.
B. Protection Board: specified in Section Sheet Waterproofing 07 1300.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify existing conditions are acceptable prior to starting this work.
B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.
C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.02 PREPARATION
A. Protect adjacent surfaces not designated to receive dampproofing.
B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.
C. Do not apply dampproofing to surfaces unacceptable to manufacturer.
D. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

3.03 APPLICATION
A. Foundation Walls: Apply one coat of dampproofing.
B. Exterior Masonry Cavity Walls: apply one coat to cavity side of masonry block walls.
C. Prime surfaces in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
D. Apply bitumen with mop.
E. Apply bitumen in one coat, continuous and uniform, at a rate of 25 sq ft/gal per coat.
F. Apply from 2 inches below finish grade elevation down to top of footings.
G. Seal items watertight with mastic, that project through dampproofing surface.
H. Place drainage panel directly over dampproofing, butt joints, place to encourage drainage downward.
I. Place protection board over drainage panel, butt joints, and adhere with mastic.
J. Scribe and cut boards around projections, penetrations, and interruptions.

END OF SECTION
SECTION 07 2100
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Board insulation at cavity wall construction, perimeter foundation wall, and underside of floor slabs.
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 07 2119 - Foamed-In-Place Insulation: Plastic foam insulation other than boards.
B. Section 07 2400 - Exterior Insulation and Finish Systems: Board insulation on exterior side of walls, finished with weatherproof coating.
C. Section 07 2500 - Weather Barriers: Separate air barrier and vapor retarder materials.
D. Section 07 5300 - Elastomeric Membrane Roofing: Insulation specified as part of roofing system.
E. Section 09 2116 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 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.

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

PART 2 PRODUCTS

2.01 APPLICATIONS
A. Insulation Under Concrete Slabs: Extruded polystyrene board.
B. Insulation at Perimeter of Foundation: Extruded polystyrene board.
C. Insulation Inside Masonry Cavity Walls: Extruded polystyrene board.
D. Insulation Over Metal Stud Framed Walls, Continuous: Extruded polystyrene board.
E. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.

2.02 FOAM BOARD INSULATION MATERIALS
A. Extruded Polystyrene Board Insulation: Extruded polystyrene board; ASTM C578; with either natural skin or cut cell surfaces, and the following characteristics:
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   3. R-value: 1 inch of material at 72 degrees F: 5, minimum.
   4. Board Thickness: 2 inches.
   6. Water Absorption, Maximum: 0.3 percent, by volume.
   7. Manufacturers:
c. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.
8. Substitutions: See Section 01 6000 - Product Requirements.

**2.03 BATT INSULATION MATERIALS**

A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; 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.
   6. Facing: Aluminum foil, one side.
   7. Manufacturers:
8. Substitutions: See Section 01 6000 - Product Requirements.

**2.04 ACCESSORIES**

A. Tape: Polyethylene self-adhering type, mesh reinforced, 2 inch wide.
B. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.
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. Adhesive: Type recommended by insulation manufacturer for application.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
B. Verify substrate surfaces are flat, free of irregularities.

**3.02 BOARD INSTALLATION AT EXTERIOR WALLS**

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

**3.03 BOARD INSTALLATION AT CAVITY WALLS**

A. Secure impale fasteners to substrate at following frequency:
B. Install boards to fit snugly between wall ties.
   1. Place membrane surface against adhesive.
C. Install boards horizontally on walls.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and to protrusions.
   4. Place impale fastener locking discs.
D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
E. Place 6 inch wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames, and tape seal in place to ensure continuity of vapor retarder and air seal.
3.04 BOARD INSTALLATION UNDER CONCRETE SLABS
   A. Place insulation under slabs on grade after base for slab has been compacted.
   B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
   C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.05 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK
   A. Installation of board insulation over low slope roof deck is specified in Section 07 5300 Elastomeric Membrane Roofing.

3.06 BATT INSTALLATION
   A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
   B. Install in exterior wall 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. Tape insulation batts in place.
   G. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.
   H. Coordinate work of this section with construction of air barrier seal specified in Section 07 2500.

3.07 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 SECTION INCLUDES
A. Foamed-in-place insulation.
   1. In exterior wall and roof crevices, window perimeters, and door shim spaces.
   2. In headers constructed with cold-formed metal framing.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide product description, insulation properties, and preparation requirements.
C. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.

1.04 FIELD CONDITIONS
A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Foamed-In-Place Insulation:
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS
A. Single Component Polyurethane Foam Sealant
B. Foamed-In-Place Insulation: Low-density, flexible, open celled, water vapor permeable polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
   1. Thermal Resistance: R-value of 3.0, minimum, per 1 inch thickness at 75 degrees F mean temperature when tested in accordance with ASTM C518.
   2. Air Permeance: 0.004 cfm/sq ft, maximum, when tested at intended thickness in accordance with ASTM E2178 or ASTM E283 at 1.5 psf.
   3. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.

2.03 ACCESSORIES
A. Primer: As required by insulation manufacturer.

PART 3 EXECUTION

3.01 APPLICATION
A. Apply insulation in accordance with manufacturer's instructions.
B. Apply insulation by spray method, to a uniform monolithic density without voids.
C. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.
D. Trim excess away for applied trim or remove as required for continuous sealant bead.

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

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Composite wall and soffit cladding of rigid insulation and reinforced finish coating (“Class PB”).
B. Drainage and water-resistive barriers behind insulation board.
C. Incidental uses of same finish coating applied directly to masonry.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Sheathing on metal studs.
B. Section 07 2500 - Weather Resistant Sheathing & Air Barrier System
C. Section 07 6200 - Sheet Metal Flashing and Trim: Perimeter flashings.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Color and finish of Exterior Insulation and Finish System shall match existing system.
C. Selection Samples: Submit manufacturer's standard range of samples illustrating available coating colors and textures.
D. Verification Samples: Submit actual samples of selected coating on specified substrate, minimum 12 inches square, illustrating project colors and textures.
E. Manufacturer's Installation Instructions: Indicate preparation required, installation techniques, and jointing requirements.

1.05 QUALITY ASSURANCE
A. Maintain copy of specified installation standard and manufacturer's installation instructions at project site during installation.
B. Installer Qualifications: Company specializing in the type of work specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Delivery: Deliver materials to project site in manufacturer's original, unopened containers with labels intact. Inspect materials and notify manufacturer of any discrepancies.
B. Storage: Store materials as directed by manufacturer's written instructions.
1. Protect Portland cement based materials from moisture and humidity. Store under cover off the ground in a dry location.
2. Protect insulation materials from exposure to sunlight.

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

1.08 WARRANTY
A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide manufacturer's standard material warranty, covering a period of not less than 5 years.
C. Provide separate warranty from installer covering labor for repairs or replacement for a period of not less than 5 years.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Acceptable Manufacturers:
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 EXTERIOR INSULATION AND FINISH SYSTEM
A. Exterior Insulation and Finish System: DRAINAGE type; reinforced finish coating on insulation board with drainage grooves adhesive-applied to water-resistive coating over substrate; provide a complete system that has been tested to show compliance with the following characteristics; include all components of specified system and substrate(s) in tested samples.
B. Fire Characteristics:
   1. Flammability: Pass, when tested in accordance with NFPA 285.
2. Ignitibility: No sustained flaming when tested in accordance with NFPA 268.

3. Potential Heat of Foam Plastic Insulation Tested Independently of Assembly: No portion of the assembly having potential heat that exceeds that of the insulation sample tested for flammability (above), when tested in accordance with NFPA 259 with results expressed in Btu per square foot.

C. Adhesion of Water-Resistive Coating to Substrate: For each combination of coating and substrate, minimum flatwise tensile bond strength of 15 psi, when tested in accordance with ASTM C297/C297M.

D. Adhesion to Water-Resistive Coating: For each combination of insulation board and substrate, when tested in accordance with ASTM C297/C297M, maximum adhesive failure of 25 percent unless flatwise tensile bond strength exceeds 15 psi in all samples.

E. Water Penetration Resistance: No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes, when tested in accordance with ASTM E331 at 2.86 psf differential pressure with tracer dye in the water spray; include in tested sample at least two vertical joints and one horizontal joint of same type to be used in construction; disassemble sample if necessary to determine extent of water penetration.

F. Drainage Efficiency: Average minimum efficiency of 90 percent, when tested in accordance with ASTM E2273 for 75 minutes.

G. Freeze-Thaw Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 10 cycles, when tested in accordance with ICC-ES AC219 or ICC-ES AC235.

H. Weathering Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 2000 hours of accelerated weathering conducted in accordance with ASTM G153 Cycle 1 or ASTM G155 Cycle 1, 5, or 9.

I. Water Degradation Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 14 days exposure, when tested in accordance with ASTM D2247.

J. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D3273.

K. Abrasion Resistance Of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D968 with 113.5 gallons of sand.

L. Impact Resistance: Construct system to provide the following impact resistance without exposure of broken reinforcing mesh, when tested in accordance with ASTM E2486/E2486M:
   1. Standard: 25 to 49 in-lb, for areas not indicated as requiring higher impact resistance.
   2. Ultra-High: Over 150 in-lb, for areas subject to potential abuse.

2.03 MATERIALS

A. Finish Coating Top Coat: Water-based, air curing, acrylic or polymer-based finish with integral color and texture.
   2. Color: As indicated on drawings.

B. Base Coat: Fiber-reinforced, acrylic or polymer-based product compatible with insulation board and reinforcing mesh.

C. Reinforcing Mesh: Balanced, open weave glass fiber fabric, treated for compatibility and improved bond with coating, weight, strength, and number of layers as required to meet required system impact rating.

D. Insulation Board: Molded expanded polystyrene (EPS) board insulation, 1, Type XI, with the following characteristics:
1. Grooved Board: Back side of board adjacent to sheathing grooved with vertical channels designed to allow moisture to drain; at drainage points provide board configuration that permits drainage to the exterior.
2. Board Thickness: As indicated on drawings.
5. Thermal Resistance (R factor per 1 inch (25.4 mm)) at 75 degrees F: 3.60.
6. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, when tested in accordance with ASTM E84.

E. Drainage Layer or Spacers: Furnished or approved by EIFS manufacturer; capable of achieving specified drainage rate; not required to be water-resistive, air retarder, or vapor retarder.
F. Water-Resistive Barrier: Dryvit Backstop.
G. Flashing Tape: Self-adhering rubberized asphalt tape with polyethylene backing or other material and surface conditioner furnished or approved by EIFS manufacturer.

2.04 ACCESSORY MATERIALS
A. Insulation Adhesive: Type required by EIFS manufacturer for project substrate.
B. Metal Flashings: As specified in Section 07 6200.
C. Trim: EIFS manufacturer's standard PVC or galvanized steel trim accessories, as required for a complete project and including starter track and drainage accessories.
D. Sealant Materials: Compatible with EIFS materials and as recommended by EIFS manufacturer.

PART 3 EXECUTION
3.01 GENERAL
A. Install in accordance with EIFS manufacturer's instructions and ASTM C1397.
B. Where different requirements appear in either document, comply with the most stringent.
C. Neither of these documents supercedes the provisions of the Contract Documents that define the contractual relationships between the parties or the scope of work.

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

3.03 INSTALLATION - WATER-RESISTIVE BARRIER
A. Apply barrier coating as recommended by coating manufacturer; prime substrate as required before application.
B. Seal substrate transitions and intersections with other materials to form continuous water-resistive barrier on exterior of sheathing, using method recommended by manufacturer.
C. At door and window rough openings and other wall penetrations, seal water-resistive barrier and flexible flashings to rough opening before installation of metal flashings, sills, or frames, using method recommended by manufacturer.
D. Lap flexible flashing or flashing tape at least 2 inches on each side of joint or transition.
E. Install Backstop according to manufacturer's written instructions.

3.04 INSTALLATION - INSULATION
A. Install in accordance with manufacturer's instructions.
B. Prior to installation of boards, install starter track and other trim level and plumb and securely fastened. Install only in full lengths, to minimize moisture intrusion; cut horizontal trim tight to vertical trim.

C. Install back wrap reinforcing mesh at all openings and terminations that are not to be protected with trim.

D. On wall surfaces, install boards horizontally.

E. Place boards in a method to maximize tight joints. Stagger vertical joints and interlock at corners. Butt edges and ends tight to adjacent board and to protrusions. Achieve a continuous flush insulation surface, with no gaps in excess of 1/16 inch.

F. Fill gaps greater than 1/16 inch with strips or shims cut from the same insulation material.

G. Rasp irregularities off surface of installed insulation board.

H. Adhesive Attachment: Use method recommended by EIFS manufacturer.

3.05 INSTALLATION - CLASS PB FINISH

A. Base Coat: Apply in thickness as necessary to fully embed reinforcing mesh, wrinkle free, including back-wrap at terminations of EIFS. Install reinforcing fabric as recommended by EIFS manufacturer.
   1. Lap reinforcing mesh edges and ends a minimum of 2-1/2 inches.
   2. Allow base coat to dry a minimum of 24 hours before next coating application.

B. At locations indicated, install second layer of reinforcing mesh embedded in second coat of base coating, tightly butting ends and edges of mesh.

C. Install expansion joints at floor lines as recommended by EIFS manufacturer.

D. Apply finish coat after base coat has dried not less than 24 hours, embed finish aggregate, and finish to a uniform texture and color.

E. Finish Coat Thickness: As recommended by manufacturer.

F. Seal control and expansion joints within the field of exterior finish and insulation system, using procedures recommended by sealant and finish system manufacturers.

G. Apply sealant at finish perimeter and expansion joints in accordance with sealant manufacturer's instructions.

3.06 CLEANING

A. Clean EIFS surfaces and work areas of foreign materials resulting from EIFS operations.

3.07 PROTECTION

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

B. Where EIFS is adjacent to grade provide wood chip mulch or straw over exposed dirt for a distance of 2'-0" from wall. Maintain protection until landscaping is installed.

END OF SECTION
SECTION 07 2500
WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

1.02 RELATED REQUIREMENTS
A. Section 03 3000 - Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.
B. Section 07 2100 - Thermal Insulation: Vapor retarder installed in conjunction with batt insulation.
D. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.

1.03 DEFINITIONS
A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.
C. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
1. Water Vapor Permeance: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on material characteristics and performance criteria.

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES
A. Air Barrier:
   1. On outside surface of sheathing of exterior walls use air barrier coating.

2.02 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)
A. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.
B. Air Barrier Coating:
   1. Air Permeance: 0.001 cubic feet per minute per square foot, maximum, when tested in accordance with ASTM E2178.
   2. Water Vapor Permeance: 18 perms, minimum, when tested in accordance with ASTM E96/E96M, Procedure B.
   3. Products:
      d. PROSOCO, Inc; R-GUARD Spray Wrap MVP: www.prosoco.com/r-guard/#sle.
2.03 ACCESSORIES
   1. Products:
      b. Substitutions: See Section 01 6000 - Product Requirements.
B. Thinners and Cleaners: As recommended by material manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that surfaces and conditions are ready to accept the work of this section.

3.02 PREPARATION
A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

3.03 INSTALLATION
A. Install materials in accordance with manufacturer's instructions.
B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
C. Coatings:
   1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
   2. Use flashing to seal to adjacent construction and to bridge joints.
D. Openings and Penetrations in Exterior Weather Barriers:
   1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
   2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with at least 4 inches wide; do not seal sill flange.
   3. At openings to be filled with non-flanged frames, seal weather barrier to all sides of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.
   4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.
   5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
   6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

3.04 PROTECTION
A. Do not leave materials exposed to weather longer than recommended by manufacturer.
SECTION 07 2500
WEATHER RESISTANT SHEATHING & AIR BARRIER SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Coated fiberglass-mat gypsum sheathing board system with integral weather-resistant barrier (WRB) and air barrier (AB) features
B. Accessory materials required for covering sheathing joints, fasteners, penetrations, rough openings, and material transitions, for use under exterior wall claddings.
C. Fluid-applied membrane air barrier

1.02 RELATED SECTIONS
A. Section 054000 Cold-Formed Metal Framing
B. Section 061000 Rough Carpentry
C. Section 079200 Joint Sealants; sealant materials and installation techniques
D. Section 092900 Gypsum Board
E. Exterior wall claddings

1.03 DEFINITIONS
A. Air Barrier (AB): Air tight barrier made of material that is relatively air impermeable but moisture vapor permeable, with sealed joints and penetrations, and with terminations sealed to adjacent surfaces.
B. Weather-Resistant Barrier (WRB): Water-shedding barrier made of material that is moisture-resistant, installed to shed water, with sealed joints and penetrations, and with terminations sealed to adjacent surfaces.
C. Rough Openings: Openings in the wall to accommodate windows and doors.
D. Material Transitions: Areas where the WRB / AB coated fiberglass-mat gypsum sheathing connects to beams, columns, slabs, parapets, foundation walls, roofing systems, and at the interface of dissimilar materials.

1.04 SUBMITTALS
A. See Section 01 3000 – Administrative Requirements, for submittal procedures.
B. Product Data and Installation Instructions: Submit manufacturer’s product data including sheathing and accessory material types, composition, descriptions and properties, installation instructions and substrate preparation recommendations.
C. Shop Drawings: Submit shop drawings indicating locations and extent of WRB / AB system, including details of typical conditions, special joint conditions, intersections with other building envelope systems and materials; counter flashings and details showing bridging of envelope at substrate changes, details of sealing penetrations, and detailed flashing around windows and doors.
D. Sample warranty: Submit a sample warranty identifying the terms and conditions of the warranty as herein specified.

1.05 WARRANTY
A. Provide manufacturer’s standard warranty against in-place exposure damage (delamination, deterioration) for 12 (twelve) months of exposure to normal weather conditions beginning with the date of installation of the product.
B. Provide manufacturer's standard warranty for sheathing to be free of manufacturing defects that make it unsuitable for its intended use. Warranty period shall be Ten (10) years from the date of purchase of the product.
C. Provide manufacturer’s standard warranty for use as a drainage plane when the cladding systems are properly designed and installed, with a warranty period of 10 years from the date of installation.
purchase of the product or, when used as a substrate in architecturally specified drainage EIFS, 12 years from the date of purchase of the product.

D. Material Warranty: Provide material manufacturer’s standard product warranty, for a minimum three (3) years from date of Substantial Completion. SPEC NOTE: VERIFY WARRANTY LENGTH WITH MANUFACTURERS SPECIFIED

1.06 QUALITY ASSURANCE- MOCK UP
A. Install WRB / AB sheathing with sealed joints and penetrations in mock-up

1.07 DELIVERY, STORAGE, AND HANDLING
A. Store WRB / AB coated fiberglass mat gypsum sheathing under cover and keep dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack sheathing flat and supported on risers on a flat platform to prevent sagging.
B. Protect fluid applied material, primers and accessory materials from damage, weather, excessive temperatures and construction traffic.
C. Store fluid applied material and primers at temperatures of 40 degrees F or above.
D. Apply fluid applied material to clean surfaces free of contaminants. Chemical residues, surface coatings or films may adversely affect adhesion. Pressure-treated wood and other contaminated surfaces should be cleaned with a solvent wipe before application.

1.08 FIELD CONDITIONS
A. Application standards where applicable are in accordance with Gypsum Association Publication GA-253 for gypsum sheathing and ASTM C1280.
B. Do not install sheathing that is moisture damaged. Indications that panels are moisture damaged include, but not limited to, discoloration, sagging, or irregular shape.
C. Allow installed sheathing to be dry to the touch before sealing joints, penetrations, rough openings, and material transitions.
D. Do not attempt to seal joints, corners, penetrations, rough openings, and material transitions when installed sheathing surface is frozen or has frost on the surface.
E. Do not apply sealing materials to sheathing when air or surface temperature is below 25F for fluid applied materials.
F. Sequencing. Do not install air barrier material before the roof assembly has been sufficiently installed to prevent a buildup of water in the interior of the building.
G. Compatibility. Do not allow air barrier materials to come in contact with chemically incompatible materials.
H. Ultra-violet exposure. Do not expose air barrier materials to sunlight longer than as recommended by the material manufacturer.

PART 2 PRODUCTS
2.01 WEATHER BARRIER ASSEMBLIES
A. Basis of Design: DensElement Barrier System as manufactured by Georgia-Pacific Gypsum LLC.
   2. Fluid-applied flashing materials: Fluid-applied flashing as approved by Georgia-Pacific Gypsum LLC.
   3. Primers, backer rods and accessory materials: As approved by Georgia-Pacific Gypsum LLC.
B. System Description: Weather-Resistant Barrier and Air Barrier assembly installed at exterior stud walls under exterior cladding, consisting of the following components as herein specified:
   2. Fluid-applied flashing to seal sheathing joints, inside and outside corners, penetrations, rough openings, and material transitions.

2.02 WEATHER-RESISTANT BARRIER (WRB) AND AIR BARRIER (AB) GYPSUM SHEATHING

A. Description: Coated fiberglass mat gypsum sheathing with integral weather-resistant barrier (WRB) and air barrier (AB) complying with applicable requirements of ICC-ES AC212, ASTM E2178, ASTM E2357.

B. Vapor Permeability: When tested as system in accordance with ASTM E96 (water method) the WRB and AB system has a minimum vapor permeance of 20 perms with sealed joints and fasteners.

C. The WRB and Air Barrier Gypsum Sheathing has a moisture absorption rate < 6%

D. Air Barrier performance requirements:
   1. Air permeance of sheathing: Sheathing with an air permeability not greater than 0.001 cfm/ft² (0.02L/s/m²) when tested in accordance with ASTM E2178.
   2. Air permeance of assembly: Assembly of sheathing and sealing components with an average air leakage not greater than 0.04 cfm/ft² (0.2L/s/m²) when tested in accordance with ASTM E2357.

2.03 FLUID-APPLIED FLASHING AND ACCESSORY MATERIALS FOR JOINTS, INSIDE AND OUTSIDE CORNERS, FASTENERS, ROUGH OPENINGS, AND MATERIAL TRANSITIONS

A. Substrate requirements:
   1. Sheathing panels should be trimmed to obtain neat fitting joints.
   2. Gaps that are more than 1/4" and less than 1" shall be filled with a backer rod to support the fluid applied flashing at the transition joint.
   3. For gaps larger than 1" use transition membrane flashing as approved by Georgia-Pacific Gypsum LLC.

B. Fluid applied flashing for panel joints, inside and outside corners, and penetrations
   1. Description: STP-based fluid applied flashing.
   2. Properties:
      b. Adhesion to fiberglass mat faced sheathing: No delamination from face of sheathing.
      d. Air permeance: meets 0.004 cubic feet per minute per square foot (0.02L/s/sq m), maximum, when tested in accordance with ASTM E2178.
      e. Water vapor permeance: >10 perms (287 ng/(Pa·s·sq m)), minimum, when tested in accordance with ASTM E96/E96M.
      f. Ultraviolet and weathering resistance: Approved for 12 months weather exposure.
      g. Comply with applicable requirements of AAMA 714
   3. Primer: Provide primer in accordance with air barrier manufacturer’s written instructions for exposed gypsum core edges.

C. Fluid applied flashing for sealing fasteners:
   1. Description: STP-based fluid applied flashing.
   2. Properties:
      b. Adhesion to fiberglass mat faced sheathing: No delamination from face of sheathing.
      d. Air permeance: meets 0.004 cubic feet per minute per square foot (0.02 L/s/sq m), maximum, when tested in accordance with ASTM E2178.
      e. Water vapor permeance: >10 perms (287 ng/(Pa·s·sq m)), minimum, when tested in accordance with ASTM E96/E96M.
      f. Ultraviolet and weathering resistance: Approved for 12 months weather exposure.
      g. Comply with applicable requirements of AAMA 714.

D. Fluid applied flashing for sealing rough openings
   1. Fluid applied flashing: STP-based fluid applied flashing.
2. Primer: Liquid primer in accordance with air barrier manufacturer’s written instructions for exposed gypsum core edges. Apply primer to raw gypsum board edges by brushing on a thin, uniform coat.

3. Properties:
   b. Flashing adhesion to fiberglass mat faced sheathing: No delamination from face of sheathing.
   d. Flashing air permeance: meets 0.004 cubic feet per minute per square foot (0.02 L/s/sq m), maximum, when tested in accordance with ASTM E2178.
   e. Flashing water vapor permeance: >10 perms (287 ng/(Pa s sq m)), minimum, when tested in accordance with ASTM E96/E96M.
   f. Ultraviolet and weathering resistance: Approved for 12 months weather exposure.
   g. Flashing comply with applicable requirements of AAMA 714.

E. Material transitions using fluid applied flashing:
   1. Refer to substrate requirements for treatment of gaps as specified herein. Gaps that are more than 1/4” and less than 1” shall be filled with a backer rod to support the fluid applied flashing at the transition joint. For gaps larger than 1” use transition membrane flashing as approved by Georgia-Pacific Gypsum LLC
   2. Fluid applied flashing for material transitions:
   3. Properties:
      b. Adhesion to fiberglass mat faced sheathing: No delamination from face of sheathing.
      c. Applied wet film thickness: 16 mils
      d. Air permeance: 0.004 cubic feet per minute per square foot (0.02L/s/sq m), maximum, when tested in accordance with ASTM E2178
      e. Water vapor permeance: >10 perms (287 ng/(Pa s sq m)), minimum, when tested in accordance with ASTM E96/E96M
      f. Ultraviolet and weathering resistance: Approved for 12 months weather exposure
      g. Comply with applicable requirements of AAMA 714

PART 3 EXECUTION

3.01 PREPARATION
   A. Remove projections, protruding fasteners, loose or damaged sheathing material at edges of panel that might interfere with proper installation to seal joints, corners, fasteners, penetrations, openings, or material transitions.
   B. Wipe down the sheathing surface to receive sealing materials with a clean cloth.
   C. Ensure field conditions are met as outlined in Part 1 – General Requirements.

3.02 INSTALLATION OF WEATHER-RESISTANT BARRIER (WRB) AND AIR BARRIER (AB) SHEATHING
   A. WRB / AB Coated fiberglass mat sheathing:
      1. Install and fasten DensElement Sheathing according to manufacturer’s detailed installation instructions
      2. Fastener and penetration treatment: Treat all sheathing fasteners with specified fluid applied flashing used for sealing joints.

3.03 FLUID APPLIED FLASHING FOR SEALING SHEATHING JOINTS, INSIDE AND OUTSIDE CORNERS, FASTENERS, ROUGH OPENINGS, AND MATERIAL TRANSITIONS
   A. Sealing DensElement Sheathing Joints using specified Fluid Applied Flashing
      1. Apply fluid applied flashing over the joint in a zigzag or ribbon pattern. Cover a minimum of 1” on both sides of the joint.
      2. With a straight edge tool, spread evenly over the sheathing joint.
      3. Apply at a rate to achieve a minimum wet mil thickness of 16 mils over the entire joint area.
B. Sealing DensElement Sheathing Vertical Corners using specified Fluid Applied Flashing
   1. Apply fluid applied flashing over the inside and/or outside corner in a zigzag or ribbon pattern. Cover a minimum of 2" on both sides of the corner.
   2. With a straight edge tool, spread evenly over the sheathing corner.
   3. Apply at a rate to achieve a minimum wet mil thickness of 16 mils over the corner area.

C. Sealing DensElement Sheathing Fasteners using specified Fluid Applied Flashing: Apply the fluid applied flashing material to fasteners and wipe down with a straight edge tool; provide a minimum 16 mil thick coating over the fastener.

D. Sealing DensElement Sheathing Rough Openings using specified Fluid Applied Flashing
   1. Apply a bead of fluid applied flashing into the entire width of the inside corners of the opening dispensed from a tube type container.
   2. Apply fluid applied flashing onto:
      a. Sills of openings
      b. Jambs of openings
      c. Headers of openings
   3. Apply fluid applied flashing over the entire width of the opening sill, jamb, and header on exterior set windows and doors. Apply fluid applied flashing over the entire width of the opening sill, jamb, and header on interior set windows and doors. Apply in a zigzag or ribbon pattern.
   4. Apply fluid applied flashing over the sheathing adjacent to the opening sill, jamb, and header in a zigzag or ribbon pattern. Cover a minimum of 2" of the sheathing surface adjacent to the opening.
   5. With a straight edge tool, spread fluid applied flashing over entire width of the sill, jamb, header, and sheathing surface adjacent to the opening.
   6. Apply at a rate to achieve a minimum wet mil thickness of 16 mils over the opening area.

E. Sealing DensElement sheathing material transitions using specified Fluid Applied Flashing
   1. Sheathing joint and transition gaps to receive fluid-applied flashing shall be less than 1/4" (6.4 mm).
   2. For gaps larger than 1/4" use shall be sealed with fluid-applied flashing as approved by Georgia-Pacific Gypsum, LLC
   3. Gaps that are more than 1/4" and less than 1" shall be filled with a backer rod to support the fluid applied flashing at the transition joint.
   4. If necessary, prime the adjacent material with primer per the material manufacturer’s recommendations.
   5. Apply fluid applied flashing over the sheathing and adjacent material in a zigzag or ribbon pattern. Ensure the flashing is a minimum of 2" on each substrate material surface.
   6. With a straight edge tool, spread fluid applied flashing over material transition joint.
   7. Apply at a rate to achieve a minimum wet mil thickness of 16 mils.

3.04 SEALING EXTERIOR WALL PENETRATIONS
A. Exterior wall penetration shall be sealed to prevent air and water infiltration. Penetrations may be sealed with fluid applied flashing.

B. For round or square pipe/duct penetrations use specified fluid applied flashing, refer to DensElement Barrier System Technical Guide for instructions for proper sealing.

3.05 FIELD QUALITY CONTROL
A. Do not cover installed WRB / AB assembly until required inspections have been completed and installation has been accepted.

B. Where applicable, allow for owner’s inspection and air barrier testing and reporting.

3.06 PROTECTION
A. Protect WRB / AB assembly from damage during installation and during the construction period.

END OF SECTION
SECTION 07 5300
ELASTOMERIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Elastomeric roofing membrane application.
B. Insulation, flat and tapered.
C. Crickets.
D. Vapor retarder.
E. Flashings.
F. Roofing stack boots and roofing expansion joints.

1.02 RELATED REQUIREMENTS
A. Section 06 1000 - Rough Carpentry: Wood nailers and curbs.
B. Section 07 6200 - Sheet Metal Flashing and Trim: Counterflashings, reglets.
C. Section 07 7200 - Roof Accessories: Roof-mounted units; prefabricated curbs.
D. Section 22 1006 - Plumbing Piping Specialties: Roof drains.

1.03 REFERENCE STANDARDS

1.04 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers; review preparation and installation procedures and coordination and scheduling necessary for related work.

1.05 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, and fasteners.
C. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE
A. Applicator Qualifications: Company specializing in performing the work of this section with minimum 5 years experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
B. Store products in weather protected environment, clear of ground and moisture.
C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
D. Protect foam insulation from direct exposure to sunlight.

1.08 FIELD CONDITIONS
A. Do not apply roofing membrane during unsuitable weather.
B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above 100 degrees F.
C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.09 WARRANTY
A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a three year period after Date of Substantial Completion. Warranty shall be executed on the unedited form included in the Project Manual.
C. Provide 20 year "no dollar limit" manufacturer's material and labor warranty to cover failure to prevent penetration of water.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. EPDM Membrane Materials:
   4. Substitutions: See Section 01 6000 - Product Requirements.
B. Insulation:
   1. Provide products from the same manufacturer as the PDM membrane or a manufacturer approved by the membrane manufacturer as part of the manufacturer's warranted system.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROOFING - UNBALLASTED APPLICATIONS
A. Elastomeric Membrane Roofing: One ply membrane, fully adhered, over insulation.
B. Acceptable Insulation Types - Tapered Application:
   1. Tapered polyisocyanurate board.

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS
A. Membrane: Ethylene-propylene-diene-terpolymer (EPDM); externally reinforced with fabric; complying with minimum properties of ASTM D4637/D4637M.
   1. Thickness: 0.060 inch (60 mil).
   2. Sheet Width: 76 inch, minimum; factory-fabricate into largest sheets possible.
   4. Tensile Strength: 1450 psi, measured in accordance with ASTM D412.
   5. Ultimate Elongation: 450 percent, measured in accordance with ASTM D412.
   6. Tear Strength: 200 lbf/inch, measured in accordance with ASTM D624.
   7. Water Absorption: +1.51 percent increase in weight, maximum, measured in accordance with ASTM D570, 24 hour immersion.
B. Seaming Materials: As recommended by membrane manufacturer.
C. Vapor Retarder: Non-bituminous, foil and fibrous mesh laminate; compatible with roofing and insulation materials. Provide over concrete decks only.

D. Flexible Flashing Material: Same material as membrane; conforming to the following:
1. Thickness: 60 mil.
2. Tensile Strength: 1,200 psi.
3. Elasticity: 50 percent with full recovery without set.

2.04 INSULATION

A. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C1289, Type II, Class 2, polymer bonded glass fiber mat both faces and with the following characteristics:
1. Compressive Strength: 16 psi
2. Tapered Board: Slope - 1/4 inch per foot minimum, minimum thickness 3 inch; fabricate of fewest layers possible.
4. Manufacturers:
   c. Versico, a division of Carlisle Construction Materials Inc; SecurShield Insulation: www.versico.com/#sle.
   d. Firestone Building ProductsISO 95+ GL.
5. Substitutions: See Section 01 6000 - Product Requirements.

B. Crickets: Polyisocyanurate board insulation, 1/2 inch slope as required to provide positive drainage throughout.

2.05 ACCESSORIES

A. Prefabricated Roofing Expansion Joint Flashing: Sheet butyl over closed-cell foam backing seamed to galvanized steel flanges.

B. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.

C. Pourable Sealer: As recommended by roofing material manufacturers to maintain specified warranty.

D. Pre-Cut Tapered Insulation:
1. Manufacturers:
   b. Substitutions: See Section 01 6000 - Product Requirements.

E. Sheathing Joint Tape: Paper type, ____ inch wide, self adhering.

F. Insulation Fasteners: Where fasteners are not exposed to view. Appropriate for purpose intended and approved by roofing manufacturer.
1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.

G. Membrane Adhesive: As recommended by membrane manufacturer.

H. Insulation Adhesive: Where underside of deck is exposed and other areas at Contractor's option. As recommended by insulation manufacturer.

I. Sealants: As recommended by membrane manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.
C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
D. Verify deck surfaces are dry and free of snow or ice.
E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and accessories are in place.

3.02 CONCRETE DECK PREPARATION
A. Fill surface honeycomb and variations with latex filler.
B. Confirm dry deck by moisture meter with 12 percent moisture maximum.

3.03 METAL DECK PREPARATION
A. Install deck sheathing on metal deck:
   1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
   2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
   3. Tape joints.
B. Mechanically fasten sheathing to roof deck, in accordance with Factory Mutual recommendations and roofing manufacturer's instructions.
   1. Over entire roof area, fasten sheathing using 6 fasteners with washers per sheathing board.

3.04 INSULATION - UNDER MEMBRANE
A. Apply vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
   1. Extend vapor retarder under cant strips and blocking to deck edge.
   2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.
C. Attachment of Insulation:
   1. Insulation shall be mechanically secured to the metal roof deck in accordance with Factory Mutual Approval Guide, and Loss Prevention Data Sheet DS 1-29, to provide a wind uplift rating of Class 1-90, in conformance with Factory Mutual (FM)Loss Prevention Data Sheet DS 1-28. Provide additional insulation fasteners at the roof perimeter and corners. Follow the Factory Mutual Loss Prevention Data Sheets DS 1-28 and DS 1-29 for specific requirements. Insulation may be adhered with an approved adhesive providing it meets the uplift requirements specified above.
   2. Insulation on concrete deck shall be adhered with an approved adhesive that meets the uplift requirements of Factory Mutual Approval Guide, and Loss Prevention Data Sheet DS 1-29, to provide a wind uplift rating of Class 1-90, in conformance with Factory Mutual (FM) Loss Prevention Data Sheet DS 1-28.
D. Do not install more insulation than can be covered by membrane in the same day.
E. Install a minimum of two layers with joints staggered and not aligned with insulation below.
F. Butt insulation boards together with no gaps greater than 1/4 inch and elevation differentiation of no greater than 1/4 inch.
G. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
H. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
I. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
J. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches.
3.05 MEMBRANE APPLICATION
A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
B. Shingle joints on sloped substrate in direction of drainage.
C. Fully Adhered Application: Apply adhesive to substrate at rate of gal/square as recommended in manufacturer's printed instructions. 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 roll.
D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
E. At intersections with vertical surfaces:
   1. Extend membrane over up a minimum of 6 inches onto vertical surfaces or as required by EIFS manufacturer.
   2. Fully adhere flexible flashing over membrane and up to nailing strips where applicable.
F. Around roof penetrations, seal flanges and flashings with flexible flashing.
G. Install roofing expansion joints where indicated. Make joints watertight.
   1. Install prefabricated joint components in accordance with manufacturer's instructions.
H. Coordinate installation of roof drains and related flashings.
I. Coordinate installation of associated counterflashings installed under other sections.

3.06 FINISHING UNBALLASTED SURFACES

3.07 PONDING
A. Upon completion of the Work or sections of work, and after a rain event, the roof will be inspected for ponding. Ponding is defined by the NRCA as standing water that exists beyond 48 hours from a rain event. If such ponding exists, Contractor shall re-install tapered insulation to remove such ponding.

3.08 CLEANING
A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.
B. Remove bituminous markings from finished surfaces.
C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
D. Repair or replace defaced or damaged finishes caused by work of this section.

3.09 PROTECTION
A. Protect installed roofing and flashings from construction operations.
B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION
SECTION 07 6200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fabricated sheet metal items, including flashings and counterflashings.
B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS
A. Section 06 1000 - Rough Carpentry: Wood nailers for sheet metal work.
B. Section 07 5300 - Elastomeric Membrane Roofing: Roofing system.
C. Section - Roof Specialties: Preformed flashings.
D. Section 07 7200 - Roof Accessories: Manufactured metal roof curbs.
E. Section - Joint Sealers.

1.03 REFERENCE STANDARDS
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

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

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

PART 2 PRODUCTS

2.01 SHEET MATERIALS
A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239 inch) thick base metal.
B. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239) inch thick base metal, shop pre-coated with PVDF coating.
   1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: As selected by Architect from manufacturer's standard colors.
C. Pre-Finished Aluminum: ASTM B209 (ASTM B209M); 20 gage, (0.032 inch) thick; plain finish shop pre-coated with modified silicone coating.
   1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: As selected by Architect from manufacturer's standard colors.

2.02 ACCESSORIES
   A. Sealant: As specified in Section 07 9005.

2.03 FABRICATION
   A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
   B. Fabricate cleats of 24 gage minimum galvanized sheet metal, continuous.
   C. Form pieces in longest possible lengths.
   D. Hem exposed edges on underside 1/2 inch; miter and seam corners.
   E. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
   F. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
   G. Fabricate flashings to allow toe to extend 2 inches over roofing surface. Return and brake edges.

2.04 OVERFLOW SCUPPERS
   A. Scuppers: As detailed on drawings.

PART 3 EXECUTION

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

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

3.03 INSTALLATION
   A. Install sheet metal to comply with the Architectural Sheet Metal Manual, Sheet Metal and Air Conditioning Contractor's National Association, Inc.
   B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.
   C. Apply plastic cement compound between metal flashings and felt flashings.
   D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
   E. Seal metal joints watertight.

END OF SECTION
SECTION 07 7100
ROOF SPECIALTIES

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Manufactured roof specialties, including copings, fascias, and gravel stops.

1.02 RELATED REQUIREMENTS
A. Section 07 7200 - Roof Accessories: Manufactured curbs, roof hatches.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
D. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Roof Edge Flashings and Copings:
   1. Firestone Products: Una-Edge CO Metal System: www.firestonebp.com
B. Pipe and Penetration Flashings:
C. Counter Flashings:
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COMPONENTS
A. Roof Edge Flashings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
3. Material: Formed aluminum sheet, 0.050 inch thick, minimum.
4. Finish: 70 percent polyvinylidene fluoride.
5. Color: To be selected by Architect from manufacturer's standard range.

B. Copings: Factory 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 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
   3. Material: Formed aluminum sheet, 0.050 inch thick, minimum.
   4. Finish: 70 percent polyvinylidene fluoride.
   5. Color: To be selected by Architect from manufacturer's standard range.

2.03 ACCESSORIES
A. Sealant for Joints in Linear Components: As recommended by component manufacturer.
B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.
C. Roof Cement: ASTM D4586/D4586M, Type I.

2.04 FINISHES
A. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as indicated.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION
A. Install components in accordance with manufacturer's instructions.
B. Seal joints within components when required by component manufacturer.
C. Anchor components securely.
D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
E. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

END OF SECTION
SECTION 07 7200
ROOF ACCESSORIES

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Manufactured curbs.
B. Roof hatch.

1.02 RELATED REQUIREMENTS
A. Section 05 3100 - Steel Decking.
B. Section 07 7100 - Roof Specialties: Other manufactured roof items.

1.03 REFERENCE STANDARDS
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS
2.01 MANUFACTURED CURBS
A. Manufactured Curbs, Equipment Rails, and Other Roof Mounting Assemblies:
B. Manufactured Curbs, Equipment Rails, and Other Roof Mounting Assemblies:
   Factory-assembled hollow sheet metal construction with fully mitered and welded corners, integral counterflashing, internal reinforcing, and top side and edges formed to shed water.
   1. Sheet Metal: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33; G60 coating designation; 18 gage, 0.048 inch thick.
   2. Roofing Cants: Provide integral sheet metal roofing cants dimensioned to begin slope at top of roofing insulation; 1:1 slope; minimum cant height 4 inches.
   3. Manufacture curb bottom and mounting flanges for installation directly on roof deck, not on insulation; match slope and configuration of roof deck.
   4. Provide the layouts and configurations indicated on the drawings.
C. Curbs Adjacent to Roof Openings: Provide curb on all sides of opening, with top of curb horizontal for equipment mounting.
   1. Provide preservative treated wood nailers along top of curb.
   2. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.
   3. Height Above Finished Roof Surface: 6 inches, minimum.
   4. Height Above Roof Deck: 14 inches, minimum.
D. Pipe, Duct, and Conduit Mounting Pedestals: Vertical posts, minimum 8 inches square unless otherwise indicated.
   1. Provide sliding channel welded along top edge with adjustable height steel bracket, manufactured to fit item supported.
   2. Height Above Finished Roof Surface: 6 inches, minimum.
   3. Height Above Roof Deck: 14 inches, minimum.

2.02 ROOF HATCHES
A. Manufacturers - Roof Hatches:
1. Acudor Products Inc; Galvanized Steel Roof Hatch: www.acudor.com/#sle.
2. Bilco Company; Type TB (all types & special size): www.bilco.com/#sle.
3. Substitutions: See Section 01 6000 - Product Requirements.

B. Roof Hatches and Smoke Vents, General: Factory-assembled steel frame and cover, complete with operating and release hardware.

C. Frames/Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
   1. Material: Galvanized steel, 14 gage, 0.0747 inch thick.
   3. Insulation: Manufacturer’s standard; 1 inch rigid glass fiber, located on outside face of curb.

D. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
   1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
   2. Hinges: Heavy duty pintle type.
   3. Hold open arm with vinyl-coated handle for manual release.

2.03 NON-PENETRATING ROOFTOP ASSEMBLIES

A. Non-Penetrating Rooftop Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly.
   1. Design Loadings and Configurations: As required by applicable codes.
   2. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
   4. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

B. Pipe Supports: Provide attachment fixtures complying with MSS SP-58 and as indicated.
   1. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
   2. See relevant piping system specification section for additional requirements.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing weather integrity.

3.03 CLEANING

A. Clean installed work to like-new condition.

3.04 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION
SECTION 07 8400
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Firestopping systems.
   B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on product characteristics, performance ratings, and limitations.
   C. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

1.03 QUALITY ASSURANCE
   A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
      1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
      2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.

1.04 FIELD CONDITIONS
   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 MANUFACTURERS
   A. Firestopping Manufacturers:
      1. 3M Fire Protection Products: www.3m.com/firestop.
      5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS
   A. Basis of Design: Hilti, Inc. www.us.hilti.com
   B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.03 FIRESTOPPING FOR FLOOR-TO-FLOOR, WALL-TO-FLOOR, AND WALL-TO-WALL JOINTS
   A. Gypsum Board Walls:
      1. Wall to Wall Joints That Have Not Been Tested For Movement Capabilities (Static):
         a. 2 Hour Construction: UL System WW-S-0063; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.
      2. Wall to Wall Joints That Have Movement Capabilities (Dynamic):
         a. 2 Hour Construction: UL System WW-D-0180; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.
         b. 2 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
      3. Top of Wall Joints at Underside of Flat Concrete:
         a. 2 Hour Construction: UL System HW-D-0079; Specified Technologies Inc. ES Elastomeric Firestop Sealant.
      4. Top of Wall Joints at Concrete Over Metal Deck:
a. 2 Hour Construction: UL System HW-D-0034; Specified Technologies Inc. ES Elastomeric Firestop Sealant.

5. Top of Wall Joints at Concrete Over Metal Deck, Wall Parallel to Ribs:
   a. 2 Hour Construction: UL System HW-D-0049; Hilti CFS-SP WB Firestop Joint Spray and CP 672.

6. Top of Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Cut to Fit Ribs:
   a. 2 Hour Construction: UL System HW-D-0103; Specified Technologies Inc. ES Elastomeric Firestop Sealant.

7. Top of Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Not Cut to Fit:
   a. 2 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.

2.04 FIRESTOPPING PENETRATIONS THROUGH CONCRETE AND CONCRETE MASONRY CONSTRUCTION

A. Blank Openings:
   1. In Floors or Walls:
      a. 2 Hour Construction: UL System C-AJ-0090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
      b. 2 Hour Construction: UL System C-AJ-0015; Specified Technologies Inc. SSM mortar.

B. Penetrations Through Floors or Walls By:
   1. Multiple Penetrations in Large Openings:
      a. 2 Hour Construction: UL System C-AJ-8143; Hilti FS-ONE MAX Intumescent Firestop Sealant.
      b. 2 Hour Construction: UL System C-AJ-8114; Specified Technologies Inc. SSM mortar.
   2. Uninsulated Metallic Pipe, Conduit, and Tubing:
      a. 2 Hour Construction: UL System C-AJ-1198; Specified Technologies Inc. SIL silicone sealant.
      b. 2 Hour Construction: UL System C-AJ-1226; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
      a. 2 Hour Construction: UL System C-AJ-2167; Hilti FS-ONE MAX Intumescent Firestop Sealant.
      b. 2 Hour Construction: UL System C-AJ-2297; Specified Technologies Inc. SSC collars.
   4. Electrical Cables Not In Conduit:
      a. 2 Hour Construction: UL System C-AJ-3213; Specified Technologies Inc. SSC collars.
      b. 2 Hour Construction: UL System C-AJ-3283; Hilti CP653 Speed Sleeve.
   5. Insulated Pipes:
      a. 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE IMAX intumescent Firestop Sealant.
      b. 2 Hour Construction: UL System C-AJ-5138; Specified Technologies Inc. LCI Intumescent Firestop Sealant.

C. Penetrations Through Walls By:
   1. Uninsulated Metallic Pipe, Conduit, and Tubing:
      a. 2 Hour Construction: UL System W-J-1067; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   2. Electrical Cables Not In Conduit:
      a. 2 Hour Construction: UL System C-AJ-3095; Hilti FS-ONE MAX Intumescent Firestop Sealant.
      b. 2 Hour Construction: UL System W-J-3141; Specified Technologies Inc. Ready-Sleeve.
3. Insulated Pipes:
   a. 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE MAX Intumescent Firestop Sealant.

4. HVAC Ducts, Uninsulated:
   a. 2 Hour Construction: UL System W-J-7109; Hilti FS-ONE MAX Intumescent Firestop Sealant or CP 606 Flexible Firestop Sealant.

5. HVAC Ducts, Insulated:
   a. 2 Hour Construction: UL System W-J-7112; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.05 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

A. Blank Openings:
   1. 2 Hour Construction: UL System W-L-0038; Specified Technologies Inc. FP Intumescent Firestop Plug.
   2. 2 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.

B. Penetrations By:
   1. Multiple Penetrations in Large Openings:
      a. 2 Hour Construction: UL System W-L-8025; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
      b. 2 Hour Construction: UL System W-L-8079; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2. Uninsulated Metallic Pipe, Conduit, and Tubing:
   a. 2 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   b. 2 Hour Construction: UL System W-L-1222; Specified Technologies Inc. LCI Intumescent Firestop Sealant.

3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
   a. 2 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
   b. 2 Hour Construction: UL System W-L-2237; Specified Technologies Inc. LCC Intumescent Firestop Collars.

4. Cable Trays with Electrical Cables:
   a. 2 Hour Construction: UL System W-L-4008; Specified Technologies Inc. SSB Intumescent Firestop pillows.
   b. 2 Hour Construction: UL System W-L-4060; Hilti FS-ONE MAX Intumescent Firestop Sealant.

5. Insulated Pipes:
   a. 2 Hour Construction: UL System W-L-5121; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
   b. 1 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.

6. HVAC Ducts, Insulated:
   a. 1 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.06 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: Use any system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and T Rating Equal to F Rating and in compliance with other specified requirements.

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 that could adversely affect bond of firestopping material.
   B. Remove incompatible materials that could adversely affect bond.
   C. Install backing materials to arrest liquid material leakage.

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 authorities having jurisdiction.
   C. Install labeling required by code.

3.04 CLEANING
   A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION
   A. Protect adjacent surfaces from damage by material installation.

END OF SECTION
SECTION 07 9005
JOINT SEALERS

PART 1 GENERAL
1.01 SECTION INCLUDES
   A. Sealants and joint backing.
   B. Precompressed foam sealers.
1.02 RELATED REQUIREMENTS
   A. Section [072500]: Sealants required in conjunction with air barriers and vapor retarders:
   B. Section [078400]: Firestopping sealants.
   C. Section [088000]: Glazing sealants and accessories.
1.03 SUBMITTALS
   A. See Section [013000], for submittal procedures.
   B. Product Data: Provide data indicating sealant performance criteria, substrate preparation, limitations, and color availability.
   C. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, and perimeter conditions requiring special attention.
1.04 FIELD CONDITIONS
   A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

PART 2 PRODUCTS
2.01 SEALANTS
   A. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.
   B. General Purpose Exterior Sealant: Polyurethane; ASTM C920, Grade NS, Class 25 minimum; Uses M, G, and A; single component.
      1. Color: To be selected by Architect from manufacturer's standard range.
      2. Applications: Use for:
         a. Control, expansion, and soft joints in masonry.
         b. Joints between concrete and other materials.
         c. Joints between metal frames and other materials.
         d. Other exterior joints for which no other sealant is indicated.
      3. Polyurethane Products:
         e. Substitutions: See Section 01 6000 - Product Requirements.
   C. 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.
   D. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
      1. Color: To be selected by Architect from manufacturer's standard range.
      2. Applications: Use for:
         a. Interior wall and ceiling control joints.
         b. Joints between door and window frames and wall surfaces.
c. Other interior joints for which no other type of sealant is indicated.

3. Products:
   e. Substitutions: See Section 01 6000 - Product Requirements.

E. 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 countertops and wall surfaces.
   2. Products:
      e. Substitutions: See Section 01 6000 - Product Requirements.

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: To be selected by Architect from manufacturer's standard colors.
   5. 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.
   6. Products:
      c. Substitutions: See Section 01 6000 - Product Requirements.

   2. Applications: Use for:
      a. Joints in sidewalks and vehicular paving.
   3. Products:

2.02 ACCESSORIES
A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
PART 3  EXECUTION

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

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

3.03  INSTALLATION
   A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
   B. Perform installation in accordance with ASTM C1193.
   C. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
      2. Neck dimension no greater than 1/3 of the joint width.
      3. Surface bond area on each side not less than 75 percent of joint width.
   D. Install bond breaker where joint backing is not used.
   E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
   F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
   G. Tool joints concave.
   H. Concrete Floor Joint Filler: Install concrete floor joint filler per manufacturer's written instructions. After floor joint filler is fully cured, shave joint filler flush with top of concrete slab.

3.04  CLEANING
   A. Clean adjacent soiled surfaces.

3.05  PROTECTION
   A. Protect sealants until cured.

END OF SECTION
SECTION 07 9200
JOINT SEALANTS

PART 2 PRODUCTS

1.01 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
      a. Wall expansion and control joints.
      b. Joints between door, window, and other frames and adjacent construction.
      c. Joints between different exposed materials.
      d. Openings below ledge angles in masonry.
      e. Other joints indicated below.
   2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
      a. Joints between door, window, and other frames and adjacent construction.
      b. Other joints indicated below.
   3. Do not seal the following types of joints.
      a. Intentional weepholes in masonry.
      b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
      c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
      d. Joints where installation of sealant is specified in another section.
      e. Joints between suspended panel ceilings/grid and walls.

B. Type ___ - Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.

C. Type ___ - Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
   1. Type ___ - Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.

1.03 NONSAG JOINT SEALANTS

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: ________, minimum.
   2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
   3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.

B. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.

C. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.

END OF SECTION
SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Non-fire-rated hollow metal doors and frames.
B. Hollow metal frames for wood doors.
C. Fire-rated hollow metal doors and frames.
D. Thermally insulated hollow metal doors with frames.
E. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS
A. Section 08 7100 - Door Hardware.
B. Section 08 8000 - Glazing:  Glass for doors and borrowed lites.
C. Section 09 9113 - Exterior Painting:  Field painting.
D. Section 09 9123 - Interior Painting:  Field painting.

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data:  Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
C. Shop Drawings:  Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

PART 2 PRODUCTS
2.01 DESIGN CRITERIA
A. Requirements for Hollow Metal Doors and Frames:
   1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Exterior Door Top Closures:  Flush end closure channel, with top and door faces aligned.
   4. Door Edge Profile:  Manufacturers standard for application indicated.
   5. Typical Door Face Sheets:  Smooth faces Refer to Door Schedule for additional information.
   7. Hardware Preparations, Selections and Locations:  Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
   8. Zinc Coating for Typical Interior and/or Exterior Locations:  Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
      a. Based on NAAMM HMMA Custom Guidelines:  Provide at least A25/ZF75 (galvannealed) for interior applications, and at least A60/ZF180 (galvannealed) or G60/Z180 (galvanized) for corrosive locations.
   B. Combined Requirements:  If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the
requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent, and notify the architect.

2.02 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated.
   1. Based on NAAMM HMMA Custom Guidelines:
      a. Comply with guidelines of NAAMM HMMA 860 for Hollow Metal Doors and Frames.
      b. Performance Level 3 - Heavy Duty, in accordance with NAAMM HMMA 805.
      c. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
      d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
      e. Zinc Coating: G90/Z275 galvanized coating; ASTM A653/A653M.
   2. Core Material: Polystyrene, 1 lbs/cu ft minimum density.
   3. Door Thermal Resistance: R-Value of 6.0 minimum, for installed thickness of polystyrene.
   5. Weatherstripping: Refer to Section 08 7100.

C. Fire-Rated Doors:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 2 - Heavy-duty.
      b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
   2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
      a. Provide units listed and labeled by UL (DIR) or ITS (DIR).
      b. Attach fire rating label to each fire rated unit.
   3. Core Material: Manufacturers standard core material/construction in compliance with requirements.

2.03 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. Exterior Door Frames: 14 gage, Face welded, seamless with joints filled.
   1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
   2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
   3. Weatherstripping: Separate, see Section 08 7100.

D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.

E. Door Frames, Fire-Rated: Knock-down type.
   1. Fire Rating: Same as door, labeled.

F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

G. Mullions for Pairs of Doors: Removable type, with profile similar to jambs.

H. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

I. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

J. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inch high to fill opening without cutting masonry units.
2.04 FINISHES
   A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
   B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.
      1. Fire-Rated Frames: Comply with fire rating requirements indicated.

2.05 ACCESSORIES
   A. Glazing: As specified in Section 08 8000, factory installed.
   B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
   C. Astragals for Double Doors:
      2. Fire-Rated Doors: Steel, shape as required for fire rating.
   D. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
   E. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.
   F. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
   G. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

   END OF SECTION
SECTION 08 1416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Flush wood doors; flush and flush glazed configuration; fire rated and non-rated.

1.02 RELATED REQUIREMENTS
A. Section 08 1113 - Hollow Metal Doors and Frames.
B. Section 08 7100 - Door Hardware.
C. Section 08 8000 - Glazing.

1.03 REFERENCE STANDARDS
A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
D. Manufacturer's Installation Instructions: Indicate special installation instructions.
E. Warranty, executed in Owner's name.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Package, deliver and store doors in accordance with specified quality standard.
B. Accept doors on site in manufacturer's packaging. Inspect for damage.
C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.06 WARRANTY
A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Wood Veneer Faced Doors:

2.02 DOORS
A. Doors: Refer to drawings for locations and additional requirements.
1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
   3. Wood veneer facing with factory transparent finish.

2.03 DOOR AND PANEL CORES
   A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
   B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS
   A. Veneer Facing for Transparent Finish: Red oak, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
      1. Vertical Edges: Same species as face veneer.
      2. “Pair Match” each pair of doors; “Set Match” pairs of doors within 10 feet of each other when doors are closed.

2.05 DOOR CONSTRUCTION
   A. Fabricate doors in accordance with door quality standard specified.
   B. Where supplementary protective edge trim is required, install trim after veneer facing has been applied full-width.
   C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
   D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
   E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
   F. Provide edge clearances in accordance with the quality standard specified.

2.06 FACTORY FINISHING - WOOD VENEER DOORS
   A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
      1. Transparent:
         a. System - 5, Varnish, Conversion.
         b. Stain: As selected by Architect.
         c. Sheen: Satin.
   B. Factory finish doors in accordance with approved sample.
   C. Seal door top edge with color sealer to match door facing.

2.07 ACCESSORIES
   A. Hollow Metal Door Frames: As specified in Section 08 1113.
   B. Wood Louvers:
      1. Material and Finish: Match face veneer species.
   C. Glazing: As specified in Section 08 8000.
D. Glazing Stops: Wood, of same species as door facing, mitered corners; prepared for countersink style tamper proof screws.

E. Door Hardware: As specified in Section 08 7100.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

**3.02 INSTALLATION**

A. Install doors in accordance with manufacturer's instructions and specified quality standard.

   1. Install fire-rated doors in accordance with NFPA 80 requirements.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

E. Coordinate installation of glazing.

F. Install door louvers plumb and level.

**3.03 TOLERANCES**

A. Conform to specified quality standard for fit and clearance tolerances.

B. Conform to specified quality standard for telegraphing, warp, and squareness.

**3.04 ADJUSTING**

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure at pull resistance rated per ADA code requirements.

END OF SECTION
SECTION 08 4313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Aluminum-framed storefront, with vision glass.

1.02 RELATED REQUIREMENTS
A. Section 07 2500 - Weather Barriers: Sealing framing to weather barrier installed on adjacent construction.
B. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.
C. Section 08 8000 - Glazing: Glass and glazing accessories.

1.03 ADMINISTRATIVE REQUIREMENTS
A. Coordinate with installation of other components that comprise the exterior enclosure.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details.
C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
D. Samples: Submit one sample of storefront system 6 x 6 inches in size illustrating finished aluminum surface, glass, and glazing materials.
E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE
A. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of experience.

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

1.07 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.

1.08 WARRANTY
A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a three year period after Date of Substantial Completion.
C. Provide ten year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
D. 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 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING
A. Center-Set Style, Thermally-Broken:
2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.

B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:

C. Substitutions: See Section 01 6000 - Product Requirements.
1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.02 STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
1. Unitized, shop assembly.
2. Glazing Rabbet: For 1 inch insulating glazing.
4. Air Infiltration Test Pressure Differential: 1.57 psf.
5. Thermal Transmittance U-Value: 0.31, maximum.
   a. Factory finish all surfaces that will be exposed in completed assemblies.
   b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
   c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
7. Finish Color: As selected by Architect from manufacturer's standard line.
8. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
10. 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.
11. 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.
12. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
13. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
14. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.

B. Performance Requirements:
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Water Penetration Resistance: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
3. Air Leakage: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.
4. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
5. Water Leakage: None, when measured in accordance with ASTM E331 at specified pressure differential.
6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
8. Dual Thermal Barrier: Provide dual continuous thermal barriers by means of poured and debridged pockets consisting of a two-part, chemically curing high density polyurethane which is bonded to the aluminum.

2.03 COMPONENTS
A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
   1. Framing members for interior applications need not be thermally broken.
   2. Glazing Stops: Flush.
B. Glazing: As specified in Section 08 8000.

2.04 MATERIALS
C. Fasteners: Zinc plated steel concealed fasteners; hardened aluminum alloys or AISI 300 series stainless steel exposed fasteners.
D. Glazing: Setting blocks, edge blocks, and spacers in accordance with ASTM C 864, shore durometer hardness as recommended by manufacturer; glazing gaskets in accordance with ASTM C 864.
E. Aluminum Sill Flashing End Dams must have 3 point attachment.
F. Glass: As specified in Section 08 8000.
G. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
H. Glazing Accessories: As specified in Section 08 8000.

2.05 FINISHES
A. Superior Performing Organic Coatings: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride (PVDF) system.
   1. Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, including minimum 70 percent PVDF color topcoat and minimum total dry film thickness of 0.9 mil; color and gloss as selected from manufacturer’s standard line.
B. Touch-Up Materials: As recommended by coating manufacturer for field application.

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 framing members for imposed loads.
G. 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 storefront in accordance with manufacturer's instructions.
B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
C. Provide alignment attachments and shims to permanently fasten system to building structure.
D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
E. Provide thermal isolation where components penetrate or disrupt building insulation.
F. Provide sill flashings at exterior storefront system. Extend extruded flashing continuous with splice joints; set in continuous beads of sealant. Turn up ends and edges; seal to adjacent work to form water tight dam.
G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
J. Install glass in accordance with Section 08 8000, using exterior dry glazing method.
K. Seal metal to metal storefront system joints using sealant recommended by system manufacturer.
L. Verify storefront system allows water entering system to be collected in gutters and wept to exterior. Verify metal joints are sealed in accordance with manufacturers installation instructions.
M. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES
A. Maximum Variation from Plumb: 0.06 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 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. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.
D. Remove excess sealant by method acceptable to sealant manufacturer.
3.05 PROTECTION
   A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION
SECTION 08 7100
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for wood, aluminum, and hollow metal doors.
B. Electrically operated and controlled hardware.
C. Lock cylinders for doors that hardware is specified in other sections.
D. Thresholds.
E. Weatherstripping and gasketing.
F. Gate locks.

1.02 RELATED REQUIREMENTS

A. Section 06 4100 - Architectural Wood Casework: Cabinet hardware.
B. Section 07 9200 - Joint Sealants: Sealants for setting exterior door thresholds.
C. Section 08 1113 - Hollow Metal Doors and Frames.
D. Section 08 1416 - Flush Wood Doors.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by affected installers and the following:
   1. Architect.
   2. Installer's Architectural Hardware Consultant (AHC).
   3. Hardware Installer.
D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
E. Keying Requirements Meeting:
   1. Attendance Required:
      a. Contractor.
      b. Owner.
      c. Architect.
      d. Installer's Architectural Hardware Consultant (AHC).
      e. Owner's Security Consultant.
   2. Agenda:
      a. Establish keying requirements.
      b. Verify locksets and locking hardware are functionally correct for project requirements.
      c. Establish keying submittal schedule and update requirements.
   3. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
      a. Access control requirements.
      b. Flow of traffic and extent of security required.
   4. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.
   5. Deliver established keying requirements to manufacturers.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
   1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
   2. Provide complete description for each door listed.

D. Shop Drawings - Electrified Door Hardware: Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
   1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
   2. Elevations: Submit front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
   3. Diagrams: Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

F. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
   1. Submit manufacturer's parts lists and templates.

G. Keying Schedule:
   1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

H. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

I. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

J. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Lock Cylinders: Ten for each master keyed group.
   3. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.
   1. Closers: Ten years, minimum.
   2. Exit Devices: Five years, minimum.
   3. Locksets and Cylinders: Three years, minimum.
   4. Other Hardware: Two years, minimum.
PART 2 PRODUCTS

2.01 HINGES

A. Manufacturers:
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Hinges: Shall be Five Knuckle Ball bearing hinges, unless noted otherwise.
   1. Bearings are to be fully hardened.
   2. Bearing shell is to be consistent shape with barrel.
   3. Minimum of 2 permanently lubricated non-detachable bearings on standard weight hinge and 4 permanently lubricated bearing on heavy weight hinges.
   4. Equip with easily seated, non-rising pins.
   5. Non Removable Pin screws shall be slotted stainless steel screws.
   6. Hinges shall be full polished, front, back and barrel.
   7. Hinge pin is to be fully plated.
   8. Bearing assembly is to be installed after plating.
   9. Sufficient size to allow 180-degree swing of door.
   10. Furnish five knuckles with flush ball bearings.
   11. Provide hinge type as listed in schedule.
   12. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
   13. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish.
   14. UL10C listed for Fire rated doors.

C. Geared Continuous Hinges:
   1. Tested and approved by BHMA for ANSI A156.26-1996 Grade 1
   2. Anti-spinning through fastener.
   3. UL10C listed for 3 hour Fire rating.
   5. Lifetime warranty.
   6. Provide Fire Pins for 3-hour fire ratings.
   7. Sufficient size to permit door to swing 180 degrees.

D. Hinges: Complying with BHMA A156.1, Grade 1.
   2. Provide hinges on every swinging door.
   3. Provide non-removable pins on exterior outswinging doors.
   4. Provide following quantity of butt hinges for each door:
      a. Doors From 60 inches High up to 90 inches High: Three hinges.
      b. Doors 90 inches High up to 120 inches High: Four hinges.

2.02 FLUSHBOLTS

A. Manufacturers:
   4. ABH.
   5. Burns.
   6. Substitutions: See Section 01 6000 - Product Requirements.

B. Flushbolts: Complying with BHMA A156.16, Grade 1.
   1. Automatic Flushbolts: Automatically latch upon closing of door; automatic retraction of bolts when active leaf is opened; located on inactive leaf of pair of doors.
2. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 25 for hollow metal label doors.
3. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 27 at wood label doors.
5. Provide Dust Proof Strike, Certified ANSI/BHMA 156.16 at doors with flush bolts without thresholds.

2.03 EXIT DEVICES

A. Manufacturers:
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Exit Devices: Complying with BHMA A156.3, Grade 1.
   1. Lever design to match lockset trim.
   2. Provide cylinder with cylinder dogging or locking trim.
   3. Provide exit devices properly sized for door width and height.
   4. Provide strike as recommended by manufacturer for application indicated.
   5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.
   6. For electrical options, provide quick connect plug-in pre-wired connectors.
   7. Exit devices to be tested and certified by UL or by a recognized independent laboratory for mechanical operational testing to 10 million cycles minimum with inspection confirming Grade 1 Loaded Forces have been maintained.
   8. Exit devices chassis to be investment cast steel, zinc dichromate.
   9. Exit devices to have stainless steel deadlocking ¾” through latch bolt.
   10. Exit devices to be equipped with sound dampening on touchbar.
   11. Non-fire rated exit devices to have cylinder dogging.
   12. Non-fire rated exit devices to have ½” minimum turn hex key dogging.
   13. Touchpad to be “T” style constructed of architectural metal with matching metal end caps.
   14. Touchbar assembly on wide style exit devices to have a ¼” clearance to allow for vision frames.
   15. All exposed exit device components to be of architectural metals and “true” architectural finishes.
   16. Provide strikes as required by application.
   17. Fire exit hardware to conform to UL10C and UBC 7-2. UL tested for Accident Hazard.
   18. The strike is to be black powder coated finish.
   19. Exit devices to have field reversible handing.
   20. Provide heavy duty vandal resistant lever trim with heavy duty investment cast stainless steel components and extra strength shock absorbing overload springs. Lever shall not require resetting. Lever design to match locksets and latches.
   22. Vertical Latch Assemblies to have gravity operation, no springs.

C. Exit Devices with Weatherized True Architectural Finish 626W:
   1. Exit devices to meet or exceed BHMA for ANSI 156.3, Grade 1.
   2. Exit devices to be tested and certified by UL or by a recognized independent laboratory to meet or exceed the following:
      a. Mechanical operational testing to 10 million cycles minimum with inspection confirming Grade 1 Loaded Forces have been maintained.
      b. BHMA 156.3 - A156.18 Salt Spray Certified 600 Hours 3 X Standard.
      c. MIL-STD-810G 509.6 Salt Fog Certified.
      d. MIL-STD-810G 510.6 Sand & Dust Certified.
      e. MIL-STD-810G 521.4 Icing/Freezing Rain Certified.
   3. Exit devices chassis to be investment cast steel, zinc dichromate.
4. Exit devices to have stainless steel deadlocking ¾” through latch bolt.
5. Exit devices to be equipped with sound dampening on touchbar.
6. Non-fire rated exit devices to have cylinder dogging.
7. Non-fire rated exit devices to have ¼” minimum turn hex key dogging.
8. All Exterior components of the exit device including the Active case cover, Touch bar, device channel, slide channel fillers, Vertical rods, latch covers and device end cap, shall be constructed of a brass base metal then plated in a double dip two step process of satin nickel and chrome.
9. Exit device shall be available with options of WTS Weatherized touch bar switch and WALW Weatherized Exit alarm (hardwired)
10. Additional non-weatherized electrified options are compatible with the 626W. Non-weatherized options are not recommended for harsh environments.
11. Touchpad to be “T” style constructed.
12. Touchbar assembly on wide style exit devices to have a ¼” clearance to allow for vision frames.
13. All exposed exit device components to be of architectural metals and “true” architectural finishes.
14. Provide strikes as required by application.
15. Fire exit hardware to conform to UL10C and UBC 7-2. UL tested for Accident Hazard.
16. The strike is to be black powder coated finish.
17. Exit devices to have field reversible handing.
18. Provide heavy duty vandal resistant lever trim with heavy duty investment cast stainless steel components and extra strength shock absorbing overload springs. Lever shall not require resetting. Lever design to match locksets and latchesets.
20. Vertical Latch Assemblies to have gravity operation, no springs.

2.04 LOCK CYLINDERS
A. Manufacturers:
   2. Substitutions: See Section 01 6000 - Product Requirements.
B. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
   1. Provide cylinders from same manufacturer as locking device.
   2. Provide cams and/or tailpieces as required for locking devices.

2.05 CYLINDRICAL LOCKS
A. Manufacturers:
   3. Substitutions: See Section 01 6000 - Product Requirements.
B. Cylindrical Locks (Bored): Complying with BHMA A156.2, Grade 1, Series 4000, Extra Heavy Duty and UL10C listed.
   1. Fit modified ANSI A115.2 door preparation.
   2. Locksets and cores to be of the same manufacturer to maintain complete lockset warranty.
   3. Locksets to have anti-rotational studs that are thru-bolted.
   4. Keyed lever shall not have exposed “keeper” hole
   5. Each lever to have independent spring mechanism controlling it
   6. 2-3/4 inch (70 mm) backset.
   7. 9/16 inch (14 mm) throw latchbolt.
   8. Provide sufficient curved strike lip to protect door trim.
   9. Outside lever sleeve to be seamless, of one-piece construction made of a hardened steel alloy.
   10. Keyed lever to be removable only after core is removed, by authorized control key.
11. Provide locksets with 7-pin removable and interchangeable core cylinders
12. Hub, side plate, shrouded rose, locking pin to be a one-piece casting with a shrouded locking lug.
13. Locksets outside locked lever must withstand minimum 1400 inch pounds of torque. In excess of that, a replaceable part will shear. Key from outside and inside lever will still operate lockset.
14. Core face must be the same finish as the lockset.
15. Functions and design as indicated in the hardware groups.

2.06 AUXILIARY LOCKS (DEADLOCKS)

A. Manufacturers:

B. Auxiliary Locks (Deadlocks): Complying with BHMA A156.36, Grade 1.
   1. Type: Mortise.
   4. Bolt Throw: 1 inch, with latch made of hardened steel.
   5. Core: 7-pin.
   6. Provide strike that matches frame.

2.07 CLOSERS

A. Manufacturers; Surface Mounted:
   1. Basis of Design: Stanley; D4550.
   3. DORMA USA, Inc; 8900 Series: www.dorma.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Closers: Complying with BHMA A156.4, Grade 1.
   1. Type: Surface mounted to door.
   2. Provide door closer on each exterior door.
   3. Provide door closer on each fire-rated and smoke-rated door.
      a. Spring hinges are not an acceptable self-closing device, unless otherwise indicated.
   4. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.
   5. At corridor entry doors, mount closer on room side of door.
   6. Closer shall have extra-duty arms and knuckles
   7. Maximum 2 7/16 inch case projection with non-ferrous cover
   8. Separate adjusting valves for closing and latching speed, and backcheck
   9. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
   10. Full rack and pinion type closer with 1½” minimum bore
   11. Closers shall be non-handed, non-sized and multi-sized.
   12. At outswinging exterior doors, mount closer on interior side of door.

2.08 OVERHEAD STOPS AND HOLDERS

A. Manufacturers:
   1. Basis of Design: ABH.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Overhead Stops and Holders (Door Checks): Complying with BHMA A156.8, Grade 1.
   1. Provide stop for every swinging door, unless otherwise indicated.
   2. Stop is not required if positive stop feature is specified for door closer; positive stop feature of door closer is not an acceptable substitute for a stop, unless otherwise indicated.
3. Concealed and surface-mounted overhead stops shall be heavy duty bronze or stainless steel.

2.09 LOW ENERGY OPERATORS

A. Manufacturers;
   1. Basis of Design: Stanley; D4990.
   3. LCN, an Allegion brand; 4640: www.allegion.com/us.

B. Provide Low Energy Operators with the following characteristics:
   1. Conform to ANSI/BHMA A156.19 as a low energy power opening device.
   2. Be listed under UL228, UL325, UL10B, UL10C, UBC 7.2 and FCC listed.
   3. Shall be non-handed.
   4. Be rated for door panels weighing up to 350 lbs (160 kg).
   5. The manual door closer within the Low Energy Operator shall be adjusted to meet Americans with Disabilities Act (ADA) 5 lbs opening force [Push-Side applications only]
   6. Operator shall be isolated from mounting plate with rubber mounts to mitigate the transmission of forces between the door and the operator.
   7. Shall have a position encoder to communicate with microprocessor.
   8. Incorporate a resetable powered operation counter that tracts both powered and non-powered cycling of the Operator.
   9. Incorporate the following adjustable settings:
      a. Hold Open Timer, to 28 seconds
      b. Open Speed
      c. Backcheck Speed
      d. Vestibule Sequence Timer
   10. Include DIP switch controls for:
       a. On board diagnostics
       b. Power close
       c. Push and Go operation
       d. Time delay logic for electrified hardware components
   11. Include terminals for auxiliary controls including:
       a. Activation devices; provide two discrete inputs
       b. Vestibule sequencing
   12. Control switches including:
       a. Day/Night open (illuminated)
       b. Power On-Off
   14. R-14 Aluminum Allow Materials
   15. For non-powered operation, the unit shall function as a standard door closer with adjustable spring force size 1 thru 6.

2.10 POWER SUPPLY

A. Provide power supply for (MLR) Motorized Electric Latch Retraction exit devices

2.11 QUICK CONNECT POWER TRANSFER

A. Power transfer device shall be a steel housing and flexible tube. Secure and inconspicuous channel is to bring power from the frame to the door.
   1. Precision EPT-12C
   2. Tube shall contain 12 Wire bundle with Stanley Quick Connect Connectors one 4 wire connector consisting of two 18AWG wires and 2 24AWG wires and one 8 wire connector with 8 24AWG wires.

B. Quick Connect plug-in connectors: Stanley quick connect plug-in must be used with a combination of the following components to work as a complete plug and play system.
   1. Best locks series 45HW, 45HM, 8KW, 9KW, 9KM
2. To include Quick connectors to Best lock products Suffix “C” Example (45HW-7DEL14H DS C)
3. Precision Exit Devices 2000 Series, DE, DS, TS, TDS, LDS, ELR
4. To include Quick connectors to Precision Electric Exit device products Prefix “C” Example (C ELR 2108 x V4908A TS)
5. Precision 12 Conductor Electric Power Transfer EPT-12C
6. Stanley 12 Hinges Conductor Hinge CECB179-12C

C. Quick Connect Wire Harnesses: The Quick Connect wire harness shall have of one four wire connector and one eight wire connector. The four wire connector has two 18AWG and two 24AWG wires. The eight wire connector has eight 24AWG wires Stanley quick connect wire harnesses are available in various length's, 3” (76mm), 6” (152mm), 12” (304mm), 26” (660mm) 32” (812mm) 38” (965mm), 44” (1117mm), 50” (1270mm) and 192” (4876mm).
1. Wire Harness that is terminated at both ends is specified as WH-size (Example WH-3).
2. Wire Harness that is terminated at one end with exposed pin head at the other is specified as WH-size P (Example WH-3P).
3. Wire Harness 6” (152mm) terminated at one end with bray leads on the other is specified as WH-6E.
   a. Notes The Wire harnesses with suffix “E” has brae wire ends, is used to connect the quick connect harness to a hardwired connection.
   b. Wire harnesses of different lengths may be combined to form a desired length
   c. The maximum size hole needed to pass through the quick connect plug is 1” (25MM).
4. For non-powered operation, the unit shall function as a standard door closer with adjustable spring force size 1 thru 6.

2.12 PROTECTION PLATES
A. Manufacturers:
4. Burns.
5. Substitutions: See Section 01 6000 - Product Requirements.
B. Protection Plates: Complying with BHMA A156.6.
C. Kickplates: Provide with four beveled edges ANSI J102, 10 inches high by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.
D. Armor Plates: Provide ANSI J101 with four beveled edges, 40 inches high by width less 1 inch on single or pairs of doors. Furnish oval-head countersunk screws to match finish.
   1. Provide cutouts for hardware as listed in the hardware sets.
   2. Provide Warnock Hersey labeled plates for 3 hour metal fire doors where allowed by local authority.
E. Drip Guard: Provide at head of exterior doors unless covered by roof or canopy.

2.13 WALL STOPS
A. Manufacturers:
3. ABH.
4. Burns.
5. Substitutions: See Section 01 6000 - Product Requirements.
B. Wall Stops: Complying with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
   1. Provide wall stops to prevent damage to wall surface upon opening door.
   2. Type: Bumper, concave, wall stop.

2.14 THRESHOLDS

A. Manufacturers:
   2. Reese.
   3. K.N. Crowder
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Thresholds: Complying with BHMA A156.21.
   1. Provide threshold at each exterior door, unless otherwise indicated.
   2. Type: Flat surface.
   4. Threshold Surface: Fluted horizontal grooves across full width.
   5. Field cut threshold to profile of frame and width of door sill for tight fit.
   6. Provide non-corroding fasteners at exterior locations.

2.15 WEATHERSTRIPPING AND GASKETING

A. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.

B. Weatherstripping: Provide at head and jambs only those units where resilient or flexible seal strip is easily replaceable. Where bar-type weatherstrip is used with parallel arm mounted closers install weatherstrip first.
   1. Weatherstrip shall be resilient seal of (Neoprene, Polyurethane, Vinyl, Pile, Nylon Brush, Silicone)
   2. UL10C Positive Pressure rated seal set when required.

C. Door Bottoms/Sweeps: Surface mounted or concealed door bottom where listed in the hardware sets.
   1. Door seal shall be resilient seal of (Neoprene, Polyurethane, Nylon Brush, Silicone)
   2. UL10C Positive Pressure rated seal set when required.

D. Thresholds: Thresholds shall be aluminum beveled type with maximum height of ½” for conformance with ADA requirements. Furnish as specified and per details. Provide fasteners and screws suitable for floor conditions.

E. Silencers: Furnish silencers on all interior frames, 3 for single doors, 2 for pairs. Omit where any type of seals occur.

2.16 SILENCERS

A. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
   1. Single Door: Provide three on strike jamb of frame.
   2. Pair of Doors: Provide two on head of frame, one for each door at latch side.

2.17 KEY CONTROL SYSTEMS

A. Key Control Systems: Complying with guidelines of BHMA A156.28.
   1. Provide keying information in compliance with DHI (KSN) standards.
   2. Keying: Grand master keyed.
   3. Include construction keying and control keying with removable core cylinders.
   4. Key to existing keying system.
   5. Supply keys in following quantities:
      a. 4 each Master keys.
      b. 1 each Grand Master keys.
      c. 15 each Construction Master keys.
      d. 1 Control keys if new system.
      e. 2 each Change keys for each keyed core.
6. Deliver keys with identifying tags to Owner by security shipment direct from hardware supplier.
7. Permanent Keys and Cores: Stamped with applicable key marking for identification. Do not include actual key cuts within visual key control marks or codes. Stamp permanent keys "Do Not Duplicate."
8. Owner or Owner's agent install permanent cores and return construction cores to hardware supplier. Construction cores and keys to remain property of hardware supplier.

2.18 FIRE DEPARTMENT LOCK BOX

A. Manufacturers:
   2. Substitutions: Not permitted.

B. Fire Department Lock Box:
   1. Heavy-duty, recessed, solid stainless-steel box with hinged door and interior gasket seal; single drill resistant lock with dust covers and tamper alarm.
   2. Capacity: Holds 10 keys.
   3. Finish: Manufacturer's standard dark bronze.

2.19 FINISHES

A. Finishes: Identified in Section 08 0671 - Door Hardware Schedule.

END OF SECTION
SECTION 08 7100
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Hardware for wood, aluminum, hollow metal, and _____ doors.
   B. Hardware for fire-rated doors.
   C. Electrically operated and controlled hardware.
   D. Thresholds.
   E. Weatherstripping, seals and door gaskets.

1.02 RELATED REQUIREMENTS
   A. Section 08 1113 - Hollow Metal Doors and Frames.
   B. Section 08 1416 - Flush Wood Doors.
   C. Section 08 3323 - Overhead Coiling Doors: Lockable coiling doors.
   D. Section 28 4600 - Fire Detection and Alarm: Electrical connection to activate door closers.
   E. Section 28 1300 - Access Control: Electronic access control devices.

1.03 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project.
   C. Hardware Schedule: Detailed listing of each item of hardware to be installed on each door. Use door numbering scheme as included in the Contract Documents. Identify electrically operated items and include power requirements.
   D. Keying Schedule: Submit for approval of Owner.
   E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
   F. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
      1. Submit manufacturer's parts lists and templates.
      2. Bitting List: List of combinations as furnished.
   G. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING
   A. Deliver all hardware items in the manufacturer's original cartons and wrappings with labels identifying the contents of each carton, relating it to the supplier's hardware schedule and indicating its intended location at the project. Include with each hardware item all accessories required for its proper installation and all installation instructions furnished by the manufacturer.

1.05 WARRANTY
   A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
   B. Provide five year warranty for door closers and _____.

PART 2 PRODUCTS

2.01 MANUFACTURERS - BASIS OF DESIGN
   A. ________
   B. Locks, Latchsets, and Exit Devices: Best Access Systems
   C. Access Control Locks: KABA Access Control: E-Plex 5700Series
D. __________.
E. As specified in this section for other products.
F. Substitutions: See Section 01 6000 - Product Requirements.

2.02 GENERAL REQUIREMENTS
A. Provide all hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated, whether or not scheduled.
B. Provide items of a single type of the same model by the same manufacturer.
C. Provide products that comply with the following:
   1. Applicable provisions of federal, state, and local codes.
   4. Hardware on Fire-Rated Doors, Except Hinges: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.
   5. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.
D. Function: Lock and latch function numbers and descriptions of manufactures series as listed in hardware schedule.
E. Electrically Operated and/or Controlled Hardware: Battery operated provide with batteries.
F. Finishes: Provide door hardware of the same finish unless otherwise indicated.
   1. Finish: As scheduled.
   2. Exceptions:
      a. Where base metal is specified to be different, provide finish that is an appearance equivalent according to BHMA A156.18.
G. Fasteners:
   1. Closer attachment to wood or metal doors: Sex bolts (SB).
   2. Surface bolt attachment to wood or metal doors: Sex bolts (SB).
   3. Concrete and Masonry Substrates: Stainless steel machine screws and lead expansion shields.

2.03 LOCKS AND LATCHES
A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
   1. If no hardware set is indicated for a swinging door provide an office lockset.
   2. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
   3. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
B. Lock Cylinders: Manufacturer’s standard tumbler type, six-pin standard core.
   1. Provide cams and/or tailpieces as required for locking devices required.
C. Keying: Grand master keyed.
D. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated "push/pull" or "not required to latch".

2.04 HINGES
A. Hinges: Provide hinges on every swinging door.
   1. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
   2. Provide ball-bearing hinges at all doors having closers.
   3. Provide hinges in the quantities indicated.
   4. Provide non-removable pins on exterior outswinging doors.
   5. Where electrified hardware is mounted in door leaf, provide power transfer hinges.
B. Manufacturers - Hinges:
3. Substitutions: See Section 01 6000 - Product Requirements.

2.05 LOCKS AND LATCHES
A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
   1. Hardware Sets indicate locking functions required for each door.
   2. If no hardware set is indicated for a swinging door provide an office lockset.
   3. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
   4. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
   5. In door sections, where a lock cylinder referenced to Section 08 7100 is specified, furnish and install a mortise lock cylinder keyed to the building keying system.
B. Electrically Operated Locks: Fail secure unless otherwise indicated.
C. Lock Cylinders: Manufacturer’s standard tumbler type, six-pin standard core.
   1. Provide cams and/or tailpieces as required for locking devices required.
D. Keying: Grand master keyed.
   1. Include construction keying.
   2. Key to existing keying system.
E. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated "push/pull" or "not required to latch".

2.06 CYLINDRICAL LOCKSETS
A. Locking Functions: As defined in BHMA A156.2, and as follows.
   1. Passage: No locking, always free entry and exit.
   2. Privacy: F76, emergency tool unlocks.
   3. Office: F82 Grade 1, key not required to lock, unlocks upon exit.
   4. Exit Only: F89, may not be left unlocked.
B. Manufacturers - Cylindrical Locksets:
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.07 EXIT DEVICES
A. Manufacturers - Exit Devices:
   1. Assa Abloy Brands, Corbin Russwin, Sargent, or Yale; ______: www.assaabloydss.com.
   2. Von Duprin, an Allegion brand; ______: www.allegion.com/us.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.08 CLOSERS
A. Manufacturers - Surface Mounted Closers:
   2. LCN, an Allegion brand; ______: www.allegion.com/us.
   3. Stanley Hardware.

2.09 STOPS AND HOLDERS
A. Stops: Complying with BHMA A156.8; provide a stop for every swinging door, unless otherwise indicated.
   1. Provide wall stops, unless otherwise indicated.
   2. If wall stops are not practical, due to configuration of room or furnishings, provide overhead stop.
3. Stop is not required if positive stop feature is specified for door closer; positive stop feature of door closer is not an acceptable substitute for a stop unless specifically so stated.

B. Manufacturers - Wall and Floor Stops/holders:
   4. Ives Manufacturing.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.10 GASKETING AND THRESHOLDS
A. Fasteners At Exterior Locations: Non-corroding.
B. Manufacturers - Gasketing and Thresholds:
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.11 PROTECTION PLATES AND ARCHITECTURAL TRIM
A. Manufacturers - Protection Plates and Architectural Trim:
   4. Ives Hardware.
   5. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.
B. Verify that electric power is available to power operated devices and of the correct characteristics.

3.02 INSTALLATION
A. Install hardware in accordance with manufacturer's instructions and applicable codes.
B. Use templates provided by hardware item manufacturer.
C. Do not install surface mounted items until finishes applied to substrate are complete.
D. Install hardware on fire-rated doors and frames in accordance with code and NFPA 80.
E. Mounting heights for hardware from finished floor to center line of hardware item. As indicated in the following list; unless noted otherwise in Door Hardware Sets Schedule or on the drawings.

3.03 ADJUSTING
A. Adjust work under provisions of Section 01 7000 - Execution and Closeout Requirements.
B. Adjust hardware for smooth operation.
C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.04 CLEANING
A. Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.
3.05 PROTECTION

A. Protect finished Work under provisions of Section 01 7000 - Execution and Closeout Requirements.
B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Glass.
   B. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS
   A. Section 08 1113 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
   B. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.

1.03 REFERENCE STANDARDS
   H. GANA (GM) - GANA Glazing Manual; 2009.

1.04 ADMINISTRATIVE REQUIREMENTS
   A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers, including installers of adjacent materials.

1.05 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. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
   D. Samples: Submit two samples 12 by 12 inch in size of glass units, showing coloration.

1.06 QUALITY ASSURANCE
   A. Perform Work in accordance with GANA Glazing Manual and GANA Sealant Manual for glazing installation methods.

1.07 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.
1.08 WARRANTY
   A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
   B. Sealed Insulating Glass Units: Provide a minimum ten (10) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2 PRODUCTS
2.01 BASIS OF DESIGN - INSULATING GLASS UNITS
   A. Sealed Insulating Glass Units: Vision glazing, with Low-E coating.
      1. Application: All exterior glazing in aluminum storefront framing.
      2. Between-lite space filled with air.
      4. Total Solar Heat Gain Coefficient: 0.19, nominal.
      5. Total Visible Light Transmittance: 32 percent, nominal.
      7. Outboard Lite: Heat-strengthened float glass, 1/4 inch thick, minimum.
         a. Low-E Coating: PPG Solarban 90 on #2 surface
         b. Tint: Solarblue.
      8. Inboard Lite: Annealed float glass, 1/4 inch thick.
         a. Tint: Clear.
      9. Total Thickness: 1 inch.
     10. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of another acceptable manufacturer.
     11. Substitution Procedures: See Section 01 6000 - Product Requirements.
         a. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.02 GLAZING UNITS
   A. Type G-2 - Single Exterior Vision Glazing:
      1. Application: Vision panels in hollow metal doors.
      2. Type: Fully tempered float glass.
      3. Tint: Clear.
      4. Thickness: 1/4 inch.
   B. Type G-3 - Single Safety Glazing:
      1. Application: All interior glazing unless otherwise indicated.
      2. Type: Fully tempered float glass.
      3. Tint: Clear.
      4. Thickness: 1/4 inch.
   C. Type G-4 - Fire-Protection-Rated Glazing:
      2. Safety Certification: 16 CFR 1201 Category II.
      3. Application: Provide this type of glazing in the following locations:
         a. Glazed lites in fire doors.
      4. Thickness: 1/4 inch.
      5. Glazing Method: As required for fire rating.

2.03 GLASS MATERIALS
   A. Float Glass Manufacturers:
   2. Other Acceptable Manufacturers:
3. Substitutions: Refer to Section 01 6000 - Product Requirements.

B. Float Glass: Provide float glass based glazing unless noted otherwise.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality-Q3.
   2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and Kind FT.
   3. Tinted Types: ASTM C1036, Class 2 - Tinted, color and performance characteristics as indicated.
   4. Thicknesses: As indicated; for exterior glazing comply with requirements indicated for wind load design regardless of thickness indicated.

C. Fire-Protection-Rated Glazing: Type, thickness, and configuration as required to achieve indicated ratings.
   1. IBC Fire Protection Rating: As indicated on drawings.
   2. Provide products listed by Underwriters Laboratories or Intertek Warnock Hersey.
   4. Labeling: Provide permanent label on each piece giving the IBC rating and other information required by the applicable code.
   5. "NT-Rated" Products: Where D-H-90 (or D-H-NT-90), D-H-60 (or D-H-NT-60), D-H-45 (or D-H-NT-45), D-H-20 (or D-H-NT-20), or any OH- rating is indicated, provide one of the following products or any specified T-rated product of equal or higher numerical rating:
      c. Substitutions: Refer to Section 01 6000 - Product Requirements.

2.04 SEALED INSULATING GLASS UNITS

A. Manufacturers:
   1. Same as for Float Glass

B. Sealed Insulating Glass Units: Types as indicated.
   1. Application: Exterior, except as otherwise indicated.
   2. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   3. Edge Spacers: Aluminum, bent and soldered corners.
   4. Edge Seal: Glass to elastomer with supplementary silicone sealant.
   5. Purge interpane space with dry hermetic air.

2.05 GLAZING COMPOUNDS

A. Manufacturers:
   5. Substitutions: Refer to Section 01 6000 - Product Requirements.

B. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining ASTM C 920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

2.06 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. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot.

C. 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 CLEANING

A. Remove glazing materials from finish surfaces.
B. Remove labels after Work is complete.
C. Clean glass and adjacent surfaces.

### 3.05 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 2116
GYPSUM BOARD ASSEMBLIES

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. Gypsum sheathing.
F. Cementitious backing board.
G. Gypsum wallboard.
H. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS
A. Section 05 4000 - Cold-Formed Metal Framing: Exterior wind-load-bearing metal stud framing.
B. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.
C. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.
D. Section 09 2216 - Non-Structural Metal Framing.

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on metal framing.
C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

PART 2 PRODUCTS
2.01 GYPSUM BOARD ASSEMBLIES
A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.
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.
C. Fire Rated Assemblies: Provide completed assemblies with the following characteristics:
   1. Fire Rated Partitions: UL listed assembly No. as noted on the drawings.
   2. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS
A. Manufacturers - Metal Framing, Connectors, and Accessories:
B. 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/120 at 5 psf.
   1. Studs: "C" shaped with flat or formed webs.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C-shaped.
   4. Drywall Suspension System: 1-1/2 in high Main Tees and Cross Tees.
5. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
6. Resilient Furring Channels: 1/2 inch depth, for attachment to substrate through both legs; both legs expanded metal mesh.
   a. Products:
      1) Same manufacturer as other framing materials.
      2) Substitutions: See Section 01 6000 - Product Requirements.

C. Exterior Non-Loadbearing Studs and Furring for Application of Gypsum Board: As specified in Section 09 2216.

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 S100-12.
   3. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
   4. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-resistance rating of the wall assembly.
   5. Deflection and Firestop Track:
      6. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.

2.03 BOARD MATERIALS

A. 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, unless otherwise indicated.
   2. Unfaced fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
   3. Thickness:
   4. Paper-Faced Products:
      a. CertainTeed Corporation; ProRoc Brand Gypsum Board.
      b. Georgia-Pacific Gypsum; ToughRock.
      c. National Gypsum Company; Gold Bond Brand Gypsum Wallboard.
      d. USG Corporation; Sheetrock Brand Gypsum Panels.
   5. Mold Resistant Paper Faced Products:
      a. CertainTeed Corporation; ProRoc Brand Moisture & Mold Resistant Gypsum Board.
      b. Georgia-Pacific Gypsum; ToughRock Mold-Guard.
      c. National Gypsum Company; Gold Bond Brand XP Gypsum Board.
      d. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.

B. Impact/Abuse Resistant Wallboard: Tested to Level 3 soft-body and hard-body impact in accordance with ASTM C1629.
   1. Application: install where indicated on drawings.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Paper-Faced Type: Gypsum wallboard as defined in ASTM C1396/C1396M.
   4. Unfaced Type: Interior fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M.
   5. Thickness: 5/8 inch.
7. **Products:**
   b. USG Corporation; Fiberock Brand Panels--VHI Abuse-Resistant.

C. **Backing Board For Wet Areas:** One of the following products:
1. **Application:** Surfaces behind tile in wet areas including toilet rooms.
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.
   a. Thickness: 1/2 inch.
   b. **Products:**
3. **ASTM Cement-Based Board:** Non-gypsum-based, cementitious board complying with ASTM C1288.
   a. Thickness: 1/2 inch.
   b. **Products:**
4. **Ceiling Board:** Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. **Application:** Ceilings, unless otherwise indicated.
   2. **Thickness:** 5/8 inch.
   3. **Edges:** Tapered.
   4. **Products:**
      a. CertainTeed Corporation; ProRoc Interior Ceiling.
      b. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board.
      c. National Gypsum Company; High Strength Brand Ceiling Board.
      d. USG Corporation; Sheetrock Brand Sag-Resistant Interior Gypsum Ceiling Board.

E. **Exterior Soffit Board:** Exterior gypsum soffit board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. **Application:** Ceilings and soffits in protected exterior areas, unless otherwise indicated.
   2. **Regular Type Thickness:** 1/2 inch.
   3. **Edges:** Tapered.
   4. **Products:**
      a. CertainTeed Corporation; ProRoc Brand Exterior Soffit Board.
      b. Georgia-Pacific Gypsum; ToughRock Fireguard C Soffit Board.
      c. National Gypsum Company; Gold Bond Brand Exterior Soffit Board.
      d. USG Corporation; Sheetrock Exterior Gypsum Ceiling Board.

2.04 **ACCESSORIES**

A. **Acoustic Sealant:** Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

B. **Finishing Accessories:** ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
   1. **Types:** As detailed or required for finished appearance.
   2. **Products:**
      a. Same manufacturer as framing materials.

C. **Joint Materials:** ASTM C475/C475M 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.
      a. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
   2. **Ready-mixed vinyl-based joint compound.**
D. **High Build Drywall Surfacer:** Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.

E. **Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members:** ASTM C1002; self-piercing tapping screws, corrosion resistant.

F. **Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness:** ASTM C954; steel drill screws, corrosion resistant.

G. **Anchorage to Substrate:** Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

H. **Adhesive for Attachment to Wood, ASTM C557 and Metal:**
   1. **Products:**
      b. Substitutions: See Section 01 6000 - Product Requirements.

**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 16 inches on center.
   1. Level ceiling and soffit system to a tolerance of 1/1200.
   2. Laterally brace entire suspension system.
   3. Install bracing as required at exterior locations to resist wind uplift.

C. **Studs:** Space studs as indicated.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. **Partitions Terminating at Ceiling:** Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. **Partitions Terminating at Structure:** Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

D. **Openings:** Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

E. **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 16 inches on center.
   2. Spacing: At 16 inches on center.

F. **Blocking:** Install wood blocking for support of:
   1. Framed openings.
   2. Wall mounted cabinets.
   4. Plumbing fixtures.
   5. Toilet partitions.
   6. Toilet accessories.
   7. Wall mounted door hardware.
   8. Visual display boards
   9. Audio/visual equipment
   10. Electric and communication wiring back boards
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.
B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place one bead continuously on substrate before installation of perimeter framing members.
   2. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.04 BOARD INSTALLATION
A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
B. Single-Layer Non-Rated: Install gypsum board perpendicular to framing, with ends and edges occurring over firm bearing.
   1. Exception: Tapered edges to receive joint treatment at right angles to framing.
C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
D. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.
E. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
   1. Seal joints, cut edges, and holes with water resistant sealant.
F. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
G. 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.
H. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.
I. Moisture Protection: Treat cut edges and holes in exterior gypsum soffit board with sealant.

3.05 INSTALLATION OF TRIM AND ACCESSORIES
A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
   2. At exterior soffits, not more than 30 feet apart in both directions.
B. Corner Beads: Install at external corners, using longest practical lengths.
C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
D. E-Z Strip Vinyl Expansion Control Joint: install according to manufacturer's written instructions.

3.06 JOINT TREATMENT
B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
   2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile, rigid vinyl, or FRP finish.
   3. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.
C. 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.
D. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.07 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 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 08 3100 - Access Doors and Panels: Access panels.
   B. Section 26 5100 - Interior Lighting: Light fixtures in ceiling system.
   C. Section 28 4600 - Fire Detection and Alarm: Fire alarm components in ceiling system.

1.03 ADMINISTRATIVE REQUIREMENTS
   A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed,
      sufficient heat is provided, dust generating activities have terminated, and overhead work is
      completed, tested, and approved.
   B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on suspension system components and acoustical units.
   C. 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 Acoustical Units: Quantity equal to 5 percent of total installed.

1.05 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.

PART 2 PRODUCTS
2.01 ACOUSTICAL UNITS
   A. Manufacturers:
      4. Substitutions: See Section 01 6000 - Product Requirements.
   B. Acoustical Units - General: ASTM E1264, Class A.
   C. Acoustical Panels Type 1: Painted mineral fiber, ASTM E1264 Type III, with the following
      characteristics:
         1. Size: 24 by 24 inches.
         2. Thickness: 3/4 inches.
         3. Composition: Wet felted.
         4. Light Reflectance: 85 percent, determined in accordance with ASTM E1264.
         5. Articulation Class (AC): 170, determined in accordance with ASTM E1264.
         7. Surface Color: White.
         10. Basis of Design Products:
             a. Armstrong CirrusTile.
2.02 SUSPENSION SYSTEM(S)

A. Manufacturers:
   6. 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 galvanized steel, commercial quality cold rolled; intermediate-duty.
   1. Profile: Tee; 15/16 inch wide face.
   2. Construction: Double web.
   4. Basis of Design Products:
      a. Armstrong Prelude.
      b. Substitutions: See Section 01 6000 - Product Requirements.

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. 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 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 ceiling plan. In the absence of a reflected plan, lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.

D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

E. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

F. 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.

G. 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.

H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
J. Do not eccentrically load system or induce rotation of runners.
K. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.
   2. Overlap and rivet corners.

3.03 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.
   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. Cut to fit irregular grid and perimeter edge trim.
      2. Make field cut edges of same profile as factory edges.
      3. Double cut and field paint exposed reveal 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
SECTION 09 6500
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Resilient sheet flooring.
B. Resilient tile flooring.
C. Resilient base.
D. Installation accessories.

1.02 RELATED REQUIREMENTS
A. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

1.03 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. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
F. 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: Quantity equivalent to 5 percent of field tile, 12 square feet of each color of accent tiles
   3. Extra Wall Base: 120 linear feet of each type and color.
   4. Extra Stair Materials: Quantity equivalent to 5 percent of each type and color.

1.04 DELIVERY, STORAGE, AND HANDLING
A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
B. Store all materials off of the floor in an acclimatized, weather-tight space.
C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

1.05 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

2.01 SHEET FLOORING
A. Vinyl Sheet Flooring - Type _____: Homogeneous without backing, with color and pattern throughout full thickness.
   1. Minimum Requirements: Comply with ASTM F1913.
   2. Thickness: 0.080 inch nominal.

2.02 TILE FLOORING
A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.
   1. Manufacturers:

2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
3. Size: 12 by 12 inch.
4. Thickness: 0.125 inch.
5. Colors: as noted on the drawings.

2.03 RESILIENT BASE
A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
   1. Manufacturers:
      c. Substitutions: See Section 01 6000 - Product Requirements.
   2. Height: 4 inch.
   3. Thickness: 0.125 inch.
   5. Length: Roll.
   6. Color: To be selected by Architect from manufacturer's full range.
   7. Accessories: Premolded external corners and internal corners.

2.04 ACCESSORIES
A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
C. Moldings, Transition and Edge Strips: Same material as flooring.
D. Filler for Coved Base: Plastic.
E. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
B. 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. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient 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 resilient flooring manufacturer and adhesive materials manufacturer.
D. Verify that required floor-mounted utilities are in correct location.
E. Contractor responsible for remediation of floor system should subfloor surface not meet moisture and PH requirements of the tile manufacturer.

3.02 PREPARATION
A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
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 fully cured.
D. Clean substrate.
E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

### 3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of sub-floor conditions.
B. Install in accordance with manufacturer's written instructions.
C. Spread only enough adhesive to permit installation of materials before initial set.
D. Fit joints and butt seams 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.
   1. Resilient Strips: Attach to substrate using adhesive.
H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
I. Install flooring in recessed floor access covers, maintaining floor pattern.

### 3.04 INSTALLATION - SHEET FLOORING

A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.

### 3.05 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.
C. Install square tile to ashlar pattern. Allow minimum 1/2 full size tile width at room or area perimeter.

### 3.06 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 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.

### 3.07 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.
B. Clean, seal, and wax in accordance with manufacturer's written instructions.

### 3.08 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION
SECTION 09 9000
PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Surface preparation.
   B. Field application of paints and other coatings.
   C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
      1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
      2. Exposed surfaces of steel lintels and ledge angles.
      3. Mechanical and Electrical:
         a. 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.
         b. In finished areas, paint shop-primed items.
         c. On the roof and outdoors, paint all equipment that is exposed to weather or to view, unless factory-finished.
         d. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
   D. Do Not Paint or Finish the Following Items:
      1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
      2. Items indicated to receive other finishes.
      3. Items indicated to remain unfinished.
      4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
      5. Floors, unless specifically so indicated.
      6. Exterior insulation and finish system (EIFS).
      7. Glass.
      8. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS
   A. Section 05 5000 - Metal Fabrications: Shop-primed items.

1.03 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide complete list of all products to be used, with the following information for each:
      1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
      2. MPI product number (e.g. MPI #47).
      3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   C. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.
   D. 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 Paint and Coatings: 1 gallon of each color; store where directed.
      3. Label each container with color in addition to the manufacturer's label.

1.04 DELIVERY, STORAGE, AND HANDLING
   A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.05 FIELD CONDITIONS
A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Provide all paint and coating products from the same manufacturer to the greatest extent possible.
   1. In the event that a single manufacturer cannot provide all specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.

B. Paints:

C. Primer Sealers: Same manufacturer as top coats.

D. Block Fillers: Same manufacturer as top coats.

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

2.02 PAINTS AND COATINGS - GENERAL
A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
   1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each coating material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

C. Colors: To be selected from manufacturer's full range of available colors.
   1. Selection to be made by Architect after award of contract.
   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 GE-OP-3L - Gypsum Board and Plaster, Opaque, Latex, 3 Coat:
   1. One coat of latex primer sealer.
   2. Flat: Two coats of latex.

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-3A - Galvanized Metals, Alkyd, 3 Coat:
   1. One coat galvanize primer.

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-2L - Ferrous Metals, Primed, Latex, 2 Coat:
   1. Touch-up with latex primer.
   2. Semi-gloss: Two coats of latex enamel.
C. Paint MgI-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
   1. One coat galvanize primer.
D. Paint GI-OP-3L - Gypsum Board/Plaster, Latex, 3 Coat:
   1. One coat of water-based primer sealer.
   2. Satin: Two coats of latex enamel.

2.05 ACCESSORY MATERIALS
A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
B. Patching Material: Latex filler.
C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION
3.01 EXAMINATION
A. Do not begin application of coatings until substrates have been properly prepared.
B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
E. Test shop-applied primer for compatibility with subsequent cover materials.
F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.

3.02 PREPARATION
A. Clean surfaces thoroughly and correct defects prior to coating application.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
D. Seal surfaces that might cause bleed through or staining of topcoat.
E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
F. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

G. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.

H. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

I. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-SP 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).

J. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.

K. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

L. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer’s instructions.

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance.

F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

G. Sand metal surfaces lightly between coats to achieve required finish.

H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finished coatings until completion of project.

B. Touch-up damaged coatings after Substantial Completion.

END OF SECTION
SECTION 10 1400
SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Room and door signs.
   B. Interior directional and informational signs.

1.02 SUBMITTALS
   A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
   B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
   C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
      1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
      2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
      3. Submit for approval by Owner through Architect prior to fabrication.
      4. Approximately 90 room signs will be required.
   D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
   E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
   F. Shop drawings: For Exterior Accent Wall Shapes indicating dimensions, attachment locations, and secure attachments.
   G. Verification Samples: Submit samples showing colors specified.
   H. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.03 DELIVERY, STORAGE, AND HANDLING
   A. Package signs as required to prevent damage before installation.
   B. Package room and door signs in sequential order of installation, labeled by floor or building.
   C. Store tape adhesive at normal room temperature.

1.04 FIELD CONDITIONS
   A. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Flat Signs:
      2. Avalis Wayfinding Solutions, Inc.: www.avalisway.com
      5. Substitutions: See Section 01 6000 - Product Requirements.
   B. Dimensional Letter Signs:
      2. Substitutions: See Section 01 6000 - Product Requirements.
2.02 SIGNAGE APPLICATIONS

A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
   1. Sign Type: Flat signs with engraved panel media as specified.
   2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
   3. Character Height: 5/8 inch.
   5. Identify all rooms with titles noted on drawings except those listed herein. Do not include room numbers, provide in braille.
   6. Single Use Rest Rooms: Identify with Toilet Room A104 as Patient Toilet and Toilet Room A110 as Staff Toilet, ADA pictogram, and braille.
   7. Exit Signs: Identify exterior egress with the word "EXIT", the ADA pictogram, and braille.

2.03 SIGN TYPES

A. Flat Signs: Signage media without frame.
   1. Edges: Square.
   2. Corners: Square.

B. Color and Font: Unless otherwise indicated:
   1. Character Font: Helvetica, Arial, or other sans serif font.
   2. Character Case: Upper case only.
   3. Background Color: As selected by Architect from manufacturer's standard colors.

2.04 TACTILE SIGNAGE MEDIA

A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
   1. Total Thickness: 1/8 inch.

2.05 DIMENSIONAL LETTERS

A. Metal Letters:
   1. Metal: Aluminum casting.
   2. Finish: Brushed, satin.

B. Plastic Letters:
   1. Material: Injection molded plastic.
   2. Color: As selected.

2.06 ACCESSORIES

A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.

B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install neatly, with horizontal edges level.
C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
D. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION
SECTION 10 2123
CUBICLE CURTAINS AND TRACK

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Suspended overhead curtain track and guides.
B. Surface mounted overhead curtain track and guides.
C. Cubicle curtains.

1.02 RELATED REQUIREMENTS
A. Section 05 5000 - Metal Fabrications: Track supports above ceiling.
B. Section 06 1000 - Rough Carpentry: Blocking and supports for track.
C. Section 09 5100 - Acoustical Ceilings: Suspended ceiling system to support track.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for curtain fabric characteristics.
C. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.
D. Samples: Submit two fabric samples, 12 by 12 inch in size illustrating fabric color.
E. Samples: Submit 12 inch sample length of curtain track including typical splice, wall and ceiling hanger, and escutcheon.
F. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Accept curtain materials on site and inspect for damage.
B. Store curtain materials on site and deliver to Owner for installation when requested.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Cubicle Track and Curtains:
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 TRACKS AND TRACK COMPONENTS
A. Tracks: Extruded aluminum sections; one piece per track run.
   1. Profile: Channel.
   3. Structural Performance: Capable of supporting vertical test load of 50 lbs without visible deflection of track or damage to supports, safely supporting moving loads, and sufficiently rigid to resist visible deflection and without permanent set.
   4. Track End Stop: To fit track section.
   5. Track Bends: Minimum 12 inch radius; fabricated without deformation of track section or impeding movement of carriers.
6. Suspension Rods: Tubular aluminum sections, sized to support design loads and designed to receive attachment from track and ceiling support.

7. Escutcheons: Where suspension rod meets finished ceiling or structure, provide escutcheons to match rod finish.


B. Curtain Carriers: Nylon rollers, size and type compatible with track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal.

C. Wand: Plastic, attached to lead carrier, for pull-to-close action.

D. Installation Accessories: Types required for specified mounting method and substrate conditions.

2.03 CURTAINS

A. Cubicle Curtains:
   1. Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
   2. Inherently flame resistant or flameproofed; capable of passing NFPA 701 test.
   4. Color/Pattern: to be selected from manufacturer's standard curtains.
   5. Open Mesh Cloth: Open weave to permit air circulation; flameproof material, manufacturer's standard color.

B. Curtain Fabrication:
   1. Width of curtain to be 10 percent wider than track length.
   2. Length of curtain to end 15 inches above finished floor.
   4. Include open mesh cloth at top 20 inches of curtain for room air circulation, attached to curtain as specified above.
   5. Seams and Hems: Manufacturer's standard fabrication method for securely sewn and finished seams and hems.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.

B. Verify that field measurements are as indicated.

3.02 INSTALLATION

A. Install curtain track to be secure, rigid, and true to ceiling line.

B. Secure track to ceiling system.

C. Install end cap.

D. Install curtains on carriers ensuring smooth operation.

END OF SECTION
SECTION 10 2600
RIGID VINYL SHEET WALL PROTECTION

PART 1 - GENERAL
1.01 SECTION INCLUDES
A. Rigid vinyl sheet for wall protection

1.02 RELATED REQUIREMENTS
A. Section 09 2216 - Gypsum Board Assemblies: Wall Construction
B. Section 10 2601 - Wall and Corner Guards

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer’s printed product data for each type of rigid vinyl sheet specified.
C. Detail Drawings: Mounting details with the appropriate adhesives for specific project substrates.
D. Samples: Verification samples of 8 inches square, of each type and color indicated.
E. Manufacturer’s Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.04 DELIVERY, STORAGE AND HANDLING
A. Deliver materials in unopened factory packaging to the jobsite.
B. Inspect materials at delivery to assure that specified products have been received.
C. Store in original packaging in a climate controlled location away from direct sunlight.

1.05 PROJECT CONDITIONS
A. Environmental Requirements: Products must be installed in an interior climate controlled environment.

1.06 WARRANTY
A. Manufacturer’s Limited Lifetime Warranty against material and manufacturing defects.

PART 2 - PRODUCTS
2.01 MANUFACTURERS
A. Basis of Design Manufacturer: InPro Corporation: www.inprocorp.com
B. Other Acceptable Manufacturers:
   2. Construction Specialties, Inc.: www.c-sgroup.com
   3. Pawling Corp: www.pawling.com

2.02 COMPONENTS
A. Materials: Chemical and stain resistant polyvinyl chloride with the addition of impact modifiers.
B. Fire Performance Characteristics:
   1. UL classified product conforming with the Class A fire rating.
C. Impact Strength: Minimum 30 ft-lbs per inch of thickness when tested in accordance with ASTM D-256-90b
D. Chemical and Stain Resistance: ASTM D-543.
E. Size: 4 feet wide by .040 inch. Provide in rolls or sheets as required to allow for as few seams as possible.

2.03 ACCESSORIES
A. Top caps, inside corners, divider bars and outside corners shall be made of extruded PVC.
2.04 FINISHES
   A. Color or pattern of sheets to be selected by the Architect from the manufacturer's premium
      finish selection. Surface shall have a semi-gloss or velvet texture.
   B. Vinyl Accessories: Top caps, inside corners, divider bars and outside corners shall be of a color
      matching the sheet.

PART 3 - EXECUTION

3.01 EXAMINATION
   A. Examine areas and conditions in which the rigid vinyl sheet will be installed.
   B. Complete all finishing operations, including painting, before beginning installation of rigid vinyl
      sheet materials.
   C. Wall surface shall be dry and free from dirt, grease and loose paint.

3.02 PREPARATION
   A. General: Prior to installation, clean substrate to remove dust, debris and loose particles.

3.03 INSTALLATION
   A. General: Locate the rigid vinyl sheet as indicated on the approved detail drawing for the
      appropriate substrate and in compliance with the manufacturer's written installation instructions.
      Install level and plumb at the height indicated on the drawings.
   B. Installation of Rigid Vinyl Sheet:
      1. Adhere to substrate with adhesive approved by manufacturer.

3.04 CLEANING
   A. At completion of the installation, clean surfaces in accordance with the manufacturer’s clean-up
      and maintenance instructions.

END OF SECTION
SECTION 10 2601
WALL AND CORNER GUARDS

PART 1 GENERAL
1.01 SECTION INCLUDES
A. Corner guard system for wall protection.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Indicate physical dimensions, features, anchorage details, and rough-in measurements.
C. Samples: Submit two sections of corner guard, 24 inch long, illustrating component design, configuration, color and finish.
D. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. Wall and Corner Guards:
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COMPONENTS
A. Corner Guards - Surface Mounted:
   1. Material: High impact vinyl with full height extruded aluminum retainer.
   2. Performance: Resist lateral impact force of 100 lbs at any point without damage or permanent set.
   3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
   4. Width of Wings: 3 inches.
   5. Corner: Square.
   6. Color: As selected from manufacturer's standard colors.
   7. Length: 8 feet.
   8. Preformed end caps.
B. Mounting Brackets and Attachment Hardware: Appropriate to component and substrate.

PART 3 EXECUTION
3.01 INSTALLATION
A. Install components in accordance with manufacturer's printed instructions, level and plumb, secured rigidly in position to wall framing members only.
B. Position corner guard above top of base.

END OF SECTION
SECTION 10 2800
TOILET AND UTILITY ROOM ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Commercial toilet accessories.
B. Utility room accessories.

1.02 RELATED REQUIREMENTS
A. Section 10 2113.13 - Metal Toilet Compartments.

1.03 ADMINISTRATIVE REQUIREMENTS
A. Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Commercial Toilet Accessories:
   4. Substitutions: Section 01 6000 - Product Requirements.
B. Electric HandDryers:
C. All items of each type to be made by the same manufacturer.

2.02 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. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
C. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
D. Adhesive: Two component epoxy type, waterproof.
E. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
F. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES
A. Stainless Steel: Satin finish, unless otherwise noted.
B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.

2.04 TOILET ROOM ACCESSORIES
A. Toilet Paper Dispenser: Furnished and installed by Owner.
B. Paper Towel Dispenser: Furnished and installed by Owner.
C. Soap Dispenser: Furnished and installed by Owner.

D. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
   1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
   2. Size: As indicated on drawings.
   3. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
   4. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.

E. Grab Bars: Stainless steel, nonslip grasping surface finish.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force, minimum.
      b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
      c. Length and Configuration: As indicated on drawings.

2.05 UTILITY ROOM ACCESSORIES
   A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
   1. Hooks: 2; 0.06 inch stainless steel rag hooks at shelf front.
   2. Mop/broom holders: 3 spring-loaded rubber cam holders at shelf front.
   3. Length: Manufacturer's standard length for number of holders/hooks.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify existing conditions before starting work.
   B. Verify exact location of accessories for installation.
   C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

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. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
   B. Install plumb and level, securely and rigidly anchored to substrate.
   C. Mounting Heights: As required by accessibility regulations and as otherwise indicated on drawings.

3.04 PROTECTION
   A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION
SECTION 10 4400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fire extinguishers.
B. Fire extinguisher cabinets.

1.02 RELATED REQUIREMENTS
A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS
B. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Fire Extinguishers:
   1. Ansul, a Tyco Business; Cleanguard: www.ansul.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.
B. Fire Extinguisher Cabinets and Accessories: Larsen Cameo Series, Model 2409-R2
   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. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gage.
   1. Class: A:B:C.
   2. Size: 10 pound.
   3. Finish: Baked polyester powder coat, red color.

2.03 WET CHEMICAL EXTINGUISHER
A. Wet Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gage.
   1. Location: Kitchen
      a. Class: K type.
      b. Size: 2.5 gallons.
      c. Size and classification as scheduled.
      d. Finish: Polished stainless steel.
      e. Temperature range: Minus 20 degrees F to 120 degrees F.
2.04 FIRE EXTINGUISHER CABINETS
   A. Cabinet Construction: Non-fire rated.
      1. Formed primed steel sheet; 0.036 inch thick base metal.
   B. Cabinet Configuration: Semi-recessed type.
      1. Size to accommodate accessories.
      2. Trim: Flat, with 5/16 inch wide face.
      3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
   C. Door: 0.036 inch thick, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with two butt hinges. Provide nylon catch.
   D. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.
   E. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
   F. Weld, fill, and grind components smooth.
   G. Finish of Cabinet Exterior Trim and Door: Primed for field paint finish.
   H. Finish of Cabinet Interior: White colored enamel.

2.05 ACCESSORIES
   A. Extinguisher Brackets: Formed steel, chrome-plated.
   B. Graphic Identification: Manufacturer's standard identification on front bubble cover - black letters.

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 3600
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Countertops for architectural cabinet work.
B. Countertops for manufactured casework.

1.02 RELATED REQUIREMENTS
A. Section 06 4100 - Architectural Wood Casework.

1.03 REFERENCE STANDARDS
D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
H. PS 1 - Structural Plywood; 2009.

1.04 SUBMITTALS
A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
C. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
D. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
E. Installation Instructions: Manufacturer's installation instructions and recommendations.
F. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

PART 2 PRODUCTS

2.01 COUNTERTOPS
A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
   1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.048 inch nominal thickness.
      a. Manufacturers:
4) Substitutions: See Section 01 6000 - Product Requirements.
   b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke
developed index of 450, maximum; when tested in accordance with ASTM E84.
   c. Laminate Core Color: Same as decorative surface.
   d. Finish: Matte or suede, gloss rating of 5 to 20.
   e. Surface Color and Pattern: As selected by Architect from the manufacturer's full line.

2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch thick;
covered with matching laminate.

3. Back and End Splashes: Same material, same construction.

4. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section
   11 - Countertops, Custom Grade.

C. Solid Surfacing Countertops and Sills: Solid surfacing sheet or plastic resin casting over
   continuous substrate.
   1. Flat Sheet Thickness: 1/4 inch, minimum.
   2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA
   LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and
   capable of being worked and repaired using standard woodworking tools; no surface
   coating; color and pattern consistent throughout thickness.
      a. Manufacturers:
         5) Substitutions: See Section 01 6000 - Product Requirements.
      b. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
      c. Color/Pattern Family: Medium-grained "salt-and-pepper" look, low contrast.
   3. Other Components Thickness: 1/2 inch, minimum.
   4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; radiused edge.
   5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
   6. Skirts: As indicated on drawings.

2.02 MATERIALS

A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply;
   minimum 3/4 inch thick; join lengths using metal splines.

B. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45pcf minimum density;
   minimum 3/4 inch thick; join lengths using metal splines.

C. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.

D. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of
   materials being joined.

E. Joint Sealant: Mildew-resistant silicone sealant, white.

2.03 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against
      cabinet or wall.
   3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or
      unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise
   indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof
      glue.
   2. Height: 4 inches, unless otherwise indicated.
C. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.
C. Attach solid surface window sills with manufacturer-approved construction adhesive. Secure with screws and finish washers at each end and at center point of each window.
D. Seal joint between back/end splashes and vertical surfaces.

END OF SECTION
SECTION 31 1413
TOPSOIL STRIPPING AND STOCKPILING

PART 1 GENERAL
1.01 SUMMARY
   A. Includes But Not Limited To:
      1. Strip and stockpile acceptable topsoil as described in Contract Documents.
   B. Related Sections:
      1. Section 31 1000: Site Clearing
      2. Section 31 2200: Grading
      3. Section 32 9113: Soil Preparation
      4. Section 32 9119: Landscape Grading

1.02 DEFINITIONS
   A. Definitions:
      1. Existing topsoil: Defined as total amount of soil stripped and stored for reuse, less
         vegetation layer stripped and disposed of as specified in Paragraphs below.

PART 2
2.01 PRODUCTS: NOT USED

PART 3 EXECUTION
3.01 PERFORMANCE
   A. Do not strip wet topsoil for storage
   B. Strip existing vegetation layer 3 inches deep from areas of site to receive buildings,
      landscaping, and paving and remove from site before stripping topsoil for storage and reuse.
   C. After stripping vegetation layer, strip existing topsoil, if present, an additional 6 inches deep
      minimum from areas of site to receive buildings and paving and store on site for later use.
      1. Existing topsoil is property of Contractor with restriction that topsoil is to be used first for
         Project landscape topsoil requirements and second for fill and backfill in non-structural
         locations.
      2. After Project fill, backfill, and landscape topsoil requirements are satisfied, remove excess
         existing topsoil from site. Do not remove existing topsoil from site without Architect’s
         written approval.

END OF SECTION
SECTION 31 2500
EROSION AND SEDIMENTATION CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Permanent erosion and sedimentation controls as described in Contract Documents and as required by the Virginia Department of Environmental Quality.

1.02 RELATED REQUIREMENTS
A. Section 01 5713: Temporary Erosion and Sedimentation Control
B. Section 31 1100: Clearing and Grubbing
C. Section 31 1413: Topsoil Stripping And Stockpiling
D. Section 31 2316: Excavation
E. Section 32 9219: Seeding
F. Section 32 9222 Hydro seeding
G. Section 32 9223 Sodding

1.03 SYSTEM DESCRIPTION
A. Performance Requirements: Protect and maintain areas disturbed by the Work, so erosion is adequately controlled and silt and sediments are not allowed to flow into any watercourse, onto adjacent properties, or into storm drains.

1.04 REFERENCES
A. United States Environmental Protection Agency:
   1. EPA Document 832/R-92-005 (Sep 1992), ‘Storm Water Management for Construction Activities

1.05 SUBMITTALS
A. Storm Water Pollution Prevention Plan - Virginia Department of Environmental Quality (VDEQ)
   1. Submitted as required by the VSMP, General Permit for Discharges from Construction Activities

PART 2 PRODUCTS

2.01 MATERIALS
A. Seed And Sod For Erosion Control:
   1. General:
      a. For Temporary Control: As described in Contract Documents and specifications.
      b. For Permanent Control: As described in Contract Documents and specifications.
   2. For conflicts between the two, the more stringent of the two.
B. Silt Fence for Erosion Control:
   1. General:
      a. Shall be in accordance with Section 3.05 of the VESCH.
C. Storm Drain Inlet Protection for Erosion Control:
   1. General:
      a. Shall be in accordance with Section 3.07 of the VESCH
D. Construction Entrance for Erosion Control:
   1. General:
      a. Shall be in accordance with Section 3.02 of the VESCH
2.02 ACCESSORIES

A. For Mulch:
   1. Mulch Stabilizers:
   2. Shall be in accordance with Section 3.36 of the VESCH Temporary Type Mulch Nets:
      Shall be in accordance with Section 3.35 of the VESCH

B. Permanent Type Mulch Nets:
   1. Shall be in accordance with Section 3.35 of the VESCH For Matting / Blankets:

C. All Accessories shall be in accordance with Section 3 of the VESCH

3.01 INSTALLATION

A. General:

B. Shall conform to the requirements of the Virginia Erosion and Sediment Control Handbook, 3rd Edition
   1. Take every reasonable precaution to avoid erosion and to prevent silting of rivers, streams, lakes, reservoirs, impoundments, and drainage ditches and swales.
   2. Keep exposure of uncompleted cut slopes, embankments, trench excavations, and site graded areas as short as possible. Initiate seeding and other erosion control measures on each segment as soon as reasonably possible.
   3. Should it become necessary to suspend construction for any length of time, shape excavated and graded areas so runoff will be intercepted and diverted to points where minimal erosion will occur. Provide and maintain temporary erosion and sediment control measures, such as berms, dikes, slope drains, silt stops, and sedimentation basins, until permanent drainage facilities or erosion control features have been completed and are operative.
   4. Handle and treat fine material placed or exposed during The Work so as to minimize possibility of it reaching surface waters. Use diversion channels, dikes, sediment traps, or other effective control measures.
   5. Provide silt stops wherever erosion control measures may not be totally capable of controlling erosion, such as in drainage channels and where steep slopes may exist.
   6. Before water is allowed to flow in any ditch, swale, or channel, install permanent erosion control measures in waterway so waterway will be safe against erosion.
   7. Take precautions in using construction equipment to minimize erosion. Do not leave wheel tracks where erosion might begin.
   8. Mulching shall follow seeding operations by no more than 24 hours.
   9. Continue erosion control measures until permanent measures have been sufficiently established and are capable of controlling erosion on their own.
   10. Do not disturb any area outside of the construction limits as shown in the construction documents.

C. Hay And Straw Mulching:
   1. Shall be in accordance with Section 3.35 of the VESCH

D. Matting:
   1. Shall be in accordance with Section 3.36 of the VESCH

E. Jute Matting:
   1. Shall be in accordance with Section 3.36 of the VESCH

F. Excelsior Matting:
   1. Shall be in accordance with Section 3.36 of the VESCH.

G. Erosion Control Mulching Blanket:
   1. Shall be in accordance with Section 3.36 of the VESCH

H. Vegetation For Erosion Control:
   1. All disturbed earthen areas will receive permanent seeding or sodding.
2. Areas that will be regraded or otherwise disturbed later during construction may be seeded with temporary / permanent seeding as specified in the construction documents

I. Hay Bales And Silt Fences:

3.02 RESTORATION

A. If any staple becomes loosened or raised, if any matting becomes loose, torn, or undermined, or if any temporary erosion and sediment control measures are disturbed, repair them immediately.

B. If seed is washed out before germination, repair damage, refertilize, and reseed.

C. Maintain mulched and matted areas, silt stops, and other temporary control measures until permanent control measures are established and no further erosion is likely.

END OF SECTION
SECTION 32 9001
COMMON PLANTING REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Common procedures and requirements for landscaping work.
B. Maintenance for new landscaping as described in Contract Documents

1.02 RELATED REQUIREMENTS:
A. Section 31 2220 - Grading
B. Section 32 9113: Soil Preparation
C. Section 32 9119: Landscape Grading
D. Section 32 9219: Seeding
E. Section 32 9222: Hydro-Seeding
F. Section 32 9223: Seeding
G. Section 32 9300: Plants

1.03 ADMINISTRATIVE REQUIREMENTS
A. Reiterate Contractor's responsibility for maintenance of new landscaping during all phases of construction period.
B. Prepare two typical landscape planting excavations and conduct percolation test to verify that water drains away within two (2) hours. Discuss results of percolation tests with Architect and Owner's representative.

1.04 SUBMITTALS
A. At completion of landscape work, submit two (2) copies of typewritten instructions recommending procedures to be established by Owner for maintenance of landscape work for one (1) full year after contract maintenance period ends.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Storage And Handling Requirements:
   1. Deliver packaged materials in containers showing weight, analysis, and name of Manufacturer.
   2. Deliver sod, plants, trees, and shrubs in healthy and vigorous condition.
   3. Protect materials from deterioration during delivery.
B. Storage And Handling Requirements:
   1. Store in location on site where they will not be endangered and where they can be adequately watered and kept in healthy and vigorous condition.
   2. Protect materials from deterioration while stored at site.

PART 2 PRODUCTS:

2.01 POST-EMERGENT WEED CONTROL:
A. Type Two Acceptable Products:
   1. Enide by Upjohn.
   2. Dymid by Elanco.
   3. Treflan or Surflan by Dow Agrosciences.
   4. Eptan by Syngenta.
   5. Equal as approved by Architect before use. See Section 01 6000.

PART 3 EXECUTION

3.01 PREPARATION
A. Before proceeding with work, verify dimensions and quantities. Report variations between Drawings and site to Architect before proceeding with landscape work.
1. Plant totals are for convenience of Contractor only and are not guaranteed. Verify amounts shown on Drawings.
2. All planting indicated on Drawings is required unless indicated otherwise.

B. Protection:
   1. Take care in performing landscaping work to avoid conditions that will create hazards. Post signs or barriers as required.
   2. Provide adequate means for protection from damage through excessive erosion, flooding, heavy rains, etc. Repair or replace damaged areas.
   3. Keep site well drained and landscape excavations dry.

3.02 DELIVERY, SEQUENCING
A. Do not plant trees and shrubs until major construction operations are completed.
B. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

3.03 STORAGE, AND HANDLING
A. Deliver packaged materials in containers showing weight, analysis, and name of Manufacturer. Protect materials from deterioration during delivery and while stored at site.
B. Deliver sod, plants, trees, and shrubs in healthy and vigorous condition and store in location on site where they will not be endangered and where they can be adequately watered and kept in healthy and vigorous condition.

3.04 INSTALLATION
A. The bioretention basin shall be completed by the contractor and inspected by the City of Roanoke prior to applying for a Certificate of Occupancy (CO). The City will not issue a CO until the basin, including the grass and plantings, is completed.
B. Interface With Other Work:
   1. Do not plant trees and shrubs until major construction operations are completed.
   2. Coordinate installation of planting materials during normal planting seasons for each type of plant material required, if construction period allows.
   3. Hand excavate as required.
   4. Maintain grade stakes until parties concerned mutually agree upon removal.
   5. When conditions detrimental to plant growth are encountered, such as rubble fill or adverse drainage conditions, notify Architect before planting.

3.05 FIELD QUALITY CONTROL
A. Field Inspection:
   1. Architect will inspect landscaping installation approximately two (2) weeks before Substantial Completion.
   2. Non-Conforming Work. Non-conforming work as covered in the General Conditions applies, but is not limited to the following:
   3. Replace landscaping that is dead or appears dead as directed by Architect within ten (10) days of notification and before Substantial Completion at no additional cost to Owner.
   4. Replace damaged plantings at no additional cost to Owner.
   5. Repair damage to irrigation, ground lighting, utilities, asphalt paving, concrete paving, concrete sidewalks, concrete curb and gutters and other items adjacent to landscaping caused by work of this Section or replace at no additional cost to Owner.

3.06 CLEANING
A. Waste Management:
   1. Immediately clean up soil or debris spilled onto pavement and dispose of deleterious materials.
3.07 PROTECTION

A. Protect planted areas against traffic or other use immediately after planting is completed by placing adequate warning signs and barricades.

B. Provide adequate protection of planted areas against trespassing, erosion, and damage of any kind. Remove this protection after Architect has accepted planted areas.

3.08 ADJUSTING

A. Replace damaged plantings at no additional cost to Owner

3.09 MAINTENANCE

A. General:

1. Before beginning maintenance period, plants shall be in at least as sound, healthy, vigorous, and in approved condition as when delivered to site, unless accepted by Architect in writing at final landscape inspection.

2. Maintain landscaping from completion of landscape installation until accepted by the Architect. Areas sodded or seeded after November 1st will be accepted following spring approximately one month after the start of the growing season, May 1st or as determined by Architect, if specified conditions have been met.

3. Replace landscaping that is dead or appears unhealthy or non-vigorous as directed by Architect before end of maintenance period. Make replacements within ten (10) days of notification. Lawn that does not live and has to be replaced shall be guaranteed and maintained an additional thirty (30) days from date of replacement.

4. The Contractor is responsible for all of the maintenance and care of all landscaping and ground cover until Project closeout and accepted by the Architect.

B. Seeded Lawn:

1. Seeded lawn areas will not be accepted as complete and thirty (30) day maintenance period will not begin until it meets the requirements noted uniform stand of grass at least 3 inches tall has been obtained without any denuded or sparse areas.

2. After grass is established and 3 inches tall, mow lawn areas at least weekly to a height of 2 inches. During this period, perform work necessary to maintain a full, even stand of grass.

3. At end of thirty (30) day maintenance period, fertilize lawns as specified in Section 32 9113.

4. Apply weed killers as necessary in order to obtain weed free lawn. Apply weed killer in accordance with manufacturer’s instructions during calm weather when air temperature is between 50 and 80 deg F.

5. Seeded areas will be accepted at Project closeout if:
   a. Seeded areas are properly established.
   b. Lawn is free of bare and dead spots and is without weeds.
   c. No surface soil is visible when grass has been cut to height of 2 inches.
   d. Seeded areas have been mowed a minimum of twice.

6. Sodded Lawn:

1. Maintain sodded lawn areas until lawn Project closeout and accepted by the Architect complies with specified requirements and throughout maintenance period.

2. Water sodded areas in sufficient quantities and at required frequency to maintain sub-soil immediately under sod continuously moist 3 to 4 inches deep.

3. Cut grass first time when it reaches 3 inches high. Continue to mow at least once each week throughout maintenance period. Remove clippings.

4. Apply weed killer as necessary to maintain weed-free lawn. Apply weed killer in accordance with manufacturer’s instructions during calm weather when air temperature is between 50 and 80 deg F.

5. At end of thirty (30) day maintenance period, fertilize lawns as recommended in Section 32 9113.

6. Sodded areas will be accepted at Project closeout if:
   a. Sodded areas are properly established.
b. Sod is free of bare and dead spots and is without weeds.
c. No surface soil is visible when grass has been cut to height of 2 inches.
d. Sodded areas have been mowed a minimum of twice.

D. Trees, Shrubs, And Plants:
  1. Maintain by pruning, cultivating, and weeding as required for healthy growth.
  2. Restore planting basins.
  3. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical positions as required.
  4. Spray as required to keep trees and shrubs free of insects and disease.
  5. Provide supplemental water by hand as needed in addition to water from sprinkling system.
  6. The contractor is required to maintain the trees, shrubs, and plants for 360 days after substantial completion or until the warranty extension expires.

END OF SECTION
SECTION 32 9113
SOIL PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Soil preparation work.
B. Soil amendments.

1.02 RELATED REQUIREMENTS:
A. Section 31 1413: Topsoil Stripping And Stockpiling
B. Section 31 2200: Grading
C. Section 32 9001: Common Planting Requirements

1.03 REFERENCES
A. Reference Standards:
   1. ASTM International:
      a. ASTM D1557-09, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3).

1.04 SUBMITTALS
A. Informational Submittals:
   1. Field Quality Control Submittals:
      a. Submit tests on imported and site topsoil by licensed laboratory before use, using Owner Form ‘Topsoil Test Report’:
         1) Before use, topsoil shall meet minimum specified requirements and be approved by Architect.
         2) If necessary, submit proposed amendments and application rates necessary to bring topsoil up to minimum specified requirements.
         3) Submit report stating location of source of imported topsoil and account of recent use.

PART 2 PRODUCTS

2.01 MATERIALS
A. Topsoil:
   1. Topsoil used in landscaped areas, whether imported, stockpiled, or in place, shall be fertile, loose, friable soil meeting following criteria:
      a. Chemical Characteristics:
         1) Acidity / alkalinity range: pH 5.5 to 7.0.
         2) Soluble Salts: less than 3.0 mmhos/cm.
         3) Sodium Absorption Ratio (SAR): less than 6.0.
         4) Organic Matter: greater than one percent.
         5) Physical Characteristics:
            (a) Gradation as defined by USDA triangle of physical characteristics as measured by hydrometer.
               (1) Sand: 15 to 60 percent.
               (2) Silt: 10 to 60 percent.
               (3) Clay: 5 to 30 percent.
            (b) Clean and free from toxic minerals and chemicals, noxious weeds, rocks larger than 1-1/2 inch in any dimension, and other objectionable materials.
            (c) Soil shall not contain more than 2 percent by volume of rocks measuring over 3/32 inch in largest size.
   2. Incorporate following soil amendments into on-site topsoil used for Project:
      a. Apply two tons per acre of pulverized agricultural grade limestone (90 pounds per 1000 square feet).
b. Apply 1000 pounds per acre (23 pounds per 1000 square feet) of 10-20-20 or equivalent nutrients (nitrogen, phosphorus, potassium).

c. Apply two tons per acre of pulverized agricultural grade gypsum, calcium sulfate dihydrate, (90 pounds per 1000 square feet).

d. Equals as approved by Architect before use. See Section 01 6200.

3. Incorporate following soil amendments into off-site topsoil used for Project:
   a. Apply pulverized agricultural grade limestone as needed to reduce the acidity of the soil to within a pH 5.5 to 7.0.
   b. Apply 1000 pounds per acre (23 pounds per 1000 square feet) of 10-20-20 or equivalent nutrients (nitrogen, phosphorus, potassium).
   c. Apply two tons per acre of pulverized agricultural grade gypsum, calcium sulfate dihydrate, (90 pounds per 1000 square feet).
   d. Equals as approved by Architect before use. See Section 01 6200.

2.02 PERFORMANCE

A. Soil Amendments:
   1. Add specified soil amendments at specified rates to lawn areas.
   2. Roto-till or otherwise mix amendments evenly into top 4 inches of topsoil.
   3. Incorporate and leach soil amendments that require leaching, such as gypsum, within such time limits that soil is sufficiently dry to allow proper application of fertilizer and soil conditioners.

END OF SECTION
SECTION 32 9119
LANDSCAPE GRADING

PART 1 GENERAL
1.01 SECTION INCLUDES:
   A. Topsoil placement and finish grading work required to prepare site for installation of landscaping as described in Contract Documents.

1.02 RELATED REQUIREMENTS:
   A. Section 31 1413: Stripping and storing of existing topsoil.
   B. Section 32 9113: ‘Soil Preparation’ for topsoil preparation and soil amendments.

1.03 REFERENCES
   A. Reference Standards:
      1. ASTM International:

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION
3.01 EXAMINATION
   A. Verification Of Conditions:
      1. Do not commence work of this Section until grading tolerances specified in Section 31 2200 are met.
      2. Do not commence work of this Section until imported, stockpiled and in place topsoil are amended as specified in Section 32 9113.

3.02 PREPARATION
   A. Protection Of In-Place Conditions:
      1. Protect utilities and site elements from damage.
   B. Surface Preparation:
      1. Disk, till, or aerate with approved agricultural aerator to depth of 6 inches.
      2. Seven days maximum before beginning seeding and planting:
         a. Loosen area 4 inches deep, dampen thoroughly, and cultivate to properly break up clods and lumps.
         b. Rake area to remove clods, rocks, weeds, roots, debris or other material 1 inch or more in and dimension.
         c. Grade and shape landscape area to bring surface to true uniform planes free from irregularities and to provide drainage and proper slope to catch basins.
      3. Limit use of heavy equipment to areas no closer than 6 feet from building or other permanent structures. Use hand held tillers for preparation of subsoil in areas closer then 6 feet.

3.03 PERFORMANCE
   A. General:
      1. Limit use of heavy equipment to areas no closer than 6 feet from building or other permanent structures.
      2. Do not expose or damage existing shrub or tree roots.
   B. Finish Grade Tolerances (As shown on General Planting Details in Contract Documents):
      1. Total topsoil depth of 4 inches minimum in lawn and groundcover planting areas. No topsoil as defined in this Section required over tree and shrub planting areas.
      2. Finish grade of planting areas before planting and after addition of soil additives shall be specified distances below top of adjacent pavement of any kind:
         a. Ground Cover Areas: 2 inches below.
b. Seeded Areas: One inch below.
c. Sodded Areas: 2 inches below.
d. Tree and Shrub Areas (not individual trees): 4 inches below.

C. Imported Topsoil:
   1. Place tested and approved topsoil:
      a. Remove organic material, rocks and clods greater than 1-1/2 inch in any dimension, and other objectionable materials.
      b. Provide amounts as required to bring surface to specified elevation relative to concrete site elements.
      c. Do not place topsoil whose moisture content makes it prone to compaction during placement process.
      d. Do not place topsoil when subgrade is either wet or frozen enough to cause clodding.

D. Stockpiled Topsoil:
   1. Redistribute tested and approved existing topsoil stored on site as a result of work of Section 31 1413.
      a. Remove organic material, rocks and clods greater than 1-1/2 inch in any dimension, and other objectionable materials.
      b. Provide additional approved imported topsoil as required to bring surface to specified elevation relative to concrete site elements.
      c. Do not place topsoil whose moisture content makes it prone to compaction during placement process.
      d. Do not place topsoil when subgrade is either wet or frozen enough to cause clodding.

E. In Place Topsoil:
   1. At locations where topsoil can remain in place and has been tested and approved, perform the following:
      a. Remove existing vegetation as required in preparation for new landscaping.
      b. Remove organic material, rocks and clods greater than 1-1/2 inch in any dimension, and other objectionable materials.
      c. Provide additional approved imported topsoil as required to bring surface to specified elevation relative to concrete site elements.
      d. Do not place topsoil whose moisture content makes it prone to compaction during placement process.
      e. Do not place topsoil when subgrade is either wet or frozen enough to cause clodding.

F. Grading:
   1. Slope grade away from building for 12 feet minimum from walls at slope of 1/2 inch in 12 inches minimum unless otherwise noted.
      a. High point of finish grade at building foundation shall be 6 inches minimum below finish floor level.
      b. Direct surface drainage in manner indicated on Contract Documents by molding surface to facilitate natural run-off of water.
      c. Fill low spots and pockets with topsoil and grade to drain properly.

G. Immediately before planting lawn and with topsoil in semi-dry condition, roll areas that are to receive lawn in two directions at approximately right angles with water ballast roller weighing 100 to 300 lbs, depending on soil type.
   1. Rake or scarify and cut or fill irregularities that develop as required until area is true and uniform, free from lumps, depressions, and irregularities.

3.04 PROTECTION
   A. After landscape areas have been prepared, take no heavy objects over them except lawn rollers.

END OF SECTION
SECTION 32 9120
TOPSOIL PLACEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Topsoil placement required for topsoil grading as described in Contract Documents.

1.02 RELATED REQUIREMENTS:
A. Section 31 1413: Stripping and storing of existing topsoil.
B. Section 31 2200: Grading
C. Section 32 9001: Common Planting Requirements
D. Section 32 9113: Soil Preparation
E. Section 32 9121: Topsoil Grading

1.03 REFERENCES
A. Reference Standards:
   1. ASTM International:

PART 2 PRODUCTS

2.01 PRODUCTS NOT USED

PART 3 EXECUTION

3.01 EXAMINATION
A. Verification Of Conditions:
   1. Do not commence work of this Section until grading tolerances specified in Section 31 2200 are met.
   2. Do not commence work of this Section until imported, stockpiled and in place topsoil are amended as specified in Section 32 9113.
   3. Receive approval from the Architect of subgrade elevations prior to commencement of this Work.

3.02 PREPARATION
A. Protection Of In-Place Conditions:
   1. Protect utilities and site elements from damage.
B. Surface Preparation:
   1. Surfaces to receive Imported and Stockpiled Topsoil:
      a. Disk, till, or aerate with approved agricultural aerator to depth of 6 inches.
      b. Place specified and approved topsoil on prepared surface.

3.03 PERFORMANCE
A. General:
   1. Limit use of heavy equipment to areas no closer than 6 feet from building or other permanent structures. Use hand held tillers for preparation of subsoil in areas closer than 6 feet.
   2. Do not expose or damage existing shrub or tree roots.

B. Topsoil Depth:
   1. Total topsoil depth of 4 inches minimum in lawn and groundcover planting areas.
   2. No topsoil as defined in this Section is required over tree and shrub planting areas or native grass, shrub, or tree areas as long as what is in place is not excessively rocky or otherwise unconducive to healthy plant growth.

C. Stockpiled Topsoil:
1. Redistribute tested and approved existing topsoil stored on site as a result of work of Section 31 1413.
   a. Remove organic material, rocks and clods greater than 1-1/2 inch in any dimension, and other objectionable materials.
   b. Provide additional approved imported topsoil as required to bring surface to specified elevation relative to concrete site elements.
   c. Do not place topsoil whose moisture content makes it prone to compaction during placement process.
   d. Do not place topsoil when subgrade is either wet or frozen enough to cause clodding.

D. In Place Topsoil:
1. At locations where topsoil can remain in place and has been tested and approved, perform the following:
   a. Remove existing vegetation as required in preparation for new landscaping.
   b. Remove organic material, rocks and clods greater than 1-1/2 inch in any dimension, and other objectionable materials.
   c. Provide additional approved imported topsoil as required to bring surface to specified elevation relative to concrete site elements.
   d. Do not place topsoil whose moisture content makes it prone to compaction during placement process.
   e. Do not place topsoil when subgrade is either wet or frozen enough to cause clodding.

E. Grading:
1. Slope grade away from building for 12 feet minimum from walls at slope of 1/2 inch in 12 inches ) minimum unless otherwise noted.
   a. High point of finish grade at building foundation shall be 6 inches minimum below finish floor level.
   b. Direct surface drainage in manner indicated on Contract Documents by molding surface to facilitate natural run-off of water.
   c. Fill low spots and pockets with topsoil and grade to drain properly.

END OF SECTION
SECTION 32 9222
HYDRO-SEEDING

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Hydro-seeded specialty seed mixes as described in Contract Documents.

1.02 RELATED REQUIREMENTS:
   A. Section 32 9001: Common Planting Requirements
   B. Section 32 9113: Soil Preparation
   C. Section 32 9119: Landscape Grading
   D. Section 32 9120: Topsoil Placement
   E. Section 32 9300: Plants

1.03 SUBMITTALS
   A. Informational Submittals:
      1. Source Quality Control Submittals:
         a. Written certification from supplier confirming seed mix, guaranteed analysis, germination rate, and purity rate.

1.04 QUALITY ASSURANCE
   A. Regulatory Agency Sustainability Approvals:
      1. Chemicals used shall meet requirements of latest rules and regulations, and other applicable state or local laws. Nothing in Contract Documents is to be construed to permit use of chemicals not conforming to these codes.
      2. Label seed in accordance with USDA rules and regulations under Federal Seed Act.

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Delivery And Acceptance Requirements:
      1. Supply wood cellulose fiber mulch compressed in 50 lb packages.

PART 2 PRODUCTS

2.01 MATERIALS
   A. Seed:
      1. Type and mix shown on Drawings.
      2. Seed shall be weed free, fresh, re-cleaned, Grade A, new crop.
   B. Hydro-Mulch:
      1. Cellulose wood fiber with no growth or germination inhibiting factors, dyed green. Material shall have equilibrium air-dry moisture content of 12 percent, plus or minus 2 percent, at time of manufacture.
      2. Fiber shall disperse rapidly in water forming homogeneous slurry and remaining in such state when agitated in hydro-mulching equipment.
   C. Binders:
      1. Tackifier to bind soil and mulch together to prevent erosion.
      2. Type Two Acceptable Products:
         a. Am-Tac by AZ-TAC Products Inc,
         c. Equal as approved by Architect before use. See Section 01 6200.
   D. Fungicide:
      1. Type Two Acceptable Products:
         a. Banol by Nor-Am Chemical Co.
         b. Equal as approved by Architect before use. See Section 01 6000.
2.02 MIXES

A. General:
   1. Amount of hydro-mulch shall be 1800 lbs per acre.
   2. Add water as necessary to provide suitable slurry mixture.
   3. Add fungicide at rates recommended by Manufacturer on installations made between 1st of April and 30 September.

B. Turf / Specialty Seeded Areas:
   1. Amount of seed specified on plan sheets
   2. Add fertilizer at 10 lbs (4.5 kg) per 1,000 sq ft (93 sq m), only for areas not receiving fertilizer under Section 32 9113.
   3. Add binder at rates recommended by Manufacturer always where slopes are 5:1 or over, and all other areas between 1st of October and 31 March.

C. Slope Stabilization Seeded Areas:
   1. Amount of seed specified on plan sheets
   2. Add fertilizer at 10 lbs per 1,000 sq ft.
   3. Add binder at rates recommended by Manufacturer always on slopes 5:1 and over.

PART 3 EXECUTION

3.01 APPLICATION

A. Interface With Other Work:
   1. Do not commence work of this Section until work of Sections 32 9113 and 32 9300 have been completed and approved.

B. Tolerances:
   1. Final grade of soil after seeding of lawn areas is complete shall be one inch below top of adjacent pavement of any kind.

C. After lawn areas are graded, apply specified slurry mix with machine capable of continuously mixing slurry and providing an application meeting Contract Document requirements. Hydro-mulch shall form an absorptive mat, but not a plant inhibiting membrane, which will allow water to percolate into underlying soil.

D. Post Application Watering:
   1. Allow slurry mixture to 'set.'
   2. Water hydro-seeded areas sufficiently to insure proper seed germination, but not cause erosion or slope failure. Repeat watering at regular intervals to keep seed germinating and growing until plantings are established.
   3. After plantings are established, decrease frequency and increase amount of water per application as necessary to meet plant water requirements.

E. If fungicide has been applied with slurry mix, make a second application of fungicide 14 days after initial application.

3.02 FIELD QUALITY CONTROL

A. Field Inspections:
   1. Seeded areas will be accepted at final inspection if:
      a. Seeded areas are properly established.
      b. Lawn is free of bare and dead spots and is without weeds.
      c. No surface soil is visible when grass has been cut to height of 2 inches.
      d. Seeded areas have been mowed a minimum of twice.

END OF SECTION
SECTION 32 9350
PLANT MAINTENANCE

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Maintenance for new landscaping

1.02 RELATED SECTIONS:
   A. Section 32 9001: Common Planting Requirements.

PART 3 EXECUTION

2.01 PERFORMANCE
   A. General:
      1. Before beginning maintenance period, plants shall be in at least as sound, healthy, vigorous, and in approved condition as when delivered to site, unless accepted by Architect in writing at final landscape inspection
      2. Maintain landscaping from completion of landscape installation to 30 days after acceptance by the Architect.
      3. Replace landscaping that is dead or appears unhealthy or non-vigorous as directed by Architect at end of maintenance period. Make replacements within 10 days of notification. Lawn that does not live and has to be replaced shall be guaranteed and maintained an additional 60 days from date of replacement.

   B. Seeded Lawn:
      1. Seeded lawn areas will not be accepted as complete and the 60 day maintenance period will not begin until uniform stand of grass at least 3 inches tall has been obtained.
      2. After grass is established and 3 inches tall, mow lawn areas at least weekly to a height of 2 inches. During this period, perform work necessary to maintain a full, even stand of grass.
      3. At end of 60 days of maintenance period, fertilize lawns with 16-16-8 at rate recommended by Fertilizer Manufacturer.
      4. Apply weed killers as necessary in order to obtain weed free lawn. Apply weed killer in accordance with manufacturer's instructions during calm weather when air temperature is between 50 and 80 deg F.

   C. Sodded Lawn:
      1. Maintain sodded lawn areas until lawn complies with specified requirements and throughout maintenance period.
      2. Water sodded areas in sufficient quantities and at required frequency to maintain sub-soil immediately under sod continuously moist 3 to 4 inches deep.
      3. Cut grass first time when it reaches 3 inches high. Continue to mow at least once each week throughout maintenance period. Remove clippings.
      4. Apply weed killer as necessary to maintain weed-free lawn. Apply weed killer in accordance with manufacturer's instructions during calm weather when air temperature is between 50 and 80 deg F.
      5. At end of 60 day maintenance period, fertilize lawns with 16-16-8 at rate recommended by Fertilizer Manufacturer.

   D. Trees, Shrubs, And Plants:
      1. Maintain by pruning, cultivating, and weeding as required for healthy growth.
      2. Restore planting basins.
      3. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical positions as required.
      4. Spray as required to keep trees and shrubs free of insects and disease.
      5. Provide supplemental water by hand as needed in addition to water from sprinkling system.

END OF SECTION
PART 1 - GENERAL

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

1.02 SUMMARY
   A. Section Includes: Every item of labor, materials, equipment and appurtenances for installing Fire Suppressions Systems included in Division 21 of the Specifications and shown on the Drawings.
   B. Related Sections:
      1. Section 21 13 13 – Wet-Pipe Sprinkler Systems
      2. Division 26 – Electrical
      3. Section 28 31 00 – Fire Detection and Alarm
   C. The Fire Suppression Drawings are diagrammatic in nature and show the general arrangement of all piping, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. Because of the small scale of the Drawings, it is not feasible to indicate all offsets, fittings and accessories that may be required. The Contractor shall investigate the construction conditions affecting the work and provide fittings and accessories as required to meet actual conditions.
   D. Where discrepancies in scope of work as to which Trade provides specific items, such as starters, disconnects, flow switches, electrical control components, etc. exist, such conflicts shall be reported to the Engineer. If such action is not taken, the Contractor, as applicable, shall furnish such items as part of his work, for complete and operable systems and equipment, as determined by the Engineer.

1.03 REGULATIONS AND STANDARDS
   A. The completed installation and all materials and equipment shall conform to local ordinances and codes, other regulations and standards listed herein or in related sections. These are intended as a minimum and shall be exceeded if required by the specifications or the Drawings. In the event of conflict between the codes, standards, or regulations, and information contained in the Contract Documents, the applicable code, standards, or regulation shall take precedence.

1.04 INSPECTION CERTIFICATES
   A. The Contractor shall furnish three copies of certificates of final acceptance to the Engineer from all inspection authorities having jurisdiction.

1.05 SUBSTANTIAL COMPLETION INSPECTION
   A. The Engineer will visit the site for the purpose of conducting a substantial completion inspection once the following items have been met by the Contractor:
      1. All fire protection systems shall be complete, operational and under automatic control.
      2. Fire suppression systems cleaning and testing shall be complete and the final report shall be approved by the Engineer.
   B. All discrepancies noted in the substantial completion report shall be corrected prior to the final inspection. The Contractor shall provide a detailed item-by-item description of all corrections made for each item on the substantial completion discrepancy list prior to scheduling final inspection by the Engineer. Additional visits required after the final inspection, for the reason that previously documented discrepancies had not been corrected at the time of the final inspection, will be made at the Contractor’s expense.

1.06 ASBESTOS
   A. Asbestos Free Materials: The intention of these Drawings and specifications is that there are no asbestos-containing materials installed on this project. To the best of the Architects and
Engineers knowledge, none of the material or equipment specified herein or shown on the Drawings contains asbestos. The Contractor shall make every effort to prevent any asbestos materials from being installed in or used on the construction of the project. At the completion of the project, the Contractor shall certify by letter that to the best of his knowledge, no asbestos-containing materials were used for or in the construction of this project.

B. Existing Materials:
1. Contractor shall review the Owners asbestos management plan to ensure suspected asbestos containing materials are under surveillance.
2. Discovery: If during the construction of this project, work involving friable asbestos is suspected, or encountered, all work in this area shall be discontinued and the Owner or the Owner’s representative, shall be notified immediately and the Owner with his own forces or by separate contract shall be responsible for complete investigation, removal, and disposition of the friable asbestos hazard in accordance with applicable laws and regulations. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, he shall make such claim as provided elsewhere in the Contract Documents.
3. Removal: All work involving the removal of friable asbestos will be done under a separate contract.

1.07 MATERIALS AND WORKMANSHIP

A. Equipment and material used in the project shall be new and undamaged. The fire suppression installation shall fit into the space allotted and shall allow adequate and acceptable clearances for entry, servicing and maintenance. Similar types of equipment shall be the products of the same manufacturer unless specified otherwise. Work shall be performed by mechanics or tradesmen skilled in the trade involved.

B. All piping and equipment shall be installed in a neat and organized manner, parallel to other work and the nearest building elements, unless specifically shown otherwise on the Drawings.

1.08 SUBMITTALS

A. Submit shop drawings, product data, hydraulic calculations and samples in accordance with Division 01 for all items marked [S][TD] as specified in related sections of these specifications. Submittals not required by the Contract Documents will not be reviewed. One (1) copy of the submittal, in pdf format, shall be submitted. One (1) copy of the submittal, in pdf format, will be returned to the Contractor. If additional copies are required, they will be the responsibility of the Contractor. One copy of approved submittals shall be turned over to the Commissioning Agent by the Contractor. If additional copies are required, they will be the responsibility of the Contractor. Where drawings are submitted, Contractor shall submit one (1) electronic copy, in pdf format. The electronic copy will be marked with the Owner, Architect and Engineer each retaining one (1) copy for their records. The file will be returned to the Contractor and the Contractor shall be responsible for all additional copies required for his use. All submittal data shall be correctly identified to show project name, and the exact model, style or size of item being submitted. Improperly identified submittals will not be reviewed by the Engineer. Each item submitted for review shall bear the Subcontractor’s stamp which states that they have reviewed the submission, that it is complete, and that in their opinion it meets the contract requirements. Contractor’s stamp shall identify the specification section, paragraph and page number for which the submittal is being made. Shop drawings will be reviewed only for general compliance with the Contract Documents. Review will not include correctness of details, proper configuration, utility connections, dimensions, sizes, quantities, and the like. Any submission which has not been reviewed and stamped by the Fire Suppression System Subcontractor will not be reviewed by the Engineer. No reviews prior to award of Contract will be considered or accepted.

C. When the Contractor is satisfied that the construction design is complete and code compliant, then the Shop Drawings, Product Data and Calculations shall be submitted to the Architect-Engineer of Record and shall be reviewed and approved before any piping or equipment is
installed. Re-submissions of the Shop Drawings, Product Data and Calculations shall include the entire original submittal. **Partial submittals or re-submittals will not be reviewed by the Engineer of Record.**

D. Submissions will be stamped by the Engineer in one of the following ways:

- "No Exceptions Taken" No exceptions are taken and subject to compliance with the Contract Documents.
- "Make Corrections Noted" Minor corrections are noted and a re-submittal is not required subject to compliance with the corrections and the Contract Documents.
- "Correct and Resubmit " The submitted material, method or system meets the intent of the specifications, yet has insufficient data to determine compliance with the Contract Documents. Re-submittal is required.
- "Rejected " The submitted material, method or systems does not meet the intent of the specifications or the contract documents. Complete re-submittal is required.

E. Submission Procedures:

1. If a submission is satisfactory to the Engineer, the Engineer will annotate the submission, "No Exceptions Taken" or "Make Corrections Noted" and transmit one (1) copy, in pdf format, to the Contractor. If a resubmission is required, the Engineer will annotate the submission "Correct and Resubmit" or "Rejected" and transmit one (1) copy, in pdf format, to the Contractor for appropriate action.

2. The Contractor shall revise and resubmit submissions as required by the Engineer until submissions are acceptable to the Engineer.

3. Approval of a working and/or shop drawings by the Engineer will constitute acceptance of the subject matter for which the drawing was submitted and not for any other structure, material, equipment or appurtenances indicated as shown.

4. The Engineer's review of the Contractor's submissions shall in no way relieve the Contractor of any of his responsibilities under the Contract. An approval of a submission shall be interpreted to mean that the Engineer has no specific objections to the submitted material, subject to conformance with the Contract Documents.

5. Where as-built drawings, record drawings and specifications are available and when provided to the Contractor for use in performing the work, the Contractor shall verify the content of such drawings and specifications, the suitability of their use in performing the work and their accuracy for the purposes in which the Contractor intends to use any record or historical documents which may be obtained. In no case shall the Contractor assume that such documents reflect a true and accurate record of the construction. Acceptance of any such materials, records, and/or drawings shall in no way result in additional cost to the Owner should an error and/or omission in these documents result in additional costs to the Contractor.

G. Equivalents: Manufacturers, trade names, and model numbers indicated herein and on Drawings shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Unless definitely stated otherwise and upon complying with Division 01, the Contractor may use any article which, in his judgment is equal to that specified and is accepted by the Engineer. Manufacturers listed first in these specifications and on Drawings were used as a basis of design. It will be the responsibility of the Contractor to verify all connections, physical sizes, capacities, etc. of all other manufacturer’s items, both named and proposed. If the equipment necessitates changes in ductwork, piping, wiring or other building systems from that indicated on the Drawings, the Contractor shall be responsible for all additional costs included and notify other trades. Where such changes are required, detail
drawings indicating all required changes shall be submitted for review at the same time the manufacturers drawings are submitted for approval.

H. Operation and Maintenance manual(s) shall be submitted in accordance with Division 01, this section; and shall include a complete product index in each volume, installation and maintenance data, parts lists, a copy of all approved shop drawings, product data hydraulic calculations and the name, address and telephone number of supplier or nearest representative. In addition to the above two (2) copies of the latest edition of NFPA No. 25 booklet “Standard for Inspection, Testing and Maintenance of Water Based Fire Protection Systems” shall be turned over to the Owner at the time of his instructions on the operation and maintenance of the Fire Suppression System. All devices, equipment and systems marked [O/M] in these specifications shall be included with all other such items that will require servicing before the duration of its useful life has been reached. Manual(s) shall be presented to the Engineer for review and transmittal to the Owner before final payment is recommended.

1.09 WARRANTY

A. Comply with Division 01 for warranty requirements.

B. Information on all warranties shall be included in the O&M Manuals specified herein to be provided to the Owner.

1.10 FIRE FLOW TESTS

A. As soon as practical after award of contract and prior to the preparation of approval or installation drawings, or doing fabrication or installation of any work, the Contractor shall make necessary arrangements to have flow tests made to determine the adequacy of the water supply system. Any revisions or adjustments to systems as indicated on the drawings which are necessitated by the results of the flow test and which changes are required to obtain approval by the Authorities having jurisdiction shall be made subject to Owner’s approval and the contract price adjusted accordingly.

1.12 COORDINATION OF WORK:

A. General: The Contract Documents indicate the extent and general arrangement of the fire suppression systems. The Contractor shall be responsible for the coordination and proper relation of the fire suppression work to the building structure and to the work of other trades. No additional compensation or extension of completion time will be granted for extra work caused by the lack of coordination.

B. Cooperation: The Contractor shall provide dimensions and locations of all openings, shafts and similar items to the proper trades and install work as required so as not to interfere with, or delay, the building construction.

C. Locations of lines and equipment shall be determined from actual field measurements. The outlines of the building shown on the Drawings are intended only as a guide to indicate relative locations of the work. Refer to Architectural and Structural Drawings for building construction details. The Contractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component. Accurate measurements and coordination shall be completed to verify dimensions and characteristics for the installation of each system.

D. Unless necessitated by equipment access or otherwise indicated in the Contract Documents, all equipment, piping, and conduit concealed above ceilings and in finished or utility spaces shall be routed as high as possible.

E. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The Fire Suppression System Subcontractor shall provide manual drains as required for his work to affect these offsets, transitions and changes in direction, as applicable.

F. Comply with Division 01 requirements for cutting and patching.

G. Roughing-In: Verify the locations of machines, door swings, block coursing, alignment of tile end and other similar features before roughing-in.
H. Fire Suppression System piping shall be concealed except in rooms or spaces without ceilings, and the equipment rooms and as indicated otherwise. Sprinkler heads in ceilings shall be located as indicated on the drawings. The Fire Suppression System Subcontractor shall give due consideration to minimize conflicts, and coordinate, with other trades as to location of equipment, piping, conduits, ductwork, grilles, diffusers, electrical switchgear, panelboards, light fixtures, etc. Full access and clearance requirements around equipment of all other trades shall be maintained.

I. Damage to Other Work: Each Contractor is responsible for damage to other work caused by his work or workmen. Repairing of damaged work shall be done by the Subcontractor who installed the work, and as directed by the Architect-Engineer; the cost of which shall be paid for by the Subcontractor responsible for the damage.

1.13 EQUIPMENT INSTALLATION

A. General: Equipment shall be installed in accordance with manufacturer’s instructions to conform to the details and application indicated.

B. Supports: Provide necessary supports for all equipment and appurtenances as required; this includes but is not limited to frames or supports for items such as tanks, air compressors, pumps, valves and other similar items requiring supports. Floor mounted equipment in Equipment Rooms shall be set on 4-inch high concrete foundation pads unless shown otherwise. All pads shall be poured such that the top of the pad is level. Foundation drawings, bolt setting information and foundation bolts shall be furnished by the equipment suppliers furnishing the equipment for all equipment required to have concrete foundations. Concrete for foundations shall be provided by the Fire Suppression System Subcontractor unless indicated otherwise. Except where indicated, all equipment shall be anchored to concrete pads.

C. Service Area: All equipment and appurtenances shall be located to permit adequate service clearance in accordance with manufacturer's recommendations and as otherwise required. Service clearance shall include but not be limited to adequate space for inspection, servicing, testing and removal of Fire Protection System including motors, controls and equipment. All piping and other equipment shall be located outside of the service area or shall be flanged for easy removal to facilitate equipment service. All equipment shall be located with sufficient distance from building features, structural components, and the equipment of other trades. Service clearance in front of electrical panels shall be the minimum as required by National Electric Code (NEC) where applicable.

D. Temporary Requirements: Openings in equipment shall be kept plugged at all times until connection is made to the system. The ends of all pipes and equipment openings shall be kept plugged or capped properly with approved devices. Approved devices are items such as specially molded plastic caps, pipe plugs, test plugs and sheet metal caps.

1.14 SLEEVES AND INSERTS:

A. General: Sleeves and inserts shall be provided and correctly located in the structure, as require for the work.

B. Inserts shall be steel and proper size for loads encountered.

C. Sleeves shall be provided for all pipes passing through concrete or masonry walls, partitions, concrete slabs installed during construction of the wall, partition or slab. Sleeves through existing concrete walls and slabs may be omitted if wall or slab can be core drilled and properly sealed in a manner acceptable to the Engineer. Sleeves placed horizontally in walls shall be standard weight ASTM A53 steel pipe of length equal to the thickness of the wall. Sleeves placed vertically in non-waterproof floors shall be 20 gauge galvanized sheet steel of length equal to thickness of slab, flared and nailed to the form, or fastened to reinforcing fabric and filled with sand during pouring to prevent deformation. Sleeves occurring in floors of rooms where hose bibs or floor drains occur, and in pipe spaces, shall be standard weight steel pipe projecting 2” above the finished floor except in Equipment Rooms they shall project four (4) inches above floor. Sleeves in floors with waterproof membrane shall be provided with flanges or flashing rings and shall be clamped or flashed into membrane. All sleeves and core drilled
openings shall be of sufficient diameter to clear bare or covered pipes by 1/4” all around except sleeves on lines subject to movement by expansion which shall clear the bare pipe or insulation on insulated pipe at least one inch all around. Pipes through exterior walls below grade and above footings shall be installed in sleeves having a minimum size of two larger pipe diameters and sealed watertight with flexible synthetic rubber seals. Sleeve shall have anchor and water stop plate. The entire assembly shall be tightened and adjusted and made watertight. Sleeves for pipes and conduit, penetrating fire (and smoke) rated partitions, walls and floors shall be sealed in accordance with the terms of U.L. Listed Through-Penetration Firestop Systems XHEZ as published in the U.L. Fire Resistance Directory. Penetrations shall exactly conform to details of the Firestop System indicated for the type of partition, wall and floor construction encountered. All penetrations through nonfireresistance rated floor assemblies and through the ceiling membrane of nonfireresistance rated roof assemblies shall be fireblocked with tightly packed mineral-wool insulation secured in place. All penetrations through equipment room walls and other areas of noise or heat generation shall be tightly sealed with mineral fiber rope. All penetrations through draftstop partitions shall be sealed to maintain the integrity of the partition. All firestopping and draftstopping of sleeves for fire suppression work shall be provided under Division 21.

1.15 ESCUTCHEONS

A. Where pipes pass through floors, walls or ceilings in finished rooms, they shall be fitted with chromium plated escutcheons of suitable pattern to effectively cover the rough opening. Where sleeves project above floors, special deep type escutcheons shall be provided.

1.16 ACCESS DOORS

A. Provide for all concealed valves or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for fire suppression work shall be furnished as a part of this Division 21 to the General Contractor for installation. The Fire Suppression Subcontractor shall provide locations of all access doors such that service may be safely performed from a ladder, lift, or platform without the need for support from the ceiling system. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable. Doors shall be metal access doors with cam lock, style to match ceiling or wall construction. Doors occurring in rated construction shall be fire rated U.L. labeled access doors correlated to preserve the integrity of the rated construction. Doors shall be prime finish steel except those in toilets, shower rooms, locker rooms, kitchens and other similar areas shall be stainless steel with brushed finish.

1.17 ELECTRICAL WIRING AND EQUIPMENT:

A. Motors shall be provided in place as an integral part of the driven equipment, ready for electrical connections. Motors shall be in accordance with NEMA Standards and of design suitable for the starting and running characteristics of the driven equipment. Minimum efficiencies of motors shall be “nominal” efficiency as indicated in ASHRAE Standard 90.1-1989 as amended by 90.1c-1993 (i.e.: 1 HP, 82.5%; 5 HP, 87.5%; 10 HP, 89.5%; 20 HP, 91%; 50 HP, 93%) and shall meet or exceed those contained in NEMA MG1-1993, Table 10-12.

B. All three phase motors over 5 HP shall be provided with minimum power factor of 90%. Power factor correction capacitors shall be provided if required and shall be furnished to the electrical subcontractor for installation. Shop Drawing submittals for motors over 5 HP shall list efficiency and power factor. Unless specified otherwise, all motors shall have continuous duty classification, 40° Centigrade ambient temperature, shall have enclosure suitable for indicated application and shall be wound for 120 volt, single phase, 60 cycle current, except motors above 1/2 horsepower (unless indicated otherwise) shall be wound for 200V or 230V/460V as required by the secondary voltage specified for main service in Division 26. Each motor shall be selected and rated at the voltage indicated so that the driven load does not exceed the nameplate rating and service factor of the motor. All motors 460V/480V 20 HP and above and 208V/230V 10 HP and above shall be wound for wye delta (6 or 12 lead) starting with capabilities of being wired for across-the-line starting. Motors for use with variable frequency
drives (VFD) shall be wound for across-the-line type starting and shall be rated for “VFD-duty” or shall be Premium Efficiency type with Class F (1500 volt) insulation and thermal overload protection. Motors for VFD applications shall meet or exceed IEEE 519-1992. Motors for VFD applications shall have maximum 4:1 speed range corresponding to 60 Hz and 15 Hz. Power factor correction is not required when motor is used with VFD. Motors for VFD service shall be Inverter Duty Rated with internal shaft grounding to prevent common mode voltage (shaft current) bearing failures. Where 2-speed motors are indicated for motors above 1/2 horsepower, motors shall have two separate windings.

C. Motor starters and motor protective switches shall be provided under Division 26 except where specified to be furnished specifically with the driven equipment. Accessories such as auxiliary contacts, hand-off-automatic switches, start-stop switches, pilot lights, control power transformers and other similar items shall be provided in or on the controllers as required by the control sequence indicated. Starting equipment, unless factory mounted on the equipment, shall be installed under Division 26.

D. Wiring, low voltage (100 volts or less) control wiring shall be provided as a part of Section 28 31 00 “Fire Detection and Alarm”. Verify that wiring of all motors and controls required by equipment furnished is accomplished for the correct sequence of operation.

E. Comply with Division 26 requirements for wiring, line voltage (101 volts or higher) power or control wiring. Items shall be provided under Division 26.

F. Disconnects shall be provided for each item of equipment under Division 26, unless specified otherwise in other sections.

G. Miscellaneous manual or automatic control and protective or signal devices required for the sequence of operation indicated for fire suppression equipment shall be provided under the section of the specifications where the item of equipment is specified unless indicated otherwise.

1.18 PROTECTION FROM MOVING PARTS

A. Belts, pulleys, chains, gears, shafts, couplings and other rotating or moving parts located so that any person may come in close proximity thereto shall be fully enclosed or properly guarded.

1.19 MARKING AND DESIGNATION OF EQUIPMENT

A. After all other painting is completed, operating and control parts of the equipment and systems such as valves disconnect switches, motor starters and control devices shall be properly marked. Valve markers shall be metal tags with designations stamped thereon, securely chained to the respective valve. Starters disconnect switches and pneumatic or electric control instruments shall be marked with laminated engraved plastic nameplates fastened with sheet metal screws, bolts or permanent adhesive. Pressure sensitive tape is not acceptable. Identification symbols or designations shall be the same as shown on the Contract Documents.

1.20 CHARTS AND DIAGRAMS

A. General: Material as listed below shall be provided by the Contractor and shall be mounted in separate hardwood frames where directed in the field or folded and stored in a plastic document folder and located in the control cabinets. All charts, diagrams and schemes shall be photographic positives prepared from original tracings. A copy of charts and diagrams shall be included with O/M manuals.

B. Charts for identification of valves.

1.21 INSTRUCTION OF OWNER’S REPRESENTATIVE

A. Contractors shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the Fire Suppression Systems. Competent representatives of the Contractor shall spend such time as necessary to fully prepare the Owner to operate and maintain the Mechanical and Electrical systems.

1.22 CONSTRUCTION STATUS REPORT
A. Each item of discrepancies noted on Construction Status Report prepared by the Engineer shall be answered in detail in writing by the Contractor before payment can be recommended.

1.23 GRAPHICS DATABASE
A. This project’s Computer Aided Design & Drafting (CADD) drawing files may be obtained from the Engineer for use in preparing computer graphics specific to this project. Refer to Division 1. Refer to Appendix A at the end of this Section for letter of Indemnification and ordering instructions.

1.24 DEMOLITION
A. Contractor shall visit site before bidding to determine extent of demolition.

1.25 PHASING OF WORK
A. Coordinate phasing requirements with Division 01.

1.26 LIMITS OF CONTRACT
A. Fire Suppression System piping shall be extended as shown on the drawings.

1.27 TESTING OF WORK
A. Partial Testing: As much as practical, systems shall be tested as complete systems. Tests on portions of a system will be permitted to facilitate proper progress scheduling. When systems are tested in segments, a system diagram indicating portion tested and a separate and complete report including the date of test is required for each segment.
B. Concealed Work:
   1. All concealed work shall be tested and approved by the Architect/Engineer prior to the application of insulation or construction of chase walls.
   2. Covering shall not be applied to any piping nor shall any piping be concealed or covered until pipes have been tested, all leaks stopped, retested and approved
C. Fire Suppression System Testing:
   1. Perform and pay for all tests as may be required in the applicable NFPA Standards and as specified herein and as may be required by Authorities having jurisdiction. Any defects shall be corrected to the satisfaction of the Authorities having jurisdiction and the Architect-Engineer.
   2. The Fire Suppression System provided shall be tested according to NFPA-13 Chapter 24 “Systems Acceptance”.

PART 2 - PRODUCTS
2.01 PAINTING
A. Acceptable manufacturers: Except as otherwise specified, materials shall be the products of the following manufacturers:

   Sherwin-Williams
   Pratt and Lambert
   Pittsburgh Paints (PPG)
   Benjamin Moore
   Porter Paints
   Seton Identification Products
B. Materials:
   1. Deliver all paints and materials to the project site in their unopened original containers with all labels intact and legible at the time of use.
2. For adhesives and sealants applied within the building waterproofing envelope, comply with low emitting requirements in Division 01, section, “Indoor Air Quality Requirements.”

3. Sherwin-Williams Industrial Maintenance Coatings System 4000 products are listed below to establish color and a standard of quality.
   a. All Hangers and Supports: One coat Pro-Industrial Zero VOC Acrylic Gloss Black.
   b. Piping: Exposed in equipment rooms and where connections are made to equipment located in storage rooms and other utility type areas.
      (1) Priming:
         a) Bare Iron or Steel or Copper: One coat Pro-Cryl Primer (1000g/L).
         b) Galvanized Steel: Pipes and ductwork shall be chemically prepared and primed with one coat of Galvite B50W3 Primer.
      (2) Finish: All pipe lines and the supports or hangers therefore, shall be finished with Pro–Industrial Zero VOC Acrylic Gloss, gray No. SW4028 Gypsum applied in sufficient number of coats to effectively cover the prime coat. Painting of pipe hangers is specified hereinbefore.

PART 3 - EXECUTION

3.01 PAINTING

A. Workmanship: The work shall be accomplished by qualified mechanics skilled in the painting trade. Painting of equipment, piping and other materials shall not commence until all testing is complete and systems are ready for operation. Materials shall be applied according to manufacturer's directions. All containers shall be securely closed when not in use. Flammable materials shall not be stored on premises. Flammable waste shall be disposed of daily in devices approved for such purposes. Materials shall be evenly spread, and smoothly flowed on without runs or sags. Each coat shall be thoroughly dry before application of succeeding coats.

B. Protection of Work: The painters shall protect all adjacent surfaces with drop covers during the process of painting. Upon completion, paint spots, if any, shall be removed from all surfaces. Sprinkler heads shall not be painted.

C. Preparation of Surface: Surfaces to be painted shall be completely dry before applying paint. Metal surfaces shall be cleaned with mineral spirits before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be chemically pretreated with crystalline (zinc phosphate) phosphate in strict accordance with the manufacturer’s recommendations. Surfaces shall not be painted when the temperature is, or is likely to be, near the freezing point, or when they are exposed to hot sun.

3.02 IDENTIFICATION OF PIPES AND EQUIPMENT

A. Equipment: After all other painting is completed; each major item of equipment shall be properly identified with laminated engraved plastic nameplates fastened with sheet metal screws, bolts or permanent adhesive. Identification symbols and designations shall be the same as shown on the Contract Documents. Where equipment or valves are installed above lay-in ceilings the plastic nameplate shall be adhered to the face of the T-bar support so that it can be identified from within the space.

B. Piping: All piping shall be identified with Seton Ultra-Mark or equal wrap around piping system markers and arrow flow directional marker. Markers shall be pre-coiled, semi-rigid plastic or
C. Apply piping system markers after completion of required finishes on piping systems. Markers shall be applied in the following locations and where identified by the Engineer:

1. At each valve and at connection to equipment.
2. At every tee and branch connection.
3. At each riser including branch risers from mains.
4. At each side of a pipe passage through floors, walls and partitions.
5. Every 15 feet on straight runs of piping mains and branches.
6. Within 6 feet of elbows (each side).
7. At access doors or similar points that permit view of concealed piping.
8. Markers shall be provided on all piping above lay-in ceilings.
9. Provide arrow markers showing direction of flow incorporated into, or adjacent to, each piping system marker.
10. Apply all piping system markers where view is unobstructed, and legends can be read and easily identified.
11. Apply all tags and piping system markers in accordance with the supplier’s directions.
LETTER OF INDEMNIFICATION

Project Name:

Project Location:

The contractor may purchase from Ascent Engineering Group, Inc. a CD-ROM or electronic mail version of the projects CADD database. Drawing files will consist of floor plan views only, of Electrical plan sheets. All seals, details, schematics, tables, controls, etc. will be deleted. All drawings will be provided in Autocad™ 2014 format.

Ascent Engineering Group, Inc. reserves all rights to the original drawing files.

The Purchaser agrees, to the fullest extent permitted by the law, to hold harmless and indemnify Ascent Engineering Group, Inc. and the Architect, as defined in the Bid Documents, from and against all claims, liabilities, losses, damages, and costs, including but not limited to attorney's fees, arising out of or in any way connected with the use, modification, misinterpretation, misuse, or reuse by the Purchaser or others of the machine readable information and data provided by Ascent Engineering Group, Inc. under this Agreement. The foregoing indemnification applies, without limitation, to any use of the project documentation on other projects, for additions to this project, or for completion of this project by others, excepting only such use as may be authorized, in writing, by Ascent Engineering Group, Inc.

The electronic drawing files are not part of the Contract Documents for the Project. The Purchaser assumes all risks associated with the use of the transmitted files. Ascent Engineering Group, Inc. will not be responsible for any differences in the information included in the transmitted files and the information shown on the Contract Documents. Modifications to the Contract Documents made before or during construction may or may not be included in the transmitted electronic drawing files.

The Purchaser further agrees that the drawing files will only be used in graphics preparation for the above-referenced project.

Company Name of Purchaser: _____________________________________________

Purchaser's Designated Representative: _____________________________________

Title: _________________________________________________________________

Signature: _____________________________________________________________

Address: ______________________________________________________________

Return to: Ascent Engineering Group, Inc.  
4932 Frontage Road, NW  
Roanoke, VA 24019  
AEG # 16235
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. Pipes, fittings, and specialties.
   2. Fire-protection valves.
B. Related Sections:
   1. Section 22 04 00 – General Requirements for Fire Suppression
   2. Division 26 – Electrical
   3. Section 28 31 00 – Fire Detection and Alarm

1.03 DEFINITIONS
A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.04 SYSTEM DESCRIPTIONS
A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.05 PERFORMANCE REQUIREMENTS
A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified design professional, using performance requirements and design criteria indicated.
   1. Fire Flow Tests: Comply with requirements for Fire Flow Tests specified in Section 21 04 00 "General Requirements for Fire Suppression
C. Sprinkler system design shall be approved by authorities having jurisdiction.
   1. The Authorities having jurisdiction shall include the Local Building Inspector and other local Administrative Representatives.
   2. Margin of Safety for Available Water Flow and Pressure: 10 psig, including losses through water-service piping, valves, and backflow preventers.
   3. Sprinkler Occupancy Hazard Classifications:
      a. Building Service Areas: Ordinary Hazard, Group 1.
      b. General Storage Areas: Ordinary Hazard, Group 1.
      c. Offices, Toilets and Public Areas: Light Hazard.
   4. Minimum Density for Automatic-Sprinkler Piping Design:
      a. Light-Hazard Occupancy: 0.10 gpm over area as listed by NFPA 13.
      b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm area as listed by NFPA 13.
   5. Maximum Protection Area per Sprinkler:
      a. Office Spaces: 225 sq. ft.
      b. Storage Areas: 130 sq. ft.
      c. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
   6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated.
a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

1.06 SUBMITTALS

A. Submittal data is required for items in this Section and as specified in Division 01 and Section 210400 “General Requirements for Fire Suppressions”.

B. Product Data: For each type of product indicated [S]. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Comply with requirements in Division 01 and Section 210400 “General Requirements for Fire Suppression”.

C. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

D. Hydraulic Calculations: Include Hydraulic Calculations for each remote area.

E. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified design professional responsible for their preparation.

F. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are and coordinated with each other, using input from installers of the items involved:
   1. Plumbing piping.
   2. HVAC Equipment, Ductwork and hydronic piping.
   3. Items penetrating finished ceiling include the following:
      a. Lighting fixtures.
      b. Ceiling diffusers and grilles.
      c. Exit Signs.
      d. Heat and Smoke Detectors, Speakers, Projectors, Motion Sensors
   4. Electric Switchgear, panelboards

G. Qualification Data: For qualified Installer.

H. Approved Sprinkler Piping Drawings: Working plans, prepared according to The Virginia Uniform Statewide Building Code VUSBC and NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

I. Fire-hydrant flow test report.

J. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping." Comply with requirements in Section 210400 “General Requirements for Fire Suppression”.

K. Field quality-control reports.

L. Operation and Maintenance Data: For sprinkler specialties indicated [O/M], to include in emergency, operation, and maintenance manuals. Comply with requirements in Division 01 and Section 210400 “General Requirements for Fire Suppression”.

1.07 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13, "Installation of Sprinkler Systems."
2. The Virginia Uniform Statewide Building Code (VUSBC)

D. Coordinate layout and installation of fire suppression system with other construction. Comply with requirements in Section 21 04 00 “General Requirements for Fire Suppression”.

**1.08 EXTRA MATERIALS**

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets [S]: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

**2.01 PIPING MATERIALS**

A. Comply with requirements in “Piping Schedule” Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes. All pipe and fittings shall have a minimum corrosion resistance ratio (CRR) of 1.0. Submit printed data from pipe manufacturer certifying materials meet this requirement.

**2.02 STEEL PIPE AND FITTINGS [S]**

A. Standard Weight, Black Steel Pipe: ASTM A 53, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795. Pipe ends may be factory or field formed to match joining method.


D. Uncoated, Steel Couplings: ASTM A 865, threaded.


F. Malleable- or Ductile-Iron Unions: ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.


H. Steel Flanges and Flanged Unions: ASME B16.5, Class 150.


J. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International, Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.

2. Pressure Rating: 175 psig minimum.

3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.

4. Grooved-End Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

**2.03 PIPING JOINING MATERIALS**

A. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

B. Welding Filler Metals: Comply with AWS D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

**2.04 LISTED FIRE-PROTECTION VALVES [S]**

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig

B. Ball Valves:
   1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Anvil International, Inc.
      b. Victaulic Company.
   2. Standard: UL 1091 except with ball instead of disc.
   3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
   4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
   5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:
   1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Fivalco Inc.
      b. Global Safety Products, Inc.
      c. Milwaukee Valve Company.
   2. Standard: UL 1091.
   5. End Connections: Threaded.

D. Check Valves:
   1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Anvil International, Inc.
      b. Fivalco Inc.
      d. Kennedy Valve; a division of McWane, Inc.
      e. Milwaukee Valve Company.
      f. Mueller Co.; Water Products Division.
      g. NIBCO INC.
      h. Potter Roemer.
      i. Reliable Automatic Sprinkler Co., Inc.
      j. Tyco Fire & Building Products LP.
      k. United Brass Works, Inc.
      l. Victaulic Company.
      m. Viking Corporation.
   4. Type: Swing check.
   5. Body Material: Cast iron.
   6. End Connections: Flanged or grooved.

E. Bronze OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
   e. United Brass Works, Inc.
5. End Connections: Threaded.

**2.05 TRIM AND DRAIN VALVES**

A. General Requirements:
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fire Protection Products, Inc.
   b. United Brass Works, Inc.

C. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International, Inc.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
   d. Potter Roemer.
   e. Tyco Fire & Building Products LP.
   f. Victaulic Company.

D. Globe Valves:
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fire Protection Products, Inc.
   b. United Brass Works, Inc.

**2.06 SPRINKLER SPECIALTY PIPE FITTINGS**

A. Branch Outlet Fittings:
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International, Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.
B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AGF Manufacturing Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.


4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.

5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following.
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.

2. Standard: UL 199.


5. Size: Same as connected piping.

6. Inlet: Threaded.

7. Drain Outlet: Threaded and capped.

8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AGF Manufacturing Inc.
   b. Triple R Specialty.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
   e. Viking Corporation.


4. Body Material: Cast- or ductile-iron housing with sight glass.

5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

2.07 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFAC Inc.


3. Reliable Automatic Sprinkler Co., Inc.

4. Tyco Fire & Building Products LP.

5. Venus Fire Protection Ltd.


B. General Requirements:
C. Automatic Sprinklers with Heat-Responsive Element:
   2. Nonresidential Applications: UL 199.
   3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
D. Sprinkler Finishes:
   1. Chrome plated.
   2. Bronze.
E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment.
   2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

2.08 ALARM DEVICES [S]
A. Alarm-device types shall match piping and equipment connections.
B. Water-Flow Indicators:
   1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. ADT Security Services, Inc.
      b. McDonnell & Miller; ITT Industries.
      c. Potter Electric Signal Company.
      d. System Sensor; a Honeywell company.
      e. Viking Corporation.
      f. Watts Industries (Canada) Inc.
   4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
   5. Type: Paddle operated.
   7. Design Installation: Horizontal or vertical.
C. Valve Supervisory Switches:
   1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Fire-Lite Alarms, Inc.; a Honeywell company.
      b. Kennedy Valve; a division of McWane, Inc.
      c. Potter Electric Signal Company.
d. System Sensor; a Honeywell company.

3. Type: Electrically supervised.
5. Design: Signals that controlled valve is in other than fully open position.

PART 3 - EXECUTION

3.01 PREPARATION
A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
B. Report test results promptly and in writing.

3.02 PIPING INSTALLATION
A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
G. Install sprinkler piping with drains for complete system drainage.
H. Install alarm devices in piping systems.
I. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
J. Fill sprinkler system piping with water.
K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves in Section 210400 "General Requirements" for Fire-Suppression.
L. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons in Section 210400 "General Requirements for Fire-Suppression."

3.03 JOINT CONSTRUCTION
A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2and larger end connections.
D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Welded Joints: Construct joints according to AWS D10.12M, using qualified processes and welding operators according to “Quality Assurance” Article.
   1. Shopweld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.04 VALVE AND SPECIALTIES INSTALLATION
   A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
   B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
   C. Specialty Valves:
      1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

3.05 SPRINKLER INSTALLATION
   A. Install sprinklers in suspended ceilings in center both ways of acoustical ceiling panels.
   B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

3.06 IDENTIFICATION
   A. Install labeling and pipe markers on equipment and piping. Comply with requirements in NFPA 13 and Section 210400 “General Requirements for Fire Suppression”.
   B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 “Identification for Electrical Systems.”

3.07 FIELD QUALITY CONTROL
   A. Perform tests and inspections.
   B. Tests and Inspections:
      1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
      2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
      3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
   C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
   D. Prepare test and inspection reports.

3.08 CLEANING
   A. Clean dirt and debris from sprinklers.
   B. Remove and replace sprinklers with paint other than factory finish.

3.09 DEMONSTRATION
   A. Train Owner's maintenance personnel to adjust, operate, and maintain the system.
3.10 PIPING SCHEDULE
A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
B. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
   1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
   2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 and larger, shall be one of the following:
   1. Schedule 10, black-steel pipe with roll-grooved ends; grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   2. Schedule 10, black-steel pipe with plain ends; welding fittings; and welded joints.
D. Wet-pipe sprinkler system exposed to weather:
   1. As scheduled above; steel pipe and fittings coated with hot dipped galvanized steel.

3.11 SPRINKLER SCHEDULE
A. Use sprinkler types in subparagraphs below for the following applications:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended or Drywall Ceilings: Pendent sprinklers or recessed sprinklers.
B. Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
   2. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

END OF SECTION
SECTION 22 0400
GENERAL REQUIREMENTS FOR PLUMBING

PART 1 - GENERAL

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

1.02 SUMMARY – SECTION INCLUDES
A. Section Includes: Every item of labor, materials, equipment and appurtenances for installing Plumbing Systems included in Division 22 of the Specifications.
B. Related Sections:
   1. Section 03 30 00 – Cast-in Place Concrete
   2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
   3. Section 22 05 23 – General-Duty Valves for Plumbing Piping
   4. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
   5. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment
   6. Section 22 07 00 – Plumbing Insulation
   7. Section 22 11 16 – Domestic Water Piping
   8. Section 22 11 19 – Domestic Water Piping Specialties
   9. Section 22 11 23 – Domestic Water Pumps
  10. Section 22 13 16 – Sanitary Waste and Vent Piping
  11. Section 22 13 19 – Sanitary Waste Piping Specialties
  12. Section 22 14 13 – Facility Storm Drainage Piping
  13. Section 22 14 23 – Storm Drainage Piping Specialties
  14. Section 22 33 00 – Electric, Domestic – Water Heaters
  15. Section 22 40 00 – Plumbing Fixtures

1.03 DRAWINGS
A. The Plumbing Drawings are diagrammatic in nature and show the general arrangement of all piping, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. Because of the small scale of the Plumbing Drawings, it is not feasible to indicate all offsets, fittings and accessories that may be required. The Contractor shall investigate the construction conditions affecting the work and provide fittings and accessories as required to meet actual conditions.
B. Where discrepancies in scope of work as to which Trade provides specific items, such as starters, disconnects, flow switches, electrical control components, etc. exist, such conflicts shall be reported to the Engineer. If such action is not taken, the Contractor, as applicable, shall furnish such items as part of his work, for complete and operable systems and equipment, as determined by the Engineer.

1.04 REGULATIONS AND STANDARDS
A. The completed installation and all materials and equipment shall conform to local ordinances and codes, other regulations and standards listed herein or in related sections. These are intended as a minimum and shall be exceeded if required by the specifications or the Drawings. In the event of conflict between the codes, standards, or regulations, and information contained in the Contract Documents, the applicable code, standards, or regulation shall take precedence.
1.05 LIMITS OF CONTRACT
   A. Sanitary Sewer and Storm Sewer piping shall be extended under this section of the
      specifications to a point 5'-0" beyond the building line, unless otherwise indicated on the
      drawings, where the pipes shall be capped or plugged with location identified and left ready for
      connection and extension included under Division 33 Utilities.

1.06 INSPECTION CERTIFICATES
   A. The Contractor shall furnish three copies of certificates of final acceptance to the Engineer from
      all inspection authorities having jurisdiction.

1.07 SUBSTANTIAL COMPLETION INSPECTION
   A. The Engineer will visit the site for the purpose of conducting a substantial completion inspection
      once the following items have been met by the Contractor:
      1. All Plumbing systems shall be complete, operational and under automatic control.
      2. Plumbing systems cleaning, balancing, and testing shall be complete and the final report
         shall be approved by the Engineer.
   B. All discrepancies noted in the substantial completion report shall be corrected prior to the final
      inspection. The Contractor shall provide a detailed item-by-item description of all corrections
      made for each item on the substantial completion discrepancy list prior to scheduling final
      inspection by the Engineer. Additional visits required after the final inspection, for the reason
      that previously documented discrepancies had not been corrected at the time of the final
      inspection, will be made at the Contractor’s expense.

1.08 ASBESTOS
   A. Asbestos Free Materials: The intention of these Drawings and specifications is that there are
      no asbestos-containing materials installed on this project. To the best of the Architects and
      Engineers knowledge, none of the material or equipment specified herein or shown on the
      Drawings contains asbestos. The Contractor shall make every effort to prevent any asbestos
      materials from being installed in or used on the construction of the project. At the completion
      of the project, the Contractor shall certify by letter that to the best of his knowledge, no asbestos-
      containing materials were used for or in the construction of this project.
   B. Existing Materials:
      1. Contractor shall review the Owners asbestos management plan to ensure suspected
         asbestos containing materials are under surveillance.
      2. Discovery: If during the construction of this project, work involving friable asbestos is
         suspected, or encountered, all work in this area shall be discontinued and the Owner or
         the Owner’s representative, shall be notified immediately and the Owner with his own
         forces or by separate contract shall be responsible for complete investigation, removal,
         and disposition of the friable asbestos hazard in accordance with applicable laws and
         regulations. If the Contractor claims that delay or additional cost is involved because of
         such action by the Owner, he shall make such claim as provided elsewhere in the
         Contract Documents.
      3. Removal: All work involving the removal of friable asbestos will be done under a separate
         contract.

1.09 MATERIALS AND WORKMANSHIP
   A. Equipment and material used in the project shall be new and undamaged. The Plumbing
      installation shall fit into the space allotted and shall allow adequate and acceptable clearances
      for entry, servicing and maintenance. Similar types of equipment shall be the products of the
      same manufacturer unless specified otherwise. Work shall be performed by mechanics or
      tradesmen skilled in the trade involved.
   B. All piping and equipment shall be installed in a neat and organized manner, parallel to other
      work and the nearest building elements, unless specifically shown otherwise on the Drawings.
   C. Equipment and materials shall be suitable for use in the environment in which they are
      installed. Equipment exposed to outside conditions shall be adequately protected from the
weather, manufactured from materials suitable for outdoor use, and designed specifically for use in outdoor environments.

1.10 SUBMITTALS

A. Submit shop drawings, product data and samples in accordance with Division 01 for all items as specified in related sections of these specifications. One (1) copy of the submittal, in pdf format, shall be submitted. One (1) copy of the submittal, in pdf format, will be returned to the Contractor. If additional copies are required, they will be the responsibility of the Contractor. All submittal data shall be correctly identified to show project name, and the exact model, style or size of item being submitted. Improperly identified submittals will not be reviewed by the Engineer. Each item submitted for review shall bear the Subcontractor’s stamp which states that they have reviewed the submission, that it is complete, and that in their opinion it meets the contract requirements. Contractor’s stamp shall identify the specification section, paragraph and page number for which the submittal is being made. Shop drawings will be reviewed only for general compliance with the Contract Documents. Review will not include correctness of details, proper configuration, utility connections, dimensions, sizes, quantities, and the like. Any submission which has not been reviewed and stamped by the Plumbing Subcontractor will not be reviewed be the Engineer. No reviews prior to award of Contract will be considered or accepted. Re-submissions of shop drawings, product data and samples shall include the entire original submittal. **Partial submittals will not be reviewed by the Engineer.**

B. Submissions will be stamped by the Engineer in one of the following ways:

- **“No Exceptions Taken”** No exceptions are taken and subject to compliance with the Contract Documents.
- **“Make Corrections Noted”** Minor corrections are noted and a re-submittal is not required subject to compliance with the corrections and the Contract Documents.
- **“Correct and Resubmit”** The submitted material, method or system meets the intent of the specifications, yet has insufficient data to determine compliance with the Contract Documents. Re-submittal is required.
- **“Rejected”** The submitted material, method or system does not meet the intent of the specifications, or has insufficient data to determine compliance with the Contract Documents.

C. Submission Procedures:

1. If a submission is satisfactory to the Engineer, the Engineer will annotate the submission, "No Exceptions Taken" or "Make Corrections Noted" and transmit one (1) copy, in pdf format, to the Contractor. If a resubmission is required, the Engineer will annotate the submission "Correct and Resubmit" or "Rejected" and transmit one (1) copy, in pdf format, to the Contractor for appropriate action.

2. The Contractor shall revise and resubmit submissions as required by the Engineer until submissions are acceptable to the Engineer.

3. Approval of a working and/or shop drawings by the Engineer will constitute acceptance of the subject matter for which the drawing was submitted and not for any other structure, material, equipment or appurtenances indicated as shown.

4. The Engineer's review of the Contractor's submissions shall in no way relieve the Contractor of any of his responsibilities under the Contract. An approval of a submission shall be interpreted to mean that the Engineer has no specific objections to the submitted material, subject to conformance with the Contract Documents.

5. Where as-built drawings, record drawings and specifications are available and when provided to the Contractor for use in performing the work, the Contractor shall verify the
content of such drawings and specifications, the suitability of their use in performing the work and their accuracy for the purposes in which the Contractor intends to use any record or historical documents which may be obtained. In no case shall the Contractor assume that such documents reflect a true and accurate record of the construction. Acceptance of any such materials, records, and/or drawings shall in no way result in additional cost to the Owner should an error and/or omission in these documents result in additional costs to the Contractor.

D. Equivalents: Manufacturers, trade names, and model numbers indicated herein and on Drawings shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Unless definitely stated otherwise and upon complying with Division 1, the Contractor may use any article which, in his judgment is equal to that specified and is accepted by the Engineer. Manufacturers listed first in these specifications and on Drawings were used as a basis of design. It will be the responsibility of the Contractor to verify all connections, physical sizes, capacities, etc. of all other manufacturer’s items, both named or proposed. If the equipment necessitates changes in rough-in, piping, wiring or other building systems from that indicated on the Drawings, the Contractor shall be responsible for all additional costs included and notify other trades. Where such changes are required, detail drawings indicating all required changes shall be submitted for review at the same time the manufacturers drawings are submitted for approval.

E. Shop drawings, diagrams, product data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials where specifically required by specification and all items identified with an [S] behind the product title. Submittals not required by the Contract Documents will not be reviewed.

F. Shop Drawing manual(s) shall be submitted in accordance with Division 01 and shall include a complete product index, a copy of all approved shop drawings, and the name, address and telephone number of supplier or nearest representative. The manual(s) shall be presented to the Engineer for review and transmittal to the Owner before final payment is recommended.

G. Operation and Maintenance manual(s) shall be submitted in accordance with Division 01, this Section and shall include a complete product index in each volume, installation and maintenance data, parts lists, a copy of all approved shop drawings and the name, address and telephone number of supplier or nearest representative. All Plumbing devices, equipment and systems marked [O/M] in these specifications shall be included and all other such plumbing items that will require servicing before the duration of its useful life has been reached. Manual(s) shall be presented to the Engineer for review and transmittal to the Owner before final payment is recommended.

1.11 WARRANTY
A. Comply with Division 01 for warranty requirements.
B. Information on all warranties shall be included in the O&M Manuals specified herein to be provided to the Owner.

1.12 EXCAVATION AND BACKFILLING
A. General: Excavation and backfilling shall be as specified in Division 31. Backfilling shall not commence until all tests have been performed and all utility systems conform to the Contract Documents.
B. Protection of Existing Utilities: Existing utility lines to be retained, whether known or unknown and uncovered during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be restored to original condition.

1.13 VERIFYING MEASUREMENTS AND CONDITIONS
A. The exactness of grades, elevations, dimensions, or locations given on the Drawings, is not guaranteed by the Engineer. The Contractor shall, therefore, satisfy himself as to the accuracy of all grades, elevations, dimensions and locations. In all cases of interconnection of his work with existing or other work, he shall verify at the site all dimensions relating to such existing or
other work. Any errors due to the Contractor’s failure to so verify all such grades, elevations, locations, or dimensions shall be promptly rectified by him without cost to Owner.

1.14 INTERRUPTION OF UTILITY SERVICES

A. It is necessary that close liaison be maintained with the Administrative Authorities in all matters affecting interruptions of any utility services serving the facility and existing buildings. Prior to interrupting any utility service, the Administrative Authorities shall be consulted and interruptions for connections made at a time (or times) suitable to the Administrative Authorities. Work shall be laid out and planned to limit the interruption times to a minimum.

1.15 COORDINATION OF WORK

A. General: The Contract Documents indicate the extent and general arrangement of the Plumbing systems. The Contractor shall be responsible for the coordination and proper relation of the Plumbing work to the building structure and to the work of other trades. No additional compensation or extension of completion time will be granted for extra work caused by the lack of coordination. The Contractor is expected to deliver a complete and operational system.

B. Cooperation: The Contractor shall provide dimensions and locations of all openings, shafts and similar items to the proper trades and install work as required so as not to interfere with, or delay, the building construction.

C. Locations of lines and equipment shall be determined from actual field measurements. The outlines of the building shown on the Plumbing Drawings are intended only as a guide to indicate relative locations of the Plumbing work. Refer to Architectural and Structural Drawings for building construction details. The Contractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component. Accurate measurements and coordination shall be completed to verify dimensions and characteristics for the installation of each system.

D. Unless necessitated by equipment access or otherwise indicated in the Contract Documents, all equipment, piping and conduit concealed above ceilings and in finished or utility spaces shall be routed as high as possible.

E. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall provide manual air vents and drains as required for his work to affect these offsets, transitions and changes in direction, as applicable.

F. Cutting and Patching: Comply with requirements for cutting and patching specified in Division 01.

G. Roughing-In: Verify the locations of machines, door swings, block coursing, alignment of tile end and other similar features before roughing-in for Plumbing equipment components and/or controls.

H. Damage to Other Work: Each Contractor is responsible for damage to other work caused by his work or workmen. Repairing of damaged work shall be done by the Contractor who installed the work, and as directed by the Architect-Engineer; the cost of which shall be paid for by the Contractor responsible for the damage.

1.16 EQUIPMENT INSTALLATION

A. General: Equipment shall be installed in accordance with manufacturer’s instructions to conform with the details and application indicated. Where manufacturer’s recommendations or installation instructions require options or accessories not specified, they shall be included and installed by the Contractor.

B. Supports: Provide necessary supports for all equipment and appurtenances as required; this includes but is not limited to frames or supports for items such as storage tanks, water heaters, air compressors, plumbing fixtures, pumps, valves, and other similar items requiring supports. Floor mounted equipment in Equipment Rooms shall be set on 4-inch high concrete foundation pads unless shown otherwise. All pads shall be poured such that the top of the pad is level. Foundation drawings, bolt setting information and foundation bolts shall be furnished by the
subcontractors furnishing the equipment for all equipment required to have concrete foundations. Concrete for foundations shall be provided by Plumbing Subcontractor unless indicated otherwise. Except where indicated all equipment shall be anchored to concrete pads.

C. Service Area: All equipment and appurtenances shall be located to permit adequate service clearance in accordance with manufacturer’s recommendations and as otherwise required. Service clearance shall include but not be limited to service and removal of plumbing system, water heaters, pumps, motors, controls and other of equipment. All piping and other equipment shall be located outside of the service area or shall be flanged for easy removal to facilitate equipment service. All equipment shall be located with sufficient distance from building features, structural components, and the equipment of other trades. Service clearance in front of electrical panels shall be the minimum as required by National Electric Code (NEC) where applicable.

D. Temporary Requirements: Openings in equipment shall be kept plugged at all times until connection is made to the system. The ends of all pipes and equipment openings shall be kept plugged or capped properly with approved devices. Approved devices are items such as specially molded plastic caps, pipe plugs, test plugs and sheet metal caps.

1.17 EXISTING EQUIPMENT
A. General: Care shall be exercised to protect all existing equipment to be reused. The Contractor shall remove from operation all equipment that is shown to be reused and provide adequate protection including but not limited to prevention of corrosion, protection of seals, prevention of leaking, and prevention of internal/external contamination. All electronic components shall be protected from weather and moisture, deterioration and loss of programming.

1.18 SLEEVES AND INSERTS
A. General: Sleeves and inserts shall be provided and correctly located in the structure, as require for the work.
B. Inserts shall be steel and proper size for loads encountered.
C. Sleeves shall be provided for all pipes passing through concrete or masonry walls, partitions, concrete beams or slabs installed during construction of the wall, partition, beam or slab. Sleeves through existing concrete walls and slabs may be omitted if wall or slab can be core drilled and properly sealed in a manner acceptable to the Engineer. Sleeves placed horizontally in walls or in any position in beams shall be standard weight ASTM A53 steel pipe of length equal to thickness of wall or beam. Those placed vertically in non-waterproof floors shall be 20 gauge galvanized sheet steel of length equal to thickness of slab, flared and nailed to the form, or fastened to reinforcing fabric and filled with sand during pouring to prevent deformation. Sleeves occurring in floors of rooms where hose bibs or floor drains occur, and in pipe spaces, shall be standard weight steel pipe projecting 2” above the finished floor except in Equipment Rooms they shall project four (4) inches above floor. Sleeves in floors with waterproof membrane shall be provided with flanges or flashing rings and shall be clamped or flashed into membrane. All sleeves (and core drilled openings) shall be of sufficient diameter to clear bare or covered pipes by 1/4” all around except sleeves on lines subject to movement by expansion which shall clear the bare pipe or insulation on insulated pipe at least one inch all around. Pipes through exterior walls below grade and above footings shall be installed in sleeves having a minimum size of two larger pipe diameters and sealed watertight with flexible synthetic rubber seals. Sleeve shall have anchor and water stop plate. The entire assembly shall be tightened and adjusted and made watertight. Sleeves for pipes and conduit, penetrating fire (and smoke) rated partitions, walls and floors shall be sealed in accordance with the terms of U.L. Listed Through-Penetration Firestop Systems XHEZ as published in the U.L. Fire Resistance Directory. Penetrations shall exactly conform to details of the Firestop System indicated for the type of partition, wall and floor construction encountered. All penetrations through nonfireresistance rated floor assemblies and through the ceiling membrane of nonfireresistance rated roof assemblies shall be fireblocked with tightly packed mineral-wool insulation secured in place. All penetrations through equipment room walls and
other areas of noise or heat generation shall be tightly sealed with mineral fiber rope. All penetrations through draftstop partitions shall be sealed to maintain the integrity of the partition. All firestopping and draftstopping of sleeves for Plumbing work shall be provided under Division 22.

1.19 ESCUTCHEONS
A. Where pipes pass through floors, walls or ceilings in finished rooms, they shall be fitted with chromium plated escutcheons of suitable pattern to effectively cover the rough opening. Where sleeves project above floors, special deep type escutcheons shall be provided.

1.20 ACCESS DOORS
A. Provide for all concealed valves, controls, dampers, junction boxes, equipment, or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for Plumbing work shall be furnished as a part of this Division to the General Contractor for installation. The Plumbing Sub-Contractor shall provide locations of all access doors such that service may be safely performed from a ladder, lift, or platform without the need for support from the ceiling system. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable. Doors shall be metal access doors with cam lock, style to match ceiling or wall construction. Doors occurring in rated construction shall be fire rated U.L. labeled access doors correlated to preserve the integrity of the rated construction. Doors leading to concealed spaces shall be provided with means to open from the inside. Doors shall be prime finish steel except those in toilets, shower rooms, locker rooms, kitchens and other similar areas shall be stainless steel with brushed finish.

1.21 ELECTRICAL WIRING AND EQUIPMENT
A. Motors shall be provided in place as an integral part of the driven equipment, ready for electrical connections. Motors shall be in accordance with NEMA Standards and of design suitable for the starting and running characteristics of the driven equipment. Minimum efficiencies of motors shall be "nominal" efficiency as indicated in ASHRAE Standard 90.1-1989 as amended by 90.1c-1993 (ie: 1 HP, 82.5%; 5 HP, 87.5%; 10 HP, 89.5%; 20 HP, 91%; 50 HP, 93%) and shall meet or exceed those contained in NEMA MG1-1993, Table 10-12.
B. All three phase motors over 5 HP shall be provided with minimum power factor of 90%. Power factor correction capacitors shall be provided if required and shall be furnished to the electrical subcontractor for installation. Shop Drawing submittals for motors over 5 HP shall list efficiency and power factor. Unless specified otherwise, all motors shall have continuous duty classification, 40° Centigrade ambient temperature, shall have enclosure suitable for indicated application and shall be wound for 120 volt, single phase, 60 cycle current, except motors above 1/2 horsepower (unless indicated otherwise) shall be wound for 200V or 230V/460V as required by the secondary voltage specified for main service in Division 26. Each motor shall be selected and rated at the voltage indicated so that the driven load does not exceed the nameplate rating and service factor of the motor. All motors 460V/480V 20 HP and above and 208V/230V 10 HP and above shall be wound for wye delta (6 or 12 lead) starting with capabilities of being wired for across-the-line starting. Motors for use with variable frequency drives (VFD) shall be wound for across-the-line type starting and shall be rated for "VFD-duty" or shall be Premium Efficiency type with Class F (1500 volt) insulation and thermal overload protection. Motors for VFD applications shall meet or exceed IEEE 519-1992. Motors for VFD applications shall have maximum 4:1 speed range corresponding to 60 Hz and 15 Hz. Power factor correction is not required when motor is used with VFD. Motors for VFD service shall be Inverter Duty Rated with internal shaft grounding to prevent common mode voltage (shaft current) bearing failures. Where 2-speed motors are indicated for motors above 1/2 horsepower, motors shall have two separate windings.
C. Motor starters and motor protective switches shall be provided under Division 26 except where specified to be furnished specifically with the driven equipment. Accessories such as auxiliary contacts, hand-off-automatic switches, start-stop switches, pilot lights, control power transformers and other similar items shall be provided in or on the controllers as required by the
control sequence indicated. Starting equipment, unless factory mounted on the equipment, shall be installed under Division 26.

D. Wiring, low voltage (100 volts or less) control wiring shall be provided as a part of Section 23 09 00 Instrumentation and Control for HVAC. Wiring material and installation shall be in strict accordance with Division 26 and manufacturer’s recommendations to comply with the sequence of control indicated. Verify that wiring of all motors and controls required by equipment furnished is accomplished for the correct sequence of operation.

E. Wiring, line voltage (101 volts or higher) power or control wiring shall be furnished and installed under Division 26.

F. Disconnects shall be provided for each item of equipment under Division 26 unless specified otherwise in other sections.

G. Miscellaneous manual or automatic control and protective or signal devices required for the sequence of operation indicated for mechanical equipment shall be provided under the section of the specifications where the item of equipment is specified unless indicated otherwise.

1.22 PROTECTION FROM MOVING PARTS

A. Belts, pulleys, chains, gears, shafts, couplings and other rotating or moving parts located so that any person may come in close proximity thereto shall be fully enclosed or properly guarded.

1.23 RECORD OF UNDERGROUND LINES

A. On completion of the project, the Contractor shall prepare and submit to the Engineer a drawing on tracing paper and one blue line print to show the location of any underground lines installed in locations different from those on the Architect-Engineer’s Drawings. The location of cleanouts, and the distance from the building to outside sewers, mains, and manholes shall be dimensioned.

1.24 CHARTS AND DIAGRAMS

A. General: Material as listed below shall be provided by the Contractor and shall be mounted in separate hardwood frames where directed in the field or folded and stored in a plastic document folder and located in the control cabinets. All charts, diagrams and schemes shall be photographic positives prepared from original tracings. A copy of charts and diagrams shall be included with O/M manuals.

B. Automatic Temperature Control Diagrams identified as to name, sequence of operation, location and number of systems. Components of a control system shall be identified as to location, function, temperature setting and manufacturer's part number.

C. Electric Sequence Control Diagrams of entire Mechanical system.

D. Charts for identification of valves.

1.25 INSTRUCTION OF OWNER’S REPRESENTATIVE

A. Contractors shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the Plumbing systems. Competent representatives of the Contractor shall spend such time as necessary to fully prepare the Owner to operate and maintain the Plumbing systems.

1.26 CONSTRUCTION STATUS REPORT

A. Each item of discrepancies noted on Construction Status Report prepared by the Engineer shall be answered in detail in writing by the Contractor before payment can be recommended.

1.27 GRAPHICS DATABASE

A. This project’s Computer Aided Design & Drafting (CADD) drawing files may be obtained directly from the Engineer for use in preparing computer graphics specific to this project. Refer to Appendix A at the end of this Section for Letter of Indemnification and ordering instructions.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION
3.01 PHASING OF WORK
   A. Coordinate phasing requirements with Division 01.

3.02 DEMOLITION
   A. Contractor shall visit site before bidding to determine extent of demolition.
   B. Removal of Piping and Equipment: Remove all piping connections and equipment, plugging outlets, etc., such that are not required for present equipment and fixtures, or are not reused or needed for reconnecting new equipment and fixtures. Remove all equipment, fixtures, etc., indicated to be removed, or not reused or needed after the renovations are complete.
   C. Where piping or other similar items passing through rated assemblies are removed; the assemblies shall be patched in accordance with UL so as to maintain the integrity of the assembly.
   D. The Owner will select and retain such existing plumbing fixtures, equipment and materials which are indicated to be removed and not reused, as he desires. All other existing plumbing fixtures, equipment and materials indicated to be removed and not reused shall become the property of the Contractor, who shall promptly remove them from the premises. All existing equipment and fixtures indicated to be relocated shall be disconnected, removed, relocated and reconnected. All equipment and fixtures shall be protected from damage during demolition.
   E. Miscellaneous: In all altered portions of the buildings, the Contractor shall remove or alter as necessary all existing Plumbing work that is not coordinated to operate with the new construction. Demolition shall not begin until the work schedule is approved by the owner. The work shall be scheduled to prevent any disruption to the normal operations of the building.

3.03 CONNECTIONS TO EQUIPMENT:
   A. The Plumbing Installer shall make proper connections to all equipment furnished by Division 23 such as, but not limited to, roof top equipment where indicated on the drawings. This equipment, unless otherwise specified, will be furnished complete with traps, strainers, tailpieces, faucets, etc. This Contractor shall make connections to this equipment and fixtures and install water cutoffs or stops, and gas or air cocks at each piece of equipment. Comply with requirements for pipe and fittings specified under appropriate Division 22 Sections herein.
   B. The exact location of and roughing-in requirements of each piece of equipment shall be determined by the Contractor before roughing-in is done.
   C. Check Valves: Provide check valves in hot and cold water connections to fixtures where faucets or valves generally remain open during extended operation.

END OF SECTION
APPENDIX A
LETTER OF INDEMNIFICATION

Project Name:

Project Location:

The contractor may purchase from Ascent Engineering Group, Inc. a CD-ROM or electronic mail version of the projects CADD database. Drawing files will consist of floor plan views only, of Electrical plan sheets. All seals, details, schematics, tables, controls, etc. will be deleted. All drawings will be provided in Autocad™ 2014 format.

Ascent Engineering Group, Inc. reserves all rights to the original drawing files.

The Purchaser agrees, to the fullest extent permitted by the law, to hold harmless and indemnify Ascent Engineering Group, Inc. and the Architect, as defined in the Bid Documents, from and against all claims, liabilities, losses, damages, and costs, including but not limited to attorney's fees, arising out of or in any way connected with the use, modification, misinterpretation, misuse, or reuse by the Purchaser or others of the machine readable information and data provided by Ascent Engineering Group, Inc. under this Agreement. The foregoing indemnification applies, without limitation, to any use of the project documentation on other projects, for additions to this project, or for completion of this project by others, excepting only such use as may be authorized, in writing, by Ascent Engineering Group, Inc.

The electronic drawing files are not part of the Contract Documents for the Project. The Purchaser assumes all risks associated with the use of the transmitted files. Ascent Engineering Group, Inc. will not be responsible for any differences in the information included in the transmitted files and the information shown on the Contract Documents. Modifications to the Contract Documents made before or during construction may or may not be included in the transmitted electronic drawing files.

The Purchaser further agrees that the drawing files will only be used in graphics preparation for the above-referenced project.

Company Name of Purchaser: _____________________________________________

Purchaser’s Designated Representative: ________________________________

Title: ________________________________________________________________

Signature: _____________________________________________________________

Address: ______________________________________________________________

Return to: Ascent Engineering Group, Inc.
4932 Frontage Road, NW
Roanoke, VA 24019
AEG # 16235
SECTION 22 0513
COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

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: General requirements for single-phase and polyphase, general-purpose,
      horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up
      to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment
      manufacturer for field installation.
   B. Related Sections:
      1. Section 22 04 00 – General Requirements for Plumbing
      2. Section 22 11 23 – Domestic Water Pumps
      3. Section 22 33 00 – Electric, Domestic – Water Heaters
      4. Section 22 40 00 – Plumbing Fixtures
      5. Division 26 – Electrical

1.03 COORDINATION
   A. Coordinate features of motors, installed units, and accessory devices to be compatible with the
      following:
      1. Motor controllers.
      2. Torque, speed, and horsepower requirements of the load.
      3. Ratings and characteristics of supply circuit and required control sequence.
      4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS
   A. Comply with requirements in this Section except when stricter requirements are specified in
      plumbing equipment schedules or Sections.
   B. Comply with NEMA MG 1 unless otherwise indicated.
   C. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS
   A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above
      sea level.
   B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected
      loads at designated speeds, at installed altitude and environment, with indicated operating
      sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS
   A. Description: NEMA MG 1, Design B, medium induction motor.
   B. Efficiency: Energy efficient, as defined in NEMA MG 1.
   C. Service Factor: 1.15.
   D. Multispeed Motors: Variable torque.
      1. For motors with 2:1 speed ratio, consequent pole, single winding.
      2. For motors with other than 2:1 speed ratio, separate winding for each speed.
   E. Multispeed Motors: Separate winding for each speed.
F. Rotor: Random-wound, squirrel cage.
G. Bearings: Re-greaseable, shielded, antifriction ball bearings suitable for radial and thrust loading.
H. Temperature Rise: Match insulation rating.
I. Insulation: Class F.
J. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer’s standard starting characteristic.
K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.05 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.
B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
D. Motors 1/20 HP and Smaller: Shaded-pole type.
E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Used)

END OF SECTION
SECTION 22 0523
GENERAL-DUTY VALVES FOR PLUMBING PIPING

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. Brass ball valves.
   2. Bronze ball valves.
   4. Bronze globe valves.

B. Related Sections:
   1. Section 03 30 00 – Cast– in Place Concrete
   2. Section 22 04 00 – General Requirements for Plumbing
   3. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
   4. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment
   5. Section 22 07 00 – Plumbing Insulation
   6. Section 22 11 16 – Domestic Water Piping
   7. Section 22 11 19 – Domestic Water Piping Specialties
   8. Section 22 11 23 – Domestic Water Pumps
   9. Section 22 13 16 – Sanitary Waste and Vent Piping
   10. Section 22 13 19 – Sanitary Waste Piping Specialties
   11. Section 22 33 00 – Electric, Domestic – Water Heaters
   12. Section 22 40 00 – Plumbing Fixtures
   13. Division 26 – Electrical

1.03 DEFINITIONS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Nonrising stem.
E. OS&Y: Outside screw and yoke.
F. RS: Rising stem.
G. SWP: Steam working pressure.

1.04 SUBMITTALS

A. Product Data: For each type of valve indicated [S]. Comply with requirements for submittals in Division 01 and Section 22 04 00 “General Requirements for Plumbing”.

1.05 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
B. ASME Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
C. NSF Compliance for valve materials that will be in contact with potable water:
   1. NSF 61 "Drinking Water System Components - Health Effects".
   2. NSF 372 "Drinking Water System Components - Lead Content".

1.06 DELIVERY, STORAGE, AND HANDLING
A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Block check valves in either closed or open position.
B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES
A. Refer to valve schedule articles for applications of valves.
B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
C. Valve Sizes: Same as upstream piping unless otherwise indicated.
D. Valve Actuator Types:
   1. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
F. Valve-End Connections:
   1. Flanged: With flanges according to ASME B16.1 for iron valves.
   2. Solder Joint: With sockets according to ASME B16.18.
   3. Threaded: With threads according to ASME B1.20.1.
G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRASS BALL VALVES[S]
A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Jenkins Valves.
      c. DynaQuip Controls.
      d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
      e. Hammond Valve.
      f. Jamesbury; a subsidiary of Metso Automation.
g. Jomar International, LTD.

h. Kitz Corporation.

i. Legend Valve.

j. Marwin Valve; a division of Richards Industries.

k. Milwaukee Valve Company.

l. NIBCO INC.

m. Red-White Valve Corporation.

n. RuB Inc.

2. Description:
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Forged brass.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Brass.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

B. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Jenkins Valves.
      c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
      d. Hammond Valve.
      e. Jamesbury; a subsidiary of Metso Automation.
      f. Kitz Corporation.
      g. Marwin Valve; a division of Richards Industries.
      h. Milwaukee Valve Company.
      i. RuB Inc.
   2. Description:
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
      d. Body Design: Two piece.
      e. Body Material: Forged brass.
      f. Ends: Threaded.
      g. Seats: PTFE or TFE.
      h. Stem: Stainless steel.
      i. Ball: Stainless steel, vented.
      j. Port: Full.
C. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hammond Valve.
      b. Jamesbury; a subsidiary of Metso Automation.
      c. Legend Valve.
      d. Marwin Valve; a division of Richards Industries.
      e. Milwaukee Valve Company.
   2. Description:
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
      d. Body Design: Two piece.
      e. Body Material: Forged brass.
      f. Ends: Threaded.
      g. Seats: PTFE or TFE.
      h. Stem: Brass.
      i. Ball: Chrome-plated brass.
      j. Port: Regular.

2.03 BRONZE BALL VALVES [S]
   A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         a. American Valve, Inc.
         b. Conbraco Industries, Inc.; Apollo Valves.
         c. Crane Co.; Crane Valve Group; Crane Valves.
         d. Hammond Valve.
         e. Lance Valves; a division of Advanced Thermal Systems, Inc.
         f. Legend Valve.
         g. Milwaukee Valve Company.
         h. NIBCO INC.
         i. Red-White Valve Corporation.
         j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      2. Description:
         b. SWP Rating: 150 psig.
         c. CWP Rating: 600 psig.
         d. Body Design: Two piece.
         e. Body Material: Bronze.
         f. Ends: Threaded.
         g. Seats: PTFE or TFE.
         h. Stem: Bronze.
i. Ball: Chrome-plated brass.

j. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Hammond Valve.
   d. Lance Valves; a division of Advanced Thermal Systems, Inc.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Stainless steel.
   i. Ball: Stainless steel, vented.
   j. Port: Full.
   k. Port: Regular.

2.04 BRONZE SWING CHECK VALVES [S]

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Valve, Inc.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Hammond Valve.
   f. Kitz Corporation.
   g. Milwaukee Valve Company.
   h. NIBCO INC.
   i. Powell Valves.
   j. Red-White Valve Corporation.
   k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   l. Zy-Tech Global Industries, Inc.

2. Description:
   a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
e. Ends: Threaded.
f. Disc: Bronze.

B. Class 150, Bronze Swing Check Valves with Bronze Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Valve, Inc.
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Crane Co.; Crane Valve Group; Jenkins Valves.
      d. Crane Co.; Crane Valve Group; Stockham Division.
      e. Kitz Corporation.
      f. Milwaukee Valve Company.
      g. NIBCO INC.
      h. Red-White Valve Corporation.
      i. Zy-Tech Global Industries, Inc.
   2. Description:
      a. Standard: MSS SP-80, Type 3.
      b. CWP Rating: 300 psig.
      c. Body Design: Horizontal flow.
      e. Ends: Threaded.
      f. Disc: Bronze.

2.05 BRONZE GLOBE VALVES [S]

A. Class 125, Bronze Globe Valves with Bronze Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Stockham Division.
      c. Hammond Valve.
      d. Kitz Corporation.
      e. Milwaukee Valve Company.
      f. NIBCO INC.
      g. Powell Valves.
      h. Red-White Valve Corporation.
      i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      j. Zy-Tech Global Industries, Inc.
   2. Description:
      a. Standard: MSS SP-80, Type 1.
      b. CWP Rating: 200 psig.
d. Ends: Threaded.

e. Stem and Disc: Bronze.

f. Packing: Asbestos free.

g. Handwheel: Malleable iron.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

   1. Swing Check Valves: In horizontal position with hinge pin level.

3.03 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

   1. Shutoff Service: Ball valves.
   2. Throttling Service: Globe or ball valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.05 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 3 and Smaller:

   1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends. Valves in Copper Pressure-Seal Joint piping systems may have pressure seal ends.
   2. Ball Valves: Two piece, full port, brass or bronze with bronze or stainless-steel trim.
   3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Globe Valves: Class 125, bronze disc.

END OF SECTION
SECTION 22 0529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.
B. Related Sections:
1. Section 05 50 00 – Metal Fabrications
2. Section 22 04 00 – General Requirements for Plumbing
3. Section 22 05 23 – General – Duty Valves for Plumbing Piping
4. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment
5. Section 22 07 00 – Plumbing Insulation
6. Section 22 11 16 – Domestic Water Piping
7. Section 22 11 19 – Domestic Water Piping Specialties
8. Section 22 11 23 – Domestic Water Pumps
9. Section 22 13 16 – Sanitary Waste and Vent Piping
10. Section 22 13 19 – Sanitary Waste Piping Specialties
11. Section 22 14 13 – Facility Storm Drainage Piping
12. Section 22 14 23 – Storm Drainage Piping Specialties
13. Section 22 33 00 – Electric, Domestic-Water Heaters
14. Section 22 40 00 – Plumbing Fixtures

1.03 DEFINITIONS
A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.04 PERFORMANCE REQUIREMENTS
A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to SEI/ASCE 7 “Minimum Design Loads for Buildings and Other Structures.
1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.05 SUBMITTALS
A. Product Data: For each type of product indicated [S]. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing”.
B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Trapeze pipe hangers.
C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

D. Welding certificates.

1.06 QUALITY ASSURANCE
A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS
A. Carbon-Steel Pipe Hangers and Supports:
1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
B. Copper Pipe Hangers:
1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel, stainless steel or cadmium plated steel.

2.02 TRAPEZE PIPE HANGERS
A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.03 THERMAL-HANGER SHIELD INSERTS
A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Carpenter & Paterson, Inc.
3. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.04 FASTENER SYSTEMS
A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.05 EQUIPMENT SUPPORTS
A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes

2.06 MISCELLANEOUS MATERIALS
A. Structural Steel: ASTM A 36, carbon-steel plates, shapes, and bars; black and galvanized.
B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION
3.01 HANGER AND SUPPORT INSTALLATION
A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
   2. Field fabricate from ASTM A 36, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
D. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
G. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping.
I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
K. Insulated Piping:
   1. Attach clamps and spacers to piping.
a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

5. Insulated Pipes NPS 2 1/2 inches and Larger: Include reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 EQUIPMENT SUPPORTS
   A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
   B. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS
   A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
   B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
   C. Field Welding: Comply with AWS D1.1 procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
      1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
      2. Obtain fusion without undercut or overlap.
      3. Remove welding flux immediately.
      4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING
   A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
   B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.05 PAINTING
   A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
      1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
   B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
   2. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
   3. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   4. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   5. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
   2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
   3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
   4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
   5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
   2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
   4. C-Clamps (MSS Type 23): For structural shapes.
5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
6. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
7. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
8. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION
SECTION 22 0553
PAINTING AND IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Identification of piping in exposed and accessible locations.
B. Not Included in Section:
   1. Painting of piping or equipment exposed in finished areas other than those listed under “Section Includes” above.
C. Related Sections:
   1. Section 22 04 00 – General Requirements for Plumbing
   2. Section 22 05 23 – General – Duty Valves for Plumbing Piping
   3. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
   4. Section 22 07 00 – Plumbing Insulation
   5. Section 22 11 16 – Domestic Water Piping
   6. Section 22 11 19 – Domestic Water Piping Specialties
   7. Section 22 11 23 – Domestic Water Pumps
   8. Section 22 13 16 – Sanitary Waste and Vent Piping
   9. Section 22 14 13 – Facility Storm Drainage Piping
  10. Section 22 40 00 – Plumbing Fixtures

1.03 SUBMITTALS
A. For each type of Product indicated [S]. Comply with requirements in Division 01 and Section 22 04 00, “General Requirements for Plumbing”.

1.04 REFERENCED STANDARDS
A. General: The following standards or codes (latest edition) form a part of this specification to the extent indicated by the reference thereto.
B. American National Standards Institute (ANSI):
   ANSI A13.1  Scheme for Identification of Piping Systems
C. American Society for Testing and Materials (ASTM):
D. National Fire Protection Association (NFPA):
   Standard 255 Method of Test of Surface Burning Characteristics of Building Materials
E. Underwriters Laboratories, Inc. (UL)
   Standard 723 Tests for Surface Burning Characteristics of Building Materials
F. California Department of Health Services
PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Except as otherwise specified, materials shall be the products of the following manufacturers:
   1. Sherwin-Williams
   2. Pratt and Lambert
   3. Pittsburgh Paints (PPG)
   4. Benjamin Moore
   5. Porter Paints
   6. Seton Identification Products

2.02 MATERIALS

A. Deliver all paints and materials to the project site in their unopened original containers with all labels intact and legible at the time of use.

B. For adhesives and sealants applied within the building waterproofing envelope, comply with low emitting requirements in Division 01 section, "Indoor Air Quality Requirements".

C. All coatings exposed to supply and return airstreams and where applied to exposed surfaces in a return air plenum, shall have a composite flame spread rating not exceeding 25, and a smoke developed rating not exceeding 50 as tested under procedure ASTM E-84-75, NFPA 255 and UL 723. Coatings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411, latest edition.

D. Sherwin-Williams Industrial Maintenance Coatings System 4000 products are listed below to establish color and a standard of quality.
   1. All Hangers and Supports: One coat Pro-Industrial Zero VOC Acrylic Gloss Black.
   2. Piping: Exposed in equipment rooms and where connections are made to equipment located in storage rooms and other utility type areas.
      a. Priming:
         (1) Insulation Canvas or Paper Jacket: One coat Pro-Cryl Primer (1000g/L).
         (2) Insulation Aluminum Jacket: One coat Pro-Cryl Primer (1000g/L).
         (3) Bare Iron or Steel or Copper: One coat Pro-Cryl Primer (1000g/L).
         (4) Galvanized Steel: Pipes shall be chemically prepared and primed with one coat of Pro-Cryl B66-310 Primer.
      b. Finish: All pipe lines and the supports or hangers therefore, shall be finished with Pro–Industrial Zero VOC Acrylic Gloss gray No. SW4028 Gypsum applied in sufficient number of coats to effectively cover the prime coat. Painting of pipe hangers is specified hereinafter.
      c. Exterior gas piping shall be primed and painted with two (2) coats of Series 54 Alkyd Gloss Enamel, No. SW4084 Safety Yellow Color.
      d. Materials shall be as recommended by the manufacturer for the surface to be finished.
      e. Unless otherwise specified, primer shall be by the same manufacturer as the finish coat.
      f. Materials shall not be thinned or cut except as recommended by the coating manufacturer. Thinners shall be by the same manufacturer as the primer and finish coat.

E. Valve tags shall be neat circular brass with designations stamped thereon, attached with solid brass jack chain to each valve stem or handle.

F. Each item of equipment such as pumps, water heaters, tempering valves and equipment control devices such as motor starters, disconnect switches, etc. shall be properly marked with
laminated engraved plastic nameplates fastened with sheet metal screws, bolts, rivets or permanent adhesive. Pressure sensitive tape is not acceptable.

G. All piping, insulated and un-insulated, shall be identified with Seton Ultra-Mark or equal wrap around piping system markers and arrow flow directional marker. Markers shall be pre-coiled, semi-rigid plastic or polyester with sealed color graphics. Markers shall be minimum 12 inches long with 1-¼ inch high letters, formed to cover entire circumference of the pipe. Markers shall be attached to piping using plastic tie wraps. Pipe identification shall use the same designations or abbreviations used on the drawings. Marker colors shall be in accordance with ANSI.

H. For field applications within the weatherproofing system, all paints, adhesives and sealants shall comply with the requirements of the California Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. The work shall be accomplished by qualified mechanics skilled in the painting trade. Painting of equipment, piping, ductwork and other materials shall not commence until all testing is complete and systems are ready for operation. Materials shall be applied according to manufacturer’s directions. All containers shall be securely closed when not in use. Flammable materials shall not be stored on premises. Flammable waste shall be disposed of daily in devices approved for such purposes. Materials shall be evenly spread, and smoothly flowed on without runs or sags. Each coat shall be thoroughly dry before application of succeeding coats.

3.02 PROTECTION OF WORK

A. The painters shall protect all adjacent surfaces with drop covers during the process of painting. Upon completion, paint spots, if any, shall be removed from all surfaces.

3.03 PREPARATION OF SURFACE

A. Surfaces to be painted shall be completely dry before applying paint. Metal surfaces shall be cleaned with mineral spirits before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be chemically pretreated with crystalline (zinc phosphate) phosphate in strict accordance with the manufacturer’s recommendations. Surfaces shall not be painted when the temperature is, or is likely to be, near the freezing point, nor when they are exposed to hot sun.

3.04 IDENTIFICATION OF PIPES AND EQUIPMENT

A. Equipment: After all other painting is completed; each major item of equipment shall be properly identified with nameplates. Identification symbols and designations shall be the same as shown on the Contract Documents. Where equipment is installed above lay-in ceilings the plastic nameplate shall be adhered to the face of the T-bar support so that it can be identified from within the space.

B. Apply piping system markers after completion of required insulation and finishes on piping systems. Markers shall be applied in the following locations and where identified by the Engineer:

1. At each valve and at connection to equipment.
2. At every tee and branch connection.
3. At each riser including branch risers from mains.
4. At each side of a pipe passage through floors, walls and partitions.
5. Every 15 feet on straight runs of piping mains and branches.
6. Within 6 feet of elbows (each side).
7. At access doors or similar points that permit view of concealed piping.
8. Markers shall be provided on all piping above lay-in ceilings.
9. Provide arrow markers showing direction of flow incorporated into, or adjacent to, each piping system marker.
10. Apply all piping system markers where view is unobstructed, and legends can be read and easily identified.
11. Apply all tags and piping system markers in accordance with the supplier’s instructions.

END OF SECTION
SECTION 22 0700
PLUMBING 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. Insulation Materials:
      a. Mineral fiber.
      b. Polyolefin.
   2. Adhesives.
   3. Sealants.
   4. Factory-applied jackets.
   5. Tapes.
   7. Corner angles.
B. Related Sections:
   1. Section 22 04 00 – General Requirements for Plumbing
   2. Section 22 05 23 – General – Duty Valves for Plumbing Piping
   3. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
   4. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment
   5. Section 22 11 16 – Domestic Water Piping
   6. Section 22 11 19 – Domestic Water Piping Specialties
   7. Section 22 11 23 – Domestic Water Pumps
   8. Section 22 13 16 – Sanitary Waste and Vent Piping
   9. Section 22 13 19 – Sanitary Waste Piping Specialties
  10. Section 22 14 13 – Facility Storm Drainage Piping
  11. Section 22 14 23 – Storm Drainage Piping Specialties
  12. Section 22 40 00 – Plumbing Fixtures

1.03 DEFINITIONS
A. Runout: Last section of pipe from branch or main to fixtures or equipment.

1.04 SUBMITTALS
A. Product Data: For each type of product indicated [S]. Include thermal conductivity, thickness,
   and jackets (both factory and field applied, if any). Comply with requirements in Division 01 and
   Section 22 04 00, “General Requirements for Plumbing”.
B. Qualification Data: For qualified Installer.
C. Material Test Reports: From a qualified testing agency acceptable to authorities having
   jurisdiction indicating, interpreting, and certifying test results for compliance of insulation
   materials, sealers, attachments, cements, and jackets, with requirements indicated. Include
   dates of tests and test methods employed.
D. Field quality-control reports.

1.05 QUALITY ASSURANCE
A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship
   program or another craft training program certified by the Department of Labor, Bureau of
   Apprenticeship and Training.
B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-
   response characteristics indicated, as determined by testing identical products per ASTM E 84,
   by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label
insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.07 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Section 22 05 29, “Hangers and Supports for Plumbing Piping and Equipment”.

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.08 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS [S]

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; Micro-Lok.
   b. Knauf Insulation; 1000(Pipe Insulation.
   c. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

G. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armacell LLC; Tubolit.
   b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
2.02 ADHESIVES
   A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

2.03 SEALANTS
   A. Joint Sealants: Provide sealants either manufactured or recommended by the insulation material manufacturer.

2.04 TAPES
   Product performance is based on products manufactured by Venture Tape; there are slight variations among manufacturers listed.
   A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
      1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
         b. Compac Corp.; 104 and 105.
         c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
         d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
      2. Width: 3 inches.
      3. Thickness: 11.5 mils.
      5. Elongation: 2 percent.
      6. Tensile Strength: 40 lb/ft/inch in width.
      7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.05 SECUREMENTS
   A. Bands:
      1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         a. Childers Products; Bands.
         b. PABCO Metals Corporation; Bands.
         c. RPR Products, Inc.; Bands.
      2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick 3/4 inch wide with [wing or closed seal.
   B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

2.06 CORNER ANGLES
   A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 - EXECUTION

3.01 EXAMINATION
   A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
      1. Verify that systems and equipment to be insulated have been tested and are free of defects.
      2. Verify that surfaces to be insulated are clean and dry.
      3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION
   A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Keep insulation materials dry during application and finishing.

F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

G. Install insulation with least number of joints practical.

H. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

I. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

J. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

K. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

L. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section, "Penetration Firestopping", for firestopping and fire-resistive joint sealers.

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

6. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

7. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.07 Polyolefin Insulation Installation

A. Insulation Installation on Straight Pipes and Tubes:
1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.08 FINISHES
A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 22 05 53, “Painting and Identification for Plumbing Piping and Equipment”.

3.09 FIELD QUALITY CONTROL
A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.
C. Tests and Inspections:
   1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL
A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Underground piping.
   2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE
A. Domestic Cold Water:
   1. Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
      b. Polyolefin: 1 inch thick under floor slab and in walls and chases prior to Building "Dry-In".
   2. Runouts NPS 2 and smaller: Insulation shall be the following:
      a. Mineral–Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
      b. Polyolefin: 1/2 inch thick in walls and chases prior to Building "Dry-In".
B. Domestic Hot and Recirculated Hot Water:
   1. Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
      b. Polyolefin: 1 inch thick under floor slab, and in walls and chases prior to building "Dry-In".
   2. Runouts NPS 2"and smaller”
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
      b. Polyolefin: 1 inch thick in walls and chases prior to Building "Dry-In".
C. Stormwater:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
      b. Interior rain conductors, and secondary rain conductors including fittings, including the bottom of the roof drains to 3'-6” below the last fitting where the lowest
horizontal offset turns down into the vertical. Down 4'-0" below the roof drain on vertical rain conductors without horizontal offsets.

D. Roof Drain Bodies:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

   END OF SECTION
SECTION 22 1116
DOMESTIC WATER PIPING

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. Under-building slab and above ground domestic water pipes, tubes, fittings, and specialties inside the building.
      2. Specialty valves.
      3. Flexible connectors.
   B. Related Sections:
      1. Section 03 30 00 – Cast – in Place Concrete
      2. Section 22 04 00 – General Requirements for Plumbing
      3. Section 22 05 23 – General – Duty Valves for Plumbing Piping
      4. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
      5. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment
      6. Section 22 07 00 – Plumbing Insulation
      7. Section 22 11 19 – Domestic Water Piping Specialties
      8. Section 22 11 23 – Domestic Water Pumps
      9. Section 22 33 00 – Electric, Domestic – Water Heaters
     10. Section 22 40 00 – Plumbing Fixtures
     11. Section 23 09 00 – Instrumentation and Control for HVAC
     12. Division 26 – Electrical
     13. Division 31 – Earthwork
     14. Division 33 – Utilities

1.03 SUBMITTALS
   A. Product Data: For each type of product indicated [S]. Comply with requirements in Division 1 and Section 22 04 00 “General Requirements for Plumbing”.
   B. Water Samples: Specified in “Cleaning” Article.
   C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are coordinated with each other, using input from Installers of the items involved:
      1. Fire-suppression-water piping.
      2. Domestic water piping.
      3. HVAC hydronic piping.
      4. Electric Switchgear, Panelboards
   D. Field quality-control reports.

1.04 QUALITY ASSURANCE
   A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
   B. NSF Compliance for materials that will be in contact with potable water:
      1. Comply with NSF 14 for plastic, potable domestic water piping and components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

1.05 PROJECT CONDITIONS
A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
   1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
   2. Do not proceed with interruption of water service without Owner's written permission.

PART 2 - PRODUCTS
2.01 PIPING MATERIALS
A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 COPPER TUBE AND FITTINGS
A. Hard Copper Tube: Under-building slab ASTM B88, Type K; above ground ASTM B 88, Type L; water tube, drawn temper.
   4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
   5. Copper Pressure-Seal-Joint Fittings:
      a. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         1) Elkhart Products Corporation; Industrial Division.
         2) NIBCO INC.
         3) Viega; Plumbing and Heating Systems.
      b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
      c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
B. Soft Copper Tube: Under building slab, ASTM B 88, Type K water tube, annealed temper.
   2. Copper Pressure-Seal-Joint Fittings:
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         1) Elkhart Products Corporation; Industrial Division.
         2) NIBCO INC.
         3) Viega; Plumbing and Heating Systems.
      b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
      c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
2.03 PIPING JOINING MATERIALS
   A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
   B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.04 SPECIALTY VALVES [S]
   A. Comply with requirements in Section 22 05 23, "General-Duty Valves for Plumbing Piping", for general-duty metal valves.
   B. Comply with requirements in Section 22 11 19, "Domestic Water Piping Specialties", for balancing valves, drain valves, etc.

2.05 TRANSITION FITTINGS
   A. General Requirements:
      1. Same size as pipes to be joined.
      2. Pressure rating at least equal to pipes to be joined.
      3. End connections compatible with pipes to be joined.
   B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
   C. Sleeve-Type Transition Coupling: AWWA C219.
      1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         a. Cascade Waterworks Manufacturing.
         b. Dresser, Inc.; Dresser Piping Specialties.
         c. Ford Meter Box Company, Inc. (The).
         d. JCM Industries.
         e. Romac Industries, Inc.
         f. Smith-Blair, Inc; a Sensus company.
         g. Viking Johnson; c/o Mueller Co.

2.06 DIELECTRIC FITTINGS
   A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
   B. Dielectric Unions:
      1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         b. Central Plastics Company.
         c. EPCO Sales, Inc.
         d. Hart Industries International, Inc.
         e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
         f. Zurn Plumbing Products Group; Wilkins Water Control Products.
      2. Description:
         a. Pressure Rating: 150 psig at 180 deg F.
         b. End Connections: Solder-joint copper alloy and threaded ferrous.
C. Dielectric Flanges:
   1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      b. Central Plastics Company.
      c. EPCO Sales, Inc.
      d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      a. Factory-fabricated, bolted, companion-flange assembly.
      b. Pressure Rating: 150 psig.
      c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:
   1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.
   2. Description:
      a. Nonconducting materials for field assembly of companion flanges.
      b. Pressure Rating: 150 psig.
      c. Gasket: Neoprene or phenolic.
      d. Bolt Sleeves: Phenolic or polyethylene.
      e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:
   1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Calpico, Inc.
      b. Lochinvar Corporation.
   2. Description:
      a. Galvanized-steel coupling.
      b. Pressure Rating: 300 psig at 225 deg F.
      c. End Connections: Female threaded.
      d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:
   1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Perfection Corporation; a subsidiary of American Meter Company.
      b. Precision Plumbing Products, Inc.
      c. Victaulic Company.
   2. Description:
      a. Electroplated steel nipple complying with ASTM F 1545.
2.07 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Flex-Hose Co., Inc.
   2. Flexicraft Industries.
   3. Flex Pression, Ltd.
   4. Flex-Weld, Inc.
   5. Hyspan Precision Products, Inc.
   7. Metraflex, Inc.
   8. Proco Products, Inc.
   10. Unaflex, Inc.
   11. Universal Metal Hose; a Hyspan company

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
   2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
   3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Comply with requirements in Section 31 20 00, "Earth Moving", for excavating, trenching, and backfilling.

3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install shutoff valve immediately upstream of each dielectric fitting.

D. Install domestic water piping level and plumb.

E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

H. Install piping adjacent to equipment and specialties to allow service and maintenance.

I. Install piping to permit valve servicing.
J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

K. Install piping free of sags and bends.

L. Install fittings for changes in direction and branch connections.

M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

N. Install thermostats in hot-water circulation piping. Comply with requirements in Section 22 11 23, "Domestic Water Pumps", for thermostats.

O. Install thermometers at inlet of hot water circulating pump and outlet piping from each water heater. Comply with requirements in Section 22 11 19, "Domestic Water Piping Specialties", for thermometers.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 04 00, "General Requirements for Plumbing".

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 04 00, "General Requirements for Plumbing".

3.03 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

D. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

F. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.04 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Section 22 05 23, "General-Duty Valves for Plumbing Piping", for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 and smaller. Use ball or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Section 22 11 19, "Domestic Water Piping Specialties".

   1. Hose-End Drain Valves: At low points in water mains, risers, and branches.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Comply with requirements in Section 22 11 19, "Domestic Water Piping Specialties", for balancing valves.

3.05 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
1. NPS 1-1/2 and Smaller: Fitting-type coupling.
2. NPS 2 and Larger: Sleeve-type coupling.

3.06 DIELECTRIC FITTING INSTALLATION
A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.07 FLEXIBLE CONNECTOR INSTALLATION
A. Install bronze-hose flexible connectors in copper domestic water tubing.

3.08 HANGER AND SUPPORT INSTALLATION
A. Comply with requirements in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
   1. Vertical Piping: MSS Type 8 or 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.
B. Support vertical piping and tubing at base and at each floor.
C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
   2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
   3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   4. NPS 2-1/2 and Larger: 108 inches with 1/2-inch rod.
E. Install supports for vertical copper tubing every 10 feet.
F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.09 CONNECTIONS
A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to equipment and machines to allow service and maintenance.
C. Connect domestic water piping to water-service main piping with shutoff valve; extend and connect to the following:
   1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
   3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.
3.10 IDENTIFICATION
   A. Identify system components. Comply with requirements Section 22 05 53, "Painting and Identification for Plumbing Piping and Equipment", for identification materials and installation.
   B. Label pressure piping with system operating pressure.

3.11 FIELD QUALITY CONTROL
   A. Perform tests and inspections.
   B. Piping Inspections:
      1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
      2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
         a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
         b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
      3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
      4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
   C. Piping Tests:
      1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
      2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
      3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
      4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
      5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
      6. Prepare reports for tests and for corrective action required.
      7. Test all new piping prior to making connection to existing.
   D. Domestic water piping will be considered defective if it does not pass tests and inspections.
   E. Prepare test and inspection reports.

3.12 ADJUSTING
   A. Perform the following adjustments before operation:
      1. Close drain valves, hydrants, and hose bibbs.
      2. Open shutoff valves to fully open position.
      3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water return piping to provide adequate flow at indicated hot water temperature, at all times to point where hot water return pipe connects to hot water pipe.
   a. Manually adjust balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.13 CLEANING
A. Clean and disinfect potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Fill and isolate system according to either of the following:
         1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      d. Submit water samples in sterile bottles to testing agency for testing. Repeat procedures if biological examination shows contamination.
B. Prepare and submit reports of purging and disinfecting activities.
C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.14 PIPING SCHEDULE
A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
D. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
   1. Hard or soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings.
E. Aboveground domestic water piping, shall be the following:
   1. Hard copper tube, ASTM B 88, Type cast-or wrought- copper solder-joint fittings and soldered joints.
   2. Hard copper tube, ASTM B 88, Type L copper pressure-seal-joint fittings; and pressure-sealed joints.

3.15 VALVE SCHEDULE
A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
2. Throttling Duty: Use ball or globe valves Hot-Water Circulation Piping.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION
SECTION 22 1119
DOMESTIC WATER PIPING SPECIALTIES

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. Balancing Valves.
   2. Temperature-Actuated Water Mixing Valves.
   3. Wall Hydrants (Sill Cocks).
   4. Drain Valves.
   5. Water Hammer Arresters.
   6. Trap-Seal Primer Valves.
   7. Thermometers
B. Related Sections:
   1. Section 22 04 00 – General Requirements for Plumbing
   2. Section 22 05 23 – General – Duty Valves for Plumbing Piping
   3. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
   4. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment
   5. Section 22 07 00 – Plumbing Insulation
   6. Section 22 11 16 – Domestic Water Piping
   7. Section 22 11 23 – Domestic Water Pumps
   8. Section 22 33 00 – Electric, Domestic – Water Heaters
   9. Section 22 40 00 – Plumbing Fixtures
   10. Division 26 – Electrical

1.03 PERFORMANCE REQUIREMENTS
A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise
indicated.

1.04 SUBMITTALS
A. Product Data: For each type of product indicated [S]. Comply with requirements in Division 01
and Section 22 04 00 “General Requirements for Plumbing”.
B. Field quality-control test reports.
C. Operation and Maintenance Data: For domestic water piping specialties indicated [O/M],
include in emergency, operation, and maintenance manuals. Comply with requirements in
Division 01 and Section 22 04 00 “General Requirements for Plumbing”.

1.05 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70,
Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for
intended use.
B. NSF Compliance for materials that will come in contact with potable water:
   1. NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water
      piping components.
2. NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
3. NSF 372, "Drinking Water System Components - Lead Content."

PART 2 - PRODUCTS

2.01 BALANCING VALVES [S] [O/M]
A. Stainless Steel Automatic Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: ThermOmegaTech, “CircuitSolver” or accepted equal.
   2. Type: Self contained, fully automatic.
   4. Size: Same as connected piping.
   5. Return Loop Temperature: 110°F.

2.02 TEMPERATURE-ACTUATED WATER MIXING VALVES [S] [O/M]
A. Individual-Fixture, Water Tempering Valves TV-1:
   1. Manufacturers: The basis of design is shown on the drawings. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Powers, Leonard, Wilkins.
   2. Standard: ASSE 1070, thermostatically controlled water tempering valve.
   3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
   5. Temperature Control: Adjustable.
   6. Inlets and Outlet: Copper Union Threaded or Union Sweat.
   7. Finish: Rough or chrome-plated bronze.
   8. Tempered-Water Setting: 109 deg F.

2.03 WALL HYDRANTS (SILLCOCKS) [S]
A. Non-freeze Wall Hydrants (Sillcocks) SC:
   1. Manufacturers: The basis of design is shown on the drawings. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Josam, Jay R. Smith, Zurn.
   4. Operation: Loose key.
   5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
   8. Nozzle and Wall-Plate Finish: Polished nickel bronze or Chrome plated.
   9. Operating Keys(s): Two with each wall hydrant.

2.04 DRAIN VALVES
A. Ball-Valve-Type, Hose-End Drain Valves:
   2. Pressure Rating: 400-psig minimum CWP.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
8. Inlet: Threaded or solder joint.
10. Vacuum Breaker: Integral or field-installation, non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

B. Stop-and-Waste Drain Valves:
   1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
   2. Pressure Rating: 200-psig minimum CWP or Class 125.
   5. Drain: NPS 1/8 side outlet with cap.

2.05 WATER HAMMER ARRESTERS (SHOCK ABSORBERS) [S]

A. Water Hammer Arresters:
   1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. AMTROL, Inc.
      c. Tyler Pipe; Wade Div.
      d. Zurn Plumbing Products Group; Specification Drainage Operation.
   3. Type: Copper tube with piston.
   4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.06 TRAP-SEAL PRIMER VALVES [S]

A. Supply-Type, Trap-Seal Primer Valves:
   1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      MIFAB model M-500, PPP Inc. model PR-500, ProFlo model PFP 1500.
   5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
   6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
   7. Finish: Rough bronze for.

2.07 FILLED-SYSTEM THERMOMETERS [S]

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
   1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Ashcroft Inc.
b. Marsh Bellofram.
c. Miljoco Corporation.
e. REOTEMP Instrument Corporation.
f. Trerice, H. O. Co.
g. Weiss Instruments, Inc.

3. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Element: Bourdon tube or other type of pressure element.
5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
6. Dial: Non-reflective aluminum with permanently etched scale markings 0 deg F to 200 deg f.
8. Window: Glass.
9. Ring: Metal.
10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device with ASME B1.1 screw threads.
11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.
12. Accuracy: Plus or minus 1 percent of scale range.

B. Thermowells:
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with requirements in other Division 22 Sections for piping joining materials, joint construction, and basic installation requirements.

B. Install balancing valves in locations where they can easily be accessed.

C. Install water hammer arresters in water piping according to PDI-WH 201.

D. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow. **Trap primers shall be installed on all floor drains.**
E. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
F. Install thermowells with extension on insulated piping.
G. Fill thermowells with heat-transfer medium.
H. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
I. Install thermometers in the following locations:
   1. Outlet of each water heater.
   2. Inlet of each hot water circulating pump.

3.02 CONNECTIONS
A. Comply with requirements, for piping installation, in Sections 22 11 16, “Domestic Water Piping”. Drawings indicate general arrangement of piping and specialties.
B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems".
C. Connect wiring according to Section 26 05 23 "Low-Voltage Electrical Power Conductors and Cables".
D. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.03 ADJUSTING
A. Verify balancing valve operation.
B. Set field-adjustable temperature set points of temperature-actuated water mixing valves.
C. Adjust faces of thermometers to proper angle for best visibility.

END OF SECTION
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SECTION 22 1123
DOMESTIC WATER PUMPS

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. In-Line, Oil Lubricated Hot Water Circulating Pumps
B. Related Sections:
   1. Section 22 04 00 – General Requirements for Plumbing
   2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
   3. Section 22 05 23 – General – Duty Valves for Plumbing Piping
   4. Section 22 05 29 – Hanger and Supports for Plumbing Piping and Equipment
   5. Section 22 05 53 – Painting & Identification for Plumbing Piping and Equipment
   6. Section 22 07 00 – Plumbing Insulation
   7. Section 22 11 16 – Domestic Water Piping
   8. Section 22 11 19 – Domestic Water Piping Specialties
   9. Section 22 33 00 – Electric, Domestic - Water Heaters
   10. Section 23 09 00 – Instrumentations and Control for HVAC
   11. Division 26 – Electrical

1.03 DEFINITIONS
A. DDC: Direct Digital Control

1.04 SUBMITTALS
A. Product Data: For each type of product indicated [S]. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing”.
B. Operation and Maintenance Data: For domestic water pumps indicated [O/M], to include in operation and maintenance manuals. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing.

1.05 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. UL Compliance: Comply with UL 778 for motor-operated water pumps.
C. NSF Compliance for materials that will come in contact with potable water:
   1. NSF 61, “Drinking Water System Components - Health Effects; Sections 1 through 9.”

PART 2 - PRODUCTS

2.01 IN-LINE, OIL LUBRICATED HOT WATER CIRCULATING PUMPS[S] [O/M]
A. HWCP-C1: The basis of design for each pump is listed on the drawings. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following: Bell & Gossett Series, Armstrong, Taco.
B. Description: Factory-assembled and -tested, in-line, oil lubricated with overhung-impeller centrifugal pumps.
C. Pump Construction:
1. Pump and Motor Assembly: Hermetically sealed, oil lubricated with hardened steel shaft with flexible spring coupler, designed for installation with pump and motor shaft horizontal.
2. Casing: Bronze, with companion-flange connections.
3. Impeller: Brass
4. Motor: Single speed, unless otherwise indicated.

D. Capacities and Characteristics:
2. Maximum Continuous Operating Temperature: 225 deg F.
4. Pump Control: DDC.
5. Electrical Characteristics:
   a. Volts: 120.
   c. Hertz: 60.

2.02 MOTORS
A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.03 CONTROLS
A. Direct Digital Control: Comply with requirements in Section 23 09 00 “Instrumentation and Control for HVAC”.

PART 3 - EXECUTION
3.01 EXAMINATION
A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.02 PUMP INSTALLATION
A. Comply with HI 1.4.
B. Install in-line, hot water circulating pump centrifugal pump with shaft horizontal.
C. Install continuous-thread hanger rods and spring hangers of size required to support pump weight.
   1. Comply with requirements for hangers and supports in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment".

3.03 CONNECTIONS
A. Comply with requirements for piping in Section 22 11 16 "Domestic Water Piping". Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to pumps to allow service and maintenance.
C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
   1. Comply with requirements for flexible connectors in Section 22 11 16 "Domestic Water Piping".
   2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers in Section 22 11 19 "Domestic Water Piping Specialties".
D. Comply with Division 26 requirements for electrical connections and wiring methods.
E. Connect DDC Controls to pumps that they control.
F. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.04 IDENTIFICATION
A. Comply with requirements for identification in Section 22 05 53 "Painting and Identification for Plumbing Piping and Equipment" for identification of pumps.

3.05 STARTUP SERVICE
A. Perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Set DDC Controls for automatic starting and stopping operation of pumps.
   5. Perform the following startup checks for each pump before starting:
      a. Verify bearing lubrication.
      b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
      c. Verify that pump is rotating in the correct direction.
   6. Prime pump by opening suction valves and closing drains and prepare pump for operation.
   7. Start motor.
   8. Open discharge valve slowly.
   9. Adjust temperature settings on thermostats.
  10. Adjust timer settings.

3.06 ADJUSTING
A. Adjust domestic water pumps to function smoothly and lubricate as recommended by manufacturer.
B. Adjust initial temperature set points.
C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION
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SECTION 22 1316
SANITARY WASTE AND VENT PIPING

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. Pipe, tube, and fittings.
   2. Specialty pipe fittings.
B. Related Sections:
   1. Section 22 04 00 – General Requirements for Plumbing
   2. Section 22 05 29 – Hanger and Supports for Plumbing Piping and Equipment
   3. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment
   4. Section 22 07 00 – Plumbing Insulation
   5. Section 22 13 19 – Sanitary Waste Piping Specialties
   6. Section 22 40 00 – Plumbing Fixtures
   7. Division 31 - Earthwork

1.03 PERFORMANCE REQUIREMENTS
A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1.04 SUBMITTALS
A. Product Data: For each type of product indicated [S]. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing”.
B. Field quality-control reports.

1.05 QUALITY ASSURANCE
A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.06 PROJECT CONDITIONS
A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Architect and Owner no fewer than seven (7) days in advance of proposed interruption of sanitary waste service.
   2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS
A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following: AB&I Foundry, Charlotte Pipe & Foundry or Tyler Pipe. Cast iron pipe and fittings shall be manufactured in the USA bear the Collective Trademark of the Cast Iron Soil Pipe Institute.
B. Pipe and Fittings: ASTM A 74, Service class.
C. Gaskets: ASTM C 564, rubber.
D. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.03 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following: AB&I Foundry, Charlotte Pipe & Foundry or Tyler Pipe. Cast Iron Pipe and fittings shall be manufactured in the USA and bear the Collective Trademark of the Cast Iron Soil Pipe Institute.

B. Pipe and Fittings: CISPI 301.

C. CISPI, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. ANACO Coupling.
      b. Ideal Corporation.
      c. Mission Rubber Company; a division of MCP Industries, Inc.
      d. Tyler Pipe.
   3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.04 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Cellular-Core PVC Pipe: Cellular core pipe shall not be permitted.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.
   1. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Solvent Cement: ASTM D 2564.
   1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.05 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
   1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
   2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
   3. Shielded, Non-pressure Transition Couplings:
      a. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         2) Mission Rubber Company; a division of MCP Industries, Inc.
      c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.01 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified Section 31 20 00 "Earth Moving."
3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

J. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
   1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.
   2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.


L. Install underground PVC piping according to ASTM D 2321.

M. Plumbing Specialties:
   1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts in Section 22 04 00 "General Requirements for Plumbing".

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves in Section 22 04 00 "General Requirements for Plumbing".

P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons in Section 22 04 00 "General Requirements for Plumbing".
3.03 JOINT CONSTRUCTION
B. Joints for hubless, cast-iron soil pipes and fittings shall conform to CISPI 310, latest revision and be certified by NSF for compliance to CISPI 310.
C. Plastic, Non-pressure Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.04 SPECIALTY PIPE FITTING INSTALLATION
A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in OD's.
   2. In Drainage Piping: Shielded, non-pressure transition couplings.

3.05 HANGER AND SUPPORT INSTALLATION
A. Comply with requirements for pipe hanger and support devices and installation in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   3. Vertical Piping: MSS Type 8 or Type 42, clamps.
   4. Install individual, straight, horizontal piping runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      5. Base of Vertical Piping: MSS Type 52, spring hangers.
B. Support horizontal piping and tubing within 12 inches of each fitting
C. and coupling.
D. Support vertical piping and tubing at base and at each floor.
E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
G. Install supports for vertical cast-iron soil piping every 15 feet.
H. Support piping not listed above according to MSS SP-69 and manufacturer's written instructions.

3.06 CONNECTIONS
A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
C. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
   3. Install test tees (wall cleanouts) in stacks near floor and floor cleanouts with cover flush with floor.
D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.07 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification in Section 22 05 53 “Painting and Identification for Plumbing Piping and Equipment.”

3.08 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to plumbing code:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Drainage and Vent Water Test: A water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest openings of the section under test, and each section shall be filled with water, but no section shall be tested with less than 10-foot head of water. In testing successive sections, at least the upper 10 feet of the next preceding section shall be tested so that no joint or pipe in the building, except the uppermost 10 feet of the system, shall have been submitted to a test of less than 10-foot head of water. This pressure shall be held for at least 15 minutes. The system shall then be tight at all points.
   4. Drainage and Vent Air Test: An air test shall be made by forcing air into the system until there is a uniform gauge pressure of 5 psi or sufficient to balance a 10 inches column of mercury. This pressure shall be held for a test period of at least 15 minutes. Any adjustments to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period. Plastic piping shall not be tested with air unless manufacturer literature states air testing is acceptable.
   5. Drainage and Vent Final Test: The final test of the completed drainage and vent system shall be visual and in sufficient detail to determine compliance with the provisions of the plumbing code except that the plumbing shall be subjected to a smoke test where necessary for cause. Where the smoke test is utilized, it shall be made by filling all traps with water and then introducing into the entire system a pungent, thick smoke produced by one or more smoke machines. When the smoke appears at stack openings on the roof, the stack openings shall be closed and pressure equivalent to a 1-inch water column shall be held for a test period of not less than 15 minutes.
   6. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   7. Prepare reports for tests and required corrective action.

E. Clean interior of piping. Remove dirt and debris as work progresses.
F. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.09 PIPING SCHEDULE

A. Aboveground, soil waste and vent piping shall be the following:
   1. Hubless, cast-iron soil pipe and fittings CISPI, hubless-piping couplings; and coupled joints.

B. Underground, soil, waste, and vent piping shall be the following:
   1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION
SECTION 22 1319
SANITARY WASTE PIPING SPECIALTIES

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. Cleanouts.
      2. Floor Drains.
   B. Related Sections:
      1. Section 22 04 00 – General Requirements for Plumbing
      2. Section 22 05 29 – Hanger and Supports for Plumbing Piping and Equipment
      3. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment
      4. Section 22 07 00 – Plumbing Insulation
      5. Section 22 11 16 – Domestic Water Piping
      6. Section 22 11 19 – Domestic Water Piping Specialties
      7. Section 22 13 16 – Sanitary Waste and Vent Piping
      8. Section 22 14 13 – Facility Storm Drainage Piping
      9. Section 22 14 23 – Storm Drainage Piping Specialties
     10. Section 22 40 00 – Plumbing Fixtures
     11. Division 31 – Earthwork
     12. Division 33 - Utilities

1.03 DEFINITIONS
   A. PVC: Polyvinyl chloride plastic.

1.04 SUBMITTALS
   A. Product Data: For each type of product indicated [S]. Comply with requirements in Division 01 and Section 22 04 00, “General Requirements for Plumbing”:
   B. Field quality-control test reports.
   C. Operation and Maintenance Data: For drainage piping specialties indicated [O/M], to include in emergency, operation, and maintenance manuals. Comply with requirements in Division 01 and Section 22 04 00, “General Requirements for Plumbing”.

1.05 QUALITY ASSURANCE
   A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
   B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.06 COORDINATION
   A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.01 CLEANOUTS [S]
   A. Floor Cleanouts:
      1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but not limited to the following:
b. Interior Equipment Rooms and Concrete Floors of Unfinished Areas on Grade: Josam 57000-X-CI-22, Jay R. Smith 4231, Zurn Z-1400 HD cast iron frame and cover.

2. Standard: ASME A112.36.2M
3. Size: Same as connected branch or as indicated on the Drawing.
4. Type: Adjustable housing
5. Body or Ferrule Material: Cast iron.
6. Clamping Device: Not required.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy, Painted cast iron or Polished bronze.
11. Frame and Cover Shape: Round.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

B. Base of Exposed Vertical Stacks Near Floor:
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Josam 48910, Jay R. Smith 4505Y, Wade 8560E, Zurn Z-1445.
2. Standard: ASME A112.36.2M and ASTM A74, ASTM A888, or CISPI 301, for cleanout test tees.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk, brass.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: a. Painted Drywall and Finished Masonry Walls: Josam 58600-PLG, Jay R. Smith 4472, Zurn Z-1468.
2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: Hubless, cast-iron soil-pipe test tee as required to match connected piping.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

D. Outside Cleanouts:
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Josam 55000-X-22, Jay R. Smith 4233, Wade 6000-NH-X, Zurn Z-1400 NH.
2. Standard: ASME A112.36.2M.
3. Size: Same as branch or as indicated on Drawings.
4. Type: Adjustable Housing
6. Closure Plug Size: Brass with taper threads
7. Frame and Cover: Round Cast Iron
8. Top loading Classification: Heavy Duty.
9. Outlet: No-Hub or spigot.
2.02 FLOOR DRAINS [S]

A. General Requirements: Drains are listed to generally describe type and features and shall be modified and furnished as required herein, suitable for construction conditions.
   1. Drains shall have one-piece bodies or the Contractor shall effectively seal drain bodies to prevent leakage from two-piece body drains.
   2. Strainers shall be \( \frac{1}{4} \)” thick, or equivalent, nickel bronze in finished rooms and spaces.
   3. Strainer sizes shall be 8” for 4” drains unless otherwise noted.
   4. Provide flashing clamps for all floors with water-proofing membranes.
   5. Drain body shall be tapped for trap primer on floor drains equipped with trap primers.

B. Cast-Iron Floor Drains:
   1. Manufacturers: The basis of design is shown on the drawings. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Josam, Smith, Wade or Zurn.
   2. Standard: ASME A112.6.3.
   4. Outlet: Bottom, caulk or soil pipe gasket.
   5. Backwater Valve: As specified.
   7. Sediment Bucket: As specified.
   8. Top or Strainer Material: Nickel bronze, Aluminum.
   9. Top Shape: As specified.
   10. Trap Material: Cast iron or PVC.

2.03 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES [S]

A. Floor-Drain, Trap-Seal Primer Fittings:
   1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
   2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

2.04 ROOF FLASHING ASSEMBLIES

A. Comply with requirements for roof flashing specified in Division 07.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with requirements in other Division 22 Sections for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor. Cleanouts on 6” and smaller pipes shall be provided a minimum clearance of 18” for rodding. Cleanouts on 8” and larger pipes shall be provided a minimum clearance of 36” for rodding.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

F. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
   1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
   2. Size: Same as floor drain inlet.

3.02 CONNECTIONS
   A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
   B. Install piping adjacent to equipment to allow service and maintenance.

3.03 PROTECTION
   A. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION
SECTION 22 1413
FACILITY STORM DRAINAGE PIPING

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. Pipe, tube, and fittings.
      2. Specialty pipe fittings.
   B. Related Sections:
      1. Section 22 04 00 – General Requirements for Plumbing
      2. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
      3. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment
      4. Section 22 07 00 – Plumbing Insulation
      5. Section 22 14 23 – Storm Drainage Piping Specialties
      6. Division 26 – Electrical
      7. Division 31 – Earthwork
      8. Division 33 – Utilities

1.03 PERFORMANCE REQUIREMENTS
   A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
      1. Storm Drainage Piping: 10-foot head of water.

1.04 SUBMITTALS
   A. Product Data: For each type of product indicated [S]. Comply with requirements Division 01 and Section 22 04 00 “General Requirements for Plumbing”.

1.05 QUALITY ASSURANCE
   A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.06 PROJECT CONDITIONS
   A. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
      1. Notify Architect and Owner no fewer than seven (7) days in advance of proposed interruption of storm-drainage service.
      2. Do not proceed with interruption of storm-drainage service without Owner’s written permission.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS
   A. Comply with requirements in “Piping Schedule” Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following: AB&I Foundry, Charlotte Pipe and Foundry, Tyler Pipe. Cast iron pipe and fittings shall be manufactured in the USA bear the Collective Trademark of the Cast Iron Soil Pipe Institute.
B. Pipe and Fittings: CISPI 301.

C. CISPI, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. ANACO Coupling
      b. Ideal Corporation
      c. Mission Rubber Company; a division of MCP Industries, Inc.
      d. Tyler Pipe.
   3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.03 PVC PIPE AND FITTINGS
A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
B. Cellular-Core PVC Pipe: **Cellular Core Pipe shall not be permitted.**
C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
D. Adhesive Primer: ASTM F 656.
   1. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
E. Solvent Cement: ASTM D 2564.
   1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 SPECIALTY PIPE FITTINGS
A. Transition Couplings:
   1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
   2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
   3. Shielded, Non-pressure Transition Couplings:
      a. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         2) Mission Rubber Company; a division of MCP Industries, Inc.
      c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION
3.01 EARTH MOVING
A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 “Earth Moving”.

3.02 PIPING INSTALLATION
A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Where trenches are excavated such that the bottom of the trench forms the bed for the pipe, solid and continuous load bearing support shall be provided between joints. Bell holes, hub holes and coupling holes shall be provided at points where the pipe is joined. Such pipe shall not be supported on blocks to grade.

M. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
   1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.

N. Install cast-iron soil piping according to CISPI’s "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

O. Install underground PVC. Remove brackets piping according to ASTM D 2321.
   1. Install cleanouts at grade and extend to where building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts in Section 22 14 23 "Storm Drainage Piping Specialties."
   2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains in Section 22 14 23 "Storm Drainage Piping Specialties."

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves in Section 22 04 00 “General Requirements for Plumbing”.

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons in Section 22 04 00 "General Requirements for Plumbing Piping”.

3.03 JOINT CONSTRUCTION

A. Hubless, Cast-Iron Soil Piping Coupled Joints: Joints for hubless cast iron soil pipes and fittings shall conform to CISPI 310, latest revision and be certified by NSF for compliance to CISPI 310.

B. Plastic, Non-pressure Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.
3.04 SPECIALTY PIPE FITTING INSTALLATION
A. Transition Couplings:
   1. Install transition couplings at joints of piping with small differences in OD's.
   2. In Drainage Piping: Shielded, non-pressure transition couplings.

3.05 HANGER AND SUPPORT INSTALLATION
A. Comply with requirements for pipe hanger and support devices and installation in Section 22 05 53 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   3. Vertical Piping: MSS Type 8 or Type 42, clamps.
   4. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   5. Base of Vertical Piping: MSS Type 52, spring hangers.
B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
C. Support vertical piping and tubing at base and at each floor.
D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
F. Install supports for vertical cast-iron soil piping every 15 feet.

3.06 CONNECTIONS
A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
C. Connect storm drainage piping to roof drains and storm drainage specialties.
   1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
E. Make connections according to the following unless otherwise indicated:

3.07 IDENTIFICATION
A. Identify exposed storm drainage piping. Comply with requirements for identification in Section 22 07 00 "Identification for Plumbing Piping and Equipment."

3.08 FIELD QUALITY CONTROL
A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
D. Test storm drainage piping according to plumbing code:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Storm Drainage System Water Test: A water test shall be applied to the storm drainage system either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest openings of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10-foot head of water. In testing successive sections, at least the upper 10 feet of the next preceding section shall be tested so that no joint or pipe in the building except the uppermost 10 feet of the system shall have been submitted to a test of less than a 10 feet head of water. This pressure shall be held for at least 15 minutes. The system shall then be tight at all points.

4. Storm Drainage System Air Test: An air test shall be made by forcing air into the system until there is a uniform gauge pressure of 5 psi or sufficient to balance a 10-inch column of mercury. This pressure shall be held for a test period of at least 15 minutes. Any adjustments to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test periods. Plastic piping shall not be tested with air unless manufacturer literature states air testing is acceptable.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

3.09 CLEANING
   A. Clean interior of piping. Remove dirt and debris as work progresses.
   B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
   C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE
   A. Aboveground storm drainage piping shall be the following:
      1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
   B. Underground storm drainage piping shall be the following:
      1. Solid Wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION
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SECTION 22 1423
STORM DRAINAGE PIPING SPECIALTIES

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 drains
   2. Miscellaneous storm drainage piping specialties.
   3. Cleanouts.
B. Related Sections:
   1. Section 22 04 00 – General Requirements for Plumbing
   2. Section 22 05 29 – Hanger and Supports for Plumbing Piping and Equipment
   3. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment
   4. Section 22 07 00 – Plumbing Insulation
   5. Section 22 13 16 – Sanitary Waste and Vent Piping
   6. Section 22 13 19 - Sanitary Waste Piping Specialties
   7. Section 22 14 13 – Facility Storm Drainage Piping
   8. Division 31 – Earthwork
   9. Division 33 - Utilities

1.03 SUBMITTALS
A. Product Data: For each type of product indicated [S]. Comply with requirements in Division 01
and Section 22 04 00, "General Requirements for Plumbing".

1.04 QUALITY ASSURANCE
A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing
agency.

PART 2 - PRODUCTS

2.01 METAL ROOF DRAINS
A. Cast-Iron, Large-Sump, Primary Roof Drains Type RD:
   2. Body Material: Cast iron.
   3. Dimension of Body: Nominal 14-inch minimum diameter.
   4. Outlet: Bottom.
   5. Extension Collars: Required.
   6. Underdeck Clamp: Required.
   7. Expansion Joint: Not required.
   8. Sump Receiver Plate: Required.
   11. Water Dam: Not required

2.02 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES [S]
A. Open Site Drains: Type OSD
   1. Basis of Design product: Subject to Compliance provide product indicated:
      a. OSD: Josam series 67100-A, ball float backwater valve with service weight cast iron
         “no-hub” 4”x6” increaser. Install top 2’-0” above finished floor.
2. Standard: ASME A112.6.3 with backwater valve. Drains shall be manufactured in the USA.


4. Outlet: Bottom.

5. Backwater Valve: Ball float type.

2.03 CLEANOUTS [S]

A. Floor Cleanouts

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but not limited, to the following:
   b. Interior Equipment Rooms and Concrete Floors of Unfinished Areas on Grade: Josam 57000-X-CI-22, Jay R. Smith 4231, Zurn Z-1400 HD cast iron frame and cover.

2. Standard: ASME A112.36.2M

3. Size: Same as connected branch or as indicated on the Drawing.

4. Type: Adjustable housing.

5. Body or Ferrule Material: Cast iron.

6. Clamping Device: Not required.


8. Closure: Brass plug with tapered threads.

9. Adjustable Housing Material: Cast iron with threads.

10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy, Painted cast iron or Polished bronze.

11. Frame and Cover Shape: Round.


13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

B. Base of Exposed Vertical Stacks Near Floor:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Josam 48910, Jay R. Smith 4505Y, Wade 8560E, Zurn Z-1445.

2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A888, or CISPI 301, for cleanout test tees.

3. Size: Same as connected drainage piping.

4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.

5. Closure Plug: Countersunk, brass.

6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.

3. Size: Same as connected drainage piping.

4. Body Material Hubless, cast-iron soil-pipe test tee as required to match connected piping.


6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.


D. Outside Cleanouts:
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but not limited to, the following:
2. Standard: ASME A112.36.2M
3. Size: Same as branch or as indicated on Drawings
4. Type: Adjustable Housing
5. Body Material: Cast Iron
6. Closure Plug: Brass with taper thread
7. Frame and Cover: Round Cast Iron
8. Top Loading Classification: Heavy Duty
9. Outlet: No-Hub or spigot

2.04 FLASHING:
   A. Flashing is included in Division 07.

PART 3 - EXECUTION

3.01 INSTALLATION
   A. Install primary roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07 Sections.
      1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
      2. Position roof drains for easy access and maintenance.
   B. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
      1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
      2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
      3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
      4. Locate cleanouts at base of each vertical rain conductor.
   C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
   D. Set outside cleanouts flush with finished grade and provide 18” square by 6” deep concrete apron around cleanout.
   E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
   F. Install test tees in vertical conductors and near floor.
   G. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

3.02 CONNECTIONS
   A. Comply with requirements for piping in Section 22 14 13, “Facility Storm Drainage Piping”. Drawings indicate general arrangement of piping, fittings, and specialties.

3.03 PROTECTION
   A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
   B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION
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SECTION 22 3300
ELECTRIC, DOMESTIC-WATER HEATERS

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. Commercial, light-duty, storage, electric, domestic-water heaters.
   2. Domestic-water heater accessories.
B. Related Sections:
   1. Section 22 04 00 – General Requirements for Plumbing
   2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
   3. Section 22 05 23 – General-Duty Valves for Plumbing Piping
   4. Section 22 05 29 – Hanger and Supports for Plumbing Piping and Equipment
   5. Section 22 05 53 – Painting and Identification for Plumbing Piping and Equipment
   6. Section 22 07 00 – Plumbing Insulation
   7. Section 22 11 16 – Domestic Water Piping
   8. Section 22 11 19 – Domestic Water Piping Specialties
   9. Section 23 09 00 – Instrumentation and Control for HVAC
   10. Division 26 – Electrical

1.03 SUBMITTALS
A. Product Data: For each type and size of domestic-water heater indicated [S]. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing.
B. Shop Drawings:
   1. Wiring Diagrams: For power, signal, and control wiring.
C. Product Certificates: For each type of commercial, electric, domestic-water heater, from manufacturer.
D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
E. Source quality-control reports.
F. Field quality-control reports.
G. Operation and Maintenance Data: For electric, domestic-water heaters indicated [O/M], to include in emergency, operation, and maintenance manuals. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing”.
H. Warranty: Sample of special warranty.

1.04 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects" and NSF 372, "Drinking Water System Components- Lead Content".

1.05 COORDINATION
A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.06 WARRANTY
A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including storage tank and supports.
   b. Faulty operation of controls.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.
   a. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
      1) Storage Tank: Three years.
      2) Controls and Other Components: One year.
   b. Thermal Expansion Tanks: Five years.

PART 2 - PRODUCTS
2.01 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS (S) (O/M)
A. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters EWH-C1:
   1. Manufacturers: The basis of design is shown on the drawings. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following: Rheem/ Ruud Model, Bradford White, State.
      b. Pressure Rating: 150 psig.
      c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
   4. Factory-Installed Storage-Tank Appurtenances:
      a. Anode Rod: Replaceable magnesium.
      b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
      c. Drain Valve: ASSE 1005.
      d. Insulation: Comply with ASHRAE/IESNA 90.1.
      e. Jacket: Steel with enameled finish.
      f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
      g. Heating Elements: Two; electric, screw-in immersion type; wired for non-simultaneous operation unless otherwise indicated.
      h. Temperature Control: Adjustable thermostat.
      i. Safety Control: High-temperature-limit cutoff device or system.
j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

5. Special Requirements: NSF 5 construction with legs for off-floor installation.

6. Capacity and Characteristics:
   b. Temperature Setting: 120 deg F.
   c. Number of Elements: Two.
   d. Volts: 208.
   e. Phases: Three.
   f. Hertz: 60.

2.02 DOMESTIC-WATER HEATER ACCESSORIES [S]

A. Thermal Expansion Tanks TET-C1:
   1. Manufacturers: The basis of design is on the drawings. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. AMTROL Inc.
      b. Flexcon Industries.
      c. Honeywell International Inc.
      d. Pentair Pump Group (The); Myers.
      e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
      f. State Industries.
      g. Taco, Inc.
   2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.
   3. Construction:
      a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
      b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
      c. Air-Charging Valve: Factory installed.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

D. Heat-Trap Fittings: ASHRAE 90.2.

E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

F. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

H. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

I. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

J. Domestic-Water Heater Supports: Factory-fabricated steel wall mounted unit with welded gussets and brackets, front rings for threaded rod support capable of supporting domestic-water heater and water.

2.03 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and re-inspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 03 30 00 "Cast-in-Place Concrete"

1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.

2. Maintain manufacturer's recommended clearances.

3. Arrange units so controls and devices that require servicing are accessible.

4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

6. Install anchor bolts to elevations required for proper attachment to supported equipment.

7. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves in Section 22 05 23, "General-Duty Valves for Plumbing Piping".

C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water-heaters that do not have tank drains. Comply with requirements for hose-end drain valves in Section 22 11 19, "Domestic Water Piping Specialties".

E. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers in Section 22 11 19, "Domestic Water Piping Specialties".
F. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves and thermometers in Section 22 05 23, “General-Duty Valves for Plumbing Piping.”

G. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

H. Fill electric, domestic-water heaters with water.

I. Charge domestic-water compression tanks with air.

3.02 CONNECTIONS

A. Comply with requirements for piping in Section 22 11 16, “Domestic Water Piping”. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Provide proper support for thermal expansion tanks and piping. Arrange expansion tanks piping for easy removal of domestic-water heaters.

3.03 IDENTIFICATION

A. Identify system components. Comply with requirements for identification in Section 22 05 53, “Painting and Identification for Plumbing Piping and Equipment”.

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
   2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and re-inspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters.

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. Water closets.
   2. Lavatories.
   3. Sinks.
   5. Electric water coolers

B. Related Sections:
   1. Section 10 28 00 – Toilet, Bath and Laundry Accessories
   2. Section 22 04 00 – General Requirements for Plumbing
   3. Section 22 05 23 – General – Duty Valves for Plumbing Piping
   4. Section 22 11 16 – Domestic Water Piping
   5. Section 22 11 19 – Domestic Water Piping Specialties
   6. Section 22 13 16 – Sanitary Waste and Vent Piping
   7. Section 22 13 19 – Sanitary Waste Piping Specialties
   8. Division 26 - Electrical

1.03 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

C. FRP: Fiberglass-reinforced plastic.

D. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.04 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated [S]. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates. Comply with requirements in Division 01 and Section 22 04 00 “General Requirements for Plumbing”.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
   1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. NSF Compliance for fixture materials that will be in contact with potable water: NSF 61, "Drinking Water System Components--Health Effects" and NSF 372 "Drinking Water System Components-Lead Content".

E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
   3. Vitreous-China Fixtures: ASME A112.19.2M.

G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
   1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
   3. Hose-Connection Vacuum Breakers: ASSE 1011.

H. Comply with the following applicable standards and other requirements specified for miscellaneous components:

PART 2 - PRODUCTS
2.01 WATER CLOSETS [S]

A. WC-1 Water Closets:
   1. Manufacturers: The basis of design is on the drawings. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following: American Standard, Kohler, Crane, Zurn and Sloan.
   2. Description Accessible, floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer-valve operation.
      a. Style: Flushometer valve.
         1) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
         2) Height: Accessible, if shown thus.
         3) Design Consumption: 1.28 gal. /flush.
         4) Color: White.
   3. Flushometer: Include brass body with corrosion-resistant internal components, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
      a. Internal Design: Diaphragm operation.
      b. Style: Exposed.
      c. Inlet Size: NPS 1.
      d. Trip Mechanism: Oscillating, lever-handle actuator.
      e. Consumption: 1.28 gal. /flush.
      f. Tailpiece Size: NPS 1-1/4 and standard 11-1/2" length to top of bowl.
      g. Handicap accessible handle assembly mounted on the side of the compartment with the most clear floor space.
a. Material: Molded, solid plastic.
b. Configuration: Open front without cover.
c. Size: Elongated.
d. Hinge Type: CK, check.
e. Class: Extra Heavy-duty commercial.

2.02 LAVATORIES [S]

A. L-1 Lavatories:
1. Manufacturers: The basis of design is on the drawings. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: American Standard, Kohler, Crane, Zurn and Sloan.
2. Description: Wall-mounting, vitreous-china fixture.
a. Type: With back.
b. Size: 20 by 18 inches rectangular.
c. Faucet Hole Punching: Three holes, 2-inch centers.
d. Faucet Hole Location: Top.
e. Pedestal: Not required.
f. Support: Concealed arm.
3. Faucet: Moen Commercial, Chicago, T&S or Zurn. Chrome finish, vandal resistant, coordinate faucet inlet with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
a. Finish: Polished chrome plate.
b. Maximum Flow Rate: 2.2 gpm.
c. Centers: 4 inches.
d. Mounting: Deck, exposed.
e. Valve Handles: Color coded Lever.
f. Inlets: IPS1/2.
g. Spout: Rigid type.
h. Spout Outlet: Aerator.
j. Drain: Grid.
k. Water Tempering Valve: Tempering Valve is specified in Section 22 11 19, “Domestic Water Piping Specialties”.

B. Lavatory Fittings:
1. Description: Chrome finish brass lavatory supply assembly Copper Sweat, IPS or Compression ½ x OD 3/8 brass ball valve angle stops with convertible – loose key handle, chrome finish copper flexible risers, chrome finish steel escutcheons; NPS 1-¼ chrome finish cast brass ground joint swivel "P"-Trap with cleanout plug, cast brass slip nuts, 17 gage chrome finish tubular extension to wall, chrome finish steel box or bell wall flange.

C. Protective Shielding Piping Enclosures:
1. For each L-1 lavatory, the drain and water supplies shall be insulated with protective shielding enclosures from bottom of lavatory to wall.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ICC/ANSI A117.1 requirements.

D. Lavatory Supports for Stud and Drywall Partitions:
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Josam Series 17100, Jay R. Smith Series 0700, Jay R. Smith Series 0800, Zurn Series Z-1231

E. Lavatory Supports for Masonry Walls:
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Josam Series 17120-BP, Jay R. Smith Series 0728, Zurn Series Z-1254

2. Description: Rectangular steel plates complete with bolts, nuts, washers, located on back side of partition for wall mounting, lavatory type fixture. Locate plate in wall construction where no pipe space exists.

2.03 SINKS [S]

A. S-1 Sinks:

1. Manufacturers: The basis of design is on the drawings. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Elkay, Just or Moen.

2. Description: One bowl, counter-mounting, stainless-steel kitchen sink.
   a. Metal Thickness: 18 gage.
   b. Drain: 3-1/2-inch chrome plated brass with stainless steel crumb cup.
      1) Location: Near back of bowl.
   c. Punching: As required.
   d. Supplies: NPS 1/2 chrome-plated copper loose key angle with stops.
   e. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 17 gage- thick tubular brass waste to wall; and wall escutcheon(s).

3. Faucet: Moen Commercial, Chicago, T&S or Zurn. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
   a. Body Material: Commercial, solid brass
   b. Finish: Polished chrome plate.
   c. Maximum Flow Rate: 2.2 gpm, unless otherwise indicated.
   d. Mixing Valve: Two-lever handle.
   e. Mounting: Deck.
   f. Spout Outlet: Aerator.
   g. Vacuum Breaker: Not required.

2.04 MOP SINKS [S]

A. MS-1 Mop Sinks:

1. Manufacturers: The basis of design is on the drawings. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Fiat, Florestone, Mustee & Sons.

2. Description: Flush-to-wall, floor-mounting, cast-polymer fixture with rim guard.
   a. Shape: Square.
   b. Size: 24 by 24 inches
   c. Height: 10 inches.
   d. Tiling Flange: On three sides.
   e. Rim Guard: On top surfaces.
   g. Drain: Grid with NPS 3 outlet.

3. Faucet: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
   b. Finish: Rough chrome plate.
   c. Maximum Flow Rate: Unrestricted.
   d. Mixing Valve: Two-lever handle.
2.05 ELECTRIC WATER COOLERS [S]

A. EWC-1 Electric Water Coolers:
1. Available Manufacturers: The basis of design is on the drawings. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Elkay, Halsey Taylor, Oasis.

2. Description: Accessible, ARI 1010, Type PB, pressure with bubbler, Style W, wall-mounting water cooler with EZH2O bottle filling station, for adult-mounting heights.
   a. Cabinet: Bi-level with two attached cabinets, vinyl-covered steel with stainless-steel top, manufacturer’s standard color. Color selected by the Architect.
   b. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
   c. Control: Front and side push pads.
   d. Supply: NPS 3/8 with ball, gate, or globe valve.
   e. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
   f. Drain(s): Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.1.
   g. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
      1) Capacity: 8 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.
      2) Electrical Characteristics: 1/6 hp; 120-V ac; single phase; 60 Hz.
   h. Support: Type II, water cooler carrier. Refer to "Fixture Supports" Article.
   i. Support: Mounting frame or brackets for attaching to substrate.

B. Water Cooler Supports
1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Josam Co.
   c. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
3. Type II: Bi-level, hanger-type carrier with three vertical uprights.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
   1. Use carrier supports without waste fitting for fixtures with tubular waste piping.
   2. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
C. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
D. Install wall-mounting fixtures with tubular waste piping attached to supports.
E. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
F. Install toilet seats on water closets.
G. Install fixtures level and plumb according to roughing-in drawings.
H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
J. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
K. Install traps on fixture outlets.
L. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with requirements for escutcheons specified in Section 22 04 00 “General Requirements for Plumbing”
M. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section “Joint Sealants.”

3.03 CONNECTIONS
A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.04 FIELD QUALITY CONTROL
A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
3.05 ADJUSTING
   A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
   B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
   C. Replace cartridges of leaking and dripping faucets and stops.

3.06 CLEANING
   A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
      1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
      2. Remove sediment and debris from drains.
   B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 PROTECTION
   A. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION
SECTION 23 0010
HVAC GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY
A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. Work Included:
   Every item of labor, materials, equipment and appurtenances for installing complete new Heating, Ventilating and Air Conditioning Systems included in Division 23 of the Specifications.

1.02 DRAWINGS
A. The mechanical Drawings are diagrammatic in nature and show the general arrangement of all ductwork, piping, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. Because of the small scale of the mechanical Drawings, it is not feasible to indicate all offsets, fittings and accessories that may be required. The Contractor shall investigate the construction conditions affecting the work and provide fittings and accessories as required to meet actual conditions.
B. Where discrepancies in scope of work as to which Trade provides specific items, such as starters, disconnects, flow switches, electrical control components, etc. exist, such conflicts shall be reported to the Engineer. If such action is not taken, the Contractor, as applicable, shall furnish such items as part of his work, for complete and operable systems and equipment, as determined by the Engineer.

1.03 REGULATIONS AND STANDARDS
A. The completed installation and all materials and equipment shall conform to local ordinances and codes, other regulations and standards listed herein or in related sections. These are intended as a minimum and shall be exceeded if required by the specifications or the Drawings. In the event of conflict between the codes, standards, or regulations, and information contained in the Contract Documents, the applicable code, standards, or regulation shall take precedence.
B. Refer to Division 1 and Supplementary Instructions to Bidders for construction permitting requirements.

1.04 INSPECTION CERTIFICATES
A. The Contractor shall furnish three copies of certificates of final acceptance to the Engineer from all inspection authorities having jurisdiction.

1.05 SUBSTANTIAL COMPLETION INSPECTION
A. The Engineer will visit the site for the purpose of conducting a substantial completion inspection once the following items have been met by the Contractor:
   1. All HVAC systems shall be complete, operational and under automatic control.
   2. HVAC systems cleaning, balancing, and testing as described in Section 23 05 93 shall be complete and the final report shall be approved by the Engineer.
   3. Letters, signed by representatives of the manufacturer, for the air conditioning unit shall be provided attesting that their respective equipment has been started, tested, and set to operate safely and at the control points required as an integral part of the systems in which they are installed.
   4. A letter, signed by a representative of the temperature controls manufacturer as described in Section 23 09 00, shall be provided attesting that the installation of the temperature controls system is complete, proper control of all equipment, valves, dampers, and the like has been verified, set points have been established to provide proper control of installed equipment, and graphics are accurate with real time data.
5. The Contractor shall provide certification from an authorized official of the equipment manufacturer(s) stating that all refrigerant piping as described in Section 23 20 00 and specialties have been installed in accordance with the manufacturer’s recommendations.

6. The noise and vibration control supplier as described in Section 23 05 48 shall provide a letter stating that all items have been installed properly and that all equipment is adequately isolated and/or restrained.

7. The Contractor shall attest by letter that all equipment has been wired and tested to verify that the indicated sequence of motor control is established, that all safety controls function properly, that all motor protective devices are sized correctly, and that the systems are operating at the proper set points.

B. All discrepancies noted in the substantial completion report shall be corrected prior to the final inspection. The Contractor shall provide a detailed item-by-item description of all corrections made for each item on the substantial completion discrepancy list prior to scheduling final inspection by the Engineer. Additional visits required after the final inspection, for the reason that previously documented discrepancies had not been corrected at the time of the final inspection, will be made at the Contractor’s expense.

1.06 ASBESTOS
A. Asbestos Free Materials: The intention of these Drawings and specifications is that there are no asbestos-containing materials installed on this project. To the best of the Architects and Engineers’ knowledge, none of the material or equipment specified herein or shown on the Drawings contains asbestos. The Contractor shall make every effort to prevent any asbestos materials from being installed in or used on the construction of the project. At the completion of the project, the Contractor shall certify by letter that to the best of his knowledge, no asbestos-containing materials were used for or in the construction of this project.

1.07 MATERIALS AND WORKMANSHIP
A. Equipment and material used in the project shall be new and undamaged. The mechanical installation shall fit into the space allotted and shall allow adequate and acceptable clearances for entry, servicing and maintenance. Similar types of equipment shall be the products of the same manufacturer unless specified otherwise. Work shall be performed by mechanics or tradesmen skilled in the trade involved.

B. All ductwork, piping and conduit shall be installed in a neat and organized manner, parallel to other work and the nearest building elements, unless specifically shown otherwise on the Drawings.

C. Equipment and materials shall be suitable for use in the environment in which they are installed. Equipment exposed to outside conditions shall be adequately protected from the weather, manufactured from materials suitable for outdoor use, and designed specifically for use in outdoor environments.

1.08 SUBMITTALS
A. Submit shop drawings, product data and samples in accordance with Division 1 for all items as specified in related sections of these specifications. One (1) electronic (PDF) copy of the submittal shall be submitted. One (1) electronic (PDF) copy of the submittal will be returned to the Contractor. If additional copies are required, they will be the responsibility of the Contractor. Where drawings are submitted, the Contractor shall submit a minimum of two (2) sets of full scale prints. One (1) copy will be marked and returned to the Contractor, and the Contractor shall be responsible for all additional copies required for his use. All submittal data shall be correctly identified to show project name, and the exact model, style or size of item being submitted. Improperly identified submittals will not be reviewed by the Engineer. Each item submitted for review shall bear the Subcontractor’s stamp which states that they have reviewed the submission, that it is complete, and that in their opinion it meets the contract requirements. Contractor’s stamp shall identify the specification section, paragraph, and page number for which the submittal is being made. Shop drawings will be reviewed only for general compliance with the Contract Documents. Review will not include correctness of details, proper configuration,
utility connections, dimensions, sizes, quantities, and the like. Any submission which has not been reviewed and stamped by the M/E Subcontractor will not be reviewed by the Engineer. No reviews prior to award of Contract will be considered or accepted. Re-submissions of shop drawings, product data and samples shall include the entire original submittal. Partial submittals will not be reviewed by the Engineer.

B. Submissions will be stamped by the Engineer in one of the following ways:

"No Exceptions Taken"  No exceptions are taken and subject to compliance with the Contract Documents.

"Make Corrections Noted"  Minor corrections are noted and a re-submittal is not required subject to compliance with the corrections and the Contract Documents.

"Correct and Resubmit"  The submitted material, method or system meets the intent of the specifications, yet has insufficient data to determine compliance with the Contract Documents. Re-submittal is required.

"Rejected"  The submitted material, method or system does not meet the intent of the specifications, or has insufficient data to determine compliance with the Contract Documents.

C. Submission Procedures:

1. If a submission is satisfactory to the Engineer, the Engineer will annotate the submission, "No Exceptions Taken" or "Make Corrections Noted" and transmit the electronic copy to the Contractor. If a resubmission is required, the Engineer will annotate the submission "Correct and Resubmit" or "Rejected" and transmit the electronic copy to the Contractor for appropriate action.

2. The Contractor shall revise and resubmit submissions as required by the Engineer until submissions are acceptable to the Engineer.

3. Approval of a working and/or shop drawings by the Engineer will constitute acceptance of the subject matter for which the drawing was submitted and not for any other structure, material, equipment or appurtenances indicated as shown.

4. The Engineer's review of the Contractor's submissions shall in no way relieve the Contractor of any of his responsibilities under the Contract. An approval of a submission shall be interpreted to mean that the Engineer has no specific objections to the submitted material, subject to conformance with the Contract Documents.

5. Where as-built drawings, record drawings and specifications are available and when provided to the Contractor for use in performing the work, the Contractor shall verify the content of such drawings and specifications, the suitability of their use in performing the work and their accuracy for the purposes in which the Contractor intends to use any record or historical documents which may be obtained. In no case shall the Contractor assume that such documents reflect a true and accurate record of the construction. Acceptance of any such materials, records, and/or drawings shall in no way result in additional cost to the Owner should an error and/or omission in these documents result in additional costs to the Contractor.

6. On the first pages of all submittals, the Contractor shall provide a table showing all individual specification section paragraphs and drawings that apply to the equipment/component and a statement for each paragraph and drawing that the
requirements have been met. The table shall be similar in format to the following, but shall include all relevant specification paragraphs and drawings:

<table>
<thead>
<tr>
<th>Section 23 07 00 (example)</th>
<th></th>
</tr>
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<tbody>
<tr>
<td>1.2 A Comply</td>
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<tr>
<td>1.2 B Comply</td>
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<td>1.3 A Comply</td>
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<tr>
<td>Drawing M0.01 Comply</td>
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</tbody>
</table>

D. Equivalents: Manufacturers, trade names, and model numbers indicated herein and on Drawings shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Unless definitely stated otherwise and upon complying with Division 1, the Contractor may use any article which, in his judgment is equal to that specified and is accepted by the Engineer. Where three (3) or more manufacturers are named in the specifications for any item, the Contractor shall use one of the named manufacturers. No others will be reviewed or accepted. Manufacturers listed first in these specifications and on Drawings were used as a basis of design. It will be the responsibility of the Contractor to verify all connections, physical sizes, capacities, etc. of all other manufacturer’s items, both named or proposed. If the equipment necessitates changes in ductwork, piping, wiring or other building systems from that indicated on the Drawings, the Contractor shall be responsible for all additional costs included and notify other trades. Where such changes are required, detail drawings indicating all required changes shall be submitted for review at the same time the manufacturers drawings are submitted for approval.

E. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials where specifically required by specification and all items identified with an [S] behind the product title. Submittals not required by the Contract Documents will not be reviewed.

F. Shop Drawing manual(s) shall be submitted in accordance with Division 1 and shall include a complete product index, a copy of all approved shop drawings, and the name, address and telephone number of supplier or nearest representative. The manual(s) shall be presented to the Engineer for review and transmittal to the Owner before final payment is recommended.

G. Operation and Maintenance manual(s) shall be submitted in accordance with Division 1 and shall include a complete product index in each volume, installation and maintenance data, sequence of controls, parts lists, a copy of all approved shop drawings and the name, address and telephone number of supplier or nearest representative. All mechanical devices, equipment and systems marked [O/M] in these specifications shall be included and all other such mechanical items that will require servicing before the duration of its useful life has been reached. Manual(s) shall be presented to the Engineer for review and transmittal to the Owner before final payment is recommended.
1.09 WARRANTY
A. The Contractor shall provide a warranty for a period of one year for all work provided under the Contract to include, but not necessarily limited to, all systems, equipment, materials, and workmanship. This shall not be construed to limit any extended warranty periods of longer than one year for specific items or systems specified elsewhere in the Contract Documents.
B. The warranty period shall commence on the date of acceptance by the Owner and shall cover all parts and labor as required to fulfill the warranty at no cost to the Owner.
C. Refer to Division 1 for additional warranty requirements.
D. Information on all warranties shall be included in the O&M Manuals specified herein to be provided to the Owner.
E. In phased construction, warranties shall not begin until substantial completion of the FINAL phase. Contractor shall maintain all new equipment and systems until that time. Owner will maintain all existing equipment and systems. Where new systems are connected to existing, the Contractor and Owner shall determine coordination of maintenance responsibilities at the preconstruction meeting.

1.10 EXCAVATION AND BACKFILLING
A. General: Excavation and backfilling shall be as specified in Division 31. Backfilling shall not commence until all tests have been performed and all utility systems conform to the Contract Documents.
B. Protection of Existing Utilities: Existing utility lines to be retained, whether known or unknown and uncovered during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be restored to original condition.

1.11 COORDINATION OF WORK
A. General: The Contract Documents indicate the extent and general arrangement of the mechanical systems. The Contractor shall be responsible for the coordination and proper relation of the mechanical work to the building structure and to the work of other trades. No additional compensation or extension of completion time will be granted for extra work caused by the lack of coordination.
B. Cooperation: The Contractor shall provide dimensions and locations of all openings, shafts and similar items to the proper trades and install work as required so as not to interfere with, or delay, the building construction.
C. Locations of lines and equipment shall be determined from actual field measurements. The outlines of the building shown on the mechanical Drawings are intended only as a guide to indicate relative locations of the mechanical work. Refer to architectural and structural Drawings for building construction details. The Contractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component. Accurate measurements and coordination shall be completed to verify dimensions and characteristics for the installation of each system.
D. Unless necessitated by equipment access or otherwise indicated in the Contract Documents, all piping, ductwork, and conduit concealed above ceilings and in finished or utility spaces shall be routed as high as possible.
E. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall provide manual air vents and drains as required for his work to affect these offsets, transitions and changes in direction, as applicable.
F. Cutting and Patching: See Division 1.
G. Roughing-In: Verify the locations of other buildings machines, door swings, block coursing, alignment of tile end and other similar features before roughing-in for mechanical equipment components and/or controls.
H. Damage to Other Work: Each Contractor is responsible for damage to other work caused by his work or workmen. Repairing of damaged work shall be done by the Contractor who installed the work, and as directed by the Architect-Engineer; the cost of which shall be paid for by the Contractor responsible for the damage.

1.12 EQUIPMENT INSTALLATION

A. General: Equipment shall be installed in accordance with manufacturer's instructions to conform with the details and application indicated. Where manufacturer's recommendations or installation instructions require options or accessories not specified, they shall be included and installed by the Contractor.

B. Supports: Provide necessary supports for all equipment and appurtenances as required; this includes but is not limited to frames or supports for items such as tanks, compressors, boilers, plumbing fixtures, pumps, valves, fans, and other similar items requiring supports. Floor mounted equipment in Equipment Rooms shall be set on 4-inch high concrete foundation pads unless shown otherwise. All pads shall be poured such that the top of the pad is level. Foundation drawings, bolt setting information and foundation bolts shall be furnished by the subcontractors furnishing the equipment for all equipment required to have concrete foundations. Concrete for foundations shall be provided by mechanical subcontractor unless indicated otherwise. Except where indicated in Section 23 05 48, all equipment shall be anchored to concrete pads. Rooftop equipment, ductwork, and piping shall be set on pre-manufactured curbs anchored to the roof and flashed into the roofing system. Rooftop equipment, ductwork, piping, etc. shall be anchored to the curb except where vibration isolation is installed between the curb and the equipment. Unless otherwise noted, outdoor equipment (on grade) shall be installed on 4-inch thick cast-in-place concrete equipment pads.

C. Service Area: All equipment and appurtenances shall be located to permit adequate service clearance in accordance with manufacturer's recommendations and as otherwise required. Service clearance shall include but not be limited to service and removal of filters, coils, motors, controls and removal of equipment sections. Service clearance shall include adequate space for rodding and removing tubes from boilers, chillers, and heat exchangers. All piping, ductwork, and other equipment shall be located outside of the service area or shall be flanged for easy removal to facilitate equipment service. All equipment shall be located with sufficient distance from building features, structural components, and the equipment of other trades. Service clearance in front of electrical panels shall be minimum as required by National Electric Code (NEC) where applicable. Equipment requiring service and located above ceiling shall be located within two feet of the ceiling vertically to allow for proper maintenance access.

D. Temporary Requirements: Temporary filters shall be provided for all fans that are operated during construction. Return openings, grilles, and registers shall be provided with temporary filters to prevent the intrusion of dust and particulate into the return air ductwork. Temporary filter shall have a minimum efficiency of MERV 8 in accordance with ASHRAE 52.2. Openings in equipment shall be kept plugged at all times until connection is made to the system. The ends of all pipes, ducts and equipment openings shall be kept plugged or capped properly with approved devices. Approved devices are items such as specially molded plastic caps, pipe plugs, test plugs and sheet metal caps.

E. All equipment indicated to be installed exposed within finished spaces shall be installed such that all conduit, piping, and appurtenances are concealed. Air conditioning units utilizing gravity condensate drains shall be installed at an elevation necessary for the specified pipe slope.

1.13 EXISTING EQUIPMENT

A. General: Care shall be exercised to protect all existing equipment to be reused. The Contractor shall remove from operation all equipment that is shown to be reused and provide adequate protection including but not limited to prevention of corrosion, protection of seals, prevention of leaking, and prevention of internal/external contamination. All electronic components shall be protected from weather and moisture, deterioration and loss of programming.
1.14 SLEEVES AND INSERTS

A. General: Sleeves and inserts shall be provided and correctly located in the structure, as require for the work.

B. Inserts shall be steel and proper size for loads encountered.

C. Sleeves shall be provided for all pipes passing through concrete or masonry walls, partitions, concrete beams or slabs installed during construction of the wall, partition, beam or slab. Sleeves through existing concrete walls and slabs may be omitted if wall or slab can be core drilled and properly sealed in a manner acceptable to the Engineer. Sleeves placed horizontally in walls or in any position in beams shall be standard weight ASTM A53 steel pipe of length equal to thickness of wall or beam. Those placed vertically in non-waterproof floors shall be 20 gauge galvanized sheet steel of length equal to thickness of slab, flared and nailed to the form, or fastened to reinforcing fabric and filled with sand during pouring to prevent deformation. Sleeves occurring in floors of rooms where hose bibs or floor drains occur, and in pipe spaces, shall be standard weight steel pipe projecting 2" above the finished floor except in Equipment Rooms they shall project four (4) inches above floor. Sleeves in floors with waterproof membrane shall be provided with flanges or flashing rings and shall be clamped or flashed into membrane. All sleeves (and core drilled openings) shall be of sufficient diameter to clear bare or covered pipes by 1/4" all around except sleeves on lines subject to movement by expansion which shall clear the bare pipe or insulation on insulated pipe at least one inch all around. Pipes through exterior walls below grade and above footings shall be installed in sleeves having a minimum size of two larger pipe diameters and sealed watertight with flexible synthetic rubber seals. Sleeve shall have anchor and water stop plate. The entire assembly shall be tightened and adjusted and made watertight. Sleeves for pipes and conduit, penetrating fire (and smoke) rated partitions, walls and floors shall be sealed in accordance with the terms of U.L. Listed Through-Penetration Firestop Systems XHEZ as published in the U.L. Fire Resistance Directory. Penetrations shall exactly conform to details of the Firestop System indicated for the type of partition, wall and floor construction encountered. All penetrations through nonfireresistance rated floor assemblies and through the ceiling membrane of nonfireresistance rated roof assemblies shall be fireblocked with tightly packed mineral-wool insulation secured in place. All penetrations through equipment room walls and other areas of noise or heat generation shall be tightly sealed with mineral fiber rope. All penetrations through draftstop partitions shall be sealed to maintain the integrity of the partition. All firestopping and draftstopping of sleeves for mechanical work shall be provided under Division 23.

1.15 PREMANUFACTURED LIGHT GAUGE METAL STRUCTURE

A. Where piping, ductwork and conduit are supported from the light gauge structure, all connections shall be made in strict accordance with this Section and with details indicated on the Drawings. For spacing of piping and ductwork supports, see Section 23 05 00.

B. Piping 4” or larger shall not be supported by light gauge metal roof framing, but rather shall be supported only by the designated steel channels shown on the structural drawings. Any connections to the light gauge metal roof framing shall be limited to 150 pounds per connection and to a maximum of two such connections to any individual light gauge member.

C. All connections to the light gauge roof framing shall be made thru shear hangers at the face of the light gauge members. No clamps or eccentric connections shall be used that will induce twisting of the light gauge members. All connections shall be made by screws. No welding to the light gauge members will be allowed.

D. Hangers for multiple pipes or ducts shall be staggered to distribute weight on light gauge framing as evenly as possible.

1.16 ESCUTCHEONS

A. Where pipes pass through floors, walls or ceilings in finished rooms, they shall be fitted with chromium plated escutcheons of suitable pattern to effectively cover the rough opening. Where sleeves project above floors, special deep type escutcheons shall be provided.
1.17 ACCESS DOORS
A. Provide for all concealed valves, controls, dampers, junction boxes, equipment, or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for Mechanical work shall be furnished as a part of this Division to the General Contractor for installation. The Mechanical Contractor shall provide locations of all access doors such that service may be safely performed from a ladder, lift, or platform without the need for support from the ceiling system. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable. Doors shall be metal access doors with cam lock, style to match ceiling or wall construction. Doors occurring in rated construction shall be fire rated U.L. labeled access doors correlated to preserve the integrity of the rated construction. Doors leading to concealed spaces shall be provided with means to open from the inside. Doors shall be prime finish steel except those in toilets, shower rooms, locker rooms, kitchens and other similar areas shall be stainless steel with brushed finish.

1.18 ELECTRICAL WIRING AND EQUIPMENT
A. Wiring, low voltage (100 volts or less) control wiring shall be provided as a part of Division 23 in strict accordance with Division 26 and shall be in accordance with manufacturer’s recommendations to comply with the sequence of control indicated. Verify that wiring of all motors and controls required by equipment furnished is accomplished for the correct sequence of operation.
B. Wiring, line voltage (101 volts or higher) power or control wiring shall be furnished and installed under Division 26.
C. Disconnects shall be provided for each item of equipment under Division 26 unless specified otherwise in other sections.
D. Miscellaneous manual or automatic control and protective or signal devices required for the sequence of operation indicated for mechanical equipment shall be provided under the section of the specifications where the item of equipment is specified unless indicated otherwise.

1.19 PROTECTION FROM MOVING PARTS
A. Belts, pulleys, chains, gears, shafts, couplings and other rotating or moving parts located so that any person may come in close proximity thereto shall be fully enclosed or properly guarded.

1.20 RECORD OF UNDERGROUND LINES
A. On completion of the project, the Contractor shall prepare and submit to the Engineer a drawing on tracing paper and one blue line print to show the location of any underground lines installed in locations different from those on the Architect-Engineer’s Drawings. The location of cleanouts, and the distance from the building to outside sewers, mains, and manholes shall be dimensioned.

1.21 CHARTS AND DIAGRAMS
A. General: Material as listed below shall be provided by the Contractor and shall be mounted in separate hardwood frames where directed in the field or folded and stored in a plastic document folder and located in the control cabinets. All charts, diagrams and schemes shall be photographic positives prepared from original tracings. A copy of charts and diagrams shall be included with O/M manuals.
B. Automatic Temperature Control Diagrams identified as to name, sequence of operation, location and number of systems. Components of a control system shall be identified as to location, function, temperature setting and manufacturer’s part number.
C. Electric Sequence Control Diagrams of entire Mechanical system.
D. Charts for identification of valves.
1.22 INSTRUCTION OF OWNER’S REPRESENTATIVE
   A. Contractors shall instruct the representative of the Owner in the proper operation and
      maintenance of all elements of the Mechanical systems. Competent representatives of the
      Contractor shall spend such time as necessary to fully prepare the Owner to operate and
      maintain the Mechanical and Electrical systems.

1.23 COMMISSIONING OF HVAC SYSTEMS:
   A. Commissioning of this project will be coordinated and managed by the Owner’s Commissioning
      Agent. Refer to the Commissioning Plan and Division 1 for the scope and requirements for
      commissioning of mechanical systems.

1.24 CONSTRUCTION STATUS REPORT
   A. Each item of discrepancies noted on Construction Status Report prepared by the Engineer
      shall be answered in detail in writing by the Contractor before payment can be recommended.

1.25 GRAPHICS DATABASE
   A. This project’s Computer Aided Design & Drafting (CADD) drawing files may be obtained
      through the Architect/Engineer for use in preparing computer graphics specific to this project.
      See Appendix A at the end of this Section for Letter of Indemnification and ordering
      instructions.

1.26 DEMOLITION
   A. Contractor shall visit site before bidding to determine extent of demolition.
   B. Removal of Ducts, Piping and Equipment: Remove all ductwork and piping connections,
      plugging outlets, etc., such that are not required for present equipment and fixtures, or are not
      reused or needed for reconnecting new equipment and fixtures. Remove all equipment,
      fixtures, etc., indicated to be removed, or not reused or needed after the renovations are
      complete.
   C. Where piping, conduit, ductwork or other similar items passing through rated assemblies are
      removed; the assemblies shall be patched in accordance with UL so as to maintain the integrity
      of the assembly.
   D. The Owner will select and retain such existing equipment and materials which are indicated to
      be removed and not reused, as he desires. All other existing equipment and materials
      indicated to be removed and not reused shall become the property of the Contractor, who shall
      promptly remove them from the premises. All existing equipment and fixtures indicated to be
      relocated shall be disconnected, removed, relocated and reconnected. All equipment and
      fixtures shall be protected from damage during demolition.
   E. Miscellaneous: In all altered portions of the buildings, the Contractor shall remove or alter as
      necessary all existing mechanical work that is not coordinated to operate with the new
      construction. Demolition shall not begin until the work schedule is approved by the owner. The
      work shall be scheduled to prevent any disruption to the normal operations of the building.
   F. General Scope of Demolition: Remove portions of pipe and building components to allow for
      connection into existing hot water system.

1.27 PHASING OF WORK
   A. Coordinate phasing requirements with Division 1.

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

END OF SECTION
APPENDIX A
LETTER OF INDEMNIFICATION

Project Name:
Project Location:
The Contractor may obtain from Ascent Engineering Group a CD-ROM or electronic mail version of the projects Revit / CADD database. All seals, details, schematics, tables, controls, etc. will be deleted. All drawings will be provided in Autocad™ 2018 format.

Ascent Engineering Group reserves all rights to the original drawing files.

The Recipient agrees, to the fullest extent permitted by the law, to hold harmless and indemnify Ascent Engineering Group, as defined in the Bid Documents, from and against all claims, liabilities, losses, damages, and costs, including but not limited to attorney’s fees, arising out of or in any way connected with the use, modification, misinterpretation, misuse, or reuse by the Recipient or others of the machine readable information and data provided by Ascent Engineering Group under this Agreement. The foregoing indemnification applies, without limitation, to any use of the project documentation on other projects, for additions to this project, or for completion of this project by others, excepting only such use as may be authorized, in writing, by Ascent Engineering Group.

The electronic drawing files are not part of the Contract Documents for the Project. The Recipient assumes all risks associated with the use of the transmitted files. Ascent Engineering Group will not be responsible for any differences in the information included in the transmitted files and the information shown on the Contract Documents. Modifications to the Contract Documents made before or during construction may or may not be included in the transmitted electronic drawing files.

The Recipient further agrees that the drawing files will only be used in graphics preparation for the above-referenced project.

Company Name of Recipient: _____________________________________________
Recipient’s Designated Representative: ____________________________________
Title: _________________________________________________________________
Signature: ______________________________________________________________
Address: ______________________________________________________________

Return to: Ascent Engineering Group
5228 Valleypointe Parkway, Suite 4
Roanoke, VA  24019
AEG # 16235
SECTION 23 0100
OPERATION AND MAINTENANCE OF HVAC SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY
A. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. Work Included:
   1. To aid the continued instruction of operating and maintenance personnel, and to provide a source of information regarding the products incorporated into the work, furnish and deliver the data described in this section and in pertinent other sections of these specifications.
C. Related Sections:
   1. Section 23 00 10 – HVAC General Requirements
   2. Section 23 05 00 – Common Work Results for HVAC
   3. Section 23 20 00 – HVAC Piping and Pumps
   4. Section 23 30 00 – HVAC Air Distribution
   5. Section 23 70 00 – Central HVAC Equipment
   6. Section 23 80 00 – Decentralized HVAC Equipment

1.02 SUBMITTALS
A. Unless otherwise directed in other sections, or in writing by the Engineer, submit three copies of the final manual to the Engineer for approval prior to indoctrination of operation and maintenance personnel.
B. Operation and Maintenance manual(s) shall be submitted in accordance with Division 1 and shall include a complete product index in each volume, installation and maintenance data, sequence of controls, parts lists, a copy of all approved shop drawings and the name, address and telephone number of supplier or nearest representative. All mechanical devices, equipment and systems marked [O/M] in these specifications shall be included and all other such mechanical items that will require servicing before the duration of its useful life has been reached. Motor driven equipment shall include data for the motor. Manual(s) shall be presented to the Engineer for review and transmittal to the Owner before final payment is recommended.

1.03 QUALITY ASSURANCE
A. In preparing data required by this section, use only personnel who are thoroughly trained and experienced in the operation and maintenance of the described items, completely familiar with the requirements of this section, and skilled communicating the essential data.

PART 2 - PRODUCTS

2.01 INSTRUCTION MANUALS
A. Where instruction manuals are required to be submitted under other sections of these specifications, prepare in accordance with the provisions of this section.
B. Format:
   Size: 8-1/2" x 11"
   Paper: White bond, at least 20 lb. weight.
   Text: Typed (Hand printed or written is not acceptable)
   Drawings: 11" x 8-1/2" preferable; bind in with text; foldouts are acceptable; larger drawings are acceptable if folded to fit within the manual and provide a drawing pocket inside rear cover or bind in with text.
Fly Sheets: Separate each portion of the manual with neatly prepared Fly Sheets or tabbed index sheets briefly describing the contents of the ensuing portion. Fly sheets or index tabs may be in color.

Binding: Use heavy-duty plastic covers with binding mechanism concealed inside the manual; 3-ring binders are required. All binding is subject to the Engineer's approval.

C. Provide front and back covers for each manual, using durable plastic material approved by the A.E, and clearly identified on the front cover with at least the following information:

OPERATING AND MAINTENANCE INSTRUCTIONS
FOR
(Item/system name and description)
(Name and address of Contractor and sub-contractor)
(General subject of this manual)
(Name and address of Engineer)
(Engineer's approval and date approved)

D. Contents:
Neatly prepared and typewritten detailed table of contents.
Complete instructions regarding operation and maintenance of all equipment involved including lubrication, disassembly, and reassembly.
Complete nomenclature of all parts of all equipment.
Complete nomenclature and part number of all replaceable parts, name and address of nearest vendor, and all other data pertinent to procurement procedures.
Copy of all guarantees and warranties issued.
Manufacturer's bulletin, cuts, and descriptive data, where pertinent, clearly indicating the precise items included in this installation and deleting, or otherwise clearly indicating, all manufacturers' data with which this installation is not concerned.
Such other data as required in pertinent sections of these specifications.

PART 3 - EXECUTION

3.01 INSTRUCTION MANUALS

A. Revisions:
1. Following the indoctrination and instruction of operation and maintenance personnel, review all proposed revisions of the Manual with the Engineer.

END OF SECTION
SECTION 23 0500
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

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

B. Work Included:
   1. Common Motor Requirements for HVAC Equipment
   2. Variable Frequency Drives
   3. Expansion Fittings for HVAC Piping
   4. General-Duty Valves for HVAC Piping
   5. Hangers and Supports for HVAC Piping and Equipment

C. Related Sections:
   1. Division 01 -- Commissioning
   2. Section 23 00 10 – HVAC General Requirements
   3. Section 23 05 48 – Vibration and Seismic Controls for HVAC Systems
   4. Section 23 05 53 – Identification for HVAC Piping and Equipment
   5. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
   6. Section 23 09 00 – Instrumentation and Control for HVAC
   7. Section 23 20 00 – HVAC Piping and Pumps
   8. Section 23 30 00 – HVAC Air Distribution
   9. Section 23 70 00 – Central HVAC Equipment
   10. Section 23 80 00 – Decentralized HVAC Equipment

1.02 REFERENCES

A. General: The following standards or codes form a part of this specification to the extent indicated by the reference thereto.

B. American Society of Mechanical Engineers (ASME):
   C. ASME 95 Boiler and Pressure Vessel Code
   D. B16.3 Malleable Iron Threaded Fittings
   E. B16.4 Cast Iron Threaded Fittings
   F. B31.9 Building Services Piping

G. National Electrical Manufacturers Association (NEMA)
   H. Underwriters Laboratories, Inc. (UL)

1.03 COMMISSIONING OF HVAC SYSTEMS:

A. The Contractor shall provide contact information to the Commissioning Agent indicated in Division 1 for all major items of Equipment.

B. Provide additional submittal copy of major equipment for Commissioning Agent specified in Division 1.

1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with Division 1 and Section 23 00 10.

B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials marked with notation set forth in Section 23 00 10.
C. Operation and maintenance data shall be submitted in accordance with Division 1, for all items of equipment and materials marked with notation set forth in Section 23 01 00.

PART 2 - PRODUCTS

2.01 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

A. Motors shall be provided in place as an integral part of the driven equipment, ready for electrical connections. Motors shall be in accordance with NEMA Standards and of design suitable for the starting and running characteristics of the driven equipment. Motors over 5 HP shall be “premium” efficiency as defined by NEMA MG-1, latest edition.

B. All three phase motors over 5 HP shall be provided with minimum power factor of 90%. Power factor correction capacitors shall be provided if required and shall be furnished to the electrical subcontractor for installation. Shop Drawing submittals for motors over 5 HP shall list efficiency and power factor. Unless specified otherwise, all motors shall have continuous duty classification, 40° Centigrade ambient temperature, shall have enclosure suitable for indicated application and shall be wound for 120 volt, single phase, 60 cycle current, except motors above 1/2 horsepower (unless indicated otherwise) shall be wound for 200V or 230V/460V as required by the secondary voltage specified for main service in Division 26. Each motor shall be selected and rated at the voltage indicated so that the driven load does not exceed the nameplate rating and service factor of the motor. All motors 460V/480V 20 HP and above and 208V/230V 10 HP and above shall be wound for wye-delta (6 or 12 lead) starting with capabilities of being wired for across-the-line starting.

C. Motors for use with variable frequency drives (VFD) shall be wound for across-the-line type starting and shall be rated for “VFD-duty” or shall be Premium Efficiency type with Class F (1500 volt) insulation and thermal overload protection. Motors for VFD applications shall meet or exceed IEEE 519-1992. Motors for VFD applications shall have maximum 4:1 speed range corresponding to 60 Hz and 15 Hz. Power factor correction is not required when motor is used with VFD. Motors for VFD service shall be Inverter Duty Rated with internal shaft grounding to prevent common mode voltage (shaft current) bearing failures.

D. Motor starters and motor protective switches shall be provided under Division 26 except where specified to be furnished specifically with the driven equipment. Accessories such as auxiliary contacts, hand-off-automatic switches, start-stop switches, pilot lights, control power transformers and other similar items shall be provided in or on the controllers as required by the control sequence indicated. Starting equipment, unless factory mounted on the equipment, shall be installed under Division 26.

2.02 VARIABLE FREQUENCY DRIVES [S] [O/M]:

A. Variable Frequency Drives (VFD) shall convert primary power to adjustable voltage/frequency three phase AC power for stepless motor control from 5% to 105% of motor base speed. Units shall be pulse-width-modulation (PWM) type. Units shall be UL listed and suitable for installation in return air plenums, complete with Hand/Off/Auto switch, Run or Stop switch and display to indicate unit status, frequency and fault diagnostics. Unit shall have automatic soft restart after power outage, soft start/stop, and interface provisions for start/stop and control from the DDC system specified in Section 23 09 00 interconnections. Unit shall have all motor protective devices as required by NEC. Unit shall have line circuit breaker, bypass switch, motor thermal overload relay, phase-loss protection, ground-fault protection, harmonic compensated load side reactor and control transformer.

B. Drives shall be suitable for operation without damage to the connected motor. Drives shall have multiple, adjustable deadbands across the entire speed range for operation of connected equipment without vibration. Units shall have display on each drive to indicate all faults and diagnostics.

C. Drives shall be matched to driven motors in accordance with motor and drive manufacturers’ recommendations.

D. Drives shall be suitable for speed control by the DDC System specified in Section 23 09 00 using any of the following signals, 3-15 psi, 0-5 vdc, 0-10 vdc or 4-20 ma dc.
E. Drives shall be provided with current sensing device to indicate abnormal conditions such as broken belt.

F. Where wiring to the driven motor exceeds 150 feet or as otherwise recommended by the manufacturer, a load side drive filter shall be furnished and installed. Where drives have remote disconnects at the driven motor, a run contact shall be provided to stop the drive without harm if the remote disconnect is opened.

G. Drives shall be installed in NEMA classified cabinets suitable for the location in which installed. Units located outdoors shall be NEMA 3R or NEMA 4.

H. Harmonics: The drives provided shall not add significant voltage harmonic distortion to the electrical system. If voltage harmonic distortions exceed 5%, line reactors or isolation transformers shall be provided in a separate enclosure.

I. VFD shall be provided with communication interface to allow two-way communication with the DDC System specified in Section 23 09 00.

J. Warranty: Provide parts and labor warranty for a period of five (5) years.

K. Installation and Start-up:
   1. The services of a qualified manufacturer’s technical representative shall supervise the contractor’s installation, testing, and start-up of all the drives furnished under this specification. A maximum total of one (1) supervision day (8 hours) shall be provided by the manufacturer’s representative.
   2. System start-up shall include a checkout of vibration at various frequencies through field observation and manufacturer’s data on the driven equipment. Frequency deadbands shall be set-up for each point of equipment vibration.
   3. Upon acceptance of the drive equipment, training of the operators shall consist of one (1) training day (8 hours).

2.03 EXPANSION FITTINGS FOR HVAC PIPING

A. Expansion joints [S] shall be Flexonic internally guided, corrugated bellows, expansion compensator, type H or HB, 2” minimum stroke, suitable for steam or hot water service.

B. Anchors and guides for pipe shall be provided as indicated or as required at the job site to localize expansion and contraction of pipe. Anchors shall consist of heavy steel or brass collars bolted or welded to the pipe and rigidly connected to the building structure unless indicated otherwise. Anchor braces shall not be attached in places where they will damage or injure the structure during installation or by the weight or expansion force of the pipe line after installation. Detail drawings of pipe anchors shall be approved before anchor installation.

C. Flexible pipe joints at air handling units or other pieces of equipment isolated from the structure by vibration isolators as specified elsewhere shall be pipe line size and shall be Flexonics standard 125 psi, Series PCS, stainless steel or bronze, flanged, screw or sweat type connectors with longitudinally welded stainless steel bellows and braided jacket.

2.04 GENERAL-DUTY VALVES FOR HVAC PIPING

A. General: Valves shall be Apollo, Bray, Center Line, Crane, Jenkins, Jamesbury, Nibco, Milwaukee, Stockham, or Weco. All valves shall be suitable for 150 psi working pressure. Class 125 is not acceptable. Valves shall have threaded connections; except where flanges are specified they shall have fully lugged flanged connections suitable for dead-end service connections, and where installed in hard drawn copper lines they may have sweat connections. All valves shall be line size for the piping section indicated.
   1. Equipment Service Valves up to and including 2” ([S]): Valves shall be full port ball valves with stainless steel ball, 2-piece or 3-piece, brass body, bronze body, LF bronze body, or iron body, or shall be HPBV.
   2. Piping Branch Line Service Valves up to and including 4” ([S]): Valves shall be full port ball valves, as specified for equipment service valves.
3. All valves for hot water service shall have stem extension for lever handle operator to accommodate up to 2” thick insulation.

B. Check valves ([S]) shall be brass or iron body, swing type, regrinding seat and shall be suitable for 125 psi working pressure.

C. Automatic Flow Control Valves [S] [O/M] shall be Griswold, Flow Design, or Bell & Gossett and shall be provided at all hot water heating coils. Valves shall be automatic pressure compensating type and factory set to provide specified flow rates within ten (10) percent regardless of system pressure. Valves shall be selected to provide specified flow rates with a minimum pressure differential of 2 psig. Where system differential exceeds 32 psig, valves shall be selected for a range of 4-57 psig. Valve body shall be suitable for use with piping system and internal working parts shall be stainless steel, nickel plated brass or elastomeric diaphragm. All valves shall be provided with strainer, union and pressure-temperature test ports suitable for connecting differential pressure measuring devices. All valves shall be wye configuration for removal of controlling element without removing valve from piping. Each valve shall be identified as to direction of flow and flow rate. Each valve shall be provided with strainer in piping upstream of the coil. One differential pressure meter shall be provided complete with dual hose kit, valves, flow conversion chart and carrying case. Meter and accessories shall be turned over to the Owner upon final acceptance of the project. Valves shall be suitable for use with glycol/water configuration specified.

2.05 HANGERS AND SUPPORTS FOR HVAC DUCTWORK, PIPING AND EQUIPMENT

A. Suspended horizontal piping shall be supported by adjustable wrought steel clevis hangers except that straight runs of hot piping (>100°F) with 40 ft. or more between anchor and expansion device shall be supported on roller type hangers or supports. See Section 23 07 00 for calcium silicate hanger inserts at clevis hangers. All piping connected to motor driven reciprocating or rotating equipment shall have vibration isolation hangers as specified in Section 23 05 48. Protection saddle, welded to pipe, shall be provided at each roller support except on chilled water lines, saddle shall be external metal shield with calcium silicate preformed section as specified in Section 23 07 00, vapor sealed. Calcium silicate inserts may be omitted for pipe smaller than 2 inches. Where supports bear on copper pipe they shall be copper plated. Chain, strap or other makeshift devices will not be permitted as hangers of supports.

B. Maximum pipe support spacing for steel piping shall be ten feet on center, -copper and brass tubing 1-1/4” and smaller shall be supported six feet on center.

C. Vertical steel piping shall be guided or supported in the center of each riser and not over 15 feet on center, copper or brass tubing shall be supported at not over 10 feet on center; and supported at the base of each riser and/or at the top of each riser as required by the piping run. All vertical piping shall be guided or braced where required to prevent lateral movement. Bracing shall include auxiliary stanchions where piping is not in close proximity to suitable structure.

D. Refrigerant piping smaller than 3/4” shall be supported using B-Line Armafix clamps by Cooper Industries or equal.

E. Rigid support sway bracing shall be provided at changes in direction greater than 45 degrees for all pipe 4 inches and larger.

F. Pipe and suspended equipment hanger rods shall be attached to the top chord only on steel joists and beams by joist or beam clamps without welding. Welding of support rods and connection at any place other than the top chord will not be permitted unless written approval is granted by the Engineer and the Architect. C-clamp hangers shall be limited to 50 lb. or less when used at joists. Threaded rod shall be used through joist chords for loads greater than 50 lb.

G. Pipe and suspended equipment supported from concrete structure shall be high-strength screw anchor and threaded rod system. Anchor shall be zinc plated, heat treated, carbon steel with integral flanged head to accept threaded rod. Anchor shall be selected to provide a minimum
H. Duct supports shall consist of not less than 1" by 1/16" galvanized strap iron hangers spaced not over 4 feet on center, except medium and high pressure flat-oval ducts wider than 48 inches shall be supported by trapeze angles. Straps shall be lapped across the bottom ducts a minimum of 1 inch. Ductwork shall be supported from the building structure. Ductwork shall not be supported from the ceiling system or any other building services. Heavy ductwork such as medium or high pressure duct supported by hanger rods, shall be attached to the top chord only on steel joists and beams by joist or beam clamps without welding. Welding of support rods and connection at any place other than the top chord will not be permitted unless written approval is granted by the Engineer and the Architect. All ductwork shall be braced as required to prevent lateral movement.

I. Roof mounted piping supports shall be factory fabricated mounting pedestals as manufactured by Roof Products and Systems, Inc. (RPS) or equal. Pedestals shall be minimum 12 inches high, complete with equipment rail, slide channel “U” shaped mounting brackets, 18 gauge threaded galvanized rods, lateral spacer bracket and galvanized slide assembly. Supports shall be located to adequately support pipe with no more than 4 feet unsupported. Piping shall be secured to supports using accessories furnished by the support manufacturer.

J. See Section 23 00 10 for special support requirements for Pre-manufactured Light Gauge Metal Structure. Welding and connection at any location other than those specified will not be permitted unless written approval is granted by the Engineer and the Architect.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer’s recommendations.

B. Support riser piping independently from the connected horizontal piping.

C. Hangers shall be spaced so that the supported load does not exceed the load recommended by the manufacturer. The supported load shall not overstress the building structural members. Where required hangers for the suspension of heavy items do not correspond with the building structural members, provide supplemental steel members fastened to the building structural members.

D. Valves in horizontal lines shall be installed with stems horizontal or above. Flanged butterfly valves shall be provided with spacer or spool piece between valve and adjacent appurtenance. Isolation service valves shall be installed on each side of each major piece of equipment such as a heating coil and other similar items; and at any other points indicated or required for draining, isolation or sectionalizing purposes. Control valves shall be installed in accordance with control manufacturer’s recommendations.

E. Where pressure/temperature ports are indicated on the drawings, they shall be provided with full port gauge cocks that allow penetration of instrument probes.

F. Butterfly valves in horizontal lines shall be installed with the stem horizontal.

END OF SECTION
SECTION 23 0548
VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY
A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. Work Included:
   1. Vibration Isolators
   2. Inertia Bases
C. Related Sections:
   1. Section 23 00 10 – HVAC General Requirements
   2. Section 23 20 00 – HVAC Piping and Pumps
   3. Section 23 30 00 – HVAC Air Distribution
   4. Section 23 70 00 – Central HVAC Equipment
   5. Section 23 80 00 – Decentralized HVAC Equipment
   6. Division 26 - Electrical

1.02 QUALITY ASSURANCE
A. All vibration control apparatus shall be supplied by a single recognized manufacturer. The supplier of noise and vibration control equipment shall supervise, inspect and approve the installation of their equipment. The supplier shall submit a letter to the Engineer at the conclusion of the project stating that all items have been installed properly and that all equipment is adequately isolated.

1.03 SHOP DRAWINGS
A. Submit shop drawings and product data in accordance with Division 1.
B. Shop drawings, cuts, diagrams, catalog data sheets or such other data necessary to fully describe and substantiate compliance with the specifications shall be submitted for all vibration isolation equipment and materials. The Contractor shall submit drawings for review stating the static deflection, load capacity and location of the isolators, inertia slab dimensions and installation instructions.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS
B. Model numbers used in this specification are those of Kinetics Noise Control and are included to establish a standard of quality.

2.02 ISOLATOR TYPES
A. Floor Mounted Equipment:
   1. Type S spring vibration isolators shall be free-standing, unhoused, laterally stabile, steel springs, wound using high strength heat treated spring alloy steel, and shall have a horizontal spring stiffness equal to or greater than 1.0 times the rated vertical spring stiffness. Springs shall be selected to provide the tabulated minimum operating static deflections and shall provide a 50% overload capacity before reaching a solid state. Springs shall be designed to reach a solid state before exceeding the spring steel fatigue point. Springs used to isolate floor mounted equipment shall include a drilled and tapped steel top load plate, and a steel bottom load plate bonded to a 1/4” thick ribbed neoprene noise stop pad. Each spring mount shall include a steel leveling bolt, locknuts, and...
washers for attachment to supported equipment. Type S units shall be Kinetics Model FDS. Springs shall have the following minimum outside diameters:

<table>
<thead>
<tr>
<th>Spring Deflection, Inches</th>
<th>Rated Capacities, Lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Up to 370</td>
</tr>
<tr>
<td>Up to 1.5</td>
<td>1.75&quot; dia.</td>
</tr>
<tr>
<td>1.51 to 2.25</td>
<td>3.50&quot;</td>
</tr>
</tbody>
</table>

B. Suspended Equipment:

1. Type 2 hangers shall consist of a steel spring and an elastomer-in-shear isolator placed in series and encased in a welded steel bracket. The spring element of the hangers shall meet all specified characteristics of a “Type S” spring as previously specified. Springs shall be color coded for ease of load capacity identification and removable for field correction of overloaded hangers. The elastomer noise stop pad shall be selected to operate within the published load range for the pad for each spring capacity when placed in the bracket used. The hanger bracket shall be designed to carry five (5) times overload without failure, and shall allow up to 15° rod misalignment without metal to metal contact. Type 2 units shall be Kinetics Model SRH.

2. Type F hangers shall consist of an elastomer-in-shear isolator encased in a welded steel bracket. The elastomer shall be bonded to the hanger bracket and shall be selected to support the load within its published load rating. The hanger bracket shall be designed to carry a five (5) times overload without failure and allow up to 15° rod misalignment without short circuiting. Type F hanger shall be Kinetics Model RH.

2.03 BASE TYPES

A. Type 8 bases shall be prefabricated extruded aluminum rail system using 1” deflection Type S free standing stable springs and a continuous elastomeric air and water seal. All metal parts shall be non-corrosive or zinc plated. Each rail system shall be designed and sized specifically to fit the roof curb and the equipment proposed to receive the isolation rails. The upper portion of the equipment rail shall be designed to continuously support the weight of the equipment provided. Springs shall be spaced to provide a uniform 1” static deflection when equipment is mounted on the isolation rails. All rail sections shall be designed and arranged to shed water outward and shall be watertight. Type 8 bases shall be Kinetics Model KSR.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment: All equipment listed hereinafter shall be isolated from the structure and fixed parts by means of resilient vibration and noise isolators. Isolators for floor and roof mounted equipment shall be solidly anchored to the support base or floor and to the supported equipment unless indicated otherwise.

B. Piping and Conduit: All piping and electrical conduit connected to the chillers (including refrigerant piping), pumps, air handling units, or other pieces of moving equipment which are isolated from the structure by spring type vibration isolators shall be isolated from these units by flexible pipe connectors and shall be suspended on isolation hangers to a point 10 feet away. Use Type 2 hangers for suspended piping, Type S mounts for floor mounted piping. Flexible pipe connectors are specified as part of the piping work.

C. Ductwork: Flexible connections shall be incorporated in the ductwork adjacent to all air moving units as part of the sheet metal work. Ductwork shall be suspended on Type F hangers for a distance of 10 feet from these units.

3.02 MINIMUM VIBRATION ISOLATOR STATIC DEFLECTION
<table>
<thead>
<tr>
<th>Type of Equipment</th>
<th>Base Type</th>
<th>Isolator Type</th>
<th>Deflection, In.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rooftop Air Conditioning Units</td>
<td>8</td>
<td>S</td>
<td>1</td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Work Included:
   1. Identification of piping in exposed and accessible locations.
   2. Marking and designation of equipment.

C. Work Not Included:
   1. Painting of ductwork, piping or equipment located on the building exterior.
   2. Painting of ductwork, piping or equipment exposed in finished areas other than those listed under WORK INCLUDED above.
   3. Painting of existing equipment, piping or ductwork.

D. Related Sections:
   1. Section 09 90 00 – Painting and Coating
   2. Section 23 00 10 – HVAC General Requirements
   3. Section 23 05 00 – Common Work Results for HVAC
   4. Section 23 07 00 – HVAC Insulation
   5. Section 23 09 00 – Instrumentation and Control for HVAC
   6. Section 23 20 00 – HVAC Piping and Pumps
   7. Section 23 30 00 – HVAC Air Distribution
   8. Section 23 70 00 – Central HVAC Equipment
   9. Section 23 80 00 – Decentralized HVAC Equipment
   10. Division 26 - Electrical

1.02 REFERENCED STANDARDS:

A. General: The following standards or codes (latest edition) form a part of this specification to the extent indicated by the reference thereto.

B. American National Standards Institute (ANSI):
   1. ANSI A13.1 Scheme for Identification of Piping Systems

C. American Society for Testing and Materials (ASTM):

D. National Fire Protection Association (NFPA):
   1. Standard 255 Method of Test of Surface Burning Characteristics of Building Materials

E. Underwriters Laboratories, Inc. (UL)
PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Except as otherwise specified, materials shall be the products of the following manufacturers:
   1. Sherwin-Williams
   2. Pratt and Lambert
   3. Pittsburgh Paints (PPG)
   4. Benjamin Moore
   5. Porter Paints
   6. Seton Identification Products

2.02 MATERIALS:

A. Deliver all paints and materials to the project site in their unopened original containers with all labels intact and legible at the time of use.

B. All coatings exposed to supply and return airstreams and where applied to exposed surfaces in a return air plenum, shall have a composite flame spread rating not exceeding 25, and a smoke developed rating not exceeding 50 as tested under procedure ASTM E-84-75, NFPA 255 and UL 723. Coatings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411, latest edition.

C. Sherwin-Williams Industrial Maintenance Coatings System 4000 products are listed below to establish color and a standard of quality.

D. Valve tags ([S]) shall be neat circular brass with designations stamped thereon, attached with solid brass jack chain to each valve stem or handle.

E. Each item of equipment such as pumps, air handlers, etc., and equipment control devices such as motor starters, disconnect switches, etc. shall be properly marked with laminated engraved plastic nameplates ([S]) fastened with sheet metal screws, bolts or permanent adhesive. Pressure sensitive tape is not acceptable.

F. All piping, insulated and uninsulated, shall be identified ([S]) with Seton Ultra-Mark or equal wrap around piping system markers and arrow flow directional marker. Markers shall be pre-coiled, semi-rigid plenum-rated plastic or polyester with sealed color graphics. Markers shall be minimum 12 inches long with 1-¼ inch high letters, formed to cover entire circumference of the pipe. Markers shall be attached to piping using plenum-rated plastic tie wraps. Pipe identification shall use the same designations or abbreviations used on the drawings. Marker colors shall be in accordance with ANSI.

PART 3 - EXECUTION

3.01 WORKMANSHIP:

A. The work shall be accomplished by qualified mechanics skilled in the painting trade. Painting of equipment, piping, ductwork and other materials shall not commence until all testing is complete and systems are ready for operation. Materials shall be applied according to manufacturer’s directions. All containers shall be securely closed when not in use. Flammable materials shall not be stored on premises. Flammable waste shall be disposed of daily in devices approved for such purposes. Materials shall be evenly spread, and smoothly flowed on without runs or sags. Each coat shall be thoroughly dry before application of succeeding coats.

3.02 PROTECTION OF WORK:

A. The painters shall protect all adjacent surfaces with drop covers during the process of painting. Upon completion, paint spots, if any, shall be removed from all surfaces.

3.03 PREPARATION OF SURFACE:

A. Surfaces to be painted shall be completely dry before applying paint. Metal surfaces shall be cleaned with mineral spirits before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be chemically pretreated with crystalline (zinc
phosphate) phosphate in strict accordance with the manufacturer’s recommendations. Surfaces shall not be painted when the temperature is, or is likely to be, near the freezing point, nor when they are exposed to hot sun.

3.04 IDENTIFICATION OF PIPES AND EQUIPMENT:

A. Equipment: After all other painting is completed, each major item of equipment shall be properly identified with nameplates. Identification symbols and designations shall be the same as shown on the Contract Documents. Where equipment is installed above lay-in ceilings (VAV boxes, cabinet unit heaters, fan coil units, or similar), the plastic nameplate shall be adhered to the face of the T-bar support so that it can be identified from within the space.

B. Apply piping system markers after completion of required insulation and finishes on piping systems. Markers shall be applied in the following locations and where identified by the Engineer:

1. At each valve and at connection to equipment.
2. At every tee and branch connection.
3. At each riser including branch risers from mains.
4. At each side of a pipe passage through floors, walls and partitions.
5. Every 15 feet on straight runs of piping mains and branches.
6. Within 6 feet of elbows (each side).
7. At access doors or similar points that permit view of concealed piping.
8. Markers shall be provided on all piping above lay-in ceilings.
9. Provide arrow markers showing direction of flow incorporated into, or adjacent to, each piping system marker.
10. Apply all piping system markers where view is unobstructed, and legends can be read and easily identified.
11. Apply all tags and piping system markers in accordance with the supplier’s instructions.

END OF SECTION
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SECTION 23 0593
TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

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

B. Work Included:
   1. Cleaning
   2. Adjusting and Balancing

C. Related Sections:
   1. Division 01 -- Commissioning
   2. Section 23 00 10 – HVAC General Requirements
   3. Section 23 05 00 – Common Work Results for HVAC
   4. Section 23 07 00 – HVAC Insulation
   5. Section 23 09 00 – Instrumentation and Control for HVAC
   6. Section 23 20 00 – HVAC Piping and Pumps
   7. Section 23 30 00 – HVAC Air Distribution
   8. Section 23 70 00 – Central HVAC Equipment
   9. Section 23 80 00 – Decentralized HVAC Equipment

1.02 REFERENCES
A. General: The following publications listed below, form a part of this specification to the extent indicated by the reference thereto.

B. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA):
Balancing and Adjustment Manual

C. Associated Air Balancing Council (AABC):
   National Standards for Total System Balance

D. National Environmental Balancing Bureau (NEBB):

1.03 QUALIFICATIONS
A. For the air conditioning, heating and ventilation systems the Contractor shall obtain the services of a qualified, independent testing organization specializing in total system air and water testing and balancing. The Contractor shall be responsible for making changes in pulleys, belts and dampers where necessary to obtain the required air volume as determined by the Testing and Balancing Contractor. The Testing and Balancing Contractor shall provide all labor, engineering and test equipment required to adjust, test and balance all heating, ventilating, air conditioning and exhaust systems as hereinafter specified. All personnel involved in the execution of the work under the balancing contract shall be experienced and factory trained specifically in the total balancing of mechanical systems, as well as being regular employees of the Balancing Contractor. The Test and Balance Contractor shall work in close coordination with the Controls Contractor to ensure that the system is operating as designed and to aid in adjusting setpoints as necessary for proper system operation.

1.04 TAB COORDINATION AND RESPONSIBILITIES
A. The TAB Agent shall provide the following:
1. All instrumentation used in the course of testing and balancing shall be accurate and shall have been calibrated within the six months prior to commencing test and balance work for this project.

2. The TAB Agent shall conduct a pre-TAB inspection two weeks prior to commencing the test and balance. The TAB Agent shall notify the Contractor in writing of any deficiencies that would affect the ability to successfully complete the test and balance or result in an incomplete or unacceptable report.

3. During the course of the test and balance, the TAB Agent shall immediately notify the Contractor of any equipment or system discrepancies discovered that need to be corrected prior to the satisfactory completion of the test and balance procedures.

4. Equipment settings, including damper positions, valve positions, fan speed controls, and similar devices shall be marked to show final settings.

B. The Contractor shall provide the following:

1. Prior to the commencement of testing and balancing, the installation of building systems shall be fully complete. Building controls systems shall be complete, operational, and verified by the Contractor.

2. The Contractor shall resolve any discrepancies noted by the TAB Agent in the Pre-TAB Inspection prior to commencing the test and balance. The Contractor shall provide written confirmation of the corrective action that was taken to correct each deficiency.

3. The Contractor shall make available qualified personnel during the period in which the test and balance is being conducted for the purpose of problem resolution and controls support.

4. The Contractor shall resolve any deficiencies noted by the TAB Agent prior to the submission of the report and prior to any subsequent visits required by the TAB Agent.

1.05 SUBMITTALS

A. Prior to commencing work under this section, the Contractor shall submit the name of the testing organization, a proof of certification by the Associated Air Balance Council or National Environmental Balancing Bureau, and a list of five local projects on which testing and balancing has been completed for two years, for approval by the Architect/Engineer. The submittal shall include TAB procedures proposed for the systems specific to this project.

B. Heating, Air Conditioning and Ventilation Systems Balance and Performance Data: At a time no later than the Substantial Completion Inspection, the Contractor shall provide the Architect/Engineer with two (2) typewritten copies of schedules containing air and water system balance and performance data.

C. Equipment and System Verification: Letters, signed by representatives of air conditioning unit, and temperature control manufacturers, shall attest that their respective equipment installed on this project has been started, tested and set to operate safely and at the control points required as an integral part of the systems specified herein. The Contractor shall attest by letter that all equipment has been wired and tested to see that the indicated sequence of motor control is established, that all safety controls function properly, that all motor protective devices are sized correctly and that the systems are operating at the points set on the controls. The Engineers will not conduct a site visit for the purpose of determining the status of final payment until these letters are received.

D. Test data shall be submitted for all equipment and systems where specifically required by this specification and all items identified with [TD] behind the product data.

1.06 COMMISSIONING OF HVAC SYSTEMS

A. Participate in Commissioning Meetings designated by the Commissioning Agent.

B. Participate in resolving controls issues identified by the Commissioning Agent.
C. Notify Commissioning Agent a minimum of 2 weeks in advance of start-up of Testing, Adjusting and Balancing (TAB) work. Arrange and attend meeting between Commissioning Agent and TAB agency for review of TAB procedures, TAB work plan, and TAB schedule. Refer to Division 1 for complete scope of Commissioning work.

D. Provide Commissioning Agent with a copy of preliminary and final balance reports.

1.07 CONDITIONS

A. Partial Testing: As much as practical, systems shall be tested as complete systems. Tests on portions of a system will be permitted to facilitate proper progress scheduling. When systems are tested in segments, a system diagram indicating portion tested and a separate and complete report including the date of test is required for each segment.

B. Concealed Work:
   1. All concealed work shall be tested and approved by the Architect/Engineer prior to the application of insulation or construction of chase walls.
   2. Covering shall not be applied to any piping nor shall any piping be concealed or covered until pipes have been tested, all leaks stopped, retested and approved.

C. Work in Existing Buildings: Where new piping systems are connected to existing systems, test the new system prior to making connections to existing system.

PART 2 - PRODUCTS

2.01 GENERAL

A. All equipment, instruments, materials and utilities required for cleaning, testing and balancing of the air and hydronic systems shall be provided by the Contractor.

2.02 INSTRUMENTATION

A. All instruments used by this Contractor shall be accurately calibrated and maintained in good working condition.

2.03 TESTS OF MATERIALS

A. Manufacturers' certificates will be accepted in lieu of tests of materials. If individual laboratory tests are desired by the Architect-Engineer, they will be secured by this Contractor and paid for by the Owner.

PART 3 - EXECUTION

3.01 CLEANING

A. Equipment shall be wiped clean to remove all dust, oil, dirt or paint spots. Trash, plaster, mortar or paint shall be removed from all coils, plenums and end pockets.

B. Heating Piping and Ductwork shall be thoroughly blown out or flushed and cleaned of all foreign matter before connections are made to equipment. Temporary bypasses shall be provided around coils, control valves, ice tanks, heat exchangers and other similar items to prevent trash from being flushed into these items. Care shall be taken at time of installation to prevent pipe compound, scale or other objectionable matter from entering the piping systems. Strainers shall be cleaned. After all construction dirt has been removed from the building, new filters shall be installed in all air units.

3.02 ADJUSTING AND BALANCING:

A. Equipment: Before attempting to adjust and balance the air and water systems, the Contractor shall verify that the following items have been completed and are correct.
   1. Motor and bearings are properly lubricated.
   2. Direction of rotation of motors.
   3. Belt tension.
   4. Electric current flow in each phase of motors and electric heating elements.
   5. Motor protective devices are sized to properly protect installed motors.
6. Thermostats, controls, accessories and other items requiring setting or adjustment shall be set as indicated.

B. Air System Balancing Procedure:

1. Place all related supply, exhaust and return air systems in operation with the fans running at design RPM.

2. Establish system conditions for the maximum demand in airflow; generally, a cooling application. Variable volume systems shall be set and balanced such that the systems are operating at minimum static pressure necessary to maintain proper airflow at the terminal devices.

3. Measure supply air volumes by means of the duct traverse method, making a minimum of sixteen (16) readings. Test holes shall be in straight duct as far as possible downstream from elbows, takeoffs, dampers, etc. Seal duct access holes with metal snap-in plugs. The use of duct tape to seal access holes will not be permitted.

4. Adjust balancing dampers for required branch duct air quantities. Ducts with multiple branches shall have at least one branch with volume damper(s) completely open.

5. Adjust grilles and diffusers to within 10% of individual requirements specified, and also adjust so as to minimize drafts and sound in all areas. Restriction imposed by flow regulating devices in or at terminals shall be minimal. Final measurement of air quantity shall be made after optimum air pattern has been achieved.

6. The total air delivery in any particular fan system shall be obtained by adjustment of the particular fan speed. The drive motor of each fan shall not be loaded over the corrected full load amperage rating of the motor involved. Where belt drive fans are used in conjunction with VFD’s, the fan speed shall be adjusted by changing pulleys such that fan speed to achieve design airflow occurs at 60 Hz.

7. Adjust quantity of air on each zone to the values given in the specifications and/or plans.

8. If the supply fan volume is not within plus or minus 5% of the design capacity at design RPM, determine the reason by reviewing all system conditions, procedures and recorded data. Check and record the air pressure drop across filters, coils, eliminators, sound traps, etc., to see if excessive loss is occurring. Particularly study duct and casing conditions at the fan inlet and outlet.

9. Any changes that are required for the final balancing results will be provided for by the respective Contractors who supplied and installed such equipment under their contractual obligations. Such changes may encompass, but are not necessarily restricted to, the changing of pulleys, belts, dampers or adding dampers or access holes.

C. Water Systems Balancing Procedure.

1. The intent is to coordinate with the Controls contractor to establish a new differential pressure setpoint to allow for the required pressure in the new system. Existing pump flow does not need to be modified. If existing pump is not capable of achieving the required pressure of the automatic flow control valves, the Contractor shall modify the pump, including changing impellers, as required to achieve the necessary pressure.

2. Prior to commencing water balancing, the TAB Agent shall confirm that all systems have been properly filled and bled of air; strainers have been cleaned, and balancing valves (except bypass valves) are fully open.

3. All heating water systems shall be adjusted to provide required quantity to or through each component as indicated on drawings.

4. Venturi tubes, orifices or other metering fittings and pressure gauges shall be used to measure water flow rates and balance systems.

5. Systems shall be adjusted to provide the approved pressure drops through the heat transfer equipment (coils [except room units], converters, etc.) prior to the capacity testing.
Where flow metering fittings are not installed, flow balance shall be determined by measuring temperature differential across the heat transfer equipment. Automatic control valves shall be positioned for full flow through the heat transfer equipment of the system during tests. Adjustment of distribution shall be effected by means of balancing devices (cocks, valves and fittings) and automatic flow control valves as provided; service valves shall not be used. Where automatic flow control valves are utilized only pressure differential need be recorded, provided that the pressure is at least the minimum applicable to the tag rating. Where available pump capacity (as designed) is less than total flow requirements of individual heat transfer units of system served, full flow may be simulated by the temporary restriction of flow to portions of the system; specific procedures shall be delineated in the agenda.

Domestic hot water system shall be balanced to provide indicated temperature hot water at all times to the point where the hot water return pipe connects to the hot water pipe.

3.03 BALANCE AND PERFORMANCE DATA REPORT [TD]:

A. General: Each heating, ventilating and air conditioning system shall be operated and tested continuously for at least two consecutive days to verify that the system is operating satisfactorily and safely and that all equipment is producing the required capacity. To be successful, this test must be conducted with all controls in automatic position and all lights on or off to simulate day time or night time use of the building. Submit two typewritten copies of reports covering air and water system balance and performance. Reports must be received by the Architect-Engineer at least one week prior to the Contractor's request for a substantial completion inspection. Reports that contain deficiencies related to incomplete or improper system installation will be rejected by the Engineer without further review.

B. Calibration Data: The report shall include a list of all instrumentation used and the date of the most recent calibration for each instrument.

C. Balance Data: The following balance data shall be provided. Design and actual water and air flows shall be provided in tabular form.

1. All Air Handling and Air Conditioning Equipment Used for Heating, Cooling and Ventilating:
   a. System nomenclature and identification.
   b. Nameplate information: Manufacturer, model and serial number, horsepower, rpm, voltage, phase, maximum amperage.
   c. Fan speed.
   d. Static pressure profile – reading between all components and total external static pressure.
   e. Outside, return, and supply air quantities.
   f. Actual running motor amperage.
   g. For all VAV units, provide location of downstream static pressure sensor, set point (if applicable), and reading.

2. Fans:
   a. System nomenclature and identification.
   b. Nameplate information: Manufacturer, model and serial number, horsepower, rpm, voltage, phase, maximum amperage.
   c. Fan speed.
   d. Total external static pressure.
e. Air quantity.
f. Actual running motor amperage.

3. VAV boxes:
   a. Box identification.
   b. Manufacturer and size.
   c. Air handling system associated with VAV box.
   d. Cooling airflow.
   e. Minimum airflow.
   f. Heating airflow.
   g. Fan airflow and speed setting (if applicable).
   h. Correction factor for calibration of flow ring.

4. Air Outlet and Inlet:
   a. Room identification.
   b. Manufacturer.
   c. Size.
   d. Free area factor.
   e. Air quantity.
   f. Velocity.

5. Existing Pumps:
   a. System nomenclature and identification.
   b. Nameplate information: Manufacturer, model and serial number, impeller diameter, horsepower, rpm, voltage, phase, maximum amperage.
   c. Pump discharge and suction pressures along with total dynamic head (ft. H2O) at dead head and operating point.
   d. Actual running motor amperage.
   e. Triple duty valve position.
   f. For all variable volume pumping systems, provide downstream static pressure sensor set point and reading.

6. All Hydronic Coils and heat exchangers:
   a. Coil nomenclature and identification.
   b. Flow control valve nameplate information: Manufacturer, model and serial number.
   c. Differential pressure across flow control valve.
   d. Design and actual GPM.

D. Performance Data: The following information shall be recorded twice each day and twice each night during the performance test. Reading shall be taken for each item at a different time each succeeding day at least two hours later than the time the reading was taken on the preceding day.

1. All Air Handling and Air Conditioning Equipment Used for Heating, Cooling and Ventilating (except for unit heaters, VAV boxes, and cabinet unit heaters):
   a. System nomenclature and identification.
   b. Dry bulb and wet bulb temperatures entering and leaving all coils.
   c. Water flow through all coils.
d. Water temperatures entering and leaving all coils.
e. Water pressure drop through all coils.
f. (Test all electric heating coils for operation of low airflow interlock.)

2. Domestic water heater:
   a. Nameplate information: Manufacturer, model and serial number.
   b. Boiler water flow.
   c. Boiler water temperatures entering and leaving heat exchanger.
   d. Storage tank temperature and setpoint.

3. Space Pressurization:
   a. Measure and record space pressurization in corridor served by PAC-CLINIC.
   b. Coordinate with Controls Contactor for fan speed adjustments to achieve space pressurization setpoint of 0.05” w.c. (adjustable).

4. Temperature: Each Room in New Building (Clinic). Temperature measurements shall be taken with the Contractor’s calibrated equipment. Trended data from the temperature control system is not acceptable.

E. Control Setting: During the performance and balance tests, control settings may require adjustment, and if so, shall be adjusted to produce the best balanced system operation. The final setting of each operating and safety control shall be recorded. This shall include, but not be limited to, thermostats, limit controls, damper position switches, firestats, freezestats, humidistats, aquastats and other similar items.

3.04 HVAC SYSTEMS FINAL TESTS:
   A. Upon completion of the work, in accordance with these drawings and specifications, the Contractor shall make a final test in the presence of the Architect-Engineer. With all equipment energized and all controls in automatic position, the systems and equipment specified herein shall be proven to operate safely and to heat and cool the structure uniformly. If not, adjustments and corrections shall be made until satisfactory operation is achieved.

3.05 HVAC SYSTEM POST ACCEPTANCE TESTS:
   A. Should completion of the building occur at such time that the required performance test must be conducted and test data recorded and submitted during a season when both heating and cooling system performance cannot be checked, the Contractor shall perform the tests and record all such data as is available with system operating automatically under the prevailing weather conditions. That part of the system portion which cannot be recorded because of the prevailing weather shall be delayed until the weather is appropriate at which time the remaining part of the required tests shall be conducted and data recorded accordingly. Portions of the tests may not be delayed without written consent of the Engineer.

END OF SECTION
SECTION 23 0700
HVAC INSULATION

PART 1 - GENERAL

1.01 SUMMARY
A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. Work Included:
   1. Piping Insulation
   2. Ductwork Insulation
   3. Equipment Insulation
C. Related Sections:
   1. Section 23 00 10 – HVAC General Requirements
   2. Section 23 05 00 – Common Work Results for HVAC
   3. Section 23 20 00 – HVAC Piping and Pumps
   4. Section 23 30 00 – HVAC Air Distribution
   5. Section 23 70 00 – Central HVAC Equipment
   6. Section 23 80 00 – Decentralized HVAC Equipment

1.02 SUBMITTALS:
A. Submit shop drawings in accordance with Division 1 and Section 23 00 10.
B. Submit shop drawings and catalog data for each type of material proposed for this project. Indicate thickness of material for individual services, and installation methods.

1.03 REFERENCES:
A. General: The following standards or codes (latest edition) form a part of this specification to the extent indicated by the reference thereto.
B. American Society for Testing and Materials (ASTM):
C. National Fire Protection Association (NFPA):
   Standard 255 Method of Test of Surface Burning Characteristics of Building Materials
D. Underwriters Laboratories, Inc. (UL)
   Standard 723 Tests for Surface Burning Characteristics of Building Materials

PART 2 - PRODUCTS:

2.01 GENERAL
A. Acceptable Manufacturers:
   1. Manville, Owens Corning, Armstrong, IMCOA, Knauff or Certain-Teed except where specific manufacturer is named.
B. All insulation materials, jackets and fitting covers shall have a composite flame spread rating not exceeding 25, and a smoke developed rating not exceeding 50 as tested under procedure ASTM E-84-75, NFPA 255 and UL 723. Duct coverings and linings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411.

2.02 MATERIALS
A. Piping:
1. Hot Water (100°-225°F): Fine heavy density fibrous glass, rigid phenolic foam or calcium silicate insulation with general purpose jacket, molded to conform to piping, 0.25 btu•in./sq.ft./°F/hr. maximum “K” value at 75°F.

2. Refrigerant and Interior Condensate Drainage Piping: Closed cell flexible elastomeric insulation, 0.28 btu•in./sq.ft./°F/hr. maximum “K” value at 75°F, maximum water vapor transmission rating of 0.1 perms-inch. Insulation located outside the building shall have a selective finish to protect insulation from ultra violet (UV) solar radiation, unless specifically designed to withstand UV radiation.

B. Ductwork:
   1. Round Ducts, Flat Oval Ducts and Concealed Rectangular Ducts: Flexible fibrous glass insulation, 1.0 lb. density, 0.27 btu•in./sq.ft./°F/hr. maximum “K” value at 75°F, with factory applied reinforced aluminum foil vapor barrier.
   
   2. Acoustic Lining (where indicated and/or noted on Drawings): Fiberglass insulation, 0.26 btu•in./sq.ft./°F/hr. maximum “K” value at 75°F, absolute roughness of exposed surface shall not exceed 0.005 ft., coated to prevent erosion at air velocities up to 2000 fpm, 1.5 lbs/cu.ft. minimum density. Noise reduction co-efficient shall average not less than 0.60 when tested by Acoustical Material Association procedure mounting 6. Liner shall be provided with EPA approved biocide in the erosion coating to protect against microbial growth. Liner shall meet or exceed requirements of ASTM G21 (fungi resistance) and ASTM G22 (bacterial resistance). Acoustic lining shall be one inch thick unless specifically noted otherwise.

PART 3 - EXECUTION:

3.01 PREPARATION
   
   A. Do not install insulation before piping, medium/high pressure ductwork and equipment have been tested and approved.
   
   B. Ensure surface is clean and dry prior to installation. Ensure insulation material is undamaged and dry before application. Finish with system at operating conditions and temperature.

3.02 INSTALLATION
   
   A. General: Ensure insulation is continuous through inside walls and partitions. Insulated piping passing through smoke partitions, fire walls, fire partitions, and fire rated floors shall have insulation of type, thickness and density to match U.L. Through-Penetration Firestop Systems as specified in Section 23 00 10 under Sleeves and Inserts. Insulated piping passing through nonfireresistance rated floors shall be fireblocked as specified in Section 23 00 10 under Sleeves and Inserts. Insulated ducts passing through smoke partitions and fire rated assemblies where a fire damper is not required shall be insulated with calcium silicate for a length equal to twice the thickness of the wall with all voids between the sleeve and duct insulation tightly packed with mineral-wool insulation or U.L. approved packing with sealant. All penetrations through equipment room walls and other areas of noise or heat generation shall be tightly sealed with mineral fiber rope. Finish insulation neatly at hangers, supports and other protrusions.
   
   B. Piping:
      
      1. General:
         
         a. All pipe insulation (except refrigerant piping) shall be secured with outward clinching stainless steel staples and sealer.
         
         b. Fittings and valves shall be insulated and jacketed with the same material as the adjacent piping or it may be finished with a smooth coat of approved insulating cement and jacketed with an approved recovering cloth and vapor sealed. Where PVC fitting covers are used, insulation shall be wrapped tightly using sufficient quantities to prevent deformation of covers.
OR

Use mitered segments of insulation on elbows and oversized insulation on valves and tees coated with two coats of vapor barrier mastic, reinforced with glass fabric extending two inches onto adjacent pipes, and same diameter as adjoining covering. No plastic materials on fittings will be allowed.

c. Mitering of straight pipe insulation to form elbows will not be acceptable or allowed.

d. All jacket joints and seams shall be lapped not less than 2”.

e. Insulation at pipe hangers shall be H-Block Pipe Support insulation as manufactured by ICA Insulation. Supports shall be pre-formed sections of molded fiberglass, minimum 12” long, quantity as suggested by the manufacturer for a given pipe size. Insulation shall be ASTM E84 25/50 rated and shall have a service temperature rating of -120°F to +100°F. Supports shall have a minimum density of 18 lb. cu./ft. and a maximum “k” value of .30. Pipe hangers shall be oversized to enclose pipe and insulation. Provide sheet metal saddle between hanger and insulated pipe. Supports shall be placed between the bottom of the pipe to be supported and the metal shield. On pipe sizes above 5” IPS, supports should be oriented along the bottom 60° arc of the system. The thickness of the support should be the same thickness as the insulation system.

f. Elastomeric and other foam insulations shall be installed without stretching or compressing individual lengths.

2. Hot Piping:

a. Insulation shall be terminated neatly at unions, flanges, and valves. All exposed edges of insulation materials shall be sealed.

b. Where heating coils are located downstream from cooling coils and at variable air volume units, piping shall be insulated continuously up to the coil. Insulation shall be vapor sealed and installed as specified for cold piping for a distance of 5 feet from the coil.

3. Refrigerant Piping: Cover all valves and fittings with equivalent thickness of insulating material. All edges shall be tightly butted. Seal all joints vapor tight.

C. Ductwork:

1. External:

a. Rigid duct insulation shall be secured to rectangular ducts with mechanical fasteners such as metal stick clips or cupped head weld pins located a maximum of 3” from each edge and spaced a maximum of 12” on center each way. All insulation joints shall be tightly butted. All joints, voids and punctures in facing shall be sealed vapor tight with pressure sensitive foil tape and mastic.

b. Flexible duct insulation shall be provided with a minimum 2” facing flap overlapping adjacent and connecting insulation. Seams shall be stapled approximately 6” on center with ¼” outward clinching staples. Where rectangular ducts are 24” in width or greater, insulation shall be secured to the bottom of the duct with mechanical fasteners to prevent sagging. All insulation joints shall be tightly butted. All joints, voids and punctures in facing shall be sealed vapor tight with mastic.

2. Internal: The lining shall be applied to cut-to-size pieces fastened to the entire interior of the duct with mastic, stick clips and speed washers. Edges and joints shall be coated with fire resistant mastic. External duct insulation is not required on ducts with internal lining unless noted otherwise.

3. Where duct mounted heating coils are located downstream from cooling coils and at variable air volume terminal units the coil shall be provided with vapor-sealed external duct insulation on sides, top and bottom.
4. Where ductwork is indicated to have internal acoustic lining, sheet metal drops to diffuser and register necks shall be unlined and shall be externally insulated.

D. Damaged Insulation: All existing thermal coverings that are removed or damaged during construction shall be replaced or repaired to not less than original condition. Repaired sections shall provide equal or better thermal performance and vapor protection.

E. Patching: Where existing control, monitoring or other penetrating devices are removed from ductwork or piping, the insulation shall be patched to match thickness, type and finish of existing insulation.

3.03 INSULATION THICKNESS SCHEDULE

A. Piping:

<table>
<thead>
<tr>
<th>Type</th>
<th>Size, Inches</th>
<th>Insulation Thickness, Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating Water</td>
<td>1-1/4” and Under</td>
<td>1-1/2</td>
</tr>
<tr>
<td></td>
<td>1-1/2” and Over</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>“Runouts 1” and Under</td>
<td>1</td>
</tr>
<tr>
<td>Refrigerant Suction</td>
<td>All</td>
<td>1</td>
</tr>
<tr>
<td>Waste Lines Carrying</td>
<td>All</td>
<td>1/2</td>
</tr>
<tr>
<td>Condensate from A/C Units, Ice Makers, etc.</td>
<td>All</td>
<td>1/2</td>
</tr>
</tbody>
</table>

*Runouts to individual terminal units less than 4 feet in length (between the control valve and coil for HVAC piping).

B. Ductwork:

<table>
<thead>
<tr>
<th>Type</th>
<th>Insulation Thickness Inches, External</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply (Heating and Cooling)</td>
<td>1-1/2</td>
</tr>
</tbody>
</table>

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

B. Work Included:
   1. Complete System of Automatic Controls
   2. Electric Appurtenances
   3. Direct Digital Controls (DDC)

C. Related Sections:
   1. Division 01 -- Commissioning
   2. Section 23 00 10 – HVAC General Requirements
   3. Section 23 05 00 – Common Work Results for HVAC
   4. Section 23 05 53 – Identification for HVAC Piping and Equipment
   5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
   6. Section 23 09 93 – Sequence of Operations for HVAC Controls
   7. Section 23 20 00 – HVAC Piping and Pumps
   8. Section 23 30 00 – HVAC Air Distribution
   9. Section 23 70 00 – Central HVAC Equipment
   10. Section 23 80 00 – Decentralized HVAC Equipment
   11. Division 26 - Electrical

1.02 SUBMITTALS:

A. Submit shop drawings and product data in accordance with Division 1 and Section 23 00 10.

B. Provide complete shop drawings, catalog data sheets and such other data necessary to fully describe and substantiate compliance with these specifications for all control items and systems included in this section.

C. Shop drawings shall indicate the exact location(s) of the outdoor temperature sensor(s).

D. Operation and maintenance data shall be submitted in accordance with Division 1, for all items of equipment and materials indicated in this Section.

E. Application Software Documentation: Contractor shall provide a blueprint documentation of the software application program for each stand-alone digital controller. Documentation shall include block software flowchart showing the interconnection between each of the control algorithms and sequences. A program listing shall be printed on the same blueprint, along with the program flowchart, and description of the sequence of operation. This blueprint shall be stored and maintained in each stand-alone digital controller. System acceptance shall not be completed until this documentation is provided and located in each panel.

1.03 QUALITY ASSURANCE:

A. When all temperature controls have been installed, the temperature control contractor shall completely commission the system to verify that all systems and components are operating in accordance with the specifications. Where corrections or adjustments to the controlled equipment are required, the temperature control contractor shall document such changes to the Contractor, and recheck the control system once the changes have been made.

   1. All equipment and subsystems shall be operated through all specified modes of control and sequences of operation, including full load and part load conditions.
2. All physical valve and damper positions shall be visually verified to correspond with the positions indicated by the controls software.
3. All instrumentation shall be properly calibrated.

B. Final point-to-point check-out and commissioning of the Temperature Control System shall be by the temperature control manufacturer or its exclusive authorized representative.

C. At the completion of this project, the Contractor shall submit a letter to the Engineer stating that all controls have been installed as specified, that each system has been calibrated and that each system is operating in a safe and efficient manner. Included with the letter, the Contractor shall provide a digital record in PDF format of all status control and monitoring points for a 48-hour period at 4-hour intervals, one printout of each type report available, and a copy of the completed start-up checklist used by the technician during system verification.

1.04 SCOPE OF WORK:

A. Furnish and install complete direct digital temperature control systems (DDC). The direct digital control system shall be comprised of a network of various independent, stand-alone digital controllers, together with Centralized Control Stations, and Centralized Host Stations as specified to provide centralized access and facility wide control functions. The stand-alone digital controllers shall be interconnected in a communicating network to provide facility wide access and sharing of information. A Local Area Network (LAN) shall be provided to interconnect the stand-alone digital controllers for high-speed data transmission within each building. Communications between System Controllers and sub-nets of Custom Application Controllers and/or Application Specific Controllers may utilize BACnet/Zigbee communications.

1. The Temperature Controls Subcontractor shall provide technical support for the Testing and Balancing Subcontractor. The technicians shall be fully qualified in all aspects of the system and shall have extensive knowledge of the project. Support shall include, but not be limited to the following:

2. Assistance in determining hydronic and air systems pressure setpoints.
3. Assistance in determining proper automatic damper positions for all air handling units, air conditioning units, and VAV units.
4. Simulating conditions as necessary for proper and optimized testing and balancing of the air and hydronic systems.
5. Where Wireless communications are used:
   a. IEEE 802.15.4 radios shall be used to minimize risk of interference and maximize battery life, reliability, and range.
   b. Communication between equipment controllers shall conform to ZigBee Building Automation (ZBA) standard as BACnet tunneling devices to ensure future integration of other ZBA certified devices.

B. Programming shall be provided in accordance with commonly accepted industry standards and practices to ensure proper and efficient control of all equipment and systems. Where ASDC’s with factory programming are not capable of operating systems in the sequence described herein, the Contractor shall provide a digital controller with custom programming.

C. Programming shall be provided to accomplish the sequence of operations as described in Section 23 09 93. Changes to the operational sequences shall be made only with written approval from the Engineer.

1.05 COMMISSIONING OF HVAC SYSTEMS:

A. Refer to Division 1 for work of Commissioning Agent and coordination with work of Division 23.

B. Notify Commissioning Agent a minimum of two weeks in advance of controls work for the following procedures:

1. Point-to-point wiring check-out,
2. Owner verification of controls graphics, setpoints, and alarms,
3. System start-up and check-out,
4. Initial system tuning,
5. Owner training.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:
A. Component parts of this system shall be manufactured by Trane. Trane is used as basis of design and is the current buildings BAS manufacturer. Any submitted equals shall be submitted as a pre-bid RFI and approved PRIOR to bidding.
B. Installation shall be by qualified employees or authorized representative of the temperature control manufacturer. Temperature control work by independent contractors performing work without direct supervision from the authorized representative will not be accepted.

2.02 SYSTEM REQUIREMENTS:
A. The system shall be a complete system of automatic temperature regulation of the DDC type with electric and electronic accessories and components as indicated. The system shall be backwards-compatible with the Owner’s existing operating and control systems.
B. The software shall not require any licensing fees or annual fees. The host must be able to support a minimum of 50 simultaneous users with the ability to expand the system to accommodate an unlimited number of users.
C. All control items except thermostats, sensors and transmitters located in rooms shall be properly identified with engraved plastic nameplates permanently attached.
D. Room thermostat, sensor and transmitter locations shall be coordinated to align vertically or horizontally with adjacent light switches or control instruments. Room thermostats and sensors shall be mounted with bottom 5'-4" above the floor.
E. All components and materials shall be UL or ASTM rated for use in air plenums.

2.03 MATERIALS:
A. Sensors, Transmitters and Thermostats:
1. Temperature sensors for the Direct Digital Control (DDC) System shall be precision RTD's or thermistor. Accuracy shall be plus or minus 1 degree F over the entire control range. Sensors for pipe applications shall be immersion type, provided with pipe well. Sensors for duct application shall be of the averaging type, with a 5 foot or a 22 foot length element. Duct element length shall be adequate to serpentine across the entire duct area. Where sensors are located downstream of fans or at least 10 duct diameters downstream of coils, elbows, junctions, or dampers, single point sensors may be used. Outdoor temperature sensors shall be provided with sunshield of copper or painted aluminum on a northern exposure. Space temperature sensors shall be compatible with unit controller and shall be provided in a decorative metal or plastic enclosure. Sensors located in gymnasiaums or multi-purpose rooms shall be provided with heavy-duty wire guards. Sensors located in public spaces such as corridors and public toilets shall be recessed type with flush mounted stainless steel blanking cover. Space sensors shall be provided with set-point adjustment and override switch/button. Where wireless space sensors are used, battery life shall be 7.5 years or greater with lithium batteries. Sensors shall be provided with lithium batteries.
2. Differential pressure transmitters for measuring duct system pressures, shall have an approximate range of no greater than two times the maximum operating pressures of the duct system.
3. Differential pressure sensors for measuring space static pressure relative to outside static pressure shall have a range of -0.1 to 0.1" w.c. and an accuracy of ±1%. The low port shall be connected to an outside air static sensing probe, such as a Dwyer A-306,
designed to mitigate the effects of wind. The high port shall be connected to a tube terminating through the ceiling into the occupied space.

4. Differential pressure transmitters for measuring hydronic system differential pressure shall be two-wire type with true differential pressure sensing, ceramic sensor technology, stainless steel housing, NEMA 4 rated, and shall have an approximate range of no greater than two times the maximum differential pressure of the piping system. Unit shall be equal to Kele DPW-692.

5. Humidity sensors shall provide a range of 0-100% relative humidity and an accuracy of plus or minus 2% RH from 0 to 93.8% RH at 25 degrees Celsius. Accuracy shall be plus or minus 1% RH within 10% RH of the user setpoint. Operating temperatures shall be from -40 degrees Fahrenheit to +176 degrees Fahrenheit. The unit shall not be damaged when exposed to 100% relative humidity.

6. High temperature thermostat for detection of excessive temperature in the duct shall be U.L. listed, manual reset type with an adjustable temperature setting. Set at 136°F.

7. Low temperature thermostat for detection of low temperature in the duct shall be manual reset type with 20’ temperature sensitive element, located downstream from the coil. If any portion of the element senses a temperature below its setting, the contacts shall break. Set at 35°F. Units shall be double pole for connection to the fan starter circuit and for monitoring by the DDC.

8. Electric thermostats shall be line voltage type complete with auto-off switch. The thermostat shall be rated for 6 amps at 120 volts.

9. Remote bulb electric thermostats shall be equipped with a liquid-filled capillary tube 8’ long. The electrical rating shall be 10 amps at 120 volts.

10. Surface-mounted aquastats shall have adjustable set point and 10° differential. Contacts shall be rated 10 amps at 120 volts.

11. Carbon dioxide sensors shall be auto-calibration type with LCD display. Units shall utilize non-dispersive infrared (NDIR) and shall have a range of 0-2000 ppm CO2. Units shall have accuracy of ±3%. Operating range shall be 32°F to 122°F. Outputs shall be 0-10 VDC or 4-20 mA. Unit housings shall be suitable for installation in return air plenums (where applicable) and shall have a standard one (1) year element warranty with lifetime warranty on calibration.

12. Space mounted combination carbon dioxide/relative humidity/temperature sensors. Where the drawings indicate multiple space sensors at a single location, a combination sensor shall be used. The combination sensor shall provide the functions matching the sensor annotations on the drawings. Operating range shall be 32°F to 122°F. Outputs shall be 0-10 VDC or 4-20 mA. Unit shall be provided with a one (1) year warranty.
   a. Temperature accuracy shall be ± 1 degree. Sensors shall be provided with set-point adjustment and override switch/button.
   b. Carbon dioxide sensing (where indicated) shall be auto-calibration type with utilizing non-dispersive infrared (NDIR) with gold-plated optical chamber. Range shall be 0-2000 ppm CO2. Units shall have accuracy of ±3%. Field replaceable carbon dioxide element shall be provided with a lifetime warranty on calibration.
   c. Humidity sensors (where indicated) shall provide a range of 10-90% relative humidity and an accuracy of plus or minus 2% RH with an operating range of 0 to 100% RH at 25 degrees Celsius. Field replaceable relative humidity element shall be provided with a one (1) year warranty

13. Current relays shall be Hawkeye 700 Series or approved equal. Units shall be self-induced powered, solid state electronic with status and power LED’s and binary output. Units shall be automatically self adjusting to detect loss-of-load and under current conditions (broken belt, etc.) with a range of 3 to 135 amps. Units shall be suitable for use with variable frequency drives, automatically compensating for changes in frequency
and voltage. Operating range shall be 5°F to 185°F. Units shall have a limited five (5) year warranty.

14. Airflow Measuring Stations shall be constructed of aluminum or stainless steel. Units shall be ASHRAE Traversing design with shrouded impact sensors, accuracy of ± 2% and repeatability of ± 0.25% at minimum airflow of 400 FPM and maximum airflow of 10,000 FPM. Units shall have 1/4 inch NPT pressure connections and shall be suitable for maximum 200°F airstream.

B. Valves shall be sized by the control manufacturer and shall have threaded connections except valves over 2" which shall have flanged connections. Valve packing shall be U-cup silicone or reinforced Teflon except where indicated. Maximum allowable pressure drop shall be 5 psi for water valves and 60% of inlet steam pressure for steam valves. All valves shall be equipped with positive positioners where indicated.

1. DDC valve actuators shall be electronic, low voltage modulating type, hydraulic or gear train, with spring return. Actuators shall be sized to provide smooth and positive operation and tight shutoff against full design system pressure. Valves for VAV boxes shall be drive-open, drive-closed type.

2. Valves for heating water service shall be normally open type. Valve bodies 2" and smaller shall be bronze or high grade red brass in sizes 1/2" through 2". Valve bodies 2-1/2" and larger shall be iron.

3. All modulating valves shall have a minimum rangeability of 25 to 1. Modulating valves 2" and smaller shall be characterized butt type.

4. All valves shall have stainless steel stems with replaceable packing, stem, seats and disk, ball or plug.

5. The pressure characteristics of all valves shall be the same or better than the piping in which installed and shall be suitable for the design system pressures indicated. Valve bodies shall have minimum ratings of 125 psig water service unless noted otherwise.

C. Dampers and Damper Motors:

1. Control dampers shall be Ruskin Model CD36 low leakage type manufactured specifically to control the air flow in heating, ventilating and air conditioning systems. Frames shall be made of galvanized sheet steel, formed into channels and riveted. In addition to the rigid frame construction, corner brackets shall be used to maintain alignment of the damper. Blades shall consist of formed galvanized sheets, formed for extra strength to withstand high velocities and static pressures. Square or hex blade pins shall be furnished to assure non-slip pivoting of the blades when a damper is used as a single module or is interconnected with others. Motor operated dampers shall be Class 1A with maximum leakage rate of 4 cfm/ft² at 1.0 inch water gauge when tested in accordance with AMCA 500D. Maximum blade width shall be 8".

2. Damper actuators shall be provided for all automatic dampers. Damper actuators controlled from the DDC shall be electronic modulating type, low voltage, spring return and shall be of sufficient capacity to operate the connected damper. Outside air and relief air damper actuators shall be spring return normally closed. Line voltage motors shall be two-position type.

D. Transformers are required for low voltage control items. Control manufacturer shall provide transformers with adequate capacity to operate connected equipment.

E. Miscellaneous relays, transformers, switches and other devices shall be provided as required for the sequence of control indicated. Relays shall be located adjacent to the controlled device such as motor or motor starter. Relays may be located within starters and equipment control panels where space is available and where approved by NEC. Relays outside of the controlled device shall be provided with NEMA enclosure suitable for location where installed.
F. Disconnect Switches shall be provided for each 120V power connection to Stand-Alone Digital Controllers, Application-Specific Digital Controllers and all other electronic devices provided under this Section.

G. Uninterruptible power supply (UPS) with power conditioning shall be provided for each Building Network Controller and Stand-Alone Digital Controller. UPS power shall be capable of providing a minimum of 15 minutes backup power.

H. Direct Digital Control System:
   1. Building Network Controllers:
      a. Central Building Controllers shall be provided as required by the system architecture for network communication with, and supervision over the control system. The controller shall provide for custom programming, global management, and overriding control of the all components of the control system via a LAN or communications link. Controller shall provide seamless communication with all Stand-Alone Digital Controllers, Application Specific Digital Controllers, unitary controllers, and third party controllers where indicated. Controllers shall be provided with Ethernet card capable of 10/100/1000 megabits for connection to Owner’s LAN/WAN.
   
   2. Stand-Alone Digital Controllers:
      a. Stand-Alone Digital Controllers shall be programmable controllers capable of custom programming provided for air handling units, heating water systems, chilled water systems, and other similar equipment/systems.
      
         b. Stand-Alone Digital Controllers shall be 16-bit microcomputer based, providing a multi-tasking operating system for control functions simultaneous with all other facility management, operator interface, and system communications functions. Stand-alone digital controllers shall provide true floating point arithmetic calculations, to accommodate accumulation of large totalized valves, and shall support calculation and accumulation of values up to 10 to the thirty-eighth power. Controllers connected to the local area network shall provide communications to all connected stand-alone digital controllers. Controllers shall be tested and certified to operate in ambient temperature of -40°F to + 140°F. Stand-alone digital controllers shall provide interface for portable operator access to password controlled access to all levels of operational capability, from simple information access, to full programmability of all functions.
      
         c. All programming defining the functions to be performed by the stand-alone digital controller, including but not limited to application programs and point database, shall be protected from loss due to power failure for a minimum of thirty days. Systems providing non-volatile memory for these functions are preferred. Systems not providing non-volatile memory shall provide battery backup sufficient to provide protection for the specified period.
      
         d. Each Stand-Alone Digital Controller shall be provided with a minimum of 8 spare inputs and outputs. These spare points shall be allocated as follows: 2 spare binary outputs, 2 spare binary inputs, 2 spare analog outputs, and 2 spare analog inputs.
      
         e. Stand-Alone Digital Controller operating system software shall be multi-tasking. Multi-tasking capability shall be provided to simultaneously perform at least, but not limited to, the following functions:
            1) Downloading of application program changes to the stand-alone digital controller without affecting the simultaneous operation of existing operating application programming.
            2) Printing of scheduled or on-demand reports without pre-empting operator functions.
3. **Application Specific Digital Controllers:**
   a. Application Specific Digital Controllers (ASDC) with factory programming and no time clock may be provided for equipment such as VAV units, fan coil units, unit heaters, exhaust fans, small unitary equipment, etc. provided they are capable of controlling the equipment in accordance with the Drawings and the specified sequence of operations. ASDC’s shall be capable of receiving program changes and time functions via the LAN or communications link. ASDC’s shall be capable of making monitored point available to the DDC.
   b. DDC control, monitoring and alarm functions may be extended to remote equipment by the use of ASDC’s. Use of ASDC’s shall be transparent to the central DDC without effect on DDC functions or color graphic displays.
   c. Each ASDC shall be microprocessor based DDC and shall perform all sequences as indicated and shall communicate with all other DDC controllers via the LAN or communications link. Each ASDC shall also be capable of stand-alone operation and as directed by the central DDC system.
   d. Each ASDC shall provide for portable operator interface either through connection to the space sensor or connection directly to the ASDC.
   e. Programmable ASDC’s shall be provided with 72 hour battery back-up or non-volatile EEPROM memory and self-contained clock. The clock shall be capable of time synchronization from the DDC.

4. **Unitary Control Interfaces:**
   a. Where unitary controls of packaged equipment are capable of communicating with the specified control system, they may be integrated into the network in lieu of Stand-Alone Digital Controllers. All specified functions and monitoring points shall be provided as specified in the Drawings and/or sequence of operations. Where required control and monitoring points are not provided as part of the unitary controls, DDC control and monitoring shall be provided.

5. **Centralized Host Stations:**
   a. The digital control system shall have capacity to support a Centralized Host Station. Centralized Host Stations shall, in conjunction with the network of stand-alone digital controllers, and additional computers or components, provide the performance requirements within this specification. The centralized host station shall include all hardware and software components to serve as a centralized facility operator station providing color graphics, facility wide access and coordination of global control strategies, and centralized documentation. The centralized host station is existing.

I. **Centralized Host Station Performance Requirements:**
   1. **Color Graphic Operator Interface:** The color graphic terminal shall be driven by software allowing the operator to access any system information via a “system penetration” method. “System penetration” shall allow the operator to begin at an entire site plan color graphic display and progressively select portions of the site plan to be chosen for closer inspection or selection of a more detailed color graphic display of a desired portion of the facility. The operator shall be able in this manner to “penetrate” to any desired system information without being required to enter any commands via the keyboard.
   2. **Dynamic Color Graphic Displays:** Color graphic floor plan displays and system schematics for each piece of mechanical equipment including air handling units shall be provided to optimize system performance analysis and speed alarm recognition. All mark numbers for equipment, controller and sensor designations shall exactly match those indicated on the Contract Drawings unless otherwise directed by the Owner. All software and hardware upgrades shall be provided as required to integrate color graphics of this Contract with the Owner’s existing color graphics. All Campus, Building and Floor Plan graphic conceptuals shall be approved by the Owner prior to creation of screen graphics.
Names and numbers for rooms, wings, and buildings shall be in accordance with the Owner’s final numbering systems. Color graphic display shall include, but not be limited to:

a. The real-time value dynamic display of any connected point in the network of stand-alone digital controllers.

b. The alarm status condition of any desired system alarm point.

c. Any software parameter such as setpoints for control sequences, minimum position adjustments, or throttling ranges.

d. All systems having air-side economizer shall display calculated or measured return air and outside air enthalpies.

3. Appearance of color graphics shall follow the below-listed order of penetration progression:

a. Plan color view of each building showing each floor and penthouse.

b. Entire color floor plan of the building on one screen without scrolling, and showing all equipment rooms with tags of all equipment located therein, and locations of all major system space sensors.

c. Large scale color floor plan view of each equipment room showing actual locations of controlled or monitored equipment.

d. Each item of equipment with dynamic color graphic system schematic display.

e. Each system schematic display shall be “linked” to the previous graphic, and to the system parameters of each monitored and controlled point.

f. All screen graphics for systems with economizers shall show calculated values of enthalpy for outdoor air and return air.

g. All graphics shall have user definable background, line and text colors for all screens.

4. Centralized Scheduling and Modification: The color graphic terminal shall support operator access to the global scheduling screens which allow the operator to review and modify any or all controlled schedules as desired. The centralized scheduling function shall allow modification of equipment and lighting operating schedules, modification of facility holiday schedules, and when desired allow assignment of temporary schedules for designated portions of the facility or specific equipment.

5. Global Electrical Demand Limiting Control shall have the capability to allow the operator to review and modify the parameters affecting global demand control strategies. Demand control shall utilize sliding window control algorithm with provision for multiple load shed facility wide as appropriate to owner’s requirements. Time of day demand limits shall be assignable to appropriate billing period time slots.

6. Energy Management Reporting shall have the capability to provide daily, weekly, monthly, and/or yearly formatted reports of facility, metered electrical consumption. Reports shall provide detail information for hourly KWH consumption, daily peak hour of consumption, daily time of peak demand, demand setpoint in use at time of peak, daily degree days, and outside air temperature and relative humidity at time of peak. Reports shall be created to provide individual reporting as desired by the owner for multiple facility meters, multiple sites, or aggregate facility metering combining multiple meters. The centralized host station shall retain daily summary energy data for up to five years. Reports can be designated as automatically printed, or called-up for report printout demand. The centralized host station shall support auto dial polling for remote sites for individual energy reporting and histories of multiple sites and have sufficient capacity to accommodate auto polling and report accumulation of a minimum of 100 sites. Reporting parameters, formatting, and frequency shall be in accordance with the Owners preferences.
7. Optimum Start Control programs shall be self-learning and shall adapt the algorithm parameters to the optimum values for each applied zone. Optimum start/stop shall provide separate control outputs for heating, cooling, fan and ventilation control sub-systems to maximize energy efficiency. The Centralized Host Station shall provide operator access to all optimum start parameters for designated items, equipment, or scheduled systems. Trend Reports: The Centralized Host System shall support logging and historical accumulation of trended data from the entire facility, or multiple sites with capacity for acquiring trend data from a minimum of 100 sites. The system shall be capable of utilizing dedicated logging printers and provide the capacity to document printed trend data accumulated from any or all of the stand-alone digital controllers in connected on-site network, or from any number of remote sites which connect to the centralized host system dedicated logging printer via dial-up modem or Ethernet connection. The centralized host system shall provide capacity to store to disk a directory of at least 150 trend logs. Such trend logs can be accessed from the directory by the operator at any time for analysis of selected sets of the trended data, display onto the screen, or hard copy documentation.

8. Third Party Software Packages: The Centralized Host System shall provide the capacity to run specific third party software packages for word processing, spreadsheets, or database management programs.

9. Database Archiving: The Centralized Host System shall provide capability to up-load or download global control functions and programs being performed by the network of stand-alone digital controllers, and the individual database and application programming resident in each controller in the facility, or on remote sites. The up-load programs shall be retained on the centralized host system’s hard disk for system backup. Programs may be modified using editor functions, and downloaded to individual units as desired.

10. Database Maintenance Reports: The centralized host system shall provide a daily report of all modifications made to any software function in the system. Report shall include the specific setpoints, schedules, sequence parameters, or limits that were modified and the time and location of the modification, and the identification of the operator making the modification.

11. Override Report: The centralized host system shall provide a daily report of all overrides issued, and/or in force on the system. Override reports shall allow tracking of operator functions and maintenance of desired operational conditions.

12. System Maintenance Report: The centralized host system shall provide a report of maintenance items on an automatic printout basis. Maintenance events shall be settable by the user based on event, elapsed run time, number of cycles or calendar day/date.

13. All operator access shall have multiple-level password protection. All setpoints for safeties shall be protected by the highest level password.

14. All help files imbedded in the software as well as all auxiliary software necessary for full access and to allow programming and other functions shall be provided and made accessible to the operator.

J. Control Panels shall be a fully electronic analog control or digital control system, providing all control functions for the equipment specified to be controlled from that panel. Each control panel shall serve one or more equipment systems. Multiple control panels serving a single piece of equipment are prohibited. Each control point shall serve a single, distinct input or output. Control functions to be performed by control panels are as described hereinafter in the sequences of operation and on the drawings. Each panel shall service one or more equipment systems.

K. All signals between the DDC control panel and the monitored or controlled devices shall be low voltage (less than 100 volts).

L. Sensing of temperature, humidity, differential pressure, and all other inputs shall be industry standard signals by one of the following types:
1. 0-20 mA
2. 4-20 mA
3. 0-5 VDC
4. 0-12 VDC
5. Resistance Signals

All inputs shall be compatible with the controllers used, and with the requirements for readout of variables.

M. On/Off Outputs: The control panel shall internally provide test points for the circuit driving the equipment contactor, for troubleshooting the low voltage circuit to the contactor. All relays or digital output modules shall provide a pilot light or LED display of this same status.

N. Modulating Outputs shall be industry standard 0-5 VDC, 0-12 VDC or Milliamp outputs of 0-20 mA or 4-20 mA, or drive open/drive closed type modulating outputs. Drive open/drive closed type controllers shall include sufficient components and control algorithms.

O. Standard Software Function Libraries: Complete libraries of control algorithms for DDC, Energy Management, and Facilities Management functions shall be resident for all stand-alone digital controllers and shall be drawn from for the creation of the application programming.

P. Energy Management Control: The network of stand-alone controllers shall individually perform Time of Day Scheduling, Optimum Start/Stop, Enthalpy Optimization, and all Control Optimization strategies, such as Supply Air Reset, and Soft Start Ramp-up, for their connected systems of equipment. Coordination of strategies involving multiple systems of equipment shall be performed by sharing of necessary data between the stand-alone controllers on the communicating network.

Q. Electric Demand Limiting Control: The stand-alone controllers shall have the capability to communicate and provide coordination for global electric demand limiting control. Demand limiting algorithm shall be resident within a selected stand-alone digital controller and shall issue load shed commands to the network for control of specific items of equipment. Demand limiting shall be sliding window demand control with a minimum of three user definable time of day demand limit setpoints. Multiple load shed tables shall be definable, and be shed for rotational or sequential restoration as appropriate for the loads within each designated shed table. The stand-alone digital controller to which electrical consumption meters may be installed shall provide for daily, and monthly formatted reports of metered electrical consumption. Reports shall be individually named and identified with a title line definable for each report, and shall provide information as detailed as hourly KWH consumption, daily peak hour of consumption, daily time of peak demand, demand setpoint in use at time of peak, daily degree days, and outside air temperature and relative humidity at time of peak. Reports shall be created to provide individual reporting as desired by the Owner for multiple facility meters, multiple sites, or aggregate facility metering combining multiple meters. System shall have capability to designate reports for automatic print, or call-up for report printout on demand, as well as upload to selected centralized host system for historically archiving.

R. Alarm Occurrence Status: Alarm condition reports shall provide a printout listing the status of specific items associated with the equipment generating the alarm. Report shall be routed to a specific printer or combination of printers at the Centralized Host Station or the on-site programming unit. Report shall record time and status information and allow operational personnel to use this information to diagnose the alarm situation.

S. Telecommunications Support: Each building network shall be provided with the necessary equipment, programming, and connections to communicate with remote host computers through one auto dial/auto answer modem and through an Ethernet connection to the Owner’s LAN/WAN.

T. Remote Access and Notification: The system shall be installed such that access to the entire facility can be accomplished through both the modem and the Owner’s LAN/WAN. The modem and Ethernet connection shall each be capable of providing the following functions:
1. Access to the entire facility control system by the Contractor to provide service and diagnostic support.
2. Access by the Owner from off-site for similar purposes, and for remote operation, monitoring, and adjustment of facility functions.
3. Notification of desired exceptions and alarms to multiple remote sites scheduled as necessary for business hours, or off-hours reporting.

U. Off Hours Exception Reporting shall provide the Owner a means of specifying up to two remote sites for which off hours exceptions shall be reported. Selection of the site to be connected shall be programmed by the Temperature Controls Subcontractor as directed by the Owner, and set to change automatically per time of day and day of week.

V. Generally, the stand-alone digital controller and control panel shall be located on or near the unit, which they control as indicated on the Drawings.

W. Lightning arrestors shall be provided on all wiring, which exists or enters the building. Arrestors shall be located adjacent to the protected equipment.

X. As a part of this contract the Temperature Control Subcontractor shall provide two hours of classroom instruction in operation, programming and maintenance of the system to owners operating and maintenance personnel. Instructors shall be fully qualified in all aspects of the system. Training shall be scheduled as required by the owner and shall take place at an owner-designated location. Training shall be video recorded and provided to the Owner in DVD format.

PART 3 - EXECUTION

3.01 WORK BY OTHERS:
A. All line voltage wiring (101 volts or more) shall be furnished and installed as a part of Division 26.
B. All low voltage wiring (100 volts or below) shall be furnished and installed as an integral part of this section of the specification in strict accordance with Division 26. Refer to Division 26 for special requirements of separation between Control and Instrumentation wiring from Communications/Data Cabling.
C. All dampers, valves, immersion wells and pipe pressure tappings will be installed by the Mechanical Contractor.
D. All relays, firestats, sensors, annunciators, alarms, or other electrical devices not indicated to be installed by Division 26, shall be installed under Division 23. Coordinate with Division 26 for locations as necessary.
E. BAS Contractor shall coordinate the location of all control panels with Division 26 and 27. All power circuits and communication network/devices necessary for the control panels shall be provided within the Contract.

3.02 GENERAL SEQUENCE REQUIREMENTS:
A. Refer to Section 23 09 93 for Sequence of Operation for HVAC Controls.

3.03 INTERFACE WITH PACKAGED UNITARY EQUIPMENT CONTROLLERS:
A. Where packaged equipment is indicated elsewhere within the Contract Documents to provide unitary control with BACNET or similar interface, the DDC shall communicate with and monitor the packaged controllers. Coordinate with available equipment protocols, BACNET MS/TP. At a minimum, the DDC system shall:
1. Provide signals to the packaged controllers for occupancy and all setpoints necessary. Setpoints adjustment shall be available through the graphics interface. Occupancy scheduling shall be as indicated for equipment with DDC control.
2. Monitor all unit alarms and provide an alarm within the BAS of any alarm conditions within the unit. Alarm indications shall be specific to the type alarm occurring with the unit.
3. Monitor all points indicated within this section, all points indicated within the respective equipment specifications and all points shown on the controls schematic Drawings. Additional points shall include monitoring of actual unit percent capacity or stages of capacity where available. Where any control or data point is not provided within the equipment controls, the DDC shall provide the necessary input/output, sensor, etc. necessary for control or monitoring of that point.

4. Provide graphics displays for all packaged equipment to include: all points indicated within this section, all points indicated within the respective packaged equipment specifications, and all points shown on the controls schematic Drawings. The main graphics display for the respective unit shall include all points shown on the controls schematic Drawings. Any data available in excess of that indicated above shall be available outside the main graphics screen.

3.04 SYSTEM MONITORING AND ALARM

A. The DDC shall provide an alarm for the following points as applicable to each unit, system, or piece of equipment. Where points occur in more than one unit or system, an alarm shall be provided for each system in which it occurs. The alarm indication shall be specific as to the parameter that has either exceeded or fallen below limits or provides indication that the system is not operating as commanded. The alarm indication shall identify the system in which the alarm occurs. Limits for alarm indication shall be coordinated with the Owner's representative and shall not be so tight as to cause nuisance alarms.

1. Economizer Fault Detection and Diagnostic (FDD) alarms
2. High/low discharge air temperature for all VAV units
3. Return air humidity
4. Discharge static pressure for all VAV units (exceeds high limit)
5. Differential static pressure across filters
6. Minimum outside airflow on VAV units (below setpoint)
7. High return or space CO2
8. VFD alarm indication
9. Current relays
10. High/low space temperature
11. Duct smoke detectors
12. Differential pressure across fans
13. VAV box low airflow condition
14. Activation of freeze protection
15. Float switch alarms

3.05 INSTALLATION

A. The location of all control items on the exterior of the building shall be approved by the Architect prior to installation.

B. Where the condition occurs, provide insulated sub bases for all space temperature sensors located on exterior walls.

C. All sensors located in equipment, ductwork and piping shall be installed with appropriate fittings such that devices are securely attached to coils, duct, pipe, or similar and are not free to move, rotate, or become dislodged. The use of adhesives for attachment is not permitted.

3.06 SERVICE AND GUARANTEE

A. The entire control system shall be serviced and maintained in first class condition by the control manufacturer for a period of one year after acceptance at no extra cost to the Owner.

END OF SECTION
SECTION 23 0993
SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.01 SUMMARY
A. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.
B. Work Included:
   1. Sequence of Operations for HVAC Systems
C. Related Sections:
   1. Division 01 -- Commissioning
   2. Section 23 00 10 – HVAC General Requirements
   3. Section 23 05 00 – Common Work Results for HVAC
   4. Section 23 05 53 – Identification for HVAC Piping and Equipment
   5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
   6. Section 23 09 00 – Instrumentation and Control for HVAC
   7. Section 23 20 00 – HVAC Piping and Pumps
   8. Section 23 30 00 – HVAC Air Distribution
   9. Section 23 70 00 – Central HVAC Equipment
   10. Section 23 80 00 – Decentralized HVAC Equipment

1.02 GENERAL REQUIREMENTS
A. Programming shall be provided in accordance with commonly accepted industry standards and practices to ensure proper and efficient control of all equipment and systems.
B. Control sequences shall be accomplished in accordance with control drawings and the sequences specified in this section and described on the drawings. It is the intent of this section to utilize sequences included in pre-programmed controllers when such sequences provide the intended operation. Where factory programming is incapable of providing the sequence specified in the Contract Documents, a custom controller with custom programming shall be provided.

1.03 SUBMITTALS
A. Refer to Section 23 09 00, Instrumentation and Control for HVAC.

1.04 WARRANTY
A. Refer to Section 23 09 00, Instrumentation and Control for HVAC.

1.05 COMMISSIONING OF HVAC SYSTEMS:
A. Refer to Section 23 09 00, Instrumentation and Control for HVAC.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 GENERAL SEQUENCE REQUIREMENTS:
A. Set points: All control setpoints shall be provided with appropriate deadbands where necessary to prevent the excessive cycling of equipment, valves, dampers, etc.
B. Failure of Digital Control System: The control system shall be installed to fail safe to the heating mode.
   1. All air handling and air conditioning units shall fail on with outside air damper closed, heating valves open to the coil and the reset valve open to the boilers.
   2. Night setback shall fail to day (occupied) mode.
3. Heating water system shall fail with boiler energized to boiler control and heating water pump on.
4. All interlocked exhaust fans shall be de-energized with the dampers closed.

C. Unoccupied Period Freeze Protection: When outdoor air temperature falls below 35°F during unoccupied periods, the following sequence shall occur.
1. Heating (and chilled) water pumps shall be energized (pumps should be energized whenever any space requires heat).
2. All air unit heating (and cooling) valves shall be fully open when the fan is off.
3. All outdoor air damper s shall be closed and verified.
4. All exhaust fans shall be de-energized with dampers closed (should already be de-energized during unoccupied periods).

D. Unoccupied Periods: At times when the building is unoccupied, the DDC shall control all systems to maintain an adjustable night setting for both heating and cooling. Unless otherwise specified, all outside air dampers shall be closed and all exhaust fans shall be de-energized. Where fan powered VAV boxes are utilized, night heating shall be performed as required by the individual terminal units without energizing the associated air handling units. Terminal units such as cabinet unit heaters and fan coil units shall cycle the fans as necessary to maintain unoccupied setpoints. The DDC shall stagger the occupied/unoccupied schedules for all air handling units to prevent large fluctuations in heating or cooling demand. Activation of the manual override on a space temperature sensor, where applicable, shall result in the following: the space temperature setpoint shall be indexed to the occupied setpoint for that space and the system serving that space shall be indexed to the occupied mode. All other spaces shall be maintained at unoccupied temperature setpoints.

E. Morning Warm-up: All air systems shall bring space up to occupied temperature before opening outside air dampers as part of the optimal start sequence.

F. System Start-up: Following any type of system shutdown, the DDC shall stagger the starting of all electrical loads to reduce electric peak demand.

G. System Shut-down: At any time air systems are de-energized, the DDC shall disable all ancillary systems dependent upon air movement such as electric heaters, humidifiers and direct expansion cooling. Ancillary systems required for freeze protection (except electric coils) shall remain operational.

H. Direct Expansion (DX) Cooling: Where the Sequence of Operation calls for DDC control of refrigeration compressors, condensing units or packaged compressor-cooling, the DDC shall provide “minimum-on” and “minimum-off” times in accordance with the equipment manufacturer’s recommendations.

I. Smoke Detection Control: Upon activation of an air handling unit duct smoke detector, all fan powered VAV boxes associated with that unit shall be deenergized.

J. Refer to the Electric Sequence Controls Schematics on the drawings for automatic control of fans, ancillary heating equipment, and other similar items. The following hard-wired interlocks shall be provided in addition to any others indicated on the Electric Sequence Controls Schematics:
1. Activation of duct smoke detectors shall de-energize associated supply fans and return/relief fans (where applicable).
2. Cooling coil condensate drain pans shall be provided with safety switches to de-energize the unit and alarm the DDC upon accumulation of water.

K. All screen graphics for systems with economizers shall show calculated values of enthalpy for outdoor air and return air.

3.02 SEQUENCE OF OPERATION:
A. Packaged Rooftop Air Conditioners (PAC-CLINIC):

1. Morning Warm-up/Cool-down: At a predetermined optimal time calculated by the DDC, the DDC shall energize the unit supply fan. The outside air damper shall remain closed, return air damper shall remain open, and associated building exhaust fans shall remain off thru CR-1.

2. Occupied Control: During occupancy the DDC shall enable the unit controller, the outdoor air damper shall be opened to its minimum position (as required to maintain minimum outdoor air flow as sensed by AF-1), return damper shall be closed proportionately, and the interlocked building exhaust fans shall be energized.

3. Control Modes: The unit controller shall provide the following modes at a minimum:
   a. Differential Enthalpy Economizer Mode
   b. Heating Mode
   c. Cooling Mode
   d. Dehumidification Mode
   e. Demand Control Ventilation Mode

4. Differential Enthalpy Economizer Mode: At any time the outside air enthalpy, as sensed by the DDC, exceeds the return air enthalpy, the DDC shall modulate damper D-1 to its low minimum position, and modulate open D-2 to maintain discharge air temperature.

5. Heating Mode: At outdoor air temperatures less than 50° (adj.), the unit controller shall enter heating mode. The controller shall modulate heating valve V-1 to maintain space temperature setpoint. Hot gas reheat is disable when in heating mode.

6. Cooling Mode: At outdoor air temperatures greater than 55°F (adj.), the unit controller shall enter cooling mode. The controller shall modulate the compressors as required to maintain space temperature setpoint.

7. Dehumidification Mode: When return air humidity levels exceed 60% (adj.) the unit shall enter dehumidification mode. The controller shall modulate the compressors to maintain a 55° (adj.) cooling coil discharge air temperature as sensed by TE-5. Hot gas reheat shall be modulated as required to maintain space temperature setpoint.

8. Demand Control Ventilation Mode: When the demand control ventilation (DCV) threshold (1,200 ppm) (adj.) as sensed by CO2-1 in space is reached, the outdoor air damper, D-1 shall start to modulate open to bring in more fresh air to reduce the return air CO2 level. The damper shall modulate open in small increments until the CO2 level is satisfied or the damper reaches the high minimum position. Once the threshold is satisfied, the damper shall return to normal operation. At no point should damper D-1 open to a position greater than the schedule minimum unless economizer conditions prevail.

9. Airflow Measuring: The DDC shall verify minimum outside air flows as sensed by AF-1 and modulate damper D-1 as necessary to maintain the minimum outside air setpoint as indicated on the Drawings.

10. Duct Smoke Detectors: When products of combustion are sensed by SD-1, SD-2, or additional duct smoke detectors as indicated on the drawings, the unit fan shall be deenergized.

11. System Monitoring: In addition to all points listed above, the DDC shall monitor return air temperature through TE-3; outdoor air temperature through TE-4; return air humidity through HE-1; and VFD alarms.

B. Variable Volume Heating Box: On a fall in space temperature as sensed by TE-1, the box damper D-1 shall modulate closed to its minimum position. On a further fall in space temperature, V-1 shall modulate open to the heating coil. Dual minimums shall be provided. At outside air temperatures at or below 45°F (adjustable), high minimums shall be maintained. At outside air temperatures above 45°F (adjustable), low minimums shall be maintained. During night operation TE-1 shall maintain a reduced night setting. When outside air temperature is
above 55 degrees, and upon a rise in space CO2 levels above setpoint, 1000 ppm (adjustable), as sensed by CO2-1, the DDC shall utilize a standard PID loop to modulate damper D-1 to maintain CO2 setpoint, and valve V-1 to maintain space temperature. When damper D-1 is at maximum scheduled airflow and CO2 levels remain above setpoint, box shall signal the DDC to increase outdoor air from associated air handling unit, until setpoint is reached or air handling unit is at maximum. Override shall last maximum 9 hours (adjustable), if space CO2 remains above setpoint after override, the box shall alarm the DDC. The DDC shall not allow Damper D-1 to open past maximum scheduled airflow.

C. Miscellaneous Electric Heating (Wall Heaters): The DDC shall disable electric heat at outdoor temperatures above 40°F (adj.). Space setpoint shall be 55°F (adj.). The DDC shall also stagger the enable commands of all electric heaters by a minimum of 1 minute (adj.) so as to limit the instantaneous demand.

D. Domestic Hot Water System: The BAS shall energize the domestic hot water recirculation pumps based on return water temperature during occupied hours. The domestic hot water recirculation pumps shall be disabled during unoccupied hours. If during unoccupied times, any air handler is sequenced to the Occupied mode, the BAS shall energize the domestic hot water circulation pumps to run thorough their normal sequence.

END OF SECTION
SECTION 23 2000  
HVAC PIPING AND PUMPS

PART 1 - GENERAL

1.01 SUMMARY

A. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Work Included:
   1. Pipe and Pipe Fittings
   2. Hydronic Pipe Specialties
   3. Miscellaneous Piping Specialties
   4. HVAC Water Treatment

C. Related Sections:
   1. Division 01 -- Commissioning
   2. Section 23 00 10 – HVAC General Requirements
   3. Section 23 05 00 – Common Work Results for HVAC
   4. Section 23 05 48 – Vibration and Seismic Controls for HVAC Equipment and Piping
   5. Section 23 05 53 – Identification for HVAC Piping and Equipment
   6. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
   7. Section 23 09 00 – Instrumentation and Control for HVAC
   8. Section 23 70 00 – Central HVAC Equipment
   9. Section 23 80 00 – Decentralized HVAC Equipment

1.02 REFERENCES:

A. General: The following standards or codes form a part of this specification to the extent indicated by the reference thereto.

B. American Society for Testing and Materials (ASTM):
   A53-88a Pipe, Steel, Black and Hot-dipped, Zinc-coated, Welded and Seamless
   A106-88a Seamless Carbon Steel Pipe for High Temperature Service
   A120-88a Pipe, Steel Black and Hot-dipped, Zinc-coated, Welded and Seamless for Ordinary Uses
   A126-84 Gray Iron Castings for Valves, Flanges and Pipe Fittings
   A254-88 Copper Brazed Steel Tubing
   A420-88 Piping Fittings of Wrought Iron Carbon Steel and Alloy Steel for Low Temperature Service
   A539-88 Electric-Resistance-Welded Coiled Steel Tubing for Gas and Fuel Oil Lines
   B32-89 Solder Metal
   B42-88 Seamless Copper Pipe, Standard Sizes
   B75-86 Seamless Copper Tube
   B88-95a Seamless Copper Water Tube

C. American Society of Mechanical Engineers (ASME):
   ASME 95 Boiler and Pressure Vessel Code
   B16.3 Malleable Iron Threaded Fittings
   B16.4 Cast Iron Threaded Fittings
**B31.9 Building Services Piping**

D. National Electrical Manufacturers Association (NEMA)
E. Underwriters Laboratories, Inc. (UL)

**1.03 COMMISSIONING OF HVAC SYSTEMS:**

A. The Contractor shall provide contact information to the Commissioning Agent indicated in Division 1 for all major items of Equipment.

B. Provide additional submittal copy of major equipment for Commissioning Agent specified in Division 1.

**1.04 SUBMITTALS:**

A. Submit shop drawings, product data and samples in accordance with Division 1 and Section 23 00 10.

B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials marked with notation set forth in Section 23 00 10.

C. Operation and maintenance data shall be submitted in accordance with Division 1, for all items of equipment and materials marked with notation set forth in Section 23 00 10.

**PART 2 - PRODUCTS**

**2.01 PIPE AND FITTINGS:**

A. Material Standards:
   1. Steel pipe shall be manufactured in accordance with ASTM A53 and shall be so labeled.
   2. Copper pipe shall be manufactured in accordance with ASTM B88 and shall be so labeled.

B. Heated Water Lines: Pipe 4” and smaller shall be type L hard drawn copper tubing or standard weight schedule 40 black steel pipe over 4” shall be standard weight black steel. Fittings for steel pipe shall be standard weight, threaded, black, malleable in accordance with ASME B16.3 or cast iron in accordance with ASME B16.4 except fittings over 2” size may be welding type. Flanges shall be weld neck type. All fittings shall be suitable for 125 psi water service.

C. Cooling coil condensate drain lines shall be type L hard drawn copper tubing. Fittings shall match the piping.

D. Refrigerant piping shall be type “ACR” hard drawn copper tubing, factory cleaned, dehydrated and capped with wrought copper fittings. Provide all accessories including, but not limited to, refrigerant duty ball type shutoff valves, solenoid valves, expansion valves, moisture indicating sight glass, replaceable core filter dryers, access ports with gasketed screw-on covers for charging and measuring subcooling, hot gas bypass valve (where indicated) and other accessories recommended by the refrigeration equipment manufacturer. Expansion valves shall be balanced port, externally equalized type. Provide heat exchangers for subcooling and suction line accumulator as recommended by the manufacturer. All components shall be selected and sized for the lowest pressure drop at the capacities indicated. Prior to offering the system for final acceptance, the Contractor shall submit a written certification from an authorized official of the equipment manufacturer stating the complete system, to include refrigerant piping, has been installed in accordance with the manufacturer’s recommendations.

**2.02 HYDRONIC PIPE SPECIALTIES:**

A. Manual air vents on 3/4” piping shall be chromium plated brass 1/8” NPT coin operated type. Provide extension tube if required to maintain access to vent operator. Manual air vents on 1” and larger branch piping and hydronic mains shall be a minimum 1/2” ball valve with hose thread adaptors. Extend vent piping as necessary to locate valves in accessible locations. Air vents and vent piping shall be suitable for 150 psi working pressure.

B. Automatic air vents ([S]) shall be Hoffman No. 79, suitable for 75 psi service and shall provide venting operation under all conditions. Exhaust port from each shall be extended with a
concealed 1/4" copper tubing to floor of equipment rooms, to a drain, or to 6" above grade at building exterior.

2.03 MISCELLANEOUS PIPING SPECIALTIES:

A. Strainers shall be Y type with stainless steel basket suitable for 125 psi service. All strainers shall be provided with blowdown valves.

B. Dielectric fittings such as couplings or flanges shall be installed to isolate pipes of non-ferrous metal where connection is made to ferrous metal. Isolation shall be accomplished by use of a brass converter fitting of threaded brass or bronze couplings, or flanged joints with gaskets and bolt bushings. Materials shall withstand pressure and temperature as required. Valves of the same materials may also be used.

C. Drains shall be accessible and shall consist of 3/4" ball valves with hose thread adapters, cap and chain unless indicated otherwise.

D. Escutcheons shall be the split pattern chromium plated bronze or steel. Special height escutcheons shall be provided where extended sleeves are used. Escutcheons shall be sized to cover the entire opening.

E. Water seals (Trap) shall be provided on condensate drain from each air handling unit. Seal shall be of sufficient depth to prevent blowout or siphoning of water and shall be configured as indicated on the Drawings.

F. Pipe sleeves shall be installed as outlined in SECTION 23 00 10 HVAC GENERAL REQUIREMENTS.

2.04 HVAC WATER TREATMENT

A. For glycol water treatment, see Section 23 80 00.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION:

A. General: Sleeves and sealant shall be provided where pipes pass through floors, partitions or walls as outlined in Section 23 00 10, HVAC GENERAL REQUIREMENTS. Pipe shall be cut accurately to measurements established at the job site and worked into place without springing or forcing, properly clearing all windows, doors and other openings. Pipe in finished areas shall be concealed. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted. Each end of each piece of pipe shall be reamed. Pipe shall be installed to permit free expansion and contraction without damage to joints or hangers. Changes in direction shall be made with fittings. Bushings and all thread nipples will not be allowed.

B. All piping shall be installed with sufficient pitch to insure adequate drainage and all high points in water lines shall be provided with auto-air vents, all low points with drains. Cooling coil condensate drain lines shall slope 1/8" per foot in direction of flow. Pipe extending through the roof shall be properly flashed.

C. Bull head tee piping connections shall not be used in supply or return arrangements.

D. Piping connections to equipment shall be provided with unions or flanges. Banked water coils shall be piped in reverse return arrangement with a balancing cock in the return leg of each coil. Connections shall not be made to any equipment until the piping systems have been cleaned completely and are free of all dirt.

E. Open ends of pipe lines or equipment shall be properly capped or plugged during installation to keep dirt or foreign material out of the system.

F. Escutcheons shall be provided where exposed pipes pass through finished walls or floors.

G. Miscellaneous piping terminating at floor drains or in the air shall be resiliently anchored to protect against fatigue or damage incurred as a result of vibration or abuse.

H. All underground piping shall be installed minimum 3'-0" below grade and minimum 4'-0" below roadways unless otherwise indicated on the Drawings.
I. Joints:

1. Copper tubing shall be cut square, ends reamed and all filings and dust wiped from interior of pipe. Joints shall be soldered with solder drawn through the full fitting length. Excess solder shall be wiped from joint before solder hardens. Solder shall be 95/5 composition – 50/50 will not be allowed. All solder joints shall have piping surfaces sanded or brushed. Self-cleaning solder flux as a substitute for sanding or brushing is not acceptable.

2. Threaded joints shall be made with tapered threads properly cut. Joints shall be made tight with a stiff mixture of litharge and glycerin or other approved thread joint compound applied with a brush to the male threads only. Not more than three threads shall show after the joint is made up. The use of thread protectors for pipe couplings is not acceptable. Expanding self-hardening pipe dope (“expando”) shall not be used.

3. Welded Joints:

   a. Welded joints shall be fusion-welded by qualified welders in accordance with American National Standard B31.1.06, Chapter 5, unless otherwise required. Changes in direction of piping shall be made with welding fittings only. Mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. The contractor shall wire brush and paint welded pipe welds before insulation is applied.

   b. All pipe welding shall be done only by competent and experienced welders. High test welding rods suitable for the material to be welded are to be used throughout. All welds shall be built up to a thickness of 1 ½ times pipe wall thickness. All tees, branches, reducers or specialties that may be required in welded piping shall be carefully laid out by welders, using templates, and the joints shall have carefully matched intersections and shall be properly spaced. Finished pass on all welds shall be a smooth continuous weld cap. Multiple “stringers” on horizontal welds will not be acceptable.

   c. During welding, all piping shall be securely clamped in place so that true alignment is held throughout the welding process. Where there is apt to be distortion, proper allowance shall be made so that the sections to be joined will be in proper alignment after the weld is completed. Care shall be exercised to prevent the occurrence of protruded metal into the pipe. All welds shall be of sound metal, free from laps, cold shuts, gas pockets, oxide inclusions and similar defects.

   d. Adequate protection blankets, screens, etc. shall be provided during cutting and welding to protect existing adjacent surfaces.

4. Flanges and unions shall be faced true and made square and tight. Unions shall be 125 psi service, bronze seat type. Flanges shall be ASA Standard 125 psi service with red rubber gaskets. Unions or flange joints shall be provided on each side of each valve 2-1/2” or larger and in each line immediately preceding the connection to each major piece of equipment such as a heating coil and other similar items.

3.02 REFRIGERANT PIPING:

   A. All refrigerant piping shall be sized, installed, and routed in accordance with the refrigeration equipment manufacturer's recommendations.

   B. All piping joints and the inside of all piping shall be clean. Burnish all mating surfaces until all dirt, oxide, or other debris is removed. Using no flux, braze all joints using hard solder equal to Stay-Bright for pipe 2 inches and below or Stay-Silver for pipe larger than 2 inches. Remove all internal components from refrigerant accessories which may be subject to heat damage prior to brazing.

   C. Before charging, refrigerant lines shall be thoroughly cleaned and purged. Refrigerant lines shall be pulled down to a vacuum of 500 microns and then pressure tested according to the manufacturer’s instructions before charging with refrigerant.
D. All filters from filter dryers shall be replaced after 48 hours of system operation and prior to final acceptance.
E. Refrigerant circuit access ports located outdoors shall be fitted with locking-type tamper resistant caps or shall be otherwise secured to prevent unauthorized access.

3.03 CONTROL ACCESSORIES:
A. Control valves, pipe wells and pressure tappings shall be furnished under Section 23 09 00 and installed as work of this Section.

3.04 TESTING:
A. Heating Water Piping:
1. Piping shall be tested and results approved by the Architect/Engineer prior to application of insulation.
2. Piping system shall be capped and subjected to a static water pressure of 50 psig above operating pressure (minimum 125 psig), and pressure maintained for four (4) hours with no leaks or loss in pressure. Testing with air is prohibited.
3. Test source of pressure shall be isolated from the system before conducting pressure tests.

3.05 SYSTEM STARTUP:
A. When heating water system has been tested and made tight, flush all dirt, trash, and extraneous material with cleaner as recommended by equipment, and glycol manufacturers and in accordance with Sections 23 80 00 and 23 05 93. Prior to the balance and operating tests, the system shall be charged and completely filled with a solution of 30% propylene glycol by weight with corrosion inhibitor. Glycol shall be as specified in Section 23 80 00. Automotive glycol or products containing petroleum distillates shall not be used. Contractor shall advise Owner as to the necessity to avoid chromate and other water treatment chemicals which may degrade the glycol and shall instruct Owner in the frequency and procedures of inhibitor maintenance.

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY

A. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Work Included:
   1. HVAC Ductwork
   2. Air Duct Accessories
   3. HVAC Fans
   4. Air Terminal Units
   5. Air Outlets and Inlets

C. Related Sections:
   1. Section 01 91 13 – General Commissioning Requirements
   2. Section 23 00 10 – HVAC General Requirements
   3. Section 23 05 00 – Common Work Results for HVAC
   4. Section 23 05 48 – Vibration and Seismic Controls for HVAC Equipment and Piping
   5. Section 23 05 53 – Identification for HVAC Piping and Equipment
   6. Section 23 07 00 – HVAC Insulation
   7. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
   8. Section 23 09 00 – Instrumentation and Control for HVAC
   9. Section 23 80 00 – Decentralized HVAC Equipment

1.02 REFERENCES:

A. General: The following standards or codes form a part of this specification to the extent indicated by the reference thereto.

B. Air Movement and Comfort Association (AMCA):
   - Bulletin 210, Standard Test Code for Air Moving Devices
   - Standard 511, Air Performance and Water Penetration

C. American Society for Testing and Materials (ASTM):
   - ASTM A 525 General Requirements for Steel Sheet, Zinc Coated (Galvanized) By the Hot-Dip Process
   - ASTM A 527 Steel Sheet, Zinc Coated (Galvanized) By the Hot-Dip Process, Lock-Forming Quality

D. Underwriters Laboratories, Inc. (UL)
   - Standard 723 Tests for Surface Burning Characteristics of Building Materials

E. Sheet Metal and Air Conditioning Contractors’ Association (SMACNA)
   - Duct Construction Standards (Latest Edition)

F. National Fire Protection Association (NFPA):
   - Standard 90A – Standard for the Installation of Air Conditioning and Ventilating Systems
2. Standard 90B – Standard for the installation of Warm Air Heating and Air Conditioning Systems

1.03 DEFINITIONS:
A. Duct Sizes: Sizes shown on Drawings are actual sheet metal dimensions. For acoustically lined ducts, sizes indicated are actual sheet metal sizes allowing for 1” thick acoustic lining. For double wall ductwork, sizes indicated are inside dimensions.
B. Low Pressure Ductwork: Static pressure rating less than 2” w.g. and velocities less than 2000 fpm.
C. Medium Pressure Ductwork: Static pressure rating less than 6” w.g. and velocities greater than 2000 fpm and all ductwork upstream of VAV boxes.
D. High Pressure Ductwork: Static pressure rating over 6” w.g. and velocities greater than 2000 fpm.

1.04 COMMISSIONING OF HVAC SYSTEMS:
A. The Contractor shall provide contact information to the Commissioning Agent indicated in Division 1 for all major items of Equipment.
B. Provide additional submittal copy of major equipment for Commissioning Agent specified in Division 1.

1.05 SUBMITTALS:
A. Submit shop drawings, product data and samples in accordance with Division 1 and Section 23 00 10.
B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these specifications shall be submitted for all equipment and materials marked with notation set forth in Section 23 00 10.
C. Operation and maintenance data shall be submitted in accordance with Division 1, for all items of equipment and materials marked with notation set forth in Section 23 01 00.
D. All fans for use with Variable Frequency Drives (VFD) shall have critical speed and multiples of critical speed indicated on each submittal.

PART 2 - PRODUCTS
2.01 HVAC DUCTWORK
A. Materials:
1. Sheet Metal Ducts: Trademarked galvanized steel, lock forming quality, having zinc coating of 0.90 ounces per square foot for each side (G90, ASTM A653 and A653M).
2. All ductwork without external insulation, exposed to view in finished, non-utility spaces shall have paint-grip or galvaneal coating to accept field painting.
3. Fasteners: Use rivets and bolts throughout; sheet metal screws may be used on low pressure ducts.
4. Sealants: United McGill "United Duct Sealer" or equal. Water and fire resistant when dry, compatible with mating materials. Where sealants are used on exposed ductwork, composition shall be designed to prevent bleed-through of finish paint, or sealant shall be pre-painted with a coating impervious to bleed-through.
5. All duct and accessory materials shall have a composite flame spread rating not exceeding 25, and a smoke developed rating not exceeding 50 as tested under procedure ASTM E-84-75, NFPA 255 and UL 723. Duct coverings and linings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C411.
B. Fabrication:
1. All ductwork shall conform accurately to the dimensions indicated on plans and shall be fabricated and installed in accordance with ASHRAE Guide and Data Books and SMACNA Duct Construction Standards, except that sheet metal gauges and zinc coating shall not be lighter than specified under this Section.

2. All rectangular sheet metal ducts over 18” wide shall be cross-broken for rigidity.

3. Reinforcing angles, stiffeners and tie-rods for all sheet metal ducts shall be provided where required to prevent sagging, buckling, and vibration in accordance with the latest SMACNA Duct Construction Standards Publication. Reinforcing for flat oval duct shall be provided as specified for rectangular duct in accordance with the latest SMACNA Duct Construction Standards Publication.

4. Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth interior surface.

5. Where square elbows are indicated on the Drawings, curved elbows may be used provided the centerline radius is not less than 1-1/2 times the width of duct and as space allows.

6. Provide turning vanes in all square elbows. Provide air foil type turning vanes on all ducts more than 24" wide. Mitered round elbows (2-piece) shall not be used unless specifically indicated. Mitered round elbows shall have airfoil turning vanes.

7. Transitions shall be made with a slope ratio of 4:1, except at equipment divergence and convergence shall not exceed a slope ratio of 3:1.

8. All duct joints and seams shall be mechanically tight, and sealed with sealant or gaskets to provide a substantially airtight system.

9. All duct liners shall be installed using fasteners in strict accordance with SMACNA Duct Construction Standards. Fastener pins shall be clinched pin type or welded pin type. The use of adhesive type pins is not acceptable. All liners shall have transverse edges coated with adhesive, all corners lapped and butted or folded.

10. Duct liners at fan discharges shall be lapped on outside of fan discharge flange or shall have metal nosing on leading edge. Fastening pin length shall be equal to liner thickness.

11. Provide easements where low pressure ductwork conflicts with piping and structure. Where easement exceeds 10% duct area, split into two ducts maintaining original duct area.

C. Low Pressure Ducts:

1. Sheet Metal Gauges:
   a. Rectangular Ducts:
      
      | Max. Dimen., In. | Min. Gauge |
      |------------------|------------|
      | Up to 30         | 24         |
      | 31 to 54         | 22         |
      | 55 to 84         | 20         |
      | 85 and Over      | 18         |
   b. Round Ducts:
      
      | Duct Diameter, In. | Min. Gauge |
      |--------------------|------------|
      | Up to 22           | 24         |
      | 23 to 36           | 22         |
      | 37 to 50           | 20         |
      | 51 to 60           | 18         |
      | 61 to 84           | 16         |
D. Medium and High Pressure Ducts:

1. Sheet Metal Gauges:
   a. Rectangular Ducts:
      
      | Max. Dimen., In. | Min. Gauge |
      |----------------|-----------|
      | Up to 18        | 22        |
      | 19 to 48        | 20        |
      | 49 to 72        | 18        |
      | 73 to 96        | 16        |
      | 97 to 144       | 14        |

   b. Round Ducts (Factory Made With Spiral Lock Seams equal to United McGill):
      
      | Duct Diameter, In. | Min. Gauge |
      |--------------------|-----------|
      | Up to 26           | 24        |
      | 28 to 36           | 22        |
      | 38 to 50           | 20        |
      | 51 to 60           | 18        |
      | 61 and Over        | 16        |

   c. Flat-Oval Ducts (Factory Made With Spiral Lock Seams equal to United McGill):
      
      | Max. Width, In. | Min. Gauge |
      |----------------|-----------|
      | 9 to 24         | 24        |
      | 25 to 48        | 22        |
      | 49 to 70        | 20        |
      | 71 and Over     | 18        |

2. Fittings shall be minimum 20 gauge on flat oval, but not less than 2 gauges heavier than ductwork in which it is installed on round and flat oval. Fittings for duct sizes 5" round and below may be minimum 24 gauge.

3. All take-offs shall be full body pre-manufactured 45° conical lateral type or alternate pre-manufactured fitting with equivalent loss coefficient. The use of field-installed or factory lateral taps or manifolds is not acceptable.

4. All elbows shall have centerline radius (R = 1.5 D), and shall be stamped or pressed smooth radius or minimum five gore type. Adjustable gore type fittings are not acceptable.

E. Flexible Ducts [S]: Flexible Ducts shall be Flexmaster Type 1M or Thermaflex type M-KE. Duct shall incorporate acoustic rated CPE or PE inner liner, 1” thick fiberglass insulation, and reinforced metalized vapor barrier. Maximum C factor shall be 0.24 btu/hr/sq.ft./°F at 75°F mean temperature. Duct shall have a working pressure of not less than 6 inches w.g. for positive pressure and 1 inch w.g. for negative pressure and suitable for velocities up to 4000 fpm. Vapor transmission shall be less than 0.05 Perm when tested in accordance with ASTM E96, Procedure A. The entire assembly shall be rated and marked as UL 181 Class 1. Flame Spread Rating shall not exceed 25 and Smoke Developed Rating shall not exceed 50 when tested in accordance with ASTM E-84-75, NFPA 255, and UL 723. Minimum duct insertion loss at 2500 fpm for a 10-foot length of straight duct shall be as listed below when tested in accordance with ADC FD-72 R:

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<thead>
<tr>
<th>Octave Band</th>
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<th>6</th>
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<tr>
<td>Duct Insertion Loss, dB</td>
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<td>Frequency, Hz</td>
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<td>8 inch duct</td>
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<td>29</td>
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<tr>
<td>12 inch duct</td>
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<td>26</td>
<td>27</td>
<td>33</td>
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</tbody>
</table>

F. Special Ducts:
1. Provide a 4-inch diameter galvanized steel exhaust duct for all residential clothes dryers. Duct shall discharge outside the building and terminate with a weatherproof wall cap. Connection at wall shall be a recessed noncombustible metal wall box or wall receptacle. Coordinate exact location of wall box with dryer provided for flush installation of dryer to wall. Coordinate location with Owner where dryer is not in Contract. Wall box shall have paintable surface, shall have hidden nailing flanges, contain gas line connection when gas dryer is provided.

2.02 AIR DUCT ACCESSORIES
A. Access Doors:
1. Doors for low pressure rectangular ductwork shall be galvanized steel, 20 gauge rigid type, 12" X 16" minimum size unless noted otherwise, except where size of duct will not accommodate this size, they shall be as large as possible. Door shall have gasket, two hinges, and two compression latches with outside and inside handles. Provide insulated doors where installed in insulated ductwork.
2. Doors for round or flat-oval low, medium or high pressure ductwork shall be a complete factory mounted, duct section/access door assembly constructed of minimum 20 gauge galvanized steel. Access door shall match within two inches the diameter of duct and shall be complete with gasket, insulated door with handle, compression clips and chain retainer.
B. Dampers:
1. General:
   a. Fabricate of galvanized steel.
   b. Where dampers are located in accessible spaces, operators shall be locking type quadrant operators. Quadrant operators shall be installed on 1-1/2" high 4 bend galvanized steel bracket so that duct insulation may be extended and sealed under the quadrant operator.
   c. End of damper rod on each damper shall be grooved to show damper position.
C. Manual Volume Dampers shall be opposed blade multi-louver construction 16 gauge minimum with molded synthetic or stainless steel bearings, galvanized channel iron frame and maximum blade width of 8 inches. Axles shall be positively locked into blades to prevent slippage or loosening. Damper blades shall be interlocking type with linkage, control shaft, and standoff locking regulator (Rossi Everlock or equal).
D. Rectangular branch take-off connections from mains shall be made using 45 degree entry fittings per SMACNA 1995 figure 2-6. Grille and register connections to mains shall be made using 45 degree entry fittings where space allows. Where diffuser, register or grille is located too close to the main, air deflectors shall be used. Air deflectors shall be factory fabricated. Adjustable deflectors shall be complete with worm gear operator when behind grilles, an extension rod and concealed regulator when above plaster ceilings, or self-locking lever type regulator when accessible.
E. Instrument Test Holes: Holes, with patches, in ducts and plenums shall be provided where directed or necessary for using pitot tubes for taking air measurements for balancing the air systems. At locations where ducts or plenums are insulated and on all medium and high pressure ductwork die cast collars with threaded neoprene caps shall be provided.
F. Apparatus Connections: At points where sheet metal connections are made to fans or where ducts of dissimilar metal are connected, provide a flexible connection of neoprene coated canvas of sufficient length to eliminate transmission of vibration. Flexible connections shall be securely fastened and air tight.

G. Duct Sleeves: All ducts shall have sleeved openings 1" larger than the overall duct dimensions framed in place when the wall is constructed and 1/4" larger when floors are poured. Space between duct or duct insulation and sleeve shall be tightly filled with mineral fiber rope insulation and sealed. All duct penetrations through corridor walls, floors not requiring fire dampers and walls indicated to be smoke partitions shall be sealed with U.L. approved firestopping sealant. In fire partitions or floors requiring fire dampers, the duct sleeve shall be sized to match the fire damper frame with all voids packed tight with mineral fiber rope. All penetrations through draftstop partitions shall be sealed to maintain the integrity of the partition. Flanges, constructed of 20 gauge galvanized sheet metal, not less than 3" wide, shall be installed at each opening in finished areas.

H. Spin-in collar [S] shall be 20 gauge galvanized steel, welded and riveted construction. Each fitting shall have conical bell-mouth duct fitting, locking groove, insulation guard, adjustable damper with 3/8" square shaft, u-bolt, nylon bushings, and standoff locking regulator (Rossi Everlock or equal).

I. All wire mesh, woven metal fabric, bird screens, and similar items shall be constructed from corrosion resistant, galvanized steel or aluminum.

J. Acoustic Lining: See Section 23 07 00.

2.03 HVAC FANS [S] [O/M]

A. Roof fans and sidewall fans shall be equal to Greenheck of model indicated, roof or sidewall vent type, power exhaust fans having backward curved aluminum or steel blade centrifugal fan, directly or belt connected as indicated to motor in fully enclosed air cooled motor compartment, outside of exhaust air stream. Fan and motor housing shall be aluminum. Provide electronically commutated motors (ECM) for all fans unless otherwise noted. ECM motor shall be suitable for connection to DDC system specified in 23 09 00 where required. All ECM motors shall be complete with means to adjust the speed of the fan either through the DDC system or at the fan. All ECM motors shall be speed controllable down to 20% of full speed (80% turndown). ECM motor shall be a minimum of 85% efficient at all speeds. Each fan shall be complete with bird screen and motor operated dampers. Each fan shall be tested and rated in accordance with AMCA Standard #210. Each fan motor shall be factory wired to a terminal strip mounted in a junction box attached inside the motor housing. A weather resistant switch or disconnect, with thermal overload, shall be provided in wiring between the terminal strip and motor connection.

B. All motor operated dampers shall be Class 1A with maximum leakage rate of 4 cfm/ft2 at 1.0 inch water gauge when tested in accordance with AMCA 500D.

C. Prefabricated curbs shall be insulated type, 12-14 inches high complete with mounting flange, integral cant strip and rack or flange to support dampers. Outer shell shall be mitered and welded continuously to form a rigid leakproof shell, inner shell shall be solid metal similarly constructed. Wood nailing strips shall be bolted to top of curb shell to provide means for securing flashing material to the curb. Curb shall be constructed of aluminum. Curb sidewalls shall be fully insulated to minimum R-5. Top of curb shall be gasketed for airtight fit of rooftop unit.

D. See PART 1 for spare parts requirements.

2.04 AIR TERMINAL UNITS [S] [O/M]

A. Variable Air Volume Heating Boxes
   1. General: Variable volume heating boxes shall be Trane or Environmental Technologies Inc. hot water heating units complete with insulated casing, damper and damper seat, pressure independent type with heating coil.
2. Casing shall be minimum 24 gauge welded steel construction. Casing shall be internally insulated acoustically and thermally with not less than 1/2 inch, 1.5 lb. density fiberglass complying with NFPA-90A and UL 181. Unit inlet shall contain a factory mounted damper or air valve for controls indicated.

3. Air Volume shall be controlled by single blade 16 gauge steel damper and 20 gauge seat, with integral actuator factory installed. Integral flow taps and calibration chart shall be provided on each unit. Leakage rate shall not exceed 4 percent at 3.0 inches wg. Unit shall be equipped with pressure compensating control with volume regulator for pressure-independent operation.

4. Heating Coil shall be hot water flanged type and shall be as specified in Section 23 80 00. Coil shall be mounted at the unit discharge as indicated.

5. Controls shall be factory mounted and shall be furnished under Section 23 09 00, complete with fused power disconnect.

2.05 AIR OUTLETS AND INLETS [S]:

A. Acceptable Manufacturers:

B. General:
   1. All devices shall be commercial grade and shall be constructed of steel or aluminum as indicated on the drawings.
   2. Manufacturer shall certify cataloged performance and ensure correct application of each air device to provide air pattern, velocity, pressure drop and sound characteristics NC suitable for space installed. Shop drawings shall include location, designation, air quantity, size, pressure drop, throw ft, and sound level NC, individually enumerated for each air device.
   3. All devices located in ceilings shall have white baked enamel finish. Devices at other locations shall have prime finish suitable for painting or anodized aluminum unless noted otherwise.
   4. Maximum air outlet noise level shall not exceed NC30.

C. Diffusers:
   1. Square ceiling diffusers shall be welded steel or aluminum as indicated on the drawings, removable core, louver face, complete with equalizing grid, volume control unit and adjustable vanes for down-discharge pattern.

D. Registers and Grilles:
   1. Return and exhaust registers shall be aluminum, unless noted otherwise, complete with 45 degree fixed airfoil vanes at not more than 1/2 inch centers. Provide 1 or 1-1/4 inch margin, 1/8 inch beveled frame with concealed screw holes. Damper shall be opposed blade face operated type with removable key. Units on watertight ducts shall be all polished stainless steel or aluminum with baked enamel finish, including damper, linkage, core and frame.
   2. Grilles shall be as specified for registers except without opposed blade dampers.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Duct clearance and lengths shall be established from measurements taken at the job site before any ducts are fabricated.

B. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing and balancing of system. Where exhaust ducts are installed within a chase or shaft, pitot tube shall extend to the outside of the chase or shaft and be capped.
C. Locate ducts with sufficient space around equipment to allow normal passage, and operating and maintenance activity.
D. Locate all ductwork to align with the ceiling grid where connections are to be made to Diffusers, Registers and Grilles. Field verify exact grid location before installing ductwork.
E. Locate all Diffusers, Registers and Grilles as indicated on plans and in accordance with the Reflected Ceiling Plans, if provided.
F. Provide low loss factory fabricated fittings for all round take-off connections to low velocity rectangular ducts.
G. All Flex duct shall be properly supported to prevent any short radius bends or kinks. Connections to diffusers shall be made using long radius bends or elbows with turning vanes to ensure that airflow is distributed evenly across the neck of the diffuser. Conditions that create higher airflows in one quadrant of diffuser throw are not acceptable. Maximum flex duct runout length shall be 5 feet. Flex duct shall not penetrate wall construction of any type.
   1. Flex duct clamps shall be Thermaflex Snaplock Clamp or equal using minimum ½” wide stainless-steel band with cadmium plated hex bolt to tighten band with worm-gear action.
H. Install duct accessory items in accordance with manufacturers printed instructions.
I. Install volume, smoke and fire dampers where shown on plans.
J. Manual volume dampers shall be installed at all branch connections, divided flow branches, and end-of-run diffuser/register connections for low pressure supply, return, and exhaust duct systems. Manual volume dampers shall be installed within 3 feet of the main duct.
K. Provide access doors at all automatic dampers, fire/smoke dampers, duct heaters, duct mounted coils, thermostats and at all other points requiring inspection or servicing. Duct access doors for fire and smoke dampers shall be permanently labeled with minimum 1/2 inch high letters reading FIRE DAMPER or SMOKE DAMPER. Labeling shall be as specified for equipment nameplates under Section 23 05 53.
L. Fire dampers shall be UL listed for the type assembly in which they are installed.
M. Where clothes dryer exhaust duct is installed concealed within the building construction, a label shall be provided indicating the equivalent length of the exhaust duct. The label shall be located within six feet of the duct connection. Where dryer exhaust duct is concealed within walls or behind hard ceilings, shield plates shall be installed between the duct and the finished face of the framing members to prevent damage from nails or screws. Coordinate dryer wall box with baseboard molding and masonry coursing as applicable.
N. Connection of horizontal ducts to rooftop exhaust fans shall be made using radiused elbows or mitered elbows with turning vanes. Duct transitions shall be as hereinbefore specified.
O. Ductwork installed or stored on site shall be protected such that open ends are covered to prevent construction dust and debris and other foreign matter from being introduced into the duct systems. If at any time during construction, dust or debris is discovered within the duct systems or duct openings are observed to be unprotected, the Contractor will be responsible for properly cleaning all duct systems in accordance with NADCA procedures for the respective type of ductwork.

P. Grille, Register and Diffuser Installation:
   1. Boots to diffusers shall fit airtight to diffuser necks and diffusers shall be securely fastened thereto.
   2. Where grilles are installed at walls or ceilings, the duct shall be fastened securely to the masonry or panel at each side of the opening and the grille shall be securely fastened snug against the masonry or panel.
   3. If flanged grille frames are used on exposed ducts, runout shall be same size as outside dimension of flange and full depth of register assembly.
   4. Unless otherwise indicated in the Contract Documents, sidewall grilles and registers to be installed high shall be installed within 6 inches of the ceiling or nearest overhead
projection. Unless otherwise indicated in the Contract Documents, sidewall registers and or grilles to be installed low shall be installed within 6 inches of the floor, but shall be coordinated with cove or base molding. Sidewall registers shall also be coordinated with the block coursing where applicable.

5. Ceiling diffusers shall be installed in and coordinated with the ceiling tile or other ceiling units. Diffusers, Registers and Grilles shall be centered in each ceiling unit, unless shown otherwise. Mounting frames shall be installed as required to support diffusers, registers and grilles. Grilles, registers and diffusers shall not be supported from the ceiling system, conduit, piping or unrelated ductwork.

Q. Patching: Where existing control, monitoring or other penetrating devices are removed from ductwork, the opening shall be patched to match thickness, type and finish of existing ductwork, and sealed airtight.

3.02 DUCT SCHEDULE:

A. All ductwork shall be fabricated, installed, sealed, and tested in accordance with the schedule below. All testing shall be in accordance with the latest edition of the SMACNA HVAC Air Duct Leakage Test Manual.

1. Testing shall be conducted and the results approved by the Architect/Engineer prior to the application of insulation.

2. The Architect/Engineer shall be notified one week prior to conducting the test. Unless specifically waived, the Engineer and Owner reserve the right to witness the test. Final, signed and dated test results shall be documented as outlined in SMACNA HVAC Air Duct Leakage Test Manual and submitted to the Architect/Engineer.

B. Supply Ductwork

1. Medium pressure (to include all ductwork upstream of VAV boxes):
   a. Pressure Class: Positive 6” w.g.
   b. Seal Class: A
   c. Leakage Class for Round Duct: 3
   d. Leakage Class for Rectangular Duct: 6
   e. Testing Requirement: 100%

2. Low pressure duct downstream of VAV boxes:
   a. Pressure Class: Positive 2” w.g.
   b. Seal Class: A
   c. Leakage Class for Round Duct: 12
   d. Leakage Class for Rectangular Duct: 12
   e. Testing Requirement: 25%

3. Low pressure duct connected to air handling units, energy recovery units, and rooftop air conditioning units/heat pumps in excess of 5 tons:
   a. Pressure Class: Positive 3” w.g.
   b. Seal Class: A
   c. Leakage Class for Round Duct: 6
   d. Leakage Class for Rectangular Duct: 6
   e. Testing Requirement: 25%

4. Ductwork connected to equipment not listed above:
   a. Pressure Class: Positive 2” w.g.
   b. Seal Class: A
   c. Leakage Class for Round Duct: 12
d. Leakage Class for Rectangular Duct: 12
e. Testing Requirement: N/A

C. Return Ductwork:
   1. Ductwork exposed in conditioned spaces or installed in ceiling return plenums:
      a. Pressure Class: Negative 2” w.g.
      b. Seal Class: A
      c. Leakage Class for Round Duct: 24
      d. Leakage Class for Rectangular Duct: 24
      e. Testing Requirement: N/A
   2. Ductwork connected to equipment not listed above:
      a. Pressure Class: Negative 2” w.g.
      b. Seal Class: A
      c. Leakage Class for Round Duct: 12
      d. Leakage Class for Rectangular Duct: 12
      e. Testing Requirement: N/A

D. Exhaust Ductwork:
   1. Negative pressure general exhaust:
      a. Pressure Class: Negative 2” w.g.
      b. Seal Class: A
      c. Leakage Class for Round Duct: 12
      d. Leakage Class for Rectangular Duct: 12
      e. Testing Requirement: N/A

3.03 FANS:
   A. Coordinate roof opening and locations with structural system.

3.04 VARIABLE VOLUME HEATING BOXES:
   A. Coordinate unit location with lights, piping, ductwork and structural system. Units to be located to allow proper clearances for access and allow installation of ceilings at proper height.
   B. Units shall be located within two feet of the ceiling vertically to allow for proper maintenance.
   C. Units shall be installed with a minimum uninterrupted straight duct run equal to two times the duct diameter immediately upstream.

END OF SECTION
SECTION 23 7000
CENTRAL HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY:

A. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Work Included:
   1. Packaged Outdoor Unitary HVAC Equipment

C. Related Sections:
   1. Division 01 -- Commissioning
   2. Section 23 00 10 – HVAC General Requirements
   3. Section 23 05 00 – Common Work Results for HVAC
   4. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
   5. Section 23 05 53 – Identification for HVAC Piping and Equipment
   6. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
   7. Section 23 09 00 – Instrumentation and Control for HVAC
   8. Section 23 20 00 – HVAC Piping and Pumps
   9. Section 23 30 00 – HVAC Air Distribution

1.02 REFERENCES:

A. General: The following standards or codes form a part of this specification to the extent indicated by the reference thereto.

B. Air Moving and Conditioning Association, Inc. (AMCA):
   Bulletin 210 Standard Test Code for Air Moving Devices

C. Air Conditioning and Refrigeration Institute (ARI):
   Guideline T Thermal Performance for Cool Storage Equipment
   Standard 210 Standard for Unitary Air Conditioning Equipment
   Standard 410 Standard for Forced Circulation Air Cooling and Heating Coils
   Standard 430 Standard for Central Station Air Handling Units

D. American National Standards Institute (ANSI):
   Standard B31.1 Code for Pressure Piping

E. American Society of Heating, Refrigeration and Air Conditioning Engineers (ANSI/ASHRAE):
   Standard 15 Safety Code for Mechanical Refrigeration

F. National Fire Protection Association (NFPA):
   Standard 30 Flammable and Combustible Liquids Code
   Standard 90A Air Conditioning and Ventilating Systems of other than Residence Type

G. National Electrical Manufacturers Association (NEMA)

H. Sheet Metal and Air Conditioning Contractors’ Association (SMACNA)
   Duct Construction Standards (Latest Edition)

I. International Fuel Gas Code (IFGC)

J. International Energy Conservation Code (IECC)

K. Underwriters Laboratories, Inc. (UL)
1.03 EQUIPMENT LABEL:
A. All mechanical equipment and appliances shall be listed and labeled by a nationally recognized
testing and inspection agency approved by the authority having jurisdiction. All equipment and
appliances shall be installed in accordance with the conditions of the listing. Manufacturer's
installation instructions shall be available at the job site at the time of inspection.

1.04 COMMISSIONING OF HVAC SYSTEMS:
A. The Contractor shall provide contact information to the Commissioning Agent indicated in
Division 1 for all major items of Equipment.
B. Provide additional submittal copy of major equipment for Commissioning Agent specified in
Division 1.

1.05 SUBMITTALS:
A. Submit shop drawings, product data and samples in accordance with Division 1 and Section 23
00 10.
B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and
substantiate compliance with these specifications shall be submitted for all equipment and
materials marked with notation set forth in Section 23 00 10.
C. Operation and maintenance data shall be submitted in accordance with Division 1, for all items
of equipment and materials marked with notation set forth in Section 23 01 00.
D. All fans for use with Variable Frequency Drives (VFD) shall have critical speed and multiples of
critical speed indicated on each submittal.

1.06 SPARE PARTS:
A. Each cooling or heating unit shall be provided with 3 sets of filters. At end of construction each
unit shall be provided with a clean filter and one set shall be turned over to the Owner as
spares.
B. Each belt driven piece of equipment shall be provided with one spare set of belts to be turned
over to the Owner at the end of construction.

PART 2 - PRODUCTS

2.01 PACKAGED OUTDOOR UNITARY HVAC EQUIPMENT [S] [O/M]:
A. General: Rooftop air conditioning units shall be Trane factory fabricated units furnished
complete with all components as specified herein and as required by application and model
number indicated on drawings. Units shall be packaged direct expansion single-zone draw
through type with air-tight and weather-tight insulated and gasketed casing, fans, motors,
direct drive, drain pan, cooling coil, compressors, air cooled condenser, filter, and
economizer. Each unit shall have physical dimensions suitable for allotted space and allow
complete removal of filters, coils, drain pans and accessories without having to dismantle the
unit, adjacent equipment or building components. Units shall be sized to allow piping to enter
the unit within the curb and to allow valves and accessories within the unit casing. Where units
are indicated to be variable air volume, unit mounted and wired variable frequency drives
(VFD’s) as specified hereinafter shall be provided for the supply.
B. Casings for all sections of the unit shall be single wall galvanized steel construction with
removable access panels or access doors as required for each individual section of unit.
Casing shall be completely insulated internally with a minimum half-inch thick, one pound
density fiberglass insulation factory coated with manufacturer’s standard material to prevent
erosion of insulating material.
C. Condensing section shall be complete with a scroll compressor with centrifugal type oil pumps,
condenser coil, stamped sheet metal condenser coil guards, condenser fans, motor starters,
controls and piping enclosed in a sheet steel enclosure recommended for outside installation.
Condenser fans shall have aluminum blades and be direct drive, vertical discharge as shown.
Motors shall be permanently lubricated with integral thermal overload protection. Intake and
discharge openings shall be provided with stamped sheet metal coil guards. Condensing unit
controls shall provide automatic capacity modulation and condenser and evaporator pressure control for operation down to 0°F outside air temperature.

D. Supply fan shall be double width double inlet centrifugal type with galvanized steel housing. Fan wheel shall be forward curved type mounted on solid steel fan shaft supported by grease lubricated ball bearings with average minimum life of 200,000 hours. Bearings shall be provided with lubrication facilities located outside of the unit enclosure. Fan shall be provided with unit mounted motor. Fan shall be statically and dynamically balanced at the factory after unit has been assembled. Fan shall be certified in accordance with ARI 430.

E. Fan casing shall be provided with hinged, gasketed and insulated access door with quick opening latches. Access door shall be located on drive side of fan housing. Location of access shall be coordinated with drawings to assure adequate clearances and service capabilities.

F. Coils:
1. Cooling coils shall be direct expansion refrigerant type as specified in Section 23 80 00.
2. All coils shall be installed within casing sections. Coil casings shall completely enclose all coil items including headers and return bends. Casing shall provide a minimum of six inches between coils to allow for field mounting of sensors or instrumentation. Casing shall provide removable access panels for removal of coils without disassembling remainder of unit. Stainless steel condensate drain pans are required for all cooling coils. Stacked cooling coils shall be provided with intermediate drain pans internally piped to main drain pan. Coil drain pans shall be insulated to prevent sweating under all conditions. Drain pan shall be provided with mastic coating to prevent corrosion. Drain pan shall slope to drain all moisture collected from the coil. Drain piping connections shall be provided at the lowest point of the drain pan.

G. Combination filter mixing section shall be included in the packaged unit. Section shall include angular filter holding racks, outside air and return air dampers. Section shall be complete with access panel to facilitate filter media installation and replacement. Filter face velocity shall not exceed 350 feet per minute. Dampers for outside air and return air shall be full size of unit openings and shall be low leakage type with maximum leakage rate not to exceed 5 cfm per square foot at one inch water gauge. Damper arrangement shall provide proper mixing of outside air and return air.

H. All units shall be provided with an internal and integral airflow monitoring station for measuring minimum outside airflow. Accuracy shall be ±5% with an operating temperature range of –20°F to 120°F. Airflow monitoring station shall be compatible with the Building Automation System specified in Section 23 09 00. The airflow signal shall be an industry standard 0-10 vdc, or 4-20 mA for analog input to the Building Automation System.

I. Fiberglass filters shall be pleated media, UL Class 2 listed and labeled, two inches thick. Filter media shall have a rigid frame around entire perimeter and rigid support grille on entering and leaving faces to adequately support the filter media.

J. Unit shall be capable of operating at 100% economizer, with complete outside air, return air, and barometric relief air dampers. Provide controls as required for comparative enthalpy economizer.

K. Unit Controls shall be factory furnished, installed and coordinated to operate with the system specified in 23 09 00. System shall include all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays. Control system shall be a factory-mounted stand alone microprocessor-based DDC with all necessary sensors and interfaces to monitor and operate all functions as outlined in the equipment/control schedule and required for complete unit operation. The DDC controller shall be a Native BACnet applications controller that can communicate on a RS-485 LAN using the BACnet MS/TP protocol. Control system shall be mounted in the unit main control compartment. Factory-mounted DDC control system shall be factory-programmed and run-tested prior to shipment to verify functions and logic. A unit-mounted intelligent programmable interface device shall be
included for communication, display and setpoint control. A unit-mounted Hand/Off/Auto switch shall be included to allow for servicing. Refer to Section 23 09 93 for Sequence of Operation requirements of the packaged DDC controller. Refer to the Control Schematics on the Drawings to obtain configuration requirements of specific units. All points indicated on the controls diagrams shall be communicated to/with the Building Automation System. The controls shall be capable of receiving setpoint and occupancy signals from the Building Automation System.

L. Unit shall have through the base factory wired circuit breaker and non-powered 15A GFI convenience outlet. Circuit breaker shall be a thermal magnetic, molded case, HACR type with provisions for through the base electrical connections. The circuit breaker shall be installed in a water tight enclosure in the unit with access through a swinging door. Wiring shall be provided from the switch to the unit high voltage terminal block. The circuit breaker shall be sized to provide overcurrent protection in accordance with NEC and UL guidelines and be agency recognized by UL/CSA. Unit shall also have integral phase monitor to protect motors and compressors against problems associated with phase loss, phase imbalance or phase reversal.

M. All duct openings in unit floor over 12 inches wide shall have personnel-load-rated safety grates.

N. Rooftop units shall be provided with factory fabricated curb, 12”-14” high suitable for vibration isolation rail. The roof curb shall be pitched to match the pitch of the roof such that the top of the curb is level without the use of shims or other similar type devices.

O. Warranty: Motor-compressor shall be guaranteed for 5 years.

P. See PART 1 for spare parts requirements.

PART 3 - EXECUTION

3.01 GENERAL:

A. All equipment and materials, specified herein or shown on the drawings shall be installed complete, coordinated with all other work, tested and made tight and put into safe controlled operation to perform its intended function as a part of this project.

B. All rooftop equipment shall be secured to the roof framing structure.

3.02 ROOFTOP AIR CONDITIONING UNITS:

A. Coordinate all openings and location with structural systems.

B. Contractor’s attention is directed to Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment for requirements.

C. Install and connect unit in accordance with manufacturer’s recommendations and contract drawing details. Should conflicts in the two occur notify the Architect/Engineer.

D. Coordinate all control items with Section 23 09 00 Instrumentation and Control for HVAC.

END OF SECTION
SECTION 23 8000
DECENTRALIZED HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY:
A. Related Documents: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. Work Included:
1. Ductless Split System Air Conditioners
2. Heating and Cooling Coils
3. Electric Wall Heaters
4. Glycol Heat Transfer Fluid
5. Miscellaneous Appurtenances
C. Related Sections:
1. Division 01 -- Commissioning
2. Section 23 00 10 – HVAC General Requirements
3. Section 23 05 00 – Common Work Results for HVAC
4. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
5. Section 23 05 53 – Identification for HVAC Piping and Equipment
6. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
7. Section 23 09 00 – Instrumentation and Control for HVAC
8. Section 23 20 00 – HVAC Piping and Pumps
9. Section 23 30 00 – HVAC Air Distribution

1.02 REFERENCES:
A. General: The following standards or codes form a part of this specification to the extent indicated by the reference thereto.
B. Air Moving and Conditioning Association, Inc. (AMCA):
   Bulletin 210 Standard Test Code for Air Moving Devices
C. Air Conditioning and Refrigeration Institute (ARI):
   Standard 210 Standard for Unitary Air Conditioning Equipment
   Standard 240 Standard for Unitary Heat Pump
   Standard 310 Standard for Packaged Terminal Air Conditioners
   Standard 410 Standard for Forced Circulation Air Cooling and Heating Coils
   Standard 440 Standard for Room Fan Coil Air Conditioners
D. American National Standards Institute (ANSI):
   Standard B31.1 Code for Pressure Piping
E. American Society of Heating, Refrigeration and Air Conditioning Engineers (ANSI/ASHRAE):
   Standard 15 Safety Code for Mechanical Refrigeration
F. National Fire Protection Association (NFPA):
   Standard 90A Air Conditioning and Ventilating Systems of other than Residence Type
G. National Electrical Manufacturers Association (NEMA)
H. Sheet Metal and Air Conditioning Contractors’ Association (SMACNA)
Duct Construction Standards (Latest Edition)

I. Underwriters Laboratories, Inc. (UL)

1.03 EQUIPMENT LABEL:
   A. All mechanical equipment and appliances shall be listed and labeled by a nationally recognized
testing and inspection agency approved by the authority having jurisdiction. All equipment and
appliances shall be installed in accordance with the conditions of the listing. Manufacturer’s
installation instructions shall be available at the job site at the time of inspection.

1.04 COMMISSIONING OF HVAC SYSTEMS:
   A. The Contractor shall provide contact information to the Commissioning Agent indicated in
Division 1 for all major items of Equipment.
   B. Provide additional submittal copy of major equipment for Commissioning Agent specified in
Division 1.

1.05 SUBMITTALS:
   A. Submit shop drawings, product data and samples in accordance with Division 1 and Section 23
00 10.
   B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and
substantiate compliance with these specifications shall be submitted for all equipment and
materials marked with notation set forth in Section 23 00 10.
   C. Operation and maintenance data shall be submitted in accordance with Division1, for all items
of equipment and materials marked with notation set forth in Section 23 01 00.

1.06 SPARE PARTS:
   A. Each cooling or heating unit shall be provided with 3 sets of filters. At end of construction each
unit shall be provided with a clean filter and one set shall be turned over to the Owner as
spares.
   B. Each belt driven piece of equipment shall be provided with one spare set of belts to be turned
over to the Owner at the end of construction.

PART 2 - PRODUCTS

2.01 DUCTLESS SPLIT SYSTEM AIR CONDITIONERS [S] [O/M]:
   A. General: Equipment specified under this heading shall be manufactured by Mitsubishi, Daikin,
Sanyo, or equal. Each system shall consist of condensing unit, air unit, refrigerant piping and
system controls. Each system shall conform with the applicable ARI standards.
   B. Condensing (outdoor) unit shall be complete with compressor-motor unit, condenser coil,
welded-wire or stamped sheet metal condenser coil guards, condenser fans, motor starters,
controls and piping enclosed in a sheet steel enclosure recommended for outside installation.
Condenser fans shall be vertical or horizontal discharge. Intake and discharge opening shall be
safely guarded. Condensing unit controls and accessories shall provide automatic capacity
modulation and condenser and evaporator pressure control for operation down to 0°F outside
air temperature. Crankcase heater shall be provided. Unit shall be supported in accordance
with manufacturer’s installation instruction.
   C. Fan coil unit (indoor) shall be a wall mounted configuration complete with cooling coil. Fan
motor and drive, filters, controls, refrigerant piping, insulated enclosure and guide vanes on air
discharge. Cooling Coils shall be non-ferrous direct expansion type. Filters shall be
manufacturer provided, permanent, washable filter which is user accessible. Provide capillary
tube and sight glass for each cooling coil circuit.
   D. Condensate pump shall be, in addition to manufacturer supplied unit, Sauermann Model # Si-
3200. Pump shall be rated for minimum 3.3 GPH; 3.3 feet suction head; and 10 feet discharge
head. Unit shall be provided with condensate drain pan safety switch to de-energize the unit
upon accumulation of water in the drain pan.
   E. Refrigerant piping and specialties shall be as specified in Section 23 20 00.
F. Controls for safe automatic controlled operation of the system (including low ambient controller, winter start control, evaporator freeze thermostat, crankcase heater, cycle protector, thermostatic expansion valve kit) shall be from wall mounted controller. All accessory controls shall be installed in accordance with manufacturer’s recommendation.

G. Refrigerant: The piping system shall be completely charged with refrigerant and oil, and guaranteed to be free of leakages for one year.

H. Performance Test: The system shall be tested with a thoroughly cleaned filter and checked out for safe controlled operation. One week before final inspection, a letter in three copies from the certified representative shall be submitted to the Engineer certifying that the system is performing safely and satisfactorily.

I. Warranty: Motor-compressor shall be guaranteed for five (5) years.

J. See PART 1 for spare parts requirements.

K. Set rooftop condensing unit on roof mounted equipment supports. Supports shall be factory fabricated equipment mounting pedestals sized for the weight of the equipment indicated. Pedestals shall be minimum 12 inches high, complete with equipment rail, slide channel “U” shaped mounting brackets, 18 gauge threaded galvanized rods, lateral spacer bracket and galvanized slide assembly.

L. Indoor unit shall be mounted maximum 6” below the ceiling.

2.02 HEATING AND COOLING COILS [S]:

A. General: This specification applies to all coils whether remote mounted, mounted in factory fabricated air handling units or mounted in site-built units and shall be used as a guideline to establish the minimum requirements unless definitely specified otherwise for the particular case involved.

B. Water coils shall be full tube face, fin and tube type constructed of seamless copper tubes and aluminum fins mechanically bonded to tubes. Coil support frame shall be heavy gauge galvanized steel with heavy gauge flanges and support plates. Tubes shall be 1/2 inch or 5/8 inch diameter, staggered, full circulating, and completely drainable. Tube wall shall nominally be minimum 0.020 inch thickness (and minimum 0.014 inch thickness for fan coil and VAV unit coils). Fins shall be minimum .0075 inch thickness. Coils shall be factory tested and suitable for 150 psi working pressure. Mount coils for counter flow service. Where coils are furnished in sections, the return connection to each section shall be provided with a balancing cock. Cooling coil ratings shall be certified in accordance with ARI Standard #410. Maximum cooling coil face velocity shall not exceed 550 feet per minute. Fin spacing shall be such that there are a maximum of 12 fins per inch.

C. Direct expansion (DX) refrigerant evaporator coils shall be full tube face, fin and tube type constructed of seamless copper tubes and aluminum fins mechanically bonded to tubes. Coil support frame shall be heavy gauge galvanized steel with heavy gauge flanges and support plates. Tubes shall be 1/2 inch or 5/8 inch diameter. Tube wall shall be minimum 0.020 inch thickness. Fins shall be minimum .0075 inch thickness. Tubes shall be staggered and circulated with equalizing distributing tubes to match the number of compressor refrigerant circuits provided. Coil circuiting shall be full face interlaced type where required for optimum capacity reduction. Units shall be provided with brass liquid distributors for each circuit. Coils shall be factory proof tested at 450 psig and leak tested at 300 psig, cleaned, dehydrated and sealed with dry nitrogen charge. Coils shall be coordinated with the manufacturer of the condensing unit for capacities indicated. Cooling coil ratings shall be certified in accordance with ARI Standard #410. Maximum cooling coil face velocity shall not exceed 550 feet per minute.

D. Electric coils shall be UL approved and shall be 80% nickel – 20% chromium bare wire heating elements, unless indicated otherwise, mounted in a frame and wired at the factory to an identified terminal strip enclosed in a metal box on one end of the coil. Heater frame shall be constructed for slip-in or flanged frame installation as applicable. Thermal cutout shall be provided to prevent the coil from overheating. Control voltage shall be suitable for control system indicated. Contactors and fuse block shall be UL approved and mounted and wired
inside a steel cabinet for remote mounting with all wiring terminated at an identified terminal strip inside the cabinet. Provide air motion switch to prevent heater from operating unless there is proper air flow. Provide additional interlock connections as indicated in Section 23 09 00. An interlocking safety disconnect switch shall be provided in the terminal box door of each coil.

E. Heating and cooling coils in the same unit shall be provided as separate coils with independent fin sheets to allow preheat, dehumidification, and individual removal of each coil.

2.03 ELECTRIC WALL HEATERS [S] [O/M]:

A. Wall heaters shall be Markel Commercial down-flow model complete with enclosure, front panel, aluminum or corrosion resistant steel sheathed heating element, thermal limit switch, fan and fan motor and built-in disconnect switch and thermostat. All controls shall be concealed. Each unit shall be recessed type unless shown otherwise. Mount units nominal 12” above floor (except in toilets mount units nominal 6” below ceiling.)

2.04 GLYCOL HEAT TRANSFER FLUID [S] [O/M]:

A. Contractor shall coordinate with Owners existing water chemistry supplier to provide glycol compatible with existing building systems.

B. General: Heat transfer fluid shall be specially formulated inhibited propylene glycol suitable for operating temperatures from -50° F to 250°F and for use in fuel-fired boilers and chilled water systems. When mixed in 30% solution by weight in water, the heat transfer fluid shall provide a maximum freezing point of 11°F and a maximum burst temperature of -10°F. Heat transfer fluid shall be as manufactured by Dow, Union Carbide, or Houghton. Contractor shall verify that all materials coming in contact with the aqueous glycol solution are suitable for such service.

C. Corrosion Inhibitors: Heat transfer fluid shall have corrosion inhibitors factory mixed. Inhibitors shall be phosphate-based and shall provide a reserve alkalinity of minimum 10.6 ml. for a pure, unmixed solution.

D. Water Quality: Hard water mixed with glycol will degrade inhibitors, causing corrosion and formation of scale within the system. Levels of chlorides and sulphates in dilution water shall each be 25 ppm maximum. Levels of calcium and magnesium in dilution water shall each be 50 ppm maximum. Where water hardness exceeds specified maximum (total hardness above 100 ppm), the Contractor shall provide pre-diluted solutions purchased from the manufacturer, or shall use distilled, deionized or reverse osmosis-treated water. Contractor shall provide certified report of water hardness test.

E. Precleanup: Prior to installation of heat transfer fluid, the system shall be circulated for 6-10 hours using a precleaning solution of 1%-2% trisodium phosphate, then completely drained, filled again and flushed.

F. Testing: Upon installation of heat transfer fluid, the Contractor shall circulate the system for a minimum of 24 hours before testing. System shall be tested by the Contractor after initial fill, at 4 month intervals, and at the end of the first year (4 tests). System shall be tested for glycol level (%) and PH. Acceptable ranges are as follows:

| Glycol Level: 30% by weight ± 1% |
| PH: 8-10 |

Where each test shows values outside of ranges indicated, the Contractor shall amend the system solution to bring within the acceptable range. Contractor shall record test data before and after amendments.

G. Owner Test Kits: At the end of the first year, the Contractor shall provide the Owner with a refractometer as recommended by the glycol manufacturer for testing glycol concentration and two (2) test kits as provided by the glycol manufacturer for measuring PH (inhibitor level). Contractor shall instruct Owner’s representative in the proper methods and frequency of system testing and maintenance (minimum 2 hours training). Contractor shall advise Owner as to the necessity to avoid chromate and other water treatment chemicals which may degrade the glycol and shall instruct Owner in the frequency and procedures of inhibitor maintenance.
H. Warranty: Existing system is currently under Warranty. Contractor shall coordinate with Owners existing warranty provider to extend current warranty for a period of 12 months past the current warranty expiration date. Warranty shall state that the system chemistry will be maintained within the ranges listed above under Testing. This shall be in addition to manufacturer’s warranties. Contractor’s warranty testing shall be at system turnover (prior to connecting into existing system), at 6 months, and at one year from system turnover.

I. Submittals:
1. Contractor shall include the following in the initial shop drawings to demonstrate compliance with specifications;
   a. Material Specifications
   b. Material Safety Data Sheets (MSD)
   c. Warranty
2. Contractor shall submit all certified system chemistry test data and water quality data to the Architect/Engineer.
3. Contractor shall submit a letter to the Owner stating total system volume as recorded during final filling and charging with glycol.
4. Contractor shall submit a proposed maintenance contract to the Owner for continued testing and servicing of the system beyond the first year. Contract shall include all chemical required and shall include all terms and conditions for a one year contract.

2.05 MISCELLANEOUS APPURTENANCES [S] [O/M]:
A. Miscellaneous electric appurtenances such as transformers, solenoid valves, electric relays, selector switches, on-off switches, pilot lights and other similar items required by the electric sequence control diagrams and not shown to be provided by the Electrical Contractor shall be provided as part of the Mechanical Contract.
   1. Solenoid valves shall be Asco or Alco of coil rating and size to accomplish the indicated requirement.
   2. On-Off switches shall be toggle type, 20 amp. contract rating complete with engraved cover plate where required.
   3. Selector switches shall be manual selector type with the indicated poles and contacts and engraved cover plate. Contact rating shall be a minimum of 20 amps.
   4. Relays shall be G.E., Square D, or Cutler-Hammer 20 amp rating with sufficient contacts for the sequence indicated.
B. Equipment rails for rooftop condensing units shall be Roof Products and Systems (RPS), Model ER-4 or equal. Equipment rails shall be fabricated of 18 gauge galvanized steel with built-in cant, monolithic construction with integral base plate and continuous mitered and welded corner seams, with factory installed wood 2x4 nailer. Each equipment rail shall include a matching 18 gauge galvanized steel counterflashing cap with integral drip edge, all corners mitered and welded, and screws for attachment. Equipment Rails over 3 feet long shall incorporate 14 gauge internal gusset reinforcing. Rail height shall be 9"-16".
C. Dampers and Damper Motors:
   1. Automatic control dampers shall be opposed blade construction for modulating service and parallel blade construction for two-position service. Dampers shall be of the multi-louver construction with brass bearings, channel iron frame and maximum width of 10”. Damper blades shall be interlocking felt edged and air tight.
   2. Damper motors shall be provided for all automatic dampers and shall be sufficient capacity to operate the connected damper. Damper motor shall be electric type.

PART 3 - EXECUTION
3.01 GENERAL:
A. All equipment and materials, specified herein or shown on the drawings shall be installed complete, coordinated with all other work, tested and made tight and put into safe controlled operation to perform its intended function as a part of this project.

B. All rooftop equipment shall be secured to the roof framing structure.

3.02 ROOFTOP CONDENSING UNITS:
   A. Rooftop condensing units shall be installed on factory fabricated equipment rails as hereinbefore specified.

END OF SECTION
SECTION 26 0500
COMMON WORK RESULTS FOR ELECTRICAL

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 WORK INCLUDED:
A. Every item of labor, material, devices and appurtenances for installing a complete Electrical System and other related systems included in Division 26 of the Specifications.

B. Section 26 05 00 – Common Work Results For Electrical
C. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
D. Section 26 05 23 – Control Voltage Electrical Power Cables
E. Section 26 05 26 – Grounding And Bonding For Electrical Systems
F. Section 26 05 33 – Raceway And Boxes For Electrical Systems
G. Section 26 05 36 – Cable Management For Electrical Systems
H. Section 26 05 53 – Identification For Electrical Systems
I. Section 26 09 23 – Lighting Control Devices
J. Section 26 20 00 – Low-Voltage Electrical Distribution
K. Section 26 24 16 – Panelboards
L. Section 26 27 26 – Receptacles
M. Section 26 28 13 – Fuses
N. Section 26 28 16 – Enclosed Switches And Circuit Breakers
O. Section 26 29 00 – Low-Voltage Controllers
P. Section 26 50 00 – Lighting

1.03 RELATED WORK:
A. General: See all other portions of these Contract Documents and apply to those portions of work, relating to Electrical Work, the same as if repeated herein in its entirety. The Division 26 Electrical Trade shall allow for wiring and controlling all equipment requiring electrical connections as described therein even though not shown on the electrical drawings. The Division 26 Electrical Trade shall provide and install all conduits, standard boxes and grounding for Divisions 27 and 28 Trades. Divisions 27 and 28 Trades shall provide all special boxes, cabinets and enclosures to Division 26 Electrical Contractor for installation. The Division 26 Electrical Contractor shall coordinate with Divisions 27 and 28 Trades for sizes and locations of conduits, boxes, cabinets and enclosures required by Divisions 27 and 28 Trades. The Division 26 Electrical Trade shall provide and install all conduits, standard boxes, cable trays, and grounding for Division 27 & 28 Trades.

B. Section 07 80 00 - Firestopping
C. Section 09 90 00 - Painting
D. Division 11 - Equipment
E. Division 23 – Mechanical
F. Division 21 – Fire Suppression
G. Division 22 – Plumbing
H. Division 27 – Communications
I. Division 28 – Electronic Safety and Security
1.04 WORK NOT INCLUDED:
   A. Certain electrical equipment will be provided in-place as specified under other Divisions of these
      Contract Documents and other pieces of equipment such as operating controls, etc., will be
      provided f.o.b. (freight on board) premises, which shall be mounted and connected to electrically
      under Division 26.

1.05 DRAWINGS:
   A. Where conduit, equipment, devices and other electrical appurtenances are shown on the
      drawings, the general arrangement of such items on the electrical drawings shall be followed as
      closely as actual building construction and the work of other trades will permit. Because of the
      small scale of the electrical drawings, it is not feasible to indicate all offsets, fittings and
      accessories which may be required. The Contractor shall investigate the construction conditions
      affecting the work and provide fittings and accessories as required to meet actual conditions.

1.06 QUALITY ASSURANCE:
   A. Equipment and material used in the project shall be new and undamaged. The electrical
      installation shall fit into the space allotted and shall allow adequate, acceptable, clearances for
      entry, servicing, safety, and maintenance. The Contractor shall coordinate the work to ensure
      that the equipment may be moved into place without altering building components or other
      installations. All Electrical work shall be performed by a Commonwealth of Virginia Class-A
      licensed Electrical Contractor whose technicians, mechanics, or tradesmen shall be skilled in the
      trade involved. All electrical work shall be performed under the direct supervision of an electrician
      with a locally recognized and accepted master license.
   B. Equipment and material in existing installations may be reused where specifically indicated on
      the drawings.

1.07 REFERENCES:
   A. The complete installation and all materials and equipment under Division 26 shall conform to the
      Virginia Uniform Statewide Building Code, current issue, including all applicable portions of the
      National Electrical Code (NEC) and all other governing codes and regulations.
   B. All equipment used shall bear the Underwriters Laboratory (U.L.) label for the intended
      application, or other organizations label if acceptable to the Authority having jurisdiction and
      concern with product evaluation.
   C. In addition, the following codes, standards, and regulations shall apply to the complete installation
      and all materials and equipment. These are referred to by their accompanying abbreviations.
   D. National Electrical Code (NFPA No. 70) 2014 NEC
   E. National Electrical Manufacturers Association NEMA
   F. Underwriters Laboratories, Inc. UL
   G. Telecommunications Building Wiring Standards TIA/EIA
   H. All Systems' Installation Certification Compliance Documents for Installing Trades
   I. National Fire Protection Association NFPA
   J. Uniform Federal Accessibility Standards UFAS
   K. Americans with Disabilities Act Accessibility Guideline ADAAG
   L. The above standards are intended as a minimum and shall be exceeded if required by the
      Contract Documents. In the event information contained in the Contract Documents conflicts with
      one of the above mentioned codes, the codes shall take precedence.

1.08 PERMITS, LICENSES, TAXES AND INSPECTION CERTIFICATES:
   A. All permits, bonds, licenses, electrical connection fees, inspection fees and taxes required for the
      execution of the work shall be obtained and paid for by the Contractor. Under each phase of the
      Electrical work the Contractor shall furnish three copies of certificates of final acceptance to the
      Engineer from any inspection authority having jurisdiction.
B. At the completion of the job, provide the Engineer with three (3) copies of an electrical inspection certificate from the local Electrical Inspector, if such inspection is provided and/or required by the locality.

1.09 REGULATIONS AND STANDARDS:
A. The completed installation and all materials and equipment shall conform to local ordinances and codes, other regulations and standards listed herein or in related sections. These are intended as a minimum and shall be exceed if required by the specifications or Drawings. In the event of a conflict between the codes, standards, or regulations, and information contained in the Contract Documents, the applicable code, standard, or regulation shall take precedence.

1.10 SUBMITTALS:
A. Submit shop drawings, product data and samples in accordance with Division 1 for all items as specified in related sections of these specifications. One (1) electronic (PDF) copy of the submittal shall be submitted. One (1) electronic (PDF) copy of the submittal will be returned to the Contractor. If additional copies are required they will be the responsibility of the Contractor. Where drawings are submitted, the Contractor shall submit a minimum of two (2) sets of full scale prints. One (1) copy will be marked and returned to the Contractor, and the Contractor shall be responsible for all additional copies required for his use. All submittal data shall be correctly identified to show project name, and the exact model, style or size of item being submitted. Improperly identified submittals will not be reviewed by the Engineer. Each item submitted for review shall bear the Subcontractor's stamp which states that they have reviewed the submission, that it is complete, and that in their opinion it meets the contract requirements. Contractor's stamp shall identify the paragraph and page number for which the submittal is being made. Any submission which has not been reviewed and stamped by the Electrical Trade will not be reviewed by the Engineer. No reviews prior to award of Contract will be considered or accepted.

B. Shop drawings, samples, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these contract documents shall be submitted as follows:
   1. All the equipment and materials where submissions are specifically required by other Divisions of these Contract Documents.
   2. All the equipment and materials that are indicated with an [S] behind the product title. This shall include submission of the specified products equipment and materials.
   3. All the equipment and materials that are acceptable equal substitution.
   4. If submission is NOT required for the SPECIFIED products "shop drawings and product data" under 1. and 2. above, the Contractor shall NOT submit a shop drawing for the SPECIFIED products.
   5. Samples, in good working order, shall be submitted in accordance with Division 1, complete with all installation and service drawings and instructions. All samples will be returned at the submitter’s expense unless otherwise indicated. Samples may be subject to destructive testing by the Architect/Engineer.

C. Operation and Maintenance manual(s) shall be submitted in accordance with Division 1 and shall include a complete product index, a copy of all accepted shop drawings, installation and maintenance data, sequence of controls, parts lists, and the name, address and telephone number of supplier or nearest representative. All electrical devices, equipment and systems marked [O/M] in these specifications shall be included and all other such electrical items which will require servicing before the duration of its useful life has been reached. The manual(s) shall be presented to the Engineer for review and transmitted to the Owner before the final payment is recommended.

D. Equivalents: Manufacturers, trade names and model numbers indicated herein and on drawings shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Unless definitely stated otherwise and upon complying with Division 1, the Contractor may use any article of equal appearance which, in his judgment is equal to that specified and is accepted by the Engineer. Where three or more manufacturers are named in the specifications for any item, the Contractor should use one of the manufacturers. No others shall
be reviewed or accepted. Manufacturers listed first in these specifications and on drawings were used as a basis of design. It will be the responsibility of the Contractor to verify all connections, physical sizes and capacities of all other manufacturer's items, both items named herein, or items proposed. If the equipment necessitates changes in power distribution, conduit, wiring, lighting, ductwork, piping, or any other building systems from that indicated on the drawings, the Contractor shall be responsible for all additional costs included and notify other trades of the changes. Where such changes are required, detail drawings indicating all required changes shall be submitted for review at the same time the manufacturers drawings are submitted for approval. See Division 1 for substitutions.

E. The ten day prior approval requirements of The Instructions to Bidders, AIA 701, are waived for this Division of the Specifications, and unless stated otherwise the Contractor may use items that he deems as equivalent in quality and performance to the specified item subject to final acceptance of substituted items by the Engineer upon his review of shop drawings. (This paragraph cannot be used with BCOM jobs!)

F. Guarantee: Electrical equipment, materials and labor required by these specifications and accompanying drawings shall be guaranteed to be free from defective materials or workmanship, including lamps, for a period of one year after final acceptance of the project except extended warranties as specified elsewhere in these documents on specific items of equipment will be furnished by the Trade providing the equipment. Defects in material or workmanship occurring during this period shall be corrected with new material and equipment or additional labor at no cost to the Owner. Manufacturer's certificates of warranty shall be transmitted to the Owner before final payment is recommended.

1.11 WARRANTIES:
A. The Contractor shall warrant for a period of one year all work provided under the Contract to include, but not necessarily limited to, all systems, equipment, materials, and workmanship. This shall not be construed to limit any extended warranty periods of longer than one year for specific items or systems specified elsewhere in the Contract Documents.

B. The warranty period shall commence on the date of acceptance by the Owner and shall cover all parts and labor as required to fulfill the warranty at no cost to the Owner.

C. Refer to Division 1 for additional warranty requirements.

D. Information on all warranties shall be included in the O&M Manuals specified herein to be provided to the Owner.

1.12 COORDINATION OF WORK:
A. General: The contract documents indicate the extent and general arrangement of the electrical systems. The Contractor shall be responsible for the coordination and proper relation of the electrical work to the building structure and to the work of other trades. No additional compensation or extension of completion time will be granted for extra work caused by the lack of coordination.

B. Miscellaneous loads, such as control panel power, are not always shown on the Drawings. Where additional circuits are needed for such loads, extend wiring to the load from the nearest electrical panel serving receptacle loads and connect to a spare circuit breaker. Where an emergency generator is present and the device to be served is for a controls system or component, the circuit shall be derived from a panelboard fed by the emergency generation optional/standby (NEC 702) system.

C. Cooperation: The Contractor shall provide dimensions and locations of all openings, shafts and similar items to the proper trades and install work as required so as not to interfere with, or delay, the building construction.

D. Locations of lines and equipment shall be determined from actual field measurements. The outlines of the building shown on the electrical drawings are intended only as a guide to indicate relative locations of the electrical work. Refer to architectural and structural drawings for building construction details. If conflicts prevent installation of electrical work at the locations indicated,
minor deviations shall be made subject to acceptance by the Engineer, and without additional compensation.

E. Cutting and Patching: Unless stated otherwise, the Electrical Trade shall do all cutting necessary for the installation of his work. All work should be installed sufficiently in advance of new construction in order to permit installation of supports, sleeves, and similar items without cutting. Cutting which will in any way affect the building structure shall not be performed without permission of the Architect-Engineer. The Electrical Trade is responsible for patching where he does cutting. Patching shall be done to the satisfaction of the Architect-Engineer.

F. Roughing-In: Receptacles, switches, and other similar items shall align vertically or horizontally with each other, hose bibbs, thermostats, the building structure and features thereof when it appears obvious and logical that they should. All mounting heights shall be within the limits of Commonwealth of Virginia USBC and ADAAG.

G. Damage to Other Work: The Electrical Trade is responsible for damage to other work caused by his work or workmen. Repairing of damaged work shall be done by the Trade who installed the work, and as directed by the Architect-Engineer; the cost of which shall be paid for by the Electrical Trade.

1.13 ASBESTOS:

A. Asbestos Free Materials: The intention of these drawings and specifications is that there be no asbestos containing materials installed on this project. To the best of the Architects' and Engineers' knowledge, none of the material or equipment specified herein or shown on the drawings contains asbestos. The Contractor shall make every effort to prevent any asbestos materials from being installed in or used on the construction of the project. At the completion of the project, the Contractor shall certify by letter that to the best of his knowledge, no asbestos containing materials were used for or in the construction of this project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS AND MATERIALS:

A. General: Manufacturers and materials shall be as specified in subsequent sections of these specifications and as noted on the drawings. Similar types of equipment shall be the products of the same manufacturer unless specified otherwise.

2.02 SLEEVES AND INSERTS:

A. General: Sleeves and inserts shall be provided and correctly located in the structure, as required for the work.

B. Inserts shall be steel and of proper size for loads encountered.

2.03 ACCESS DOORS:

A. Provide for all junction boxes or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for work shall be furnished as a part of this Division to the General Contractor for installation. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable. Doors shall be metal access doors with cam lock, style to match ceiling or wall construction. Doors occurring in rated construction shall be fire rated U.L. labeled access doors correlated to preserve the integrity of the rated construction. Doors shall be prime finish steel except those in toilets, shower rooms, locker rooms, kitchens and other similar areas shall be aluminum with natural anodized finish. Doors shall match the access doors in Division 23 and meet the acceptance of the Architect.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. General: Materials and equipment shall be installed in accordance with manufacturer's instructions to conform to the details and application as specified in subsequent sections of these specifications and indicated on the drawings.
Supports: Provide necessary supports for all equipment and appurtenances as required; this includes, but is not limited to, frames or supports for items such as switchboards, panelboards, lighting fixtures, disconnect switches, junction boxes, conduit, motor starters, outlet boxes, and other similar items requiring supports. Floor mounted equipment in Equipment Rooms shall be set on 4-inch high concrete foundation pads unless shown otherwise. All concrete pads shall have 1” chamfered corners and edges. Foundation drawings, bolt setting information and foundation bolts shall be furnished by the subcontractors furnishing the equipment that is required to have concrete foundations. Concrete for foundations shall be provided by the Electrical Trade and in accordance with Division 03 - Concrete Work, unless noted otherwise.

Sleeves: Provide sleeves for all conduits passing through concrete or masonry walls, partitions, concrete slabs or beams installed during construction of the wall, partition, slab or beam. Sleeves placed horizontally in walls or in any position in beams shall be standard weight ASTM A53 steel pipe of length equal to the thickness of the wall or beam. Those placed vertically in non-waterproof floors shall be 20 gauge galvanized sheet steel of length equal to the thickness of the slab, flared and nailed to the form, or fastened to reinforcing fabric and filled with sand during pouring to prevent deformation. Sleeves occurring in floors of rooms where hose bibbs or floor drains provided under Division 21 occur, and in pipe spaces, shall be standard weight steel pipe projecting 1/2" above finished floor except in Equipment Rooms they shall project four (4) inches above finished floor. Sleeves in floors with waterproof membrane shall be provided with flanges or flashing rings and shall be clamped or flashed into the membrane. All sleeves shall be of sufficient diameter to allow installation of conduit except sleeves on lines subject to movement, which shall clear the conduit at least one inch all around. Conduits through exterior walls, or floors, below grade shall have seals specified in Section 26 05 43 between the conduit and wall sleeve. Sleeve shall have anchor and water stop plate. The entire assembly shall be tightened and adjusted to make watertight. Sleeves for insulated wiring and conduit, penetrating fire (and smoke) rated partitions, walls and floors shall have seals as specified in Section 26 05 43 and shall be sealed in accordance with the terms of U.L. Listed Through-Penetration Firestop Systems (XHEZ) as published in the U.L. Fire Resistance Directory. Penetrations shall exactly conform to details of the Firestop System indicated for the type of partition, wall and floor construction encountered. All penetrations through nonfireresistance rated floor assemblies and through the ceiling membrane of nonfireresistance rated roof assemblies shall be fireblocked with tightly packed mineral-wool insulation secured in place. All penetrations through equipment room walls and other areas of noise or heat generation shall be tightly sealed with mineral fiber rope. All penetrations through draftstop partitions shall be sealed to maintain the integrity of the partition. All firestopping of sleeves for electrical work shall be provided under Division 26.

Temporary Requirements: Openings in equipment shall be kept capped at all times until connection is made to the system. The ends of all conduits and equipment openings shall be kept capped properly with approved devices. Approved devices are items such as specially molded plastic caps and sheet metal caps.

Access Doors: Provide access doors for all concealed electric equipment, pull boxes, junction boxes or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for Electrical work shall be furnished by the Electrical Trade, to the Contractor for installation. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable.

Painting: All work under this Division shall be painted in accordance with Section 26 05 53, Identification for Electrical Systems. Division 26 shall also paint and identify all conduits and boxes for Divisions 27 & 28 as described in Section 26 05 53.

3.02 EXISTING WORK AND DEMOLITION:

A. Electrical Demolition: Remove all existing electrical conduits, wiring, junction boxes, outlets, lighting fixtures, wiring devices, unused panelboards, etc., indicated for demolition. Additional amounts of demolition may be required to accommodate desired renovations and new construction. Not all demolition may be shown on the drawings. All existing electrical equipment not indicated for demolition shall remain in place.
B. Equipment and Fixtures Removed: The Owner will select and retain such existing electrical equipment and materials which are indicated to be removed and not reused, as he desires. All other existing equipment and materials indicated to be removed, and not reused shall become the property of the Contractor, who shall remove them from the premises within the time frame specified under other Divisions of this Contract Document.

C. Equipment and Fixtures Relocated: All existing lighting fixtures, panelboards and other electrical equipment and materials indicated to be relocated shall be disconnected, removed, and relocated. All electrical equipment and materials shall be protected from damage during demolition. Install new phase, neutral and grounding conductors, if grounding conductor is not already present, in each feeder and branch circuit to be reworked, from the panelboard to the outlet.

D. Power Interruption: Attention is called to the fact that the existing facility shall remain in operation throughout the construction period. All necessary temporary arrangements shall be made as required to keep all electrical circuits in continuous operation during this period except for scheduled outages for circuit change-overs. The outage shall be kept to the minimum and carefully scheduled to suit the Owner.

E. Mechanical Equipment: All existing mechanical equipment being removed or relocated under this contract shall be disconnected electrically, both power and control wise, so that the Mechanical Trade can remove or relocate same.

F. Miscellaneous: In all altered portions of the buildings, the Electrical Trade shall remove or alter as necessary all existing electrical work that does not fit with the new construction. All existing work or areas that are not altered shall be reconnected as required. Where indicated changes to non-electrical facilities require minor electrical changes, these changes shall be accomplished even if not specifically indicated. Only a small portion of the existing work is shown on the drawings. Contractors submitting proposals shall visit the site to determine the scope of work under this heading as no additional compensation will be granted because of existing conditions even though the existing conditions may not be indicated on the drawings. Contractor shall thoroughly inspect the electrical systems in reworked areas and bring to the attention of the Engineer all defective or unserviceable material not scheduled for removal or replacement. Demolition shall not begin until the work schedule is approved by the Owner. The work shall be scheduled to prevent any disruption to the normal operations of the building. Refer to other Divisions for work phasing.

3.03 FIELD QUALITY CONTROL:

A. System Readings: Certain system voltage and current readings shall be taken, the values recorded and submitted in triplicate to the Engineer. Two complete sets of readings are required, one under no load and one under maximum available load. The current and voltage shall be recorded on each phase (plus voltage between all phases) at main panelboard and at each branch circuit panelboard. Additional spot readings shall be made if required. Resistance of grounding system shall be tested and recorded. Forms for submitting this report may be obtained from the Engineer's office. A sample form is bound herewith.

B. Equipment Readings: Voltage and amperage readings on each phase of each motor circuit and each resistance heater circuit installed under this contract shall be measured, the values recorded, and submitted in triplicate to the Engineer. Also record motor nameplate data, actual motor heater protective device ratings and all other data necessary for selection of heater device.

C. Verification [V]: Upon completion of the project, the Contractor shall submit a separate letter of certification (or compliance) to the Owner/Architect/Engineer that each of the following systems or equipment functions properly, conforms to all requirements of these specifications and all requirements of the manufacturer of the systems.

1. Section 26 50 00, Lighting.
2. Section 26 20 00, Low Voltage Electrical Distribution
3.04 MANUFACTURER'S ASSISTANCE:

A. Qualified technical representatives of manufacturers shall be available to visit the project and provide required assistance for any problems or trouble areas of any systems, material or equipment used in the project. Manufacturer's engineering assistance shall also be available for above problems or trouble areas. The Contractor shall purchase all materials, equipment or systems with these services included in the purchase price or otherwise be prepared to have the above service provided when needed or requested by the Engineer without additional compensation. Where one manufacturer's equipment constitutes the majority of the components or devices to make a system, the manufacturer's technically qualified representative shall inspect and accept the completed installation whether or not especially requested by the Engineer.

3.05 INSTRUCTION OF OWNER'S REPRESENTATIVE:

A. The Electrical Trade shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the Electrical systems. Competent representatives of the Contractor shall spend such time as necessary to fully prepare the Owner to operate and maintain the Electrical systems.

3.06 CONSTRUCTION STATUS REPORT:

A. Each item of discrepancies noted on Construction Status Report prepared by the Engineer shall be answered in detail in writing by the Contractor before payment can be recommended.
ELECTRICAL TEST DATA REPORT

ASCENT ENGINEERING GROUP  
VALLEYPOINTE PKWY, SUITE 4  
ROANOKE, VA 24019

PROJECT: ____________________________________
______________________________________________________________________________

Electrical Contractor: ____________________________________________________________

Date tests were made: __________________________ Date Submitted: __________________

Current Characteristics: _______ Volts _______ Phase _______ Wires

Type voltmeter used: __________________ When calibrated: ________________________

Type ammeter used: __________________ When calibrated: ________________________

Service ground - Resistance in ohms _____________________
Resistance test must be made with hand crank, magneto type, megger.

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A.
MOTOR OVERLOAD PROTECTION

REQUIRED ON ALL PHASES
(SEE N.E.C. SECT. 430 FOR
MAX. PERCENT ALLOWABLE)

NOTES:
1. IDENTIFY EACH MOTOR THUS: CWP-1, H&V-1, F-1, ETC. SAME AS SHOWN ON DWGS.
2. SMALL MOTORS MAY BE RATED THUS: HP, WATTS OR FLA.
3. ALL DATA BY ELECTRICAL CONTRACTOR.
4. SERVICE FACTOR -- IF NOT AVAILABLE ENTER DEGREE C. RISE.
5. MOTOR CONTROLLER TYPE -- FVNR, RVPW, 2-SPD/1W, 2-SPD/2W, Y/Δ, MANUAL, ETC.
6. MOTOR PROTECTION -- INCLUDE COPIES OF HEATER TABLES WITH THIS REPORT.

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*AS MEASURED WITH AMMETER AT SITE.
SECTION 26 0519
LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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 WORK INCLUDED
A. Wires and Cables, Under 600 Volts.
B. Connectors and Lugs, Under 600 Volts

1.03 RELATED WORK
A. Division 23 – Mechanical
B. Section 26 05 26 – Grounding And Bonding For Electrical Systems
C. Section 26 05 33 – Raceway And Boxes For Electrical Systems
D. Section 26 05 36 – Cable Management For Electrical Systems
E. Section 26 05 53 – Identification For Electrical Systems
F. Section 26 20 00 – Low-Voltage Electrical Distribution
G. Division 27 – Communications
H. Division 28 – Electronic Safety and Security

1.04 REFERENCES
A. All wire, cables, connectors and lugs shall be U.L. listed for the application intended, and meet NEMA applicable standards.
B. All wiring methods shall meet with NFPA applicable codes.
C. Number code all control and instrumentation wiring at all points of access.

1.05 CONDUCTOR CODING (208Y/120 and 480Y/277 Volt)
A. Color Code Conductors of 208Y/120-volt system power and lighting conductors as follows:
   Neutral    White
   Ground     Green
   Phase A    Black
   Phase B    Red
   Phase C    Blue
B. Color Code Conductors of 480Y/277-volt system* power and lighting conductors as follows:
   Neutral    Grey
   Ground     Green
   Phase A    Brown
   Phase B    Orange
   Phase C    Yellow

* Owner’s NEC compliant color code may be substituted for the above 480Y/277 code.

C. No. 12 and No. 10 conductors shall have continuous insulation color(s). Color code conductors larger than No. 10 which do not have continuous insulation color by application of at least two laps of colored tape on each conductor at all points of access. Tape shall be “Scotch,” “Highland,” or “Timflex” vinyl plastic electrical tape No. 35, or accepted equal. The 480Y/277 volt conductors shall be marked with an appropriately wide tape of the above base color and an adjacent narrow tape of yellow. Wrap-around “Brady” markers or shrinkable PVC sleeving with hot-stamped
lettering may be used and shall state the appropriate conductor identification. Label "480Y/277-Volt" on all phase conductors of the 480Y/277-volt system.

D. Number code all control and instrumentation wiring at all points of access.

1.06 CONDUCTOR SIZES
A. All conductor sizes (AWG) are based on copper. (See Section 2.02A.1 for provisions to utilize aluminum building wiring – Spec Writer to decide whether or not to permit aluminum feeder conductors)

1.07 SUBMITTALS
A. Submit shop drawings and product data in accordance with Section 26 05 00.

PART 2 - PRODUCTS
2.01 MANUFACTURERS
A. All wires and cables shall be as manufactured by General Cable, Capital Wire & Cable, Carol Cable, American Insulated Wire, Southwire, Senator, Rome, Cerro Wire and Cable, Circle Wire & Cable.

B. All connectors and lugs shall be as manufactured by T & B, Buchanan, 3M, Burndy, or accepted equal.

2.02 MATERIALS AND TYPE
A. Wiring, Power and Control:
   1. General:
      a. Conductors shall be soft annealed copper unless otherwise indicated.
      b. Feeder conductors, indicated to be size #1/0 and larger, may be aluminum in lieu of copper. Where substitution of aluminum is made, the Contractor shall take responsibility for resizing all conductors and conduits for the affected circuits in accordance with each individual overcurrent device, equipment buss rating and the NEC. In no case shall an aluminum feeder conductor, or set of conductors, have a smaller ampacity than the circuit size based on copper.
      c. All conductors #8 AWG or larger shall be stranded (except in surface raceway SR, all conductors shall be stranded).
      d. All power wiring shall be #12 AWG minimum unless otherwise indicated.
      e. All control wiring shall be #14 AWG minimum for NEC Class I and #16 AWG minimum for NEC Class II, extra fine stranding.
      f. All insulation shall be rated for 600 volts unless otherwise indicated.
   2. Building Wiring: Conductors shall be type "THWN" or "THHN" unless otherwise indicated. "THHN" shall not be used in damp or wet locations.
   3. Underground Wiring (Refer to Part-3 for limitations):
      a. #12 AWG through #6 AWG: Conductors shall be type UF copper cable with heat and moisture-resistant insulation, suitable for branch-circuit wiring. The cable shall have an insulated equipment grounding conductor. The overall covering shall be flame-retardant; moisture, fungus, and corrosion resistant; and shall be limited to use within the pole standard.
      b. #12 AWG through 500 kcmil (MCM) AWG: Conductors shall be type RH-H/USE/RHW stranded copper with Durasheath cross-linked polyethylene, thermosetting XLPE that is heat, fungus and moisture resistant.
      c. #12 AWG through 500 kcmil (MCM) AWG: Conductors shall be type XHHW-2 stranded copper cable with cross-linked polyethylene, thermosetting XLPE that is chemical and oil resistant, and suitable for wet or dry locations.
4. Flexible Metal Conduit (Liquidtight) Connections and Motor Starter Enclosures: Power and line voltage control wiring Type MTW stranded copper unless otherwise indicated for all motor connections, HVAC equipment, transformers, all other equipment subject to movement and vibration, and motor starter enclosures.

5. Flexible Cable:
   a. Shall be hard service cord, type "SO" with equipment ground conductor in addition to normal current carrying conductors, and "safety-yellow" jacket.
   b. Connectors shall be Crouse-Hinds series CG, Appleton, Kellems, O.Z./Gedney, Raco, or T & B, complete with locknut, sealing gasket, gland nut and tapered neoprene bushing.
   c. In hazardous areas, connectors shall be Crouse-Hinds CGBS.

B. Motor Connections:
   1. Connection lugs shall be Thomas and Betts, Series 54200.
   2. Insulation shall be motor stub splice insulators, Thomas and Betts, Series MSC, or Raychem MCK.

C. Connectors and Lugs, 600 Volts and Under:
   1. Material: Copper, or suitable copper alloy, for all current carrying parts and all parts coming in contact with conductors.
   2. Connectors and Lugs, No. 8 and Larger Conductors: Compression type T & B "Color-Keyed", or accepted equal by Burndy or Kearney. Mechanical compression lugs furnished with equipment are acceptable. Provide insulating covers or heat shrinkable insulators where required.
   3. Connectors, No. 10 and Smaller Conductors: Permanently indented self-insulated pressure connectors T & B, Buchanan, or accepted equal. Snap-on insulating caps are acceptable insulation. "Scotch-loks" by the 3M Company, "Wing-Nut" by Ideal, "Legrands" by Pass & Seymour (P&S) are acceptable wing type wire connectors.
   4. Lugs, No. 10 and Smaller Conductors: Permanently indented or compression type by Buchanan, Burndy, T & B, or accepted equal. Washer head screw terminals without lugs are acceptable on neutral bars, circuit breakers, wiring devices and other equipment, unless otherwise indicated. Mechanical compression lugs furnished with equipment are acceptable.
   5. Exterior Splices: Compression type T & B "Color-Keyed", complete with T & B Shrink-Kon series HS heat shrinkable insulators, or accepted equal by Burndy or Kearney.
   6. Connectors and Lugs, Aluminum: All connectors, lugs and fittings shall be UL listed for use with aluminum alloys, and aluminum to copper alloys where encountered.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Clean out raceway system before pulling wire.

B. Thoroughly inspect all existing raceway systems for burrs, deformation, rust, water, and other hazards. Inform Architect/Engineer in writing of any raceway conditions that would be detrimental to wiring, or not in compliance with Codes or practices. All existing raceways shall meet the requirements of Section 26 05 33.

C. Utilize an approved compound as required to facilitate pulling wires and cables, unless otherwise indicated.

D. 600 Volts and Under Wiring Methods:
   1. Conductor Ties:
      a. Inside each enclosure, other than outlet and junction boxes, conductors shall be bundled and trained utilizing T & B "Ty-Rap", 3M Brand Cable Ties, Tyton Cable
Ties, or accepted equal, ties. All Switchboards, Panelboards, Motor Starters, Disconnects, etc. require at least one (1) conductor tie for each circuit entering and each circuit leaving the Switchboard, Panelboard, Motor Starter and Disconnect.

2. Conductor Sizes:
   a. Line Voltage Power Wiring: No. 12 AWG minimum. Circuits and feeders larger than 20 amp. to have conductors sized for equal or greater ampacity than their protective device ratings unless otherwise indicated. All wires for 20 amp. circuits shall be #10 on runs 100 feet to 250 feet, #8 on runs 251 feet to 500 feet and #6 on runs 501 feet and above.
   b. Control Wiring:
      1) 120 Volt: If not carrying motor current, No. 14 AWG unless otherwise indicated, or required by load or distance encountered.

3. Terminal Strips: Where equipment does not have terminal strips, provide terminal strips to terminate and splice control, power limited and communication cables. Indicate wire numbers on strip with indelible pen.

4. Conductor Identification:
   a. Wire Markers:
      1) Identify lighting and receptacle branch circuit wiring by panelboard name and circuit number at all accesses.
      2) Identify motor branch circuit wiring by circuit number and phase at all accesses.
      3) Identify feeders by name of equipment from which they originate, circuit number, and phase.
      4) Identify all control wiring with a unique number for each wire.
   b. Color Code: Color code conductors to designate neutral conductor, ground conductor and phase conductors as described in Part 1 of this Section.

5. Splices:
   a. Feeders: Feeder conductors installed between electrical distribution equipment (i.e., switchboards, transformers, and panelboards) shall be free from splices, no exceptions. Any feeder conductor splices proposed by the Contractor shall be approved in advance by the Engineer; otherwise, they are not permitted.
   b. No splices shall be made in any conductor beyond the exterior walls of the Building, except in exterior pullboxes, and where approved by the Engineer.


7. Flexible Cable, Type SO: Flexible cable shall be used to connect portable equipment in kitchens, laboratories, shops, etc., as indicated and limited by the Codes.

8. Each applicable system shall have a separate conduit system unless the applicable system's manufacturer, Codes and Regulations permit other systems conductors to be installed in the same conduit.

END OF SECTION
SECTION 26 0523
CONTROL VOLTAGE ELECTRICAL POWER CABLES

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 WORK INCLUDED
   A. Power Limited Shielded Cable

1.03 RELATED WORK
   A. Division 23 - Mechanical
   B. Section 26 05 26 – Grounding And Bonding For Electrical Systems
   C. Section 26 05 33 – Raceway And Boxes For Electrical Systems
   D. Section 26 05 36 – Cable Management For Electrical Systems
   E. Section 26 05 53 – Identification For Electrical Systems
   F. Section 26 20 00 – Low-Voltage Electrical Distribution
   G. Division 27 – Communications
   H. Division 28 – Electronic Safety and Security

1.04 REFERENCES
   A. All wire, cables, connectors and lugs shall be U.L. listed for the application intended, and meet
   NEMA applicable standards.
   B. All wiring methods shall meet with NFPA applicable codes.

1.05 CONDUCTOR SIZES
   A. All conductor sizes (AWG) are based on copper.
   B. Number code all control and instrumentation wiring at all points of access.

1.06 SUBMITTALS
   A. Submit shop drawings and product data in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
   A. All connectors and lugs shall be as manufactured by T & B, Buchanan, 3M, Burndy, or accepted
      equal.
   B. All power limited shielded twisted pair shall be as manufactured by Manhattan, Belden, Alpha,
      West Penn, Anixter [S].

2.02 MATERIALS AND TYPE
   A. Wiring, Power and Control:
      1. General:
         a. All control wiring shall be #14 AWG minimum for NEC Class I and #16 AWG
            minimum for NEC Class II, extra fine stranding.
         b. All insulation shall be rated for 600 volts unless otherwise indicated.
      2. Plenum rated power limited twisted pair cable.
         a. For Remote Control, Signaling and Power-Limited Circuits as per NEC-725 for Class
            2 and 3 circuits.
            1) General: Cable shall be UL classified, Subject 13, non-conduit application in
               ceiling air plenum in accordance with NEC 725 and as specified below.
2) Control and Instrumentation (24 volt) (Heating, Ventilating and Air Conditioning): Control and instrumentation (24 volt) shall be the minimum of two (2) #16 twisted pair configuration, type CL2P and CL3P insulated stranded tinned copper conductors with 1-1/2 minimum lay, flame retardant, low smoke insulation as required by Class, insulated jacket, color coded, 100% aluminum polyester tape shield, #18 AWG tinned copper drain wire or as indicated otherwise herein.

3) Control and Instrumentation (Heating, Ventilating and Air Conditioning): Thermocouple extension wire shall be compatible with the specific thermocouple material and shall have the same features as "(2)" except the wire shall meet ANSI standard MC96.1 (Temperature Measurement Thermocouples) and have proper amount of pairs for the application.

4) Direct Digital Control System: Wiring between pilot relays, sensors, DDC's and control processing unit shall have proper amount of pairs and be the type as required by Digital Control System installed by temperature control system trade, and shall have similar features of "(2)".

5) Other Systems: Wiring on the applicable systems load side shall be gauge, pairs and shield as required by the applicable system's manufacturer and shall have similar features as to "(2)". Provide shield if required by applicable system's manufacturer or Codes.

b. For Telephone, Outside Wiring for Fire Alarm and Burglar Alarm, Telephone-like Systems Circuits per NEC 800:

1) Cable shall be UL Classified, Subject 13, non-conduit application in ceiling air plenum in accordance with NEC 800.

2) Cable features shall be twisted pair configuration, type CMP, color coded, solid tinned copper conductor, flame retardant, low smoke insulation, 100% aluminum polyester tape shield complete with tinned copper drain wire. The quantity of pairs, gauge and shielding requirements shall be determined by the applicable system's manufacturer. Provide shield if required by applicable system's manufacturer or Codes.

c. For Fire Protective Signaling System Circuits per NEC-760:

1) The cable shall be UL Classified, Subject 13, non-conduit application in ceiling air plenum in accordance with NEC 760 and as specified below.

2) Cable features shall be twisted pair configuration, type FPLP, color coded, solid tinned copper conductor, flame retardant, low smoke insulation, 100% aluminum polyester tape shield complete with tinned copper drain wire. The quantity of pairs, gauge and shielding requirements shall be determined by the fire alarm system manufacturer. Provide shield if required by the fire alarm system's manufacturer or codes.

3. Power limited twisted pair cable (Not for air plenums):

a. For Remote Control, Signaling and Power-Limited Circuits as per NEC-725 for Class 2 and 3 circuits.

1) General: Cable shall be UL classified for non-conduit application in ceiling void (non-air plenum) in accordance with NEC 725 and for application in multi system common raceway in accordance with NEC 725 and as specified below.

2) Control and Instrumentation (24 volt) (Heating, Ventilating and Air Conditioning): Control and instrumentation (24 volt) shall be the minimum of two (2) #16 twisted pair configuration, insulated stranded tinned copper conductors with 1-1/2 minimum lay, types CL2 or CL3, or riser type cables
CL2R or CL3R, as required by Class, insulated, jacket, color coded, 100% aluminum polyester tape shield, #18 AWG tinned copper drain wire or as indicated otherwise herein.

3) Control and Instrumentation (Heating, Ventilating and Air Conditioning): Thermocouple extension wire shall be compatible with the specific thermocouple material and shall have the same features as "(2)", except the wire shall meet ANSI standard MC96.1 (Temperature Measurement Thermocouples) and have proper amount of pairs for the application.

4) Direct Digital Control System: Wiring between pilot relays, sensors, DDC's and control processing unit shall have proper amount of pairs and be the type as required by Digital Control System installed by temperature control system trade, and shall have similar features of "(2)".

5) Other Systems: Wiring on the applicable systems load side shall be gauge, pairs and shield as required by the applicable system's manufacturer and shall have similar features as to "(2)". Provide shield if required by applicable system's manufacturer or Codes.

b. For Telephone, Outside Wiring for Fire Alarm and Burglar Alarm, Telephone-like Systems Circuits per NEC 800:

1) Cables shall be UL Classified for non-conduit application in ceiling void in accordance with NEC-800 and for application in multi-system common raceway application in accordance with NEC 800.

2) Cable features shall be twisted pair configuration, type CM or CMR, color coded, insulated solid tinned copper conductor, insulated jacket, 100% aluminum polyester tape shield complete with tinned copper drain wire. The quantity of pairs, gauge and shielding requirements shall be determined by the applicable system's manufacturer. Provide shield if required by applicable system's manufacturer or Codes.

b. For Fire Protective Signaling System Circuits per NEC-760:

1) The cable shall be UL Classified for non-conduit application in ceiling void in accordance with NEC 760 and as specified below.

2) Cable features shall be twisted pair configuration, type FPL or riser type FPLR as required, color coded, insulated solid tinned copper conductor, insulated jacket, 100% aluminum polyester tape shield complete with tinned copper drain wire. The quantity of pairs, gauge and shielding requirements shall be determined by the fire alarm system manufacturer. Provide shield if required by the fire alarm system's manufacturer.

4. Terminal Strips shall be 600 volt barrier type with marking strip suitable for marking with indelible pens.

5. Pulling compound shall be U.L. listed.

6. Wire markers shall be wrap-around tags made of shrinkable PVC sleeving with hot-stamped blocks or slip-on beads.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Clean out raceway system before pulling wire.

B. Thoroughly inspect all existing raceway systems for burrs, deformation, rust, water, and other hazards. Inform Architect/Engineer in writing of any raceway conditions that would be detrimental to wiring, or not in compliance with Codes or practices. All existing raceways shall meet requirements of Section 26 05 33.

C. Utilize an approved compound as required to facilitate pulling wires and cables, unless otherwise indicated.
D. 600 Volts and Under Wiring Methods:

1. Conductor Ties:
   a. All power limited cable shall be bundled and trained for each system in the ceiling voids. Each bundle shall be supported from the structure with proper metallic (Caddy) clamp or hanger at the required distances. Proper type of T & B Halar cable ties are permitted for use in air plenums.

2. Conductor Sizes:
   a. Control Wiring:
      1) 120 Volt: If not carrying motor current, No. 14 AWG unless otherwise indicated, or required by load or distance encountered.
      2) 30 Volts or Under: No. 16 AWG unless otherwise indicated, or required by load or distance encountered.

3. Control and instrumentation wiring specified in Divisions 21 and 22 shall be furnished and installed by Division 26.

4. Control and instrumentation wiring specified in Division 23 shall be furnished and installed as follows:
   a. All line voltage control wiring, 101 volts, 60 Hertz or higher voltage shall be provided under Division 26.
   b. All low voltage control raceways and wiring, 100 volts and lower voltages and thermocouple extension wiring, shall be provided under Division 23, according to Section 26 05 33 and Section 26 05 23 product and material requirements, and installation methods.

5. Direct Digital Control System wiring specified in Division 23 shall be furnished and installed as follows:
   a. All line voltage control wiring, 101 volts, 60 Hertz or higher voltage, wired through the Digital Control System; and 120 volts, 60 Hertz power source wiring to the Direct Digital Control System shall be provided under Division 26.
   b. All low voltage control wiring (100 volts and lower voltages) for the Direct Digital Control System shall be provided under Division 23, in the manner as noted above for control and instrumentation wiring.

6. Plenum Rated (and Non-Plenum) Power Limited Shielded Twisted Pair Cable:
   a. All plenum rated (and non-plenum) shielded power limited cable shall be installed in accordance with NEC Article 725, 760 or 800 on the “load” side of the applicable system.
   b. Provide proper number, shielding and size of wires as required for operation of the applicable system in accordance with the manufacturer’s instructions and applicable NFPA codes.
   c. Raceway Requirements:
      1) Where an accessible ceiling system or demountable partitions are installed; hollow spaces in casework are available; or similar accessible void is available; a conduit system will not be required. If a conduit system is not utilized cables shall be installed using the specified “Open Wire Management” system.
      2) Where cable is in inaccessible ceiling voids, in inaccessible wall void, penetrates a floor or wall, or exposed on wall or at ceiling, the cable shall be in conduit.
      3) Where partial, detached or “floating” ceilings are provided or no finished ceiling is provided, the cable shall be in conduit, terminating in an accessible corridor ceiling void.
4) The above conduits shall terminate in an accessible void and shall be bushed to prevent damage to cable. All conduits shall also be grounded to the BGES.

d. Wiring splices are to be avoided to the extent possible, and if needed, they must be made only in accessible junction boxes and shall be crimp connected.

e. Transposing or changing color coding of wires shall not be permitted.

f. Wire nut-type connections are not acceptable. All connections shall be made on terminal strips (in boxes or cabinets).

g. All conductors shall be labeled on each end with "E-Z markers" or equivalent.

h. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its terminal.

i. Cabinet terminals shall be numbered and coded. All controls, function switches, etc., shall be clearly labeled on all equipment panels.

j. All connections to components and equipment shall be made with crimp type terminal connections, or method approved by applicable systems manufacturer.

k. All wiring shall be checked and tested to insure that there are no grounds, opens or shorts.

l. Ground all shields only at termination point (originating).

m. If shield is not to be grounded, pull shield back over cable jacket and insulate with heat shrink tubing to prevent accidental grounding.

n. Install cable connectors on all power limited cables entering enclosures except where cable is in protective conduit.

o. All cables installed in ceiling voids shall be attached to or supported from a vertical surface, a structural member or electrical conduit with a Caddy flexible cable support, bridle ring or cable clamp; or specified conductor tie (plenum rated where required). Absolutely do not support from ceiling system or fixture support wires except where accessing a ceiling mounted device. The cable(s) shall not block lay-in lighting fixtures, ceiling mounted HVAC equipment or ceiling tiles in order to allow full access to the ceiling void.

7. Terminal Strips: Where equipment does not have terminal strips, provide terminal strips to terminate and splice control, power limited and communication cables. Indicate wire numbers on strip with indelible pen.

8. Conductor Identification:

   a. Wire Markers:
      1) Identify all control wiring with a unique number for each wire.

   b. Splices:
      1) No splices shall be made in any conductor beyond the exterior walls of the Building except in exterior pullboxes, and where approved by the Engineer.

      2) Shielded power limited cable for Digital Control System wiring shall be splice free between sensors, DDC's and central processing unit.

9. Each applicable system shall have a separate conduit system unless the applicable system's manufacturer, Codes and Regulations permit other systems conductors to be installed in the same conduit.

END OF SECTION
SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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 WORK INCLUDED
   A. Equipment Grounding Conductor (EGC)

1.03 RELATED WORK
   A. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
   B. Section 26 05 23 – Control Voltage Electrical Power Cables
   C. Section 26 05 33 – Raceway and Boxes for Electrical Systems
   D. Section 26 05 36 – Cable Management for Electrical Systems

1.04 REFERENCES
   A. NFPA 70 (NEC), Article 250

1.05 DESCRIPTION
   A. An insulated equipment grounding conductor, color coded per section 26 05 19, and the NEC,
      shall be provided for each alternating current circuit without exception.

1.06 TESTS
   A. The equipment grounding conductor shall be tested for continuity and proper bonding to metallic
      equipment enclosures, outlet boxes, wiring devices and similar items.

PART 2 - PRODUCTS
2.01 MANUFACTURERS
   A. Ground Clamps: Thomas & Betts “GUV,” O. Z. Gedney “CG” series or Blackburn “GUV” series,
      as required by water pipe size and/or grounding electrode conductor size.

PART 3 - EXECUTION
3.01 INSTALLATION
   A. Equipment Grounding Conductor (EGC):
      1. Provide a separate insulated grounding conductor, color-coded as per Section 26 05 19,
         enclosed in the same raceway with the phase conductors for all alternating current circuits,
         even though not necessarily shown on the drawings.
      2. The equipment grounding conductor shall be secured to the equipment enclosure at the
         source of power and at the apparatus being served by the alternating current supply.
      3. The minimum size for the grounding conductor shall be as specified in Table 250.122 of
         N.E.C.
      4. Existing alternating current circuits: If an equipment grounding conductor is not present in
         the existing feeder or branch circuit to be reworked, Division 26 shall provide new phase,
         neutral and grounding conductors from the related switchboard or panelboard to the
         indicated outlet.

END OF SECTION
SECTION 26 0533
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

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 WORK INCLUDED
   A. Rigid Conduit (Heavy Wall, Intermediate Metal Conduit, Electrical Metallic Tubing and Rigid
      Non-Metallic Conduit)
   B. Flexible Conduit (Liquidtight and "Greenfield")
   C. Surface Raceway (SR) and Wireway
   D. Fittings for Conduits, Flexible Metal Conduit, Surface Raceway (SR), Wireway.
   E. Pull Boxes
   F. Junction Boxes
   G. Outlet Boxes

1.03 RELATED WORK
   A. Section 26 05 36 - Cable Management for Electrical Systems
   B. Section 26 05 53 – Identification For Electrical Systems
   C. Section 26 09 23 – Lighting Control Devices
   D. Section 26 20 00 – Low-Voltage Electrical Distribution
   E. Section 26 27 26 – Receptacles
   F. Section 26 50 00 – Lighting
   G. Division 27 – Communications
   H. Division 28 – Electronic Safety and Security

1.04 SUBMITTALS
   A. Submit shop drawings and product data in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
   A. Rigid Heavy Wall Conduit (GRS): Essex, Allied Tubing, Republic, Steelduct, Triangle, L.T.V.,
      Wheatland, or accepted equal.
   B. Intermediate Metal Conduit (I.M.C.): L.T.V., Berger Industries, Inc., Allied Tubing, or accepted
      equal.
   C. Electrical Metallic Tubing (E.M.T.): L.T.V., Wheatland, Republic, Steelduct, Berger Industries,
      Inc., or accepted equal.
   D. Rigid Non-Metallic Conduit: Carlon "PLUS" Schedule 40, 90°C, U.L. listed, Queen City Plastics,
      Sedco, Can-Tex Industries, or accepted equal.
   E. Liquidtight Flexible Metal Conduit: Anaconda "Sealtite", O.Z./Gedney "Flex-Guard", Electri-Flex
      Co. "Liquid-Tight", or accepted equal.
   F. Galvanized Single Strip Steel Flexible Conduit: American Flexible Conduit, Anaconda,
      Electri-Flex Co., or accepted equal.
   G. Fittings (All fittings to be same materials as specified for conduit):
      1. Rigid Heavy Wall and Intermediate Metal Conduit Fittings: O.Z., T & B, Efcor, Berger
         Industries, or accepted equal.
2. Electrical Metallic Tubing Fittings: T & B, Raco, Steel City, O.Z./Gedney, Berger Industries, Inc. or accepted equal.
3. Flexible Metal Conduit Fittings: T & B, O.Z./Gedney, Midwest, Steel City, or accepted equal.
4. Conduit "L's": Crouse Hinds, Killark, O.Z./Gedney, Shamrock Conduit Products, or accepted equal.
5. Cable Supports: O.Z. type M, or accepted equal.
6. Fire Wall and Smoke Partition Seals:
   a. O.Z. type CFS fire seals or T & B "Flame Safe" Fire Stop System or 3M Brand Fire Barrier Penetration Sealing System #7904, 3M Brand Fire Barrier Caulk CP-25 and Putty 303, Nelson "Flameseal" fire stop putty, or accepted equal for each conduit or cable as required [S].
   b. Wiremold FlameStopper™ FS series Thru-Wall Fitting, STI EZ-Path, or other accepted equal for installation of power limited cabling through fire wall [S].
7. Rigid Non-Metallic Conduit Fittings: Carlon, Queen City Plastics, Sedco, Can-Tex Industries, or accepted equal.
8. Insulated Throat Metallic Bushings: O.Z./Gedney Type B or BLG, T & B nylon insulated metallic, or acceptable equal by Efcor. Provide grounding lug type where required.

H. Wireway: Square D or equal by Walker, or Hoffman.
I. Pull and Junction Boxes: General Metals, Electromate Mfg. Corp., Hoffman, or accepted equal.
J. Outlet Boxes: Appleton, Raco, Steel City, or accepted equal.
K. Outlet Box Brackets: E-Z Mount Bracket Co., Inc., Vinton, Virginia 24179 (703-345-3000), or accepted equal by Caddy, Raco.

2.02 MATERIALS AND USE:
A. Rigid Heavy Wall Conduits (GRS): Of mild steel tube, electro or hot-dipped galvanized and U.L. labeled.
B. Intermediate Metal Conduit (I.M.C.): Of mild steel tube in sizes 3/4" to 4", hot-dipped galvanized or electro-galvanized and U.L. labeled. Refer to limitations under Part 3 - EXECUTION.
D. Flexible Metal Conduit:
   1. Liquidtight flexible metal conduit: Flexible galvanized steel tubing covered with extruded liquid-tight jacket of PVC and a continuous copper bonding conductor wound spirally between the convolutions. Refer to limitations in Part 3 - EXECUTION.
   2. Galvanized single strip steel flexible conduit (Commercial Greenfield): UL 1 listed. Refer to limitations in Part 3 - EXECUTION.
E. Rigid Non-Metallic Conduit: Schedule 40 PVC (polyvinyl chloride) conduit that meets and exceeds UL 651, NEMA TC2-1978 for above ground, direct burial, concrete and exposed applications. Refer to limitations in Part 3 - EXECUTION.
F. Fittings:
   1. For Rigid and Intermediate Conduit: Couplings to be galvanized or sheradized steel. Double galvanized steel locknuts shall be used where required by code. Single locknut and bushing may be used elsewhere. Insulated throat metallic bushings to be installed on all rigid conduit terminations where such bushings are required by NEC to protect the wires from abrasion. Use ground lug type where required.
   2. For E.M.T.: Steel set screw connectors, permanently indented or gland compression type. Do not use cast metal type.

4. Conduit "L's": Galvanized steel, threaded, "LB" or "LBD".

5. Cable Supports: To be installed for the support of all conductors and cables as per NEC Article 300-19.

6. For Rigid Non-Metallic Conduit: PVC fittings, elbows and cement shall be provided by the same manufacturer who provides the rigid non-metallic conduit.

7. Conduit Expansion Joints: O.Z. mechanical type, or accepted equal, on each conduit run crossing building expansion joint.

G. Wireway:
1. Wireways shall be listed to meet UL 870.
2. Wireway covers and troughs shall be constructed from a minimum of 14 gauge steel before finishes are applied. The end flanges shall be constructed from ten gauge steel. All lengths and fittings shall have smooth, rounded edges to prevent damage to wire and cable insulation. Wireway shall be furnished without knockouts.
3. Wireway covers shall have oil-resistant closed cell gasketing for sealing purposes. A solid oil-resistant neoprene joint gasket shall be used between flanges for rigidity when sections and fittings are bolted together.
4. A gasketed captive hinged connector which interlocks with the covers shall be used at each joint. The connector shall be such that the covers cannot be closed and latched without closing the sealing connector.
5. Wireway shall be provided with quick-release cover latches which hold the cover securely in place when closed. Latches shall have provision for a sealing wire to be used when covers and latch are in the closed position.
6. Wireway covers shall be secured to the troughs with leaf type hinges which all allow full opening access to the wireway interior.
7. Provide NEMA-1, NEMA-3R, NEMA-4X, NEMA-12 or other NEMA enclosure where required by NEC or environmental conditions.

H. All boxes to be sheradized or galvanized (after fabrication) sheet steel (except floor boxes) code gauge boxes.

I. The minimum size of all boxes shall conform to the requirements of the National Electrical Code, unless noted to be larger on the drawings, and shall have adequate braces and supports.

J. Pull and Junction Boxes: All boxes shall have screw-on or hinged covers. All flush mounted boxes shall have 3/4" overlapping covers with flush-head cover retaining screws and covers in finished areas shall be prime coated with paint.

K. Outlet Boxes:
1. All boxes shall have ears turned in. Multiple gang boxes must be one piece type (not built-up). Provide 3/8" (or larger if required) fixture stud in all fixture boxes. Provide appropriate covers as required, including 3/4" deep plaster ring covers where plaster may be encountered. Provide vapor proof outlet boxes for vapor proof fixtures. Provide size and type of boxes as required by location and N.E.C., except where exposed masonry occurs, use one piece "tile boxes". All boxes shall be 4" square boxes with "tile rings" unless noted otherwise or where larger sizes are required. All outlet boxes requiring hangers shall be hung with metal hangers.
2. All exposed boxes below ceiling level shall be cast type FS or FD.

L. Stud Wall Outlet Box Brackets: Provide #E-Z 1-4, #E-Z 4-1116 or #E-Z 23-1 outlet box brackets with extension brackets or acceptable equal.

M. Outlet Box Bar Hangers: Provide adjustable or solid bar metal hangers by Appleton Electric Manufacturing or acceptable equal.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide raceway systems to achieve required distribution, switching and circuit control. All wires for all systems shall be installed in rigid metal raceways and terminated in boxes or cabinets, unless otherwise specified herein as partial conduit or non-conduit installation. Allow for making connections to all outlets, motors, etc., indicated and check plans to insure that all outlets, etc., have a designated circuit. Notify the Engineer of any discrepancies found.

B. Conduit runs are not shown on the drawings, unless specifically noted or indicated otherwise.

C. Conceal all (new) raceways (in existing and new construction) except where specifically noted on drawings or permitted as exposed. Runs in mechanical room areas may be exposed. Exposed conduit must be run parallel with the building walls and supported in a neat substantial manner. Refer to surface raceways under PART 3 - EXECUTION.

D. Cap raceway systems during course of construction and thoroughly clean inside before installation of conductors.

E. Provide a completely separate raceway system for all emergency lighting and exit sign circuits as required by N.E.C.

F. No rigid raceway for line voltage wiring shall be smaller than 3/4", except for flexible conduit, unless specifically indicated otherwise. The Electrical Trade shall size all other raceways based on the N.E.C. and verify the sizes shown on the drawings, increasing same if required by local authorities and/or codes.

G. All conduit feeding from one building area to another shall remain within the confines of the building, unless shown or noted otherwise on the drawings.

H. Field made conduit bends shall be made with an acceptable bending machine or conduit bender.

I. Flexible Metal Conduit:
   1. Liquidtight flexible metal conduit cannot be used in an air plenum ceiling void. Standard galvanized single strip steel flexible conduit shall be used in air plenum ceiling void.
   2. Liquidtight flexible metal conduit for all flexible connections, plus all short motor connections, transformers and all equipment subject to movement or vibration and where permitted by the Engineer. For flexible connections in an air plenum ceiling void, flexible metal conduit shall be substituted for liquidtight flexible metal conduit.
   3. Galvanized single strip steel flexible conduit (6' maximum length) limited to use as the flexible connection to recessed lighting fixture assemblies (only) (and in existing wall voids).

J. Rigid Metal Heavywall Conduit (GRS):
   1. All joints shall be properly threaded and made tight in standard conduit couplings.
   2. All thread conduits or nipples are not acceptable.
   3. All conduit cuts shall be square, made with a hacksaw or approved cutting machine, and reamed after threading and before installation to remove burrs.
   4. All threads, both field-cut and factory-cut, not otherwise protected, shall be painted after installation with two coats of asphaltum paint if concealed and two coats of primer base paint if installed in an exposed location.
   5. GRS shall be used in service entrance raceways where exposed.
   6. Clamps to be malleable two (2) hole galvanized iron and hangers to be rod type steel.

K. Where conduits are exposed to occupants, up to 8'-0" feet above the floor, the conduits shall be snug to the wall and secured with two (2) hole clamps (utilizing specified detention type fasteners).

L. Intermediate Metal Conduit (IMC):
   1. Applicable specifications for installation of rigid metal conduit applies to IMC.
   2. IMC can be substituted for GRS per the NEC.
M. Electrical Metallic Tubing (EMT):
1. Applicable specifications for installation of rigid metal conduit applies to E.M.T.
2. E.M.T. shall not be used underground, cast in concrete, exposed on exterior of buildings, and exposed interior locations below 8'-0" (above finished floor).
3. E.M.T. may be routed down exposed interior walls to top of panelboards, motor starters, disconnect switches, light switches, etc.
4. E.M.T. is permitted in electrical and mechanical equipment rooms, per detail on drawings.

N. Rigid Non-Metallic Conduit (PVC):
1. All elbows and nipples to be same material as specified for conduit.
2. All joints to be solvent welded in accordance with conduit manufacturer's instructions.
3. Hanger clamps to be PVC coated malleable iron and hangers to be PVC coated rod type steel.
4. Conduit clamps to be PVC coated, two hole clamps complete with nylon hardware.
5. PVC conduit shall be limited to the following applications:
   a. Underground secondary service entrance concrete encased conduits outside the perimeter of the building and routed under the concrete floor slab on grade to the service entrance equipment.
   b. Underground branch circuit and feeders (under 600 volts), telephone, fire alarm, sound system, control conduits in specified concrete encasement outside the perimeter of the building and in or under the concrete floor slab on grade. The PVC conduit can be routed from the concrete floor slab on grade directly into the masonry unit wall cavities, metal wall stud cavities up to the first wall box only, maximum 4' aff. PVC shall not be exposed within the building except if within a floor mounted enclosure or panelboard to floor conduit enclosure. The PVC conduits under a concrete floor slab on grade will not require concrete encasement if the slab is more than 2-1/2" thick. Exposed PVC conduit stubs above the concrete slab shall not be permitted. Only exposed rigid metal conduit stubs are permitted.
   c. Underground branch circuit and feeders (under 600 volts) for outdoor lighting only.
   d. Provide specified concrete encasement per Section 16115.
6. PVC shall not be acceptable in areas where subject to ambient temperatures exceeding those for which PVC conduit is approved, for the support of fixtures or other equipment and other areas not permitted by Codes.

O. Supports: Provide metallic supports as required for the proper installation of the raceway or conduit systems and all other equipment installed under this contract. Wire shall not be used to support or tie down any conduit system.

P. Empty Conduits: Pull #12 stranded gauge galvanized fishing wires or stranded nylon line through all empty conduits for all systems. These wires or lines to remain in the conduits.

Q. Exposed Masonry: Where wall finish is exposed masonry, raceways shall be so placed in wall that the masonry unit can be neatly set around it with minimum cutting and without injury to the exposed masonry face.

R. Wireways:
1. Furnish and install a complete lay-in wireway system where required. Wiring capacity shall be determined by NEC unless larger dimensions are indicated.
2. Wireway lengths and fittings shall be securely bolted together with same size slotted paint cutting hex-headed shoulder bolts and hex nuts with captive external tooth lock washers which maintain electrical ground continuity across the joint. Each joint shall be gasketed between end flanges. The sealing cover connector shall be installed so as to be held captive and maintain the lay-in ability of the wireway.
3. Wireway shall be installed in accordance with the National Electrical Code requirements.
4. Wireways shall be supported at intervals not exceeding five feet unless specially approved for supports at greater intervals. The ten-foot straight sections of wireway shall be Underwriters Laboratories, Inc. listed for support at ten-foot intervals.

S. All underground conduits including in grade and under floor slabs shall be watertight over the entire length, to prevent entry of water at connections. Provide compatible sealants for material encountered.

T. All conduits installed under the concrete slab shall be completely underneath the concrete slab. Care shall be taken to ensure that no part of the conduit is within the concrete slab.

U. Pull and Junction Boxes: Provide all necessary pull and junction boxes where indicated or required by National Electrical Code. Certain pull and junction boxes may be shown on the drawings for specific design reasons but is not to preclude the fact that additional boxes will be required to conform to codes and good practice.

V. Outlet Boxes:
1. General: All outlet boxes shall be set flush or set to meet the N.E.C. requirements; otherwise box extensions shall be installed. Mounting heights of all outlets shall be as indicated on the drawings, specified herein, or as permitted on the job. Support all boxes to maintain alignment and rigidity. Clean boxes of all foreign matter prior to installation of wiring and/or devices. Adjacent outlet boxes shall be aligned horizontally at the same height, or vertically in the same line, as required.
2. Wall Outlets:
   a. Where the outlet boxes are shown back-to-back in the walls of 6" or less in thickness, the boxes shall be offset horizontally. Through-the-wall outlet boxes shall not be permitted. Outlet boxes, indicated to be installed side-by-side in the same wall, shall be located 6" apart. All boxes shall be rigidly secured in the wall.
   b. Steel Outlet boxes in fire walls and fire separation assemblies shall be installed in accordance with Virginia USBC 704.1.1 and 714.1.6.1 respectively. Therefore outlet box openings cannot exceed 16 square inches per outlet with 100 square inches limit per 100 square feet of wall area. Where outlet boxes are shown in opposite sides of the wall or assembly, the boxes shall be separated by a horizontal distance of not less than 24 inches.
3. Exposed Masonry: The outlet boxes shall be placed in the wall to allow the masonry unit to be neatly set around the box, with the minimum of cutting and without injury to the exposed masonry face. The dimensioned heights of the outlets in the exposed masonry walls are intended to mean to the nearest masonry joint.
4. Stud Walls: The outlet boxes shall utilize the wall brackets and extensions as required. The Electrical Trade shall coordinate with the dry wall or plaster lathe installation trade for fastening the outboard part of bracket to prevent any movement of the outlet box within the wall cavity.
5. Floor Outlets: Outlets that are indicated to be installed side by side in the floor shall be located 3" apart.
6. Ceiling Outlets: All flush mounted ceiling outlet boxes shall be supported by adjustable or solid bar metal hangers or directly supported by threaded steel rods or stud type fasteners.
7. Local Switch Outlets: Prior to the installation of the local switch outlet boxes, the Contractor shall verify the door swings to insure the proper location of the box. This outlet shall be installed with a minimum of 4" of separation from door jamb trim. Refer to typical elevation for mounting outlet boxes at doors.

Conduit Termination: All rigid heavy wall metal conduits (G.R.S, I.M.C. and E.M.T.) and rigid non-metallic conduits (P.V.C.) shall terminate with locknut and bushing in all boxes, cabinets, panels, etc. Where a grounding means is not provided in the box, cabinet, panel, etc. provide a locknut and grounding bushing.

END OF SECTION
SECTION 26 0536  
CABLE MANAGEMENT FOR ELECTRICAL SYSTEMS  

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 WORK INCLUDED  
A. Wall Brackets  

1.03 SUBMITTALS  
A. Submit shop drawings and product data on all equipment specified in this section in accordance with Section 26 05 00. Provide installation shop drawings in accordance with 3.01.B.3 below.  

PART 2 - PRODUCTS  

2.01 MANUFACTURERS  
A. Open Wire Management Hardware:  

2.02 MATERIALS AND USE  
A. Wall Brackets: Wall brackets shall be multi-use "C" shaped hanger with 9/32 (7mm) diameter holes on four (4) sides. The center space shall provide the required cross section area for the cable being supported. The bracket shall be 6063-T6 aluminum with extruded box beam design (19mm x 12mm x 2mm thick walls), one (1) inch radii turns, smooth and free from sharp edges, two (2) 7mm holes in long side, one (1) 7mm hole in both short sides, and mounted with 6mm (1/4") hardware or supported with rod and clamps from structure. Use where cable tray cannot be installed.  

PART 3 - EXECUTION  

3.01 INSTALLATION  
A. Wall Brackets: The metallic "C" shaped wall (or ceiling) brackets shall be wall mounted or suspended on a minimum of 24" centers for the support of Data, telephone, fire alarm, CATV, telephone communication and direct digital controls system (Division 23) wiring and cabling. Wall brackets shall be installed in continuous and even rows, above each corridor ceiling, spaced as indicated above. Coordinate installation of wall brackets with piping, ductwork, conduits, etc. All wall brackets shall be readily accessible for installation of low voltage wiring systems. Wall brackets are required in all corridors where cable tray is not installed and in additional locations as indicated on the drawings.  

END OF SECTION
SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

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 WORK INCLUDED
   A. Prepare and paint Division 26 equipment supports and miscellaneous materials located in Equipment Rooms, Mechanical Rooms, and other utility areas housing mechanical and/or electrical equipment.
   B. Identification of conduits, junction boxes, pull boxes, cabinets, panelboards, switchgear, motor starters, disconnect switches, motor protective switches, and Division 26 system enclosures.

1.03 WORK NOT INCLUDED
   A. Painting of factory finished Division 26 Equipment such as Switchboards, Panelboards, Emergency Generator Sets, etc.

1.04 RELATED WORK
   A. Division 23 – Mechanical
   B. Section 26 05 00 – Common Work Results For Electrical
   C. Section 26 05 33 – Raceway And Boxes For Electrical Systems
   D. Section 26 05 36 – Cable Management For Electrical Systems
   E. Section 26 24 16 – Panelboards
   F. Section 26 28 16 – Enclosed Switches And Circuit Breakers
   G. Section 26 29 00 – Low-Voltage Controllers
   H. Division 27 – Communications
   I. Division 28 – Electronic Safety and Security

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS
   A. Except as otherwise specified, materials shall be the products of the following manufacturers:
      1. Sherwin-Williams
      2. Pratt and Lambert
      3. Devoe
      4. Benjamin Moore

2.02 MATERIALS
   A. Deliver all paints and materials to the project site in their original containers with all labels intact and legible at the time of use.
   B. Sherwin-Williams Industrial Maintenance Coatings System 4000 products are listed below to establish color and a standard of quality.
      1. All Hangers and Supports: One coat Series 54 Gloss Black Alkyd Enamel.
      2. Uninsulated diesel engine exhaust and other similar hot surfaces shall be painted with two coats of No. B59S8 Heat Resistant Aluminum.
      3. Exterior of belt guards and other protective guards shall be finished with two coats of Series 54 Alkyd Gloss Enamel No. SW4084 safety yellow color. Interior of and all items covered by belt guards and other protective guards shall be finished with two coats of No. SW4083 safety orange color.
4. Factory Finished Equipment finishes shall be cleaned and properly touched up with equipment manufacturers touch-up paint unless finish is severely damaged or of unacceptable quality. In the latter case, the entire finish shall be restored in accordance with painted procedures herein specified.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. The work shall be accomplished by qualified mechanics skilled in the painting trade. Painting of equipment and other materials shall not commence until all testing is complete and systems are ready for operation. Materials shall be evenly spread, and smoothly flowed on without runs or sags. Each coat shall be thoroughly dry before application of succeeding coats.

3.02 PROTECTION OF WORK

A. The painters shall protect all adjacent surfaces with drop covers during the process of painting. Upon completion, paint spots, if any, shall be removed from all surfaces not intended to be painted.

3.03 PREPARATION OF SURFACE

A. Surfaces to be painted shall be completely dry before applying paint. Metal surfaces shall be cleaned with mineral spirits before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be chemically treated with crystalline zinc phosphate in strict accordance with the manufacturer's recommendations. Surfaces shall not be painted when the temperature is, or is likely to be, near the freezing point, nor when they are exposed to hot sun.

3.04 IDENTIFICATION OF PIPES AND EQUIPMENT

A. After all painting is completed, operating and control parts of the equipment and systems such as switchgear, panelboards, telephone cabinets, system cabinets, disconnect switches, motor starters and control cabinets shall be properly identified with laminated engraved plastic nameplates fastened with sheet metal screws, bolts or permanent adhesive. Pressure sensitive tape is not acceptable. Identification symbols or designations shall be the same as shown on the contract documents.

B. Boxes; Concealed and Surface Mounted: Each junction box, pullbox or similar enclosure shall be neatly identified by stencil marking which shall indicate service contained, and circuit numbers. Stencil letters shall be upper case (Capital) not less than one-half inch high and painted with Series 54 black gloss enamel.

C. Conduit:

1. Color bands shall be painted on each conduit where exposed or accessible. Bands shall be six inches wide and shall be placed along the conduit run immediately preceding the passage of the conduit through walls, ceiling or floor, and at each equipment connection or junction box. Where sub-bands are specified, they shall be two inches wide and centered in the color band. Adjacent to each color band, the abbreviation of the name of the service contained in the conduit shall be neatly stenciled. Stencil letters shall be one-half inch high upper case, applied with Series 54 black gloss enamel. Color bands shall be Series 54 Alkyd Gloss Enamel of colors listed below.

   System               Abbrev./Color | Color Band | Color Sub-Bands
---                   ---           | ---       | ---
120/208 Volts (Normal) | 208V/Black | Black  | Yellow
277/480 Volts (Normal) | 480V/Black | Black  | Orange

4. Color Banding:

   System               Abbrev./Color | Color Band | Color Sub-Bands
---                   ---           | ---       | ---
120/208 Volts (Normal) | 208V/Black | Black  | Yellow
277/480 Volts (Normal) | 480V/Black | Black  | Orange
D. The main panelboard, generator control panel, and other similar systems shall have an engraved informational laminated nameplate with the installing trade’s name, telephone number and address for the Owner to obtain preventive maintenance, service or parts. The nameplate shall include the job order number, shop number or other identification which will identify the related equipment.

If the above address and telephone number is a branch office, the main office or manufacturers address and telephone number shall be included.

END OF SECTION
SECTION 26 0923
LIGHTING CONTROL DEVICES

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 WORK INCLUDED
   A. Switches
   B. Dimmers
   C. Low Voltage Lighting Controls
       1. Wallpods
       2. Daylighting Sensors
       3. Occupancy Sensors
   D. Low Voltage Lighting Control Equipment
   E. Plates
   F. Automatic Lighting Controls
   G. Lighting Contactors

1.03 RELATED WORK
   A. Section 26 05 23 – Control Voltage Electrical Power Cables
   B. Section 26 05 33 – Raceway And Boxes For Electrical Systems
   C. Section 26 50 00 – Lighting

1.04 SUBMITTALS
   A. Submit shop drawings, product data and wiring device samples in accordance with Sections 26 05 00.
   B. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00.
   C. Low Voltage Lighting Control Systems: Furnish the following for each system:
      1. Building floor plans (1/8” = 1'-0” scale) showing:
         a. All lighting fixtures and low voltage control devices in their correct locations and configurations.
         b. Separate plans showing control zones and orientations for all daylighting sensors.
         c. Separate plans showing control zones and orientations for all occupancy and vacancy sensors.
      2. System riser diagrams showing connections to all lighting fixtures and low voltage control devices.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
   A. Switches [S] shall be as manufactured by:
      1. Bryant,
      2. Hubbell,
      3. Cooper-Crouse Hind
      4. Pass and Seymour (P&S)
   All switches shall be by the same manufacturer.
   B. Dimmers shall be as manufactured by:
1. Hubbell,
2. Leviton,
3. Lutron

C. Low Voltage Lighting Controls and Equipment [S] shall be as manufactured by:
   1. Sensorswitch,
   2. Hubbell,
   3. Lutron

D. Wiring Device Plates [S] and Blank Plates [S] shall be as manufactured by:
   1. Bryant,
   2. Hubbell,
   3. Cooper Crouse-Hinds,
   4. Pass & Seymour (P&S)

E. Lighting Contactors [S] shall be as manufactured by:
   1. Square D
   2. ABB
   3. ASCO

F. Automatic Lighting Controls shall be as manufactured by:
   1. Sensorswitch,
   2. Hubbell,
   3. Lutron

2.02 MATERIALS AND TYPE

A. All switches, dimmers, and other wiring devices shall be as indicated on drawings and specified hereinafter.

B. Unless otherwise indicated on the drawings all switches shall be:
   1. Bryant “Tech-Spec” series,
   2. Hubbell HBL series (Industrial, Heavy-duty specification grade)
   3. Cooper Industrial Specification grade AC Quiet series
   4. Pass & Seymour (P&S) specification grade “PS” series

C. The switches shall be complete with green (brass) hexhead grounding screw, back and side wired high impact polycarbonate, LexanTM, high impact thermoplastic or nylon toggle. Switch shall be rated for the voltage, poles, amperage and circuit configuration required.

D. Plates: For all systems unless indicated otherwise.
   1. For Concealed Work: Stamped stainless steel type 302 with satin finish.
   2. For Wet Locations:
      a. While in Use (WL) (LP): Weatherproof NEMA-3R enclosure constructed of flame retardant U.V. stabilized polycarbonate, reinforced thermoplastic, die-cast metal or combinations of the above materials complete with sealing gaskets and stainless steel mounting screws; and meets OSHA and NEC requirements "WHILE IN USE". The cover shall be clear. Housing size shall depend on the wiring device being protected. Housing for receptacles shall allow both angled and straight cord connectors. As manufactured by Tay-Mac® Corp., P&S, Hubbell, Cooper Crouse-Hinds or acceptable equal.
      b. While cover is Closed (WP): Weatherproof NEMA-3R enclosure constructed of die-cast metal complete with sealing gaskets and stainless steel mounting screws; and
meets OSHA and NEC requirements while cover is "Closed". As manufactured by
P&S, Bryant, Hubbell, Cooper Crouse-Hinds or acceptable equal.

3. For F.S. or F.D. Boxes (Interior Only): Die cast covers with gaskets, as manufactured by
Crouse-Hinds, Appleton, Red Dot or acceptable equal.

4. Screws: Heads to match plate material and finish.

5. Provide blank plates for all unused outlets.

E. Wiring Device and Plate Colors: Architect will review and accept color of wiring devices and
plates. Contractor shall allow for selection from "standard" colors (grey, white, ivory, brown) of
wiring devices in his bid proposal.

F. All pilot lights shall be neon or L.E.D. type with Red color glass, unless otherwise noted. Lamp
to be sized to adequately illuminate under daylight conditions. Incandescent pilot lights are not
acceptable. LED conversion lamps are acceptable in incandescent lampholders.

G. Low Voltage Lighting Controls (Wired as specified or Wireless as acceptable equal):

1. Low Voltage Lighting Controls shall all have the following features:
   a. Fully addressable and compatible with Sensorswitch nLight control CAT-5e.
   b. Complete with power supply and 2 RJ-45 ports.
   c. Shall be configured and engraved as specified here-in and as indicated on the
drawings.
   d. 5 year product warranty.

2. Wallpods, Low Voltage [O&M] [S]:
   a. Graphic Wallpods:
      1) 3.5" Full-color touch screen.
      2) 16 On/Off/Dim controls and 16 scene controls with full user customization of
         all settings.
      3) Password protection for controls and set-up screens.
      4) Customizable screen saver image (.jpeg format) and onboard help screens.
      5) Operating temperature 14°F to 160°F.
      6) Sensorswitch nLight nPOD GFX or accepted equal by Hubbell or Lutron.
   b. Low Voltage Dimming and On/Off control Wallpods:
      1) 1, 2 or 4 channel raise/lower with 0-10V dimming control.
      2) 1, 2 or 4 channel on/off.
      3) Operating temperature 14°F to 160°F.
      4) Sensorswitch nLight nPODM DX or accepted equal by Hubbell or Lutron.
   c. Low Voltage Scene control Wallpods:
      1) Runs locally stored scenes.
      2) Runs remotely stored profiles from a gateway device. Remotely configurable
         and upgradeable.
      3) 1, 2 or 4 scene control.
      4) On/Off and Raise lower with 4 scene control.
      5) Operating temperature 14°F to 160°F.
      6) Sensorswitch nLight nPODM 1S/2S/4S or accepted equal by Hubbell or Lutron.

3. DayLighting Sensors, Low Voltage [O&M] [S]:
   a. Remotely configurable and upgradeable.
b. Automatic Set-Point Calibration.
c. Blink-back Set-Point (in footcandles).
d. Set-Point (0-200 fc)
e. Sunlight Discount Factor (1-8)
f. Occupied Bright Level (0-100%)
g. Unoccupied Dim Level (0-100%)
h. Photocell On/Off Transition Time (45 sec. – 25 min.)
i. Adaptive cloud delay to prevent cycling on cloudy days.
k. Full On/Off switching control.
l. Recessed Ceiling Applications: Sensorswitch nLight nRM ADCX series or accepted equal by Hubbell or Lutron.
m. Surface Ceiling Applications: Sensorswitch nLight nCM ADC series or accepted equal by Hubbell or Lutron.

4. Occupancy Sensors, Low Voltage [O&M] [S]:
   a. Recessed Ceiling Mounted:
      1) Dual technology; passive infrared and ultrasonic.
      2) Full 360° operation.
      3) Assorted lens choices for desired motion coverage.
      4) Minimum 24’ diameter small motion coverage at 9’ ceiling height.
      5) Minimum 48’ diameter large motion coverage at 9’ ceiling height.
      6) Sensorswitch nLight nRM PDT 9 (small motion) or nRM PDT 10 (large motion) or acceptable equals by Hubbell/Unenco, or Lutron.
   b. Surface Ceiling Mounted:
      1) Dual technology; passive infrared and ultrasonic.
      2) Full 360° operation.
      3) Assorted lens choices for desired motion coverage.
      4) Minimum 24’ diameter small motion coverage at 9’ ceiling height.
      5) Minimum 48’ diameter large motion coverage at 9’ ceiling height.
      6) Sensorswitch nLight nCM PDT 9 (small motion) or nCM PDT 10 (large motion) or acceptable equals by Hubbell/Unenco, or Lutron.
   c. Wall Mounted:
      1) Dual technology; passive infrared and ultrasonic.
      2) Full 120° operation.
      3) Small motion detection up to 40’.
      4) Large motion detection up to 70’.
      5) Beveled rear enclosure piece to facilitate corner mounting.
      6) Ceiling mounting bracket for mounting heights over 10’.
      7) Sensorswitch nLight nWV PDT 16 or acceptable equals by Hubbell/Unenco, or Lutron.
   d. Corridor Wall Mounted:
      1) Passive infrared technology.
      2) Long narrow motion.
3) Linear coverage up to 130’ at 10’ mounting height.
4) Ceiling mounting bracket for mounting heights over 10’.
5) Sensorswitch nLight nHW 13 or acceptable equals by Hubbell/Unenco, or Lutron.

e. Wall Switch:
   1) Dual technology; passive infrared and ultrasonic.
   2) Full 180° operation.
   3) Minimum 40’ diameter small motion detection.
   4) Switching and dimming control.
   5) Sensorswitch nLight nWSX PDT LV series or acceptable equals by Hubbell/Unenco, or Lutron. Include raise/lower dimming control option (DX) where required.

H. Low Voltage Lighting Control Equipment:

1. Low Voltage Lighting Equipment Components shall all have the following features:
   a. Fully addressable and compatible with Sensorswitch nLight control CAT-5e.
   b. Complete with power supply and 2 RJ-45 ports.
   c. Shall be configured and labeled as specified here-in and as indicated on the drawings.
   d. 5 year product warranty.

2. Power/Relay Packs for Low Voltage Lighting Control [O&M] [S]:
   a. Select the proper Power/Relay from the selection below.
   b. Linear Power/Relay Packs with dimming:
      1) For lighting fixtures capable of 0-10V dimming control that are not nLight capable from the factory.
      2) Maximum load 16A.
      3) Sensorswitch nLight nPP16 D Series Power Packs or acceptable equals by Hubbell/Unenco, or Lutron.
   c. Secondary Relay Pack with phase control dimming:
      1) For lighting fixtures requiring low voltage dimming control that are not 0-10V compatible.
      2) For 2 wire ballast or 3 wire dimmable ballast.
      3) Dimming ranges: High (0-100%), Low (0-100%).
      4) Dimming offset: (-200% to 200%).
      5) Requires CAT-5e power.
      6) Sensorswitch nLight nSP5 PCD series lighting control relay or acceptable equals by Hubbell/Unenco, or Lutron.
   d. For Switching of LED Lighting Loads:
      1) Maximum Load 16A.
      2) Combination unit includes power supply for up to 80ma. of bus load.
      3) Sensorswitch nLight nPP16 series or acceptable equals by Hubbell/Unenco, or Lutron.
   e. For switching of line voltage non nLight lighting loads:
      1) Maximum Load 16A.
2) Sensorswitch nLight nSP16 series slave relay pack or acceptable equals by Hubbell/Unenco, or Lutron.

f. For switching of low voltage non nLight lighting loads:
1) Maximum Load 1A @ 40 VAC/VDC.
2) Sensorswitch nLight nAR 40 series auxiliary low voltage relay or acceptable equals by Hubbell/Unenco, or Lutron.

3. Power Supplies [O&M] [S]:
a. Power Supplies shall all have the following features:
   1) Power supplies shall operate on 120V and 277V power.
   2) Plenum Rated.
   3) Complete with elongated chase nipples for direct connection through a ½” knock-out to a standard junction box.

b. For Bus and System Power over CAT-5e (80ma): Sensorswitch nLight nPS 80 series or acceptable equals by Hubbell/Unenco, or Lutron.

c. For Power to nLight Bridges: Sensorswitch nLight PS 150 series or acceptable equals by Hubbell/Unenco, or Lutron.

d. For Power to nLight Gateway Control Units and Gateway Touch Screens: Sensorswitch nLight PS 250 series or acceptable equals by Hubbell/Unenco, or Lutron.

I. Lighting Contactors:
1. Lighting contactors shall be the mechanically held type, minimum 30A rated poles of number and amperage required, with factory wired controls:
   a. Square D: Class 8903
   b. ABB: A-Line
   c. ASCO: 918 Series
   d. Refer to detail on drawings.

J. Automatic Lighting Controls:
1. Photocells by Precision Multiple Controls:
   a. Standard 120 Volts: #P2275 (1800VA - 120V)
   b. Standard 277 Volts: #P68275 (1800VA - 208 to 277V)
   c. FAA Type 120 Volts: #102FAA (1800VA - 120V only)
   d. Refer to detail on drawings.

2. Timeclocks by Intermatic or acceptable equal as indicated below [O/M]:
   a. Intermatic ET2845C 365/7 day astronomic electronic control with independent 7 day and to the minute programming Astronomic programming, automatic daylight savings adjustment, 50 holiday blocks with schedules, manual operation. Non-volatile EEPROM memory. Includes four (4) independent output circuits. Controller shall operate from 120VAC-277VAC with auto voltage detection. 100 hour super capacitor eliminates battery dependency. Select proper enclosure for environmental condition encountered.

3. Occupancy Sensors, Line Voltage [O&M] [S]:
   a. Ceiling or Wall-mounted: Provide dual technology (infrared and ultrasonic) occupancy sensors, complete with 120 or 277volt power packs for lighting in indicated spaces. Sensors shall be ceiling or wall mounted as indicated as indicated on drawings. The local room switches shall be wired after the relay’s contact. Provide a satellite relay for additional circuits under the sensor’s control. Occupancy
sensor shall be Watt-Stopper type DT-300 for 360 degree operation or DT-200 for 180 degree operation, or acceptable equals by Hubbell/Unenco, Sensorswitch, or Lutron.

b. Corridor: Provide ultrasonic sensors, complete with 120 or 277 volt power packs for lighting in corridors and elsewhere as shown on the drawings. Sensors shall be listed for coverage up to a minimum 90 foot linear distance. Sensor shall be Watt-Stopper Type WT-2255 or acceptable equal by Hubbell/Unenco, Sensorswitch, or Lutron.

c. Wall Switch: Provide single pole (2 wire) dual technology infrared (motion) and ultrasonic occupancy sensing wall switch where shown on the drawings, 800 watts @ 120 volts, 1200 watts @ 277 volts, 170 degree field of view. Switch shall be Watt-Stopper #DW-100 for single switches, #DW-200 for bi-level control, #DW-103 or #DW-203 for three-way switching or acceptable equals by Hubbell/Unenco, Sensorswitch, or Lutron.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All wiring devices shall be mounted at elevations indicated.

B. Local switches shall be coordinated with the door swings to insure the proper location of the switch. Local switches shall be a minimum of 4" from door jamb trim. Refer to elevation for mounting outlet boxes at doors.

C. Install plates on all outlets and wiring devices, with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional device plates will not be permitted.

D. Where the wall opening for a wall or casework outlet box is larger than a standard plate cover, repair the outlet opening to accept a standard size plate. “Jumbo” or “Junior Jumbo” device plates are not acceptable.

E. Low Voltage Dimming and ON/OFF Control System: Provide all components and wiring necessary for a complete and functioning Low Voltage Dimming and ON/OFF control system as indicated. Furnish and Install all wallpods, occupancy sensors, lighting sensors, power supplies and dimming controls, cat 5e cable and miscellaneous appurtenances necessary for each complete and operating system. Drawing symbols indicate which lighting zones and spaces are to have low voltage (0-10V) Dimming and ON/OFF controls.

F. Daylighting Sensors and Controls: Daylighting sensors are shown in spaces with LED lighting fixtures. Daylighting sensors and controls shall sense and dim these lighting fixtures. Dimming shall begin with fixtures located closest to exterior fenestration, and work inward in the space a minimum of 15’ as appropriate for even total illumination of the space (A combination of daylighting and controlled lighting). In all cases daylighting control strategies must comply with the IECC, 2012 Paragraph C405.2.

G. Occupancy Sensing and Control: The low voltage lighting control system shall be programmed as follows:

1. When an occupant first enters a space with lighting enabled (fixtures off), the space shall illuminate to the 50% lighting power level. This requirement is based on ASHRAE 90.1, 2010 and applies to all spaces except those listed in Paragraph 9.4.1.a through d.

2. At all times, the occupant’s manual control of the space (via wallpods) will override automatic controls.

H. Vacancy Sensing and Control: In spaces containing occupancy sensors with a ‘vs’ designation, occupancy sensors shall be programmed as vacancy sensors (wallpod ‘on,’ occupancy sensor ‘off’).
I. All solid state line voltage dimmers shall have dedicated neutral wiring from the panelboard to the fixture. Light track systems that have a shared neutral shall be wired in accordance with the dimmer and light track systems manufacturers' drawings and instructions.

J. Photocells shall be installed with view window oriented to the North and away from direct or reflected artificial or natural light sources. Mount photocell(s) 1'-6" above roof on conduit fitting and connected to circuits indicated.

K. Lighting contactors shall be installed in a NEMA enclosure rated for the environment encountered.

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 WORK INCLUDED
   A. Contactors and Relays
   B. Special Voltages
   C. Automatic Door Operators
   D. Electric Door Strike
   E. Surge and Transient (ILCP) Protection

1.03 RELATED WORK
   A. Division 08 – Openings - Finish Hardware
   B. Division 12 – Furnishings
   C. Division 21 – Fire Protection
   D. Division 22 – Plumbing
   E. Division 23 – Mechanical
   F. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
   G. Section 26 05 23 – Control Voltage Electrical Power Cables
   H. Section 26 05 33 – Raceway And Boxes For Electrical Systems
   I. Section 26 05 36 – Cable Management For Electrical Systems
   J. Section 26 05 53 – Identification For Electrical Systems
   K. Section 26 09 23 – Lighting Control Devices
   L. Section 26 27 26 – Receptacles
   M. Section 26 28 16 – Enclosed Switches And Circuit Breakers
   N. Division 27 – Communications
   O. Division 28 – Electronic Security and Safety

1.04 SUBMITTALS
   A. Submit shop drawings and product data in accordance with Section 26 05 00.
      1. Shop Drawings for contactors, relays shall include:
         a. Scale drawing of enclosure and internal components.
         b. Internal wiring schematic.
         c. Roughing-in requirements.
      2. Product Data: Submit application, technical, and installation data.
   B. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00 for contactors,
      relays, buck/boost transformers.

PART 2 - PRODUCTS

2.01 PRODUCTS
   A. Contactors and Relays:
      1. Shall be provided as required for proper circuit control. Each contactor shall have a
         hand-off-automatic switch and L.E.D. indicator [S] [O/M].
2. Square D Class 8903, Type L lighting contactor in NEMA-1 enclosures. Select correct coil voltage, normally open and normally closed contacts, quantity of paired contacts. The installation shall include an **undervoltage relay** if required, to drop out contactor at 85% of normal voltage [S] [O/M].


C. Isolated Loop Circuit Protector (ILCP) [S]:
   1. The ILCP furnished is to have a line to line response time of less than one (1) nanosecond capable of accepting greater than 2000 amps (35 joules each line) to earth. Shield to earth current is to be 5000 amps maximum.
   2. The ILCP is to be protected by a high dielectric insulating material and of small enough size to mount in a standard 4” square 2-1/8” deep electrical box.
   3. Spark gap devices or devices incorporated in or installed within various systems’ control panels in lieu of the specified ILCP are not acceptable.
   4. All Isolated Loop Circuit Protectors must comply with UL #497B requirements.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

A. Contactors and Relays: Install all contactors and relays in accordance with NEC as required.

B. Special Voltages: Some outlets and equipment are connected to the 277/480 volt system, 120/208 volt system and some low voltage systems. The Electrical shall be responsible for coordinating all related equipment and wiring to insure that they are related for the voltage encountered. Low voltage wiring shall not be installed in the same conduits or boxes with the building service voltage wiring unless permitted by NEC.

C. Automatic Door Operators:
   1. Automatic door operators will be furnished in-place under Division 8. Under Division 26, power and control wiring shall be made to the door operator. The door operator push-button shall be installed and connected under Division 26, and furnished under Division 8. Provide proper control and power as recommended by door operator manufacturer.
   2. If required, Division 26 shall provide 120V AC circuitry, protected transformer and/or power supply above the ceiling to coordinate proper voltage with the door operator or provide the necessary power. Include any necessary control relays.
   3. Door release shall be connected to the fire alarms 24 VDC door release circuit if door is part of the path of egress and manual unlatching (such as a panic bar) is not provided. Provide proper wiring and conduit as recommended by fire alarm system and door operator manufacturers. Refer to Section 28 31 00.

D. Electric Door Strike and Door Hardware:
   1. All electric door strike mechanisms shall be furnished in-place by Division 8 on indicated doors. System shall be battery powered from the Kaba wireless lock system. The system shall be programmed, controlled and monitored by the Kaba wireless network system and server/computer.
   2. Coordinate operation of the electric strike with all controls including Section 28 10 10 Electronic Access Control system. Division 26 shall provide all necessary controls, wiring, conduit, relays, connections not specifically specified as being provided under other Divisions.

E. Electrical connections are required for the following items in Division 21 & 22:
   1. Sprinkler Flow, Pressure and Tamper Switches, Post Indicator Valve Switch(es)
   2. Sprinkler Dry Pipe Air Compressors
F. Surge and Transient (ILCP) Protection: All power and control equipment, between the building and site facility shall have surge and/or transient protection devices to comply with UL and NEC requirements. The protection shall be on both sides.

1. Provide ILCP devices for the Fire Alarm System and other systems as required.
2. Provide ILCP devices in accordance with NEC Article 800.

END OF SECTION
SECTION 26 2416
PANELBOARDS

PART 1 - GENERAL

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

1.02 WORK INCLUDED
   A. Branch Circuit and Distribution Panelboards
   B. Main Panelboard

1.03 RELATED WORK
   A. Section 26 05 53 – Identification for Electrical Systems
   B. Section 26 28 16 – Enclosed Switches and Circuit Breakers

1.04 QUALITY ASSURANCE
   A. Integrated Circuit Breaker Panelboard Rating: Each panelboard, as a complete unit, shall have
      a rating equal to or greater than the integrated equipment rating shown on the panelboard
      schedule on the plans. Such rating shall be established by test with the circuit breakers mounted
      on the panelboard. The short-circuit tests on the circuit breaker and on the panelboard structure
      shall be made simultaneously by connecting the fault to each panelboard breaker with the
      panelboard connected to its rated voltage source. Method of testing shall be per proposed UL
      standards pertaining to listing of molded case circuit breakers for high-interrupting capacity
      ratings. The source shall be capable of supplying the specified panelboard short-circuit current
      or greater. Test data showing the completion of such tests upon the entire range of distribution
      and power panelboards to be furnished shall be submitted to the Engineer, if requested by him,
      with or before the submittal of approval drawings. Testing of panelboard circuit breakers for
      short-circuit rating only with the breaker individually mounted is not acceptable. Also, testing of
      the bus structure by applying a fixed fault to the bus structure alone is not acceptable.

1.05 REFERENCES
   A. All enclosed circuit breakers and panelboards shall meet and comply with applicable sections of
      UL, NEC and NEMA.

1.06 SUBMITTALS
   A. Submit shop drawings in accordance with Section 26 05 00.
      1. Shop drawings for each panelboard shall include:
         a. Dimensioned layout.
         b. EXACT Arrangement of circuit breakers or fusible switches as indicated in the
            schedules. (Automatic "Rejection" of shop drawings if not followed.)
         c. Bus ampacity, interrupting capacity and composition.
         d. Main lug capacity and location.
         e. Future provision.

   B. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
   A. All panelboards shall be as manufactured by Square D or acceptable equal by Cutler-Hammer,
      G.E., or Siemens.
   B. All replacement circuit breakers as indicated.
2.02 MATERIALS AND TYPE

A. General:
   1. Panels shall be dead front automatic circuit breaker as indicated and designed for type of service encountered.

B. Panelboards [S] [O/M]:
   1. Breakers: Square D frame sizes are called for on the drawings to designate type of breaker to be installed. All breakers shall have a minimum interrupting capability of 18,000 amperes rms symmetrical or higher for 480 volt panels and 10,000 amperes rms symmetrical or higher for 120 volt panels as noted on drawings, and shall be U.L. listed. The breaker's line terminal connection shall bolt directly to the panelboard's bus connecting strap or shall be a bus bar clamp type connection with bolt on device. Multi-pole breakers shall be in one molded case, common trip, with one operating handle. Where space only is indicated, provide mounting straps for future breaker.
   2. Cabinets and Trim: Cabinets shall be of all code gauge galvanized steel, 6" minimum outside depth, with studs for mounting interiors. Minimum of 4" side gutters; top and bottom gutters as required; special gutter sizes as indicated on the drawings. Raceway openings to be 2" clear from front of cabinet. Steel front shall be grey lacquered Code gauge (#12 gauge) minimum for 225 amp bus panelboards and smaller amperage types, and (#10 gauge minimum) for 250 amp bus panelboards and higher amperage types, complete with metal framed index card holder, door with flush latch, concealed hinges, lock (two keys for each panel with all panels keyed alike) concealed adjustable trim clamps or screws and hinged trim.
   3. Interior:
      a. All bus structure shall be copper with silver, cadmium or tin plating and insulated. Provide individual full solid plated copper neutral bus and solid plated copper ground bus. The bus structure and main lugs, including any feed-through lugs, sub-feed (double) lugs and main circuit breaker where required, shall have the current ratings as indicated.
      b. Panelboards that are indicated to be “Non-Linear” shall have 200% plated copper neutrals.
      c. Provide mechanical screw type U.L. Listed lugs to accept solid and/or stranded copper and aluminum conductors for 90° C rated wire to accommodate the conductors indicated including derated conductors and oversized neutrals, as required.
   4. Miscellaneous: Panelboards; that are indicated to be service equipment shall be rated and labeled for “Suitable for Service Entrance” by U. L.

C. Distribution Panels [S] [O&M]: Square D “I-Line”, or accepted equal, with circuit breakers arranged as shown on the drawings. All bus to be braced to withstand rms symmetrical amperes of short circuit stresses as noted on the drawings. Refer to paragraphs above for panelboard construction.

D. Molded Case Circuit Breakers (MCCB) [S] [O/M] shall be as specified in section 26 28 16.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Set all cabinets of all branch circuit and distribution panelboards, with top 6'-0" above finished floor, unless noted otherwise, or unless panel is taller than 4'-6".

B. Index cards to be properly labeled with typewritten letters indicating loads controlled by each circuit complete with room designation matching the Owner's final labeling.

C. Engraved laminated plates on breakers of main panels shall be filled in with the load designation.

D. Interior trims of all panels shall be pulled up flush with front covers.
E. Coordinate voltage of shunt trips with connected systems.
F. Branch circuit breakers serving the following items shall have lock-on devices.
   1. Exit signs
   2. Walk-through and/or exit (egress) lighting
   3. Fire alarm system(s)
   4. Security systems(s)
   5. Disconnect switches and receptacles
   6. HVAC controls
   7. Control circuits for shunt trips and "panic" switches.
G. Panelboards shall not be activated ("hot") without all protective covers and enclosures installed.

3.02 FIELD QUALITY CONTROL

A. Technical Assistance: The panelboard manufacturer’s representative shall generally provide installation supervision of this equipment if requested by the contractor.

B. Calibration and Testing: The panelboard manufacturer’s representative shall provide a factory trained technician for initial calibration of circuit breaker trip and time delay settings to indicated values including ground fault protection system performance testing (NEC 230.95). All calibration and testing shall be in accordance with the manufacturer’s written instructions, NETA and all applicable codes and industry standards. Written records of the calibration and test procedures shall be submitted to the Owner, Architect/Engineer and Local Authority Having Jurisdiction (if required). These test procedures shall also include an insulation test, torquing of all connections, electrical interlocking verification, etc. The Architect/Engineer and/or Owner’s representative shall have the option of witnessing the testing procedures. The contractor shall coordinate the testing with all parties concerned.

END OF SECTION
SECTION 26 2726
RECEPTACLES

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 WORK INCLUDED
   A. Receptacles
   B. Tamper Proof Receptacles
   C. Weather Resistant Receptacles
   D. Plates

1.03 RELATED WORK
   A. Section 26 05 33 – Raceway And Boxes For Electrical Systems
   B. Section 26 50 00 – Lighting

1.04 REQUIREMENTS
   A. NEC 406 (Receptacles)

1.05 SUBMITTALS
   A. Submit shop drawings, product data and wiring device samples in accordance with Sections 26
      05 00.
   B. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00.

PART 2 - PRODUCTS
2.01 MANUFACTURERS
   A. All Receptacles [S] shall be as manufactured by:
      1. Cooper Industries
      2. Hubbell
      3. Leviton
      4. Pass and Seymour (P&S)
      All receptacles shall be by the same manufacturer.
   B. Wiring Device Plates [S] and Blank Plates [S] shall be as manufactured by:
      1. Hubbell,
      2. Cooper Industries,
      3. Leviton
      4. Pass & Seymour (P&S)
      All plates shall be by the same manufacturer. "Wet Location" (WL) (LP) plate and covers by:
      1. Hubbell-Bell
      2. Hubbell-TayMac
      3. Legrand

2.02 MATERIALS AND TYPE
   A. All receptacles and other wiring devices shall be as indicated on drawings and specified
      hereinafter.
      1. Unless otherwise indicated on the drawings all standard duplex receptacles shall be:
b. Hubbell heavy duty specification grade “HBL 5362” series,
c. Cooper Industrial Specification grade “5362” series,
d. Pass & Seymour heavy duty specification grade “5362” series.
The receptacles shall be complete with one-piece plated grounding system, self-grounding, back side wired, and high impact polycarbonate, Lexan™, or nylon faces. Receptacle shall be rated for the voltage, poles, amperage and NEMA configuration required. Provide the proper nylon or polycarbonate bodied plug where indicated for equipment connection.

2. Selected NEMA 5-20 receptacles shall be corrosion resistant type as manufactured by:
   a. Cooper Industries “CR” series or
   b. Hubbell “CM and M” series unless otherwise indicated on the drawings.

3. Selected NEMA 5-20 receptacles shall be ground-fault circuit-interrupter type as indicated. Ground fault circuit interrupting receptacles, unless otherwise indicated on the drawings, shall be equal to the same receptacles series specified in paragraph A.2. Provide corrosion resistant type where indicated.

4. Selected NEMA 5-20 receptacles shall be “Hospital Grade” as indicated, and shall be the same receptacle series specified in paragraph A.2.

5. All other NEMA configurations (amperage and type) shall be equal to the same receptacle series specified in paragraph A.2. Provide matching nylon or polycarbonate bodies plug to match receptacle for all connected equipment where the equipment is not furnished with plug.

B. All Tamper Resistant Receptacles shall be as indicated on the drawings and specified hereinafter.

1. Unless otherwise indicated on the drawings all tamper resistant receptacles shall be:
   a. Cooper Industries TR8300 series.
   b. Hubbell 8300 series.
   c. Leviton 8300-SGT series
   d. P&S TR63H series.
The tamper resistant receptacles shall be complete with a one-piece grounding system, self-grounding, back side wired, and high impact polycarbonate, Lexan™, nylon or thermoplastic faces. Tamper resistant receptacles shall be hospital grade, tamper resistant with dual mechanical shutters and shall be rated for the voltage, poles, amperage and NEMA configuration required.

C. All Weather Resistant Receptacles shall be as indicated on the drawings and specified hereinafter.

1. Unless otherwise indicated on the drawings all weather resistant receptacles shall be:
   a. Cooper Industrial Specification grade “5362” series,
   b. Hubbell heavy duty specification grade “HBL 5362 WR” series,
   c. Leviton Hospital Grade “WT599-HG” series,
   d. Pass & Seymour heavy duty specification grade “WR5362” series.
The weather resistant receptacles shall be complete with a one-piece grounding system, self-grounding, back side wired, and high impact polycarbonate, Lexan™, nylon or thermoplastic faces. Receptacle shall be rated for the voltage, poles, amperage and NEMA configuration required. Provide the proper nylon or polycarbonate bodied plug where indicated for equipment connection.

D. Plates: For all systems unless indicated otherwise.

1. For Concealed Work: Stamped stainless steel type 302 with satin finish.
2. For Wet Locations, While in Use (WL) and Low Profile (LP): Weatherproof “Extra Duty” NEMA-3R enclosure constructed of die-cast aluminum complete with sealing gaskets and stainless steel mounting screws; and meets OSHA and NEC requirements "WHILE IN USE". Housing size shall depend on the wiring device being protected. Housing for receptacles shall allow both angled and straight cord connectors, and shall incorporate a "cord catch" or "cord flap" gaskets.
   a. Hubbell-Bell "RaynGuard" 5800 series
   b. Hubbell-Taymac "CodeGuard" 5800 series.
   c. Legrand WIUCAST1 series.
3. For F.S. or F.D. Boxes (Interior Only): Die cast covers with gaskets, as manufactured by Crouse-Hinds, Appleton, Red Dot or acceptable equal.
4. Screws: Heads to match plate material and finish.
5. Provide blank plates for all unused outlets.

F. Wiring Device and Plate Colors: Architect will review and accept color of wiring devices. Contractor shall allow for selection from "standard" colors (grey, white, ivory, brown) of wiring devices in his bid proposal.

PART 3 - EXECUTION

3.01 INSTALLATION
A. All wiring devices shall be mounted at elevations indicated.
B. All duplex receptacles shall be mounted vertical with ground slots towards floor, unless otherwise indicated by the Owner or Authority having jurisdiction.
C. Install plates on all outlets and wiring devices, with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional device plates will not be permitted.
D. Where the wall opening for a wall or casework outlet box is larger than a standard plate cover, repair the outlet opening to accept a standard size plate. “Jumbo” or “Junior Jumbo” device plates are not acceptable.
E. Furnish Arc-Fault, Tamper Resistant and Weather Resistant receptacles in all NEC required locations even if not specifically indicated on the drawings.
F. Provide ground-fault interrupter type (GFCI or GFI) NEMA 5-20 receptacles where NEMA 5-20 receptacles are indicated in or at the following locations unless ground fault interrupter branch circuit breakers are indicated:
   1. Bathrooms, showers, toilets, elevator pit(s), elevator machine room.
   2. Within 6'-0" radius of all lavatories and sinks, and at all elevations.
   3. Receptacles that power refrigeration compressors, evaporators, etc., shall not be GFI protected due to inherent ground fault currents which will cause nuisance tripping, unless the receptacle device is located in a kitchen in which case it must be GFCI.
   4. All other current Virginia USBC, NEC and OSHA GFCI required locations.
G. Low Profile (LP) Locations: Wiring device outlet boxes within 12" of the finished grade and located in laundry rooms, shower rooms, boiler rooms, HVAC equipment rooms, lavatories, and similar areas subject to wash-down, spray, or rinsing procedures shall be required to have wet location wiring device enclosures (WL) for "while-in-use" service. The NEC shall govern the requirement of a GFCI receptacle or similar device.
H. All exterior wiring device outlet boxes shall utilize weather resistant ground fault interrupter receptacles and wet location (WL) "While in Use" enclosures.
I. Each rooftop and grade mounted exterior Division 23 (HVAC) equipment shall be provided with a NEMA 5-20 weather resistant ground fault interrupter work receptacle in a FS/FD box and
gasketed “While in Use” (WL) weatherproof enclosure in compliance with the NEC. Connect on nearest available circuit unless a circuit is indicated.

J. Division 26 shall furnish the polycarbonate or nylon angular plugs for the indicated equipment as required. Division 26 shall install the plugs on the equipment including proper specified flexible cable (cord).

END OF SECTION
SECTION 26 2813
FUSES

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 WORK INCLUDED
   A. Fuses [S]

1.03 RELATED WORK
   A. Section 26 28 16 – Enclosed Switches And Circuit Breakers
   B. Section 26 29 00 – Low-Voltage Controllers

1.04 SUBMITTALS
   A. Submit product data in accordance with Section 26 05 00.
      1. Product Data: Submit application, technical, and installation data.

PART 2 - PRODUCTS [O/M]

2.01 MANUFACTURERS
   A. All Fuses shall be as manufactured by Cooper Industries, GEC Alsthon, Littlefuse, Gould-Shawmut (Nippon Mining). [S] [O/M]
   B. Fuse Cabinet shall be as manufactured by the above fuse manufacturer, Hoffman, Austin or acceptable equal. [S]

2.02 MATERIALS AND TYPE
   A. Motor and Panelboard Fuses: Rejection type C class RK-1, dual element, time-delay, current limiting, cartridge type, by 300™ Low-Peak Yellow™ by Bussman, Lolp© by CEFCo, Power-Pro® by Littlefuse, "AMP-TRAP 2000" by Gould-Shawmut (Nippon Mining), with a minimum interrupting rating of 200,000 amperes rms symmetrical.
   B. For applications 601 amps and higher, utilize time-delay, current limiting, silver linked UL class "L" fuses by 300™ Low-Peak™ Bussman, Short Check® by CEFCo, Power-Pro© by Littlefuse, A4BQ "AMP-TRAP 2000" by Gould-Shawmut (Nippon Mining) with a minimum interrupting rating of 200,000 amperes rms symmetrical.
   C. Cabinet: Wall mounted enclosure complete with shelves for storage of spare fuses and instruction manual. Door shall be lockable with same key as panelboards.

PART 3 - EXECUTION

3.01 INSTALLATION
   A. Fuses for motor circuits shall be sized in accordance with the fuse manufacturer's sizing chart for "motor running overload protection", unless otherwise required for a specific motor. All other fuses for other than motor circuits shall be of size and type as required by the connected equipment manufacturer's written instructions unless otherwise indicated. Labels indicating size and type of replacement fuses shall be glued to inside of door on all fusible switches, fusible motor starters and panels.

3.02 SPARE FUSES
   A. 600 Amp Fuses and Smaller: Furnish spare fuses not to exceed 10% of each rating with a minimum of three (3) per rating.
   B. 601 Amp Fuses and Larger: Furnish three (3) spare fuses of each rating.
   C. Contractor shall deliver the spare fuses with invoice to the Owner's Maintenance Operations Center.

END OF SECTION
PART 1 - GENERAL

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

1.02 WORK INCLUDED
   A. Disconnect Switches
   B. Circuit Breakers

1.03 RELATED WORK
   A. Section 26 05 53 – Identification For Electrical Systems
   B. Section 26 20 00 – Low-Voltage Electrical Distribution
   C. Section 26 24 16 - Panelboards
   D. Section 26 28 13 – Fuses
   E. Section 26 29 00 – Low-Voltage Controllers

1.04 REFERENCES
   A. All disconnect switches and circuit breakers shall meet and comply with applicable sections of U.L., N.E.C. and NEMA.

1.05 SUBMITTALS
   A. Submit shop drawings and product data in accordance with Section 26 05 00.
      1. Shop Drawings for Disconnect Switches shall include:
         a. Scale drawing of enclosure and internal components.
         b. Roughing-in requirements.
      2. Circuit Breaker shop drawings shall include:
         a. Frame type and ampere rating.
         b. Trip amperage.
         c. Interrupting rating in RMS symmetrical amps.
         d. Accessories.
      3. Product Data: Submit application, technical, and installation data.
   B. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00.

PART 2 - PRODUCTS [O/M]

2.01 MANUFACTURERS
   A. All disconnect switches shall be Square D (Group Schneider) Class 3110 Heavy Duty Visible-Blades® safety switches, General Electric Spec-Setter® Heavy Duty Type TH (to 600A), and Type TC (800A & 1200) safety switches [S][O/M], Cutler-Hammer/Eaton Heavy Duty Type DH series safety switches, and Siemens Vacu-Break VBII™ Heavy Duty safety switches.
   B. All circuit breakers shall be as manufactured by Square D or acceptable equal by Cutler-Hammer/Eaton, General Electric (GE) or Siemens.

2.02 MATERIALS AND TYPE
   A. Disconnect Switches [S] [O/M]: Rated for voltage encountered, poles and amperage as required. Heavy Duty, NEMA enclosures, fusible for rejection type class R fuses only, solid neutral assembly, equipment grounding kit, unless otherwise indicated. Refer to NEMA type under PART 3 - EXECUTION.
   B. Molded Case Circuit Breakers (MCCB) [S] [O/M]:
1. Ratings and special features shall be as scheduled.
2. Trips shall be thermal magnetic with inverse time delay and instantaneous time-current characteristics.
3. 225 ampere frame and larger MCCB shall have permanent non-interchangeable trips, factory-calibrated at 40 degrees C, and adjustable magnetic feature set by a single adjustment. Interchangeable trips will be considered as an alternative.
4. Industrial grade MCCB shall be provided except that commercial grade MCCB (quick-lag "Q-Line") may be used for MCCB 100 amperes and below where other indicated criteria are met.
5. Ambient compensating MCCB shall be provided for outdoor applications or where indicated on drawings.
6. MCCB shall not be used for switching lights unless they are specifically rated for switching duty.
7. U.L. listed HACR type circuit breakers shall be provided for use with air conditioning, heating and refrigeration equipment having motor group combinations and marked for use with HACR type circuit breakers.
8. Electronic Trip Circuit Breakers: Square D "Micrologic" trip system or accepted equal to include the following features (unless otherwise indicated in schedules):
   a. 100% Rated
   b. True RMS Sensing
   c. Interchangeable Trip Units
   d. LI, LIG, LS(I)G (Instantaneous OFF) Configurations (as scheduled)
   e. Short-time Delay = 1/t IN & 1/t OUT
   f. Ground-fault Delay = 1/t IN & 1/t OUT
   g. Short-time Withstand Rating
   h. Integral Ground-fault Testing
   i. LED Long-time Pickup Indication
   j. Zone Selective Interlocking (Short-time & Ground-fault) with main protective device and downstream protective devices
   k. Thermal & Magnetic Backup Protection
   l. Long-time & Ground-Fault Memory
   m. Local Trip Indicators - Overload, Short-circuit, Ground-fault
   n. Local Ammeter/Trip Indicator
   o. Trip unit seal kit
   p. Externally accessible test port
   q. High level selective over-ride
   r. Neutral Current Transformer
   s. One (1) universal test set, for the entire project, to be used for required test procedures prior to project completion.
9. Circuit breakers shall have removable lugs. Lugs shall be UL listed for copper and aluminum conductors. Breakers shall be UL listed for installation of mechanical screw-type lugs and compression type lugs.
10. Current limiting circuit breakers shall meet UL 489 requirements, NEMA Standard AB3-2013 and Federal Specifications W-C-375B/GEN.
11. Combinations for series connected interrupting ratings shall be recognized by Underwriters Laboratories and shall appear in the Recognized Component Directory under the "Circuit
Breakers - Series Connected" product category DKSY2. Current limiting circuit breakers shall allow the use of branch circuit breakers with lower interrupting capacities on systems capable of delivering fault currents up to 200,000 rms symmetrical amperes at 480V ac and 100,000 rms symmetrical amperes at 600V ac.

12. Add-on ground fault modules (GFM) shall be a U.L. Listed circuit breaker accessory complete with adjustable time and levels, ground fault sensing device and relay, push-to-test button, indicator, neutral transformer, zone-interlock restraint interface module, and 120 volt control power for integral test. Provide a factory installed ground-fault shunt trip in related circuit breaker.

C. Fuses: Provide specified fuses, sizes as required.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide disconnect switches for all motors and appliances for the project where required by the National Electrical Code; and rated for the voltage encountered complete with required poles, amperage rating and all accessories. Not all disconnect switches required by NFPA-70 are necessarily indicated on the drawings.

B. All roof mounted fans shall have a disconnect switch (device) mounted under the hood by the Mechanical Trade. This switch (device) shall be wired in series with the firestats on the fans.

C. Provide rain-tight NEMA-3R, NEMA-4, NEMA-4X, explosion-proof or other NEMA enclosures for switches where required by NEC and environmental conditions.

D. Certain fusible disconnect switches shall be fully U.L. Service Equipment rated and labeled as indicated by the electrical distribution system.

E. Coordinate voltage of shunt trips with connected systems.

3.02 FIELD QUALITY CONTROL

A. Technical Assistance: The electrical gear manufacturer’s representative shall generally provide installation supervision of this equipment if requested by the contractor.

B. Calibration and Testing: The electrical gear manufacturer’s representative shall provide a factory trained technician for initial calibration of circuit breaker trip and time delay settings to indicated values. All calibration and testing shall be in accordance with the manufacturer’s written instructions, and all applicable codes and industry standards. Written records of the calibration and test procedures shall be submitted to the Owner, Engineer and Authority Having Jurisdiction (if required). These test procedures shall also include an insulation test, torquing of all connections, electrical interlocking verification, etc. The Engineer and/or Owner’s representative shall have the option of witnessing the testing procedures. The contractor shall coordinate the testing with all parties concerned.

END OF SECTION
SECTION 26 2900
LOW-VOLTAGE CONTROLLERS

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 WORK INCLUDED
A. Motor Protective Switches
B. Magnetic Starters, including across-the-line starters and reduced-voltage starters.
C. Variable Frequency Drives (VFD’s), Installation of Division 23 VFD’s
D. Control Accessories

1.03 RELATED WORK
A. General: The Contractor shall consult all other sections of these Contract Documents specifications containing any type of equipment requiring electrical connections and allow for wiring and controlling all equipment as described therein even though not shown on the electrical drawings. See mechanical drawings for exact locations and names of Mechanical Equipment and Controls. (Division 23)
B. Division 23 - Mechanical
C. Section 26 28 13 - Fuses

1.04 SUBMITTALS
A. Submit shop drawings and product data in accordance with Section 26 05 00.
   1. Shop Drawings shall include:
      a. Scale drawing enclosure and internal components.
      b. Internal wiring schematic.
      c. Roughing-in requirements.
   2. Product Data: Submit application, technical, and installation data.
B. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. All motor starters shall be as manufactured by Square D, Furnas, Cutler-Hammer/Eaton, G.E., Siemens, or Allen Bradley. All controllers and accessories to be by the same manufacturer.
B. Phase Protection Relays shall be by Diversified Electronics, Inc. (Available from Wesco, Johnson Control and others) or acceptable equal.
C. Interposing (Interface) Relays: Square-D or Potter-Brumfield.

2.02 MATERIALS AND TYPE
A. Motor Protective Switches [S] [O/M]: Marked ‘MP’ on drawings. Manual type with overload relay for each phase, with poles as required and separately wired neon or L.E.D. pilot light. M.P. switch and pilot shall be mounted on one (1) multi-gang plate.
   1. Magnetic Starters [S] [O/M]: Where M.S. is marked on the drawings, provide an across-the-line combination starter complete with the following:
   2. Disconnect Switch: Fusible disconnect switch for rejection type Class RK-1 fuses only, unless non-fusible is indicated.
   3. Overload Relays [S] [O/M]:

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a. NEMA Size 00 to 4 Contactor: Factory calibrated, directly heated, **NEMA-10**, block design, three (3) pole, bi-metallic overload relay, and ambient temperature compensation.

b. Current sensing solid state overload relays are not acceptable due to the non-automatic reset for unbalanced phase currents.

4. Indicating Lights: L.E.D. indicating lights for "power available" (green) and "run" (red). **Incandescent indicating light modules are not acceptable**, except with LED conversion lamps.

5. Control Voltage: Control circuits and holding coils shall be 120 volts. Provide individual transformers of required size where higher voltages are encountered. Protect control circuit in accordance with N.E.C.

6. **Reduced-Voltage (Part Winding) Combination Starters [S] [O/M]**: Unless indicated otherwise, all 480 volt, 3 phase, 20 horsepower and larger motors; or all 208 volt, 3 phase, 10 horsepower and larger motors shall be provided with part-winding combination motor starters complete with all specified accessories including oversized enclosures. Other types of reduced-voltage combination motor starters shall be as indicated. Coordinate all motor starters with Division 23 motors to insure motors are setup to work with reduced-voltage starters.

B. **Heaters [S] [O/M]**: Install thermal overload heater elements in all switches and starters on the job whether or not the switches and starters are furnished by this subcontractor. Assume responsibility for proper application of motor running protection for all motors in accordance with the manufacturer's recommendations and the nameplate rating of the motors actually installed. All phases to have overload protection. (Not required on solid state overload relay.)

C. **Control Stations [S]**: Standard duty with maintained contact, start-stop buttons and red neon or L.E.D. indicating light, unless otherwise indicated. All start-stop buttons, hand-off-automatic switches, pilots, etc., mounted in covers of motor starters as required, unless noted otherwise.

D. **Enclosures [S]**: All motor starters and VFD's shall have **NEMA-1 oversized** enclosures except motor starters in damp, wet or exterior (outdoors) locations shall have NEMA-3R oversized enclosures. Motor starters in kitchens and food preparation areas shall have NEMA-4X oversized enclosures.

E. **Phase Protection Relay (PLP) [S] [O/M]**: Provide Diversified Electronics, Inc., or accepted equal phase sequence and unbalance monitor, SLD Series, to monitor phase unbalance, under-voltage, phase sequence and regeneration. Monitor shall have adjustable phase unbalance, under-voltage and time delay (to break).

F. **Interposing (Interface) Relays [S]**: Square D #8501 RS 14 V20 (120 volt) relay(s) with #8501 NR45 socket, 5 amp contacts, control coil burden is 3.5 VA in rush and 1.2 VA sealed mounted in the oversized motor starter enclosure (bucket).

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

A. Motors: All motors and motor-driven equipment will be provided in place by another Trade, ready for connection by the Electrical Trade with control equipment provided by the Trade who provides the equipment unless specifically indicated otherwise. Motor branch circuits, etc., are designed for motor sizes as shown on the drawings. The motors and motor-driven equipment actually installed may vary from these sizes. The Electrical Trade shall verify actual sizes and notify the Engineer of any required changes.

B. Provide all required motor starters and motor protective switches, rated for the voltage encountered, complete with required poles, amperage rating and all accessories, unless indicated otherwise. Required motor starters may not be indicated on the electrical drawings. Refer to mechanical (and other divisions) equipment drawings and specifications for additional starter requirements, and provide starters as required. Provide all H.O.A. switches, L.E.D. pilots, auxiliary contacts, etc. in starters and M.P. Switches as required by Electric Sequence Control Diagrams. Provide all other control devices as called for by drawings and specifications. Provide
"power available" and "run" L.E.D. indicating lights for all motor starters. The "power available" L.E.D. indicating lights are not necessarily indicated in the Electric Sequence Control Diagrams.

C. Variable Frequency Drives (VFD's) (Furnished by Division 23):
   1. The qualified manufacturer's technical representative shall supervise the contractor's installation, testing, and start-up of all the drives furnished under Division 23. A maximum total of one (1) supervision day (8 hours) shall be provided by the manufacturer's representative.
   2. Division 26 shall provide assistance to Division 23 for system start-up. The VFD system start-up shall include a checkout of vibration at various frequencies through field observation and manufacturer's data on the driven equipment. Frequency deadbands shall be set-up for each point of equipment vibration.

D. Responsibility: The Mechanical Trade is responsible for the proper operation of the mechanical systems. The Electrical Trade is responsible for all electrical work in connection therewith.

E. Provide a motor protective switch in the cabinet of wall mounted unit heaters or fan coil units; and on one side of ceiling mounted units unless indicated otherwise. Position the switch to prevent the radiation from affecting the overload protection.

F. Motor Operated Dampers (MOD's): Division 26 shall interconnect all line voltage MOD's with Division 23 air-handling units and fans with proper voltage and ampacity wiring for sequence of operation as required by the Mechanical Drawings. Provide a 120 volt – 20 amp circuit from the next available spare breaker in the closest mechanical or receptacle circuit panel where a circuit is not specifically indicated on the drawings. MOD's may be connected as part of the motor control circuit, verify with the Division 23 Electric Sequence Control Diagrams.

G. Phase Loss Protection Relays shall be provided for the following three (3) phase equipment:
   1. All three (3) phase equipment as indicated to have "PLP" contacts on the Division 23 Electric Sequence Control Drawings. Select the monitor (relay) for the line voltage encountered.
   2. All three (3) phase (walk-in) refrigerators and (walk-in) freezers as instructed by Kitchen Equipment Installing Trade.
   3. All three (3) phase motors 10hp and larger.
   4. All Division 23 Variable Speed Drives.

   Phase loss protection relays shall be installed in the Division 26 motor starter oversized enclosures.

H. All motor starters shall be provided with sound isolation mounting when mounted adjacent to an occupied space such as corridor, office, classroom, auditorium, gym or similar space.

I. Install all motor protective switches adjacent to the panelboard serving the switch unless indicated otherwise on the drawing or Division 23 Electric Sequence Controls. Each switch shall be installed in an individual outlet box, arranged in vertical or horizontal rows. Provide recessed outlet boxes if the adjacent panel is recessed. Provide cast type single gang boxes if the adjacent panel is surface mounted.

J. Certain multi-speed fractional horsepower motors are indicated on the Division 23 Electric Sequence Drawings to have built-in overload protection in the motor in lieu of motor protective switches.

K. Provide interposing (interface) relays for the Division 23 microprocessor based building control system module relay output (and Section 28 31 00 Fire Detection and Alarm) if the system's output relay contact is overburdened.

L. All wiring within the motor starter (control) enclosure and to the motor shall be Type MTW stranded copper per Section 26 05 19 and Section 26 05 23.

M. Division 26 will furnish power factor correction capacitors with their motors over five (5) horsepower unless otherwise indicated. Division 26 shall install and connect these capacitors to cycle with the motors. The capacitors shall be connected on the motor side of the overcurrent
protective device at the motor starter. The overcurrent device shall be adjusted to reflect the reduced line current. Size capacitor conductors per NEC Article 460.

END OF SECTION
SECTION 26 50 00
LIGHTING

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 WORK INCLUDED
   A. Lighting Fixtures
   B. LEDs

1.03 RELATED WORK
   A. Division 9 – Finishes
   B. Section 26 05 00 – Common Work Results For Electrical
   C. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
   D. Section 26 05 23 – Control Voltage Electrical Power Cables
   E. Section 26 05 26 – Grounding And Bonding For Electrical Systems
   F. Section 26 05 33 – Raceway And Boxes For Electrical Systems

1.04 REFERENCES
   A. The complete fixture and installation method including the lamps, fixture construction, ballast, sockets, wiring, raceway, suspension system, fixture environment shall be in accordance with:
      2. N.E.C.
      3. Fixture and application use listed by U.L. Inc.
      5. All above references shall be current issue in effect at time of bid.

1.05 SUBMITTALS
   A. Submit shop drawings and product data in accordance with Section 26 05 00.
      1. Shop Drawings shall include:
         a. Photometrics.
         b. Dimensions.
         c. Roughing-in requirements.
         d. Point by point footcandle study for exterior post lighting.
   B. Submit Operation and Maintenance Manuals in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
   A. Lighting Fixtures: Lighting fixture manufacturer's names and catalog numbers are noted on drawings and are used to designate the type, general design, size, quality, etc., of fixtures desired [S][O/M][V].
   B. LEDs [S]:
      1. LED: Lamps, with electronic drivers, as scheduled on the drawings.

2.02 MATERIALS AND TYPE
   A. The LED luminaires supplied shall have the proper trim, frames, mounting devices, configuration, and accessories necessary to be properly installed in the building construction.
Catalog numbers of luminaires in the “Luminaire Schedule” or “Lighting Fixture Schedule” on the Drawings are to establish a type of luminaire and not to determine a method of mounting.

1. Catalog numbers scheduled on the Drawings may indicate luminaire compatibility with certain types of ceiling construction. The Contractor shall determine exact type of ceilings actually to be furnished in each area and shall obtain luminaires to suit, deviating from specified catalog numbers or descriptions only where necessary, and only to the extent necessary to insure luminaire-ceiling compatibility. The Contractor shall notify the Architect/Engineer and Owner in writing where such changes are to be made.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Recessed Fixtures: Comply with NEMA LE 4.

D. CRI of minimum 80. Minimum CCT of 4000 K.

E. Rated lamp life of 50,000 hours.

F. Lamps dimmable from 100 percent to 0 percent of maximum light output where stipulated on drawings.

G. Internal driver.

H. Nominal Operating Voltage: 277 V AC.

I. Housings
   1. Extruded-aluminum housing and heat sink.
   2. Powder-coat painted finish to match luminaire.

J. Listed and labeled as complying with UL 8750.

K. Double lock nuts shall be used at the load bearing ends of threaded pipe used as part of a stem mounting assembly.

L. Metal Parts: Free of burrs and sharp corners and edges.

M. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

N. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

O. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.
   4. Laminated Silver Metallized Film: 90 percent.

P. Diffusers and Globes:
   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness: At least 0.125 inch minimum unless otherwise noted.
      b. UV stabilized.

Q. Glass: Annealed crystal glass, unless otherwise indicated.

R. Factory-Applied Labels: Comply with UL 1598. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles.

   1. Label shall include the following:
      a. “USE ONLY”.
      b. CCT and CRI for all luminaires.

S. Where vandal proof or tamper proof fixtures are specified, tamper proof screwdrivers shall also be provided.

   1. Refer to Division 01 Section “Extra Materials.”
T. Light Calculations for pendant high bay LED and Wireguard Fixtures: Provide fixtures with required drivers with absolute lumen output to match configuration and luminance shown on the drawings.

U. Exterior Post Lights [S] [O/M]:
   1. The pole shall be complete with matching base cover, four (4) or more galvanized 50,000 PSI steel anchor bolts, two (2) galvanized 50,000 PSI nuts per bolt, two (2) galvanized washers per bolt.
   2. The entire exterior post light assembly including the foundation shall be capable of withstanding 100 MPH winds with a 1.3 gust factor and an overall safety factor of 1.65.

2.03 POWER SUPPLY UNIT (DRIVERS)
   A. Luminaires shall be equipped with an LED driver(s) that accepts the voltage as indicated on the "Luminaire (Lighting Fixture) Schedule". Individual driver(s) shall be replaceable.
   B. Driver(s) shall be UL8750 class 2 compliant for their intended purpose.
   C. Total harmonic distortion (THD) for current: \( \leq 20\% \):
      1. Comply with NEMA SSL 1 and rated for a THD of less than 20 percent at all voltages.
      2. Driver must be labeled to comply with RFI (Radio Frequency Interference) requirements of FCC Title 47 Part 15.
   D. Driver(s) shall be rated to operate between -30ºC to 50ºC minimum.
   E. Individual driver(s) shall be equipped with surge protection (6kV minimum) in accordance with IEEE/ANSI C62.4.1. Driver shall be protected against damage due to either an open circuit or short circuit fault condition on the driver output.
   F. Driver(s) shall have a minimum efficiency of 85%.
   G. Drivers shall deliver full-range dimming from 0-10V control signal.
      1. Exam: Pulse Width Modulation (PWM).
      2. Corridor: Pulse Width Modulation (PWM).

2.04 LED LIGHT SOURCE (LIGHT ENGINE)
   A. Individual light engine(s) shall be replaceable.
   B. LED light engine(s) shall have a minimum lifetime of 50,000+ hours at 40º C and shall have a minimum efficiency of 80 lumens per watt.
   C. LED dies shall be tested in accordance with I.E.S.N.A. LM-80-08 standards.
   D. Thermal management shall be passive by design and shall consist of heat sinks with no fans, pumps, or liquids.

PART 3 - EXECUTION

3.01 INSTALLATION
   A. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
   B. LED luminaires (lighting fixtures) shall be installed as shown on the Drawings and in accordance with the manufacturer's recommendations.
   C. Recessed lay-in type linear LED luminaires shall be supported from the building structure independently of the ceiling grids with a minimum of four (4) steel tie wires per luminaire or as detailed on the Drawings.
   D. Recessed lay-in type linear LED luminaires installed in lay-in type ceiling tile shall be securely fastened from the building structure and be installed in the lay-in type ceiling in such a manner that the louver/lens housing may be easily opened and so that the luminaires may be removed and relocated without forcing the luminaires or changing the grid system tie wires. Coordinate with the ceiling installer before the ceiling grid is installed to assure a mutually satisfactory installation of ceiling and luminaires.
E. Recessed LED luminaires installed in “hard” ceiling systems (i.e. drywall, metal pan, etc.) shall be securely fastened from the building structure and be installed in such a manner that the louver/lens housing may be easily opened and so that the luminaires may be removed and relocated without forcing the luminaires or changing the ceiling support system. Coordinate with the ceiling installer before the ceiling is installed to assure a mutually satisfactory installation of ceiling and luminaires.

F. Surface mounted linear LED luminaires shall be supported from the building structure with a minimum of two (2) 1/4-inch threaded rods per each one (1) foot wide by four (4) foot long and a minimum of four (4) 1/4 inch threaded rods per each two (2) foot wide by four (4) foot long luminaire as detailed on the Drawings.

G. Pendant/suspended luminaires shall be supported from the building structure with 1/4-inch threaded rods at each of the luminaires suspension points. Hardware connections to the threaded rods shall be listed components from the luminaire manufacturer and be specifically designed for the type of suspension called for on the Drawings. Installation shall be in accordance with the manufacturer's instructions.

H. Recessed non-linear LED luminaires (i.e. downlights) located in lay-in type ceiling tile shall be mounted in the center of the tile or as shown on the Drawings and shall be supported by means of bar hangers extended across the main ceiling support members and also supported from the building structure with no less than one (1) 1/4 - inch threaded rod per luminaire. Where luminaires are installed in sloped ceilings the luminaires shall be complete with appropriate slopped ceiling adapters.

I. Surface mounted non-linear LED luminaires and exit lights shall be supported from the building structure with a minimum of two (2) 1/4 inch threaded rods per luminaire or exit light.

J. 1-1/2- inch x 1-1/2- inch steel framing channel shall be used where required to span bar joists and otherwise facilitate structural support for luminaires and exit lights.

K. Ceiling grid layouts when indicated on the electrical Drawings are for convenience only.

L. Pendant mounted luminaires and exit lights shall be located to avoid mechanical systems, ductwork, piping, structural members, and the like.

M. Supports shall not terminate or be fastened directly to the roof decking.

N. Coordinate the luminaires layout with the Architect/Engineer and all other trades before the ceiling grid, air outlets, and luminaires are installed. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them.

1. Before fixture order is placed, the Contractor will be responsible for checking type of ceiling in all spaces to determine if fixture type indicated is correct to fit ceiling encountered and if exposed fixture finish indicated is correct.

2. All recessed LED light fixtures mounted in lay-in ceilings shall be fastened to the adjacent T-bars by Caddy #515 fasteners, or accepted equal. Support outlet boxes and fixtures from building structure independent of associated ceiling suspension system. Where a recessed 1’ x 4’, 2’ x 2’ or 2’ x 4’ lay-in LED fixture is indicated, the Electrical Trade shall provide a minimum of two (2) auxiliary support wires at the diagonal corners of the recessed fixture. These auxiliary support wires shall be equal to or greater than the support wires for the ceiling system and capable of supporting the fixture if the ceiling system support wires were compromised. The auxiliary support wires shall attach **directly** to the fixture, at the fixture manufacturer's indicated locations. These wires shall be attached and supported from the structure in the same manner as the ceiling system support wires. Where support wires are attached to the structural steel above the ceiling system, utilize CADDY catalog number 4H24 flange clamps or equal at the point of attachment to the structural steel.

3. The installation of all air-handling troffers shall be coordinated with the Mechanical Trade who will install the duct portion. Troffers not utilized for air supply, shall have air supply slots function as return air openings directly to the plenum unless otherwise noted. Air slot closure strips shall be installed by the Mechanical Subcontractor where required.

4. Lighting fixtures are shown in mechanical rooms for quantity and approximate location only. Coordinate exact location of all fixtures with Mechanical Trade. Some lighting fixtures
will have to be mounted below ducts and pipes or on walls. Where possible, fixture to be approximately 8'-6" above floor to bottom.

5. The combined fixture body and enclosure for classroom use (library, labs, etc.) shall meet the V.C.P. Criteria of the Commonwealth of Virginia's Department of Education. Complete E.T.L., E.R.L., B.A.L.L., or I.T.L. photometric test data shall be submitted with the fixture shop drawing.

6. Where an emergency driver is indicated, the charging circuit (unswitched lighting circuit) shall be connected on the local (circuit indicated on the drawings) unswitched lighting circuit controlling that fixture or fixture group. The emergency driver output circuit shall be connected on the local switched circuit. The emergency driver shall power a minimum of two (2) lamps in the same fixture to meet the Codes unless otherwise indicated.

7. All exterior post lighting fixtures shall be mounted on reinforced concrete foundation bases adequate for the site soil and weather conditions encountered. A detail generally illustrating the type and shape of the desired foundation is shown on the drawings and is issued for bidding purposes only. The Electrical Trade shall submit a similar detail of the foundation for their proposed lighting fixture and pole and shall obtain approval of the Architect's Structural Engineer. The post light foundation design factors shall include, but are not limited to, the following considerations:
   a. Structural adequacy of concrete, with steel reinforcing as necessary.
   b. Depth adequate to prevent frost heave.
   c. Size large enough to encase anchor bolts with adequate thickness, preferably not less than 3 inches between the bolts and the soil.
   d. Top surface of foundation shall be wide enough for the baseplate of the pole. Round foundations shall have the top surface diameter not less than 1-1/2 times the width of the pole base.
   e. Larger foundations shall be used where adjacent trenching or other disturbances of the surrounding soil has occurred, where the soil quality is of poor strength characteristics, or if above-average winds are to be expected at the site.
   f. Where required or indicated, provide "breakaway devices" that meet the Commonwealth of Virginia's Department of Transportation (VDOT) requirements, meet the latest AASHTO "Breakaway Criteria", are approved by FHWA and meets the standards and regulations of the Local Authority Having Jurisdiction. Sources for "breakaway devices" is HAPCo (Division of Kearney National, Inc., Abingdon, VA 24210, Phone (540) 628-7171, FAX (540) 628-7707.

8. All exit signs shall have the required individual or group flashing interface devices for connection to Section 28 31 00 Fire Detection and Alarm general alarm output for visual indicating appliances (per UFAS 4.28.3).

3.02 GENERAL CONFORMANCE

A. Surface mounted luminaires shall not have gaps between the luminaire and attaching surface, except where required by code regulations or manufacturer's instructions.

B. Recessed luminaires shall not have gaps between the luminaire trim and the adjacent surface. Where light leaks occur, suitable gaskets shall be furnished and installed.

C. Install luminaires level, plumb and true. Align rows accurately in three (3) dimensions.

D. Where luminaires are to be installed in areas without ceilings, furnish supports consisting of threaded rods and steel channels as required to have a finished mounting height of 8'-0" to bottom of the luminaire (or other mounting height as shown on the Drawings), unless pendant or chain mounting is indicated on the Drawings or Luminaire Schedule.

E. Recessed luminaires shall be connected with flexible metal conduit (maximum 6'-0" length) from outlet boxes mounted above or alongside of luminaire. Luminaires shall be wired in such a way that removal of one shall not disrupt the continuity of power to the others.

F. Multi Purpose Room Light Fixtures:
1. Install as to allow the bottom of the light fixture at same elevation as bottom of truss steel. The light fixtures are to be installed above the bottom cord of the roof truss and not to be installed on the bottom of the steel truss.

G. Comply with requirements in Division 26, Section "Low-Voltage Electrical Power Conductors and Cables" and Division 26, Section "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

H. All luminaires designated for damp locations shall have sealed conduit entries. Any luminaire leaking water before or during the warranty period shall be repaired or replaced.

I. Prior to final inspection, check all LED luminaires for damages during construction and replace the damaged luminaires. All luminaires shall be cleaned at the time of final acceptance of the building.

3.03 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26, Section "Identification for Electrical Systems".

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections.

B. Operational Test: After installing luminaires, switches, accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

D. Luminaire will be considered defective if it does not pass operation tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.05 ADJUSTING

A. Occupancy Adjustments: When requested within twelve (12) months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.

2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3. Adjust aimable luminaires in the presence of Architect.

4. Conduct short-duration tests on all emergency lighting.

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 WORK INCLUDED:
   A. Every item of labor, material, devices and appurtenances for installing a complete Electronic Communications Systems and other related systems included in Division 27 of the Specifications.
      1. Section 27 05 26 – Grounding and Bonding for Communications Systems
      2. Section 27 05 28 – Pathways for Communications Systems
      3. Section 27 05 53 – Identification for Communications Systems

1.03 RELATED WORK:
   A. General: See all other portions of these Contract Documents and apply to those portions of work, relating to the Division 27 systems, the same as if repeated herein in its entirety. The Division 27 Trades shall provide and install all wiring, all equipment, all electronics, all software and accessories as specified and shown on the drawings and as needed to provide complete and operational systems. Division 27 Trades shall provide to Division 26 special boxes, cabinets, racks, hangers, and etc.; for installation.
   B. Division 23 - Mechanical
   C. Division 26 - Electrical
   D. Division 28 – Electronic Safety and Security

1.04 DRAWINGS:
   A. Where conduit, equipment, devices and other electrical appurtenances are shown on the drawings, the general arrangement of such items on the electrical drawings shall be followed as closely as actual building construction and the work of other trades will permit. Because of the small scale of the electrical drawings, it is not feasible to indicate all offsets, fittings and accessories which may be required. The Contractor shall investigate the construction conditions affecting the work and provide fittings and accessories as required to meet actual conditions.

1.05 QUALITY ASSURANCE:
   A. Equipment and material used in the project shall be new and undamaged. The installation shall fit into the space allotted and shall allow adequate, acceptable, clearances for entry, servicing, safety, and maintenance. The Contractors shall coordinate the work to ensure that the equipment may be moved into place without altering building components or other installations. All electronic communication systems (above) work shall be performed by a
Commonwealth of Virginia Class-A licensed Electrical Contractor(s) whose technicians, mechanics, or tradesmen shall be skilled and certified in the trade involved. All Division 27 work shall be performed under the direct supervision of the equipment systems' authorized technician with a locally recognized and accepted master electrician's license. All work under Division 27 shall be provided by a single-source Division 27 vendor/subcontractor.

B. Equipment and material in existing installations may be reused where specifically indicated on the drawings.

1.06 REFERENCES:

A. The complete installation and all materials and equipment under Division 27 shall conform to the current Commonwealth of Virginia Statewide Building Code including all applicable portions of the National Electrical Code (NEC) and all other governing codes, regulations and certifications. All wiring methods shall adhere to Division 27 specified wiring methods.

B. All equipment used shall bear the Underwriters Laboratory (U.L.) label for the intended application, or other organizations label if acceptable to the Authority having jurisdiction and concern with product evaluation.

C. In addition, the following codes, standards, and regulations shall apply to the complete installation and all materials and equipment. These are referred to by their accompanying abbreviations.

1. National Electrical Code (NFPA No. 70) 2014 NEC
2. National Electrical Manufacturers Association NEMA
3. Underwriters Laboratories, Inc. UL
4. Telecommunications Building Wiring Standards TIA/EIA
5. All Systems' Installation Certification Compliance Documents for Installing Trades
7. Uniform Federal Accessibility Standards UFAS
8. Americans with Disabilities Act Accessibility Guideline ADAAG

D. The above standards are intended as a minimum and shall be exceeded if required by the Contract Documents. In the event information contained in the Contract Documents conflicts with one of the above mentioned codes, the codes shall take precedence.

1.07 PERMITS, LICENSES, TAXES AND INSPECTION CERTIFICATES:

A. All permits, bonds, licenses, inspection fees and taxes required for the execution of the work shall be obtained and paid for by the Contractor. Under each phase of the Division 27 work, the Contractor shall furnish three copies of certificates of final acceptance to the Engineer from any inspection authority having jurisdiction.

1.08 REGULATIONS AND STANDARDS:

A. The completed installation and all materials and equipment shall conform to local ordinances and codes, other regulations and standards listed herein or in related sections. These are intended as a minimum and shall be exceeded if required by the specifications or the Drawings. In the event of conflict between the codes, standards, or regulations, and information contained in the Contract Documents, the applicable code, standards, or regulation shall take precedence.

1.09 SUBMITTALS:
A. Submit shop drawings, product data and samples in accordance with Division 1 for all items as specified in related sections of these specifications. Eight (8) copies of the submittal shall be submitted. Five (5) copies of the submittal will be returned to the Contractor. If additional copies are required, they will be the responsibility of the Contractor. Where drawings are submitted, the Contractor shall submit two (2) sets of full scale prints. One copy will be marked and returned to the Contractor and the Contractor shall be responsible for all additional copies required for his use. All submittal data shall be correctly identified to show project name, and the exact model, style or size of item being submitted. Improperly identified submittals will not be reviewed by the Engineer. Each item submitted for review shall bear the Subcontractor’s stamp, which states that they have reviewed the submission, that it is complete, and that in their opinion it meets the contract requirements. Contractors stamp shall identify the paragraph and page number for which the submittal is being made. Any submission, which has not been reviewed and stamped by the Division 27 Trades, will not be reviewed by the Engineer. No reviews prior to award of Contract will be considered or accepted, unless otherwise specified.

B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these Contract Documents shall be submitted as follows:

1. All the equipment and materials where submissions are specifically required by other Divisions of these Contract Documents.

2. All the equipment and materials that are indicated with a [S] behind the product title. This shall include submission of the specified products equipment and materials.

3. All the equipment and materials that are acceptable equal substitution.

4. If submission is NOT required for the SPECIFIED products "shop drawings and product data" under 1. and 2. above, the Contractor shall NOT submit the SPECIFIED products "shop drawings and product data".

5. Samples, in good working order, shall be submitted in accordance with Division 1, complete with all installation and service drawings and instructions. All samples will be returned at the submitter’s expense unless otherwise indicated. Samples may be subject to destructive testing by Engineer.

C. Operation and Maintenance manuals shall be submitted in accordance with Division 1 and shall include a copy of all accepted shop drawings, installation and maintenance data, operation instructions, parts lists, and the name, address and telephone number of supplier or nearest representative. All electrical and electronic devices, equipment and systems marked [O/M] in these specifications shall be included and all other such electrical and electronic items which will require servicing before the duration of its useful life has been reached. Manuals shall be presented to the Engineer for review and transmitted to the Owner before the final payment is recommended.

D. Equivalents:

1. Not all of the Manufacturers, trade names and/or model numbers are indicated herein, or on the drawings.

2. Unless definitely stated otherwise and upon complying with Division 1, the Contractor may use any article of equal appearance, which in their judgment is equal to the article that is specified and is accepted by the Engineer.

3. Where three (3) or more manufacturers are named in the specifications for any item, the Contractor shall use one of the three (3) listed manufacturers. No other
manufacturers shall be reviewed or accepted. Manufacturers that are listed first in these specifications and on drawings were used as a basis of design.

4. It will be the responsibility of the Contractor to verify all connections, physical sizes and capacities of all other manufacturer's items, both named or proposed. If the equipment necessitates changes in power distribution, conduit, wiring, lighting, wiring, or any other building systems from that indicated on the drawings, the Contractor shall be responsible for all additional costs included and notify other trades of the changes. Where such changes are required, detail drawings indicating all required changes shall be submitted for review at the same time the manufacturers drawings are submitted for approval.

5. Refer to Division 1 for substitutions.

E. The ten day prior approval requirements of The Instructions to Bidders, AIA 701, are waived for this Division of the Specifications, and unless stated otherwise, the Contractor may use items that he deems as equivalent in quality and performance to the specified item subject to final acceptance of substituted items by the Engineer upon his review of shop drawings.

F. Guarantee: Electronic Communication Systems equipment, materials and labor required by these specifications and accompanying drawings shall be guaranteed to be free from defective materials or workmanship for a period of one year after final acceptance of the project except extended warranties as specified elsewhere in these documents on specific items of equipment will be furnished by the Trade providing the equipment. Defects in material or workmanship occurring during this period shall be corrected with new material and equipment or additional labor at no cost to the Owner. Manufacturer's certificates of warranty shall be transmitted to the Owner before final payment is recommended.

1.10 WARRANTIES:

A. The Contractor shall warrant for a period of one year all work provided under the Contract to include, but not necessarily limited to, all systems, equipment, materials, and workmanship. This shall not be construed to limit any extended warranty periods of longer than one year for specific items or systems specified elsewhere in the Contract Documents.

B. The warranty period shall commence on the date of acceptance by the Owner and shall cover all parts and labor as required to fulfill the warranty at no cost to the Owner.

C. Refer to Division 1 for additional warranty requirements.

D. Information on all warranties shall be included in the O&M manuals specified herein to be provided to the Owner.

1.11 COORDINATION OF WORK:

A. General: The contract documents indicate the extent and general arrangement of the communications systems. The Contractor shall be responsible for the coordination and proper relation of the communications systems work to the building structure and to the work of other trades. No additional compensation or extension of completion time will be granted for extra work caused by the lack of coordination.

B. Cooperation: The Contractor shall provide dimensions and locations of all openings, shafts and similar items to the proper trades and install work as required so as not to interfere with, or delay, installation of systems under construction in the buildings.
C. Locations of lines and equipment shall be determined from actual field measurements. The outlines of the building shown on the contract drawings are intended only as a guide to indicate relative locations of the electrical work. Refer to the existing buildings and structural components to determine actual measurements. If conflicts prevent installation of communications systems work at the locations indicated, minor deviations shall be made subject to acceptance by the Engineer, and without additional compensation.

D. Cutting and Patching: See Division 1 and Division 26.

E. Roughing-In: Equipment, racks, cabinets, devices, and other similar items shall align vertically or horizontally with each other, the building structure and features thereof when it appears obvious and logical that they should. All mounting heights shall be within the limits of Commonwealth of Virginia USBC and ADAAG.

F. All Division 23 BAS control panels are not necessarily indicated on the drawings. Division 27 shall be responsible for providing communication data network connection to each BAS control panel installed.

G. Damage to Other Work: The Division 27 Trades are responsible for damage to other work caused by his work or workmen. Repairing of damaged work shall be done by the Trade who installed the work, and as directed by the Engineer; the cost of which shall be paid for by the Division 27 Trades.

1.12 ASBESTOS:

A. Asbestos Free Materials: The intention of these drawings and specifications is that there be no asbestos containing materials installed on this project. To the best of the Engineers' knowledge, none of the material or equipment specified herein or shown on the drawings contains asbestos. The Contractor shall make every effort to prevent any asbestos materials from being installed in or used on the construction of the project. At the completion of the project, the Contractor shall certify by letter that to the best of his knowledge, no asbestos containing materials were used for or in the construction of this project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS AND MATERIALS:

A. General: Manufacturers and materials shall be as specified in subsequent sections of these specifications and as noted on the drawings. Similar types of equipment shall be the products of the same manufacturer unless specified otherwise.

2.02 SLEEVES AND INSERTS:

A. General: Sleeves and inserts shall be provided and correctly located in the structure, as required for the work.

B. Inserts shall be steel and of proper size for loads encountered.

2.03 ACCESS DOORS:

A. Provide for all junction boxes or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for work shall be furnished as a part of this Division to the General Contractor for installation. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable. Doors shall be metal access doors with cam lock, style to match ceiling or wall construction. Doors
occurring in rated construction shall be fire rated U.L. labeled access doors correlated to preserve the integrity of the rated construction. Doors shall be prime finish steel except those in toilets, shower rooms, locker rooms, kitchens and other similar areas shall be aluminum with natural anodized finish. Doors shall match the access doors in Division 23 and meet the acceptance of the Architect.

PART 3 – EXECUTION

3.01 INSTALLATION:

A. General: Materials and equipment shall be installed in accordance with manufacturer's instructions to conform with the details and application as specified in subsequent sections of these specifications and indicated on the drawings.

B. Division 27 shall coordinate with BAS Contractor for the location of all control panels. All communications network connections necessary for control panels shall be provided and included within the Contract.

C. Supports: Provide necessary supports for all equipment and appurtenances as required; this includes, but is not limited to, frames or supports for items such as cabinets, junction boxes, conduit, outlet boxes, and other similar items requiring supports. Foundation drawings, bolt setting information and foundation bolts shall be furnished by the subcontractors furnishing the equipment for all equipment required to be bolted to the floor, wall or above ceiling structure.

D. Sleeves: Provided by Division 26.

E. Temporary Requirements: Openings in equipment shall be kept capped at all times until connection is made to the system. The ends of all conduits and equipment openings shall be kept capped properly with approved devices. Approved devices are items such as specially molded plastic caps and sheet metal caps.

F. Access Doors: Provide access doors for all concealed electric equipment, pull boxes, junction boxes or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for Division 27 work shall be furnished by Electrical Trade to the Contractor for installation. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable.

G. Painting: All work under this Division shall be painted in accordance with Section 27 05 53, Identification for Communications Systems.

3.02 MANUFACTURER'S ASSISTANCE:

A. Qualified technical representatives of manufacturers shall be available to visit the project and provide required assistance for any problems or trouble areas of any systems, material or equipment used in the project. Manufacturer's engineering assistance shall also be available for above problems or trouble areas. The Contractor shall purchase all materials, equipment or systems with these services included in the purchase price or otherwise be prepared to have the above service provided when needed or requested by the Engineer without additional compensation. Where one manufacturer's equipment constitutes the majority of the components or devices to make a system, the manufacturer's technically qualified representative shall inspect and accept the completed installation whether or not especially requested by the Engineer.
3.03 INSTRUCTION AND TRAINING OF OWNER'S REPRESENTATIVE:

A. The Division 27 Trades shall instruct and train the representatives of the Owner in the proper operation and maintenance of all elements of the Electronic Communication Systems. Competent representatives of the Contractor shall spend one (1) week for each of the respective Division 27 systems, unless noted otherwise hereinbelow. The times and locations for instruction and training to the Owner's personal shall be set by the Owner at times and locations determined by the Owner over a period once the systems are functional for instruction and training. The instruction and training shall be given to all personal as deemed necessary by the Owner. The instruction and training shall prepare the Owner to fully operate and maintain all of the above systems.

3.04 CONSTRUCTION STATUS REPORT:

A. Each item of discrepancies noted on Construction Status Report prepared by the Architect/Engineer shall be answered in detail in writing by the Contractor before payment can be recommended.

END OF SECTION
APPENDIX A
LETTER OF INDEMNIFICATION

Project Name:

Project Location:

The Contractor may obtain from Ascent Engineering Group a CD-ROM or electronic mail version of the projects Revit / CADD database. All seals, details, schematics, tables, controls, etc. will be deleted. All drawings will be provided in Autocad™ 2018 format.

Ascent Engineering Group reserves all rights to the original drawing files.

The Recipient agrees, to the fullest extent permitted by the law, to hold harmless and indemnify Ascent Engineering Group, as defined in the Bid Documents, from and against all claims, liabilities, losses, damages, and costs, including but not limited to attorney’s fees, arising out of or in any way connected with the use, modification, misinterpretation, misuse, or reuse by the Recipient or others of the machine readable information and data provided by Ascent Engineering Group under this Agreement. The foregoing indemnification applies, without limitation, to any use of the project documentation on other projects, for additions to this project, or for completion of this project by others, excepting only such use as may be authorized, in writing, by Ascent Engineering Group.

The electronic drawing files are not part of the Contract Documents for the Project. The Recipient assumes all risks associated with the use of the transmitted files. Ascent Engineering Group will not be responsible for any differences in the information included in the transmitted files and the information shown on the Contract Documents. Modifications to the Contract Documents made before or during construction may or may not be included in the transmitted electronic drawing files.

The Recipient further agrees that the drawing files will only be used in graphics preparation for the above-referenced project.

Company Name of Recipient: _____________________________________________
Recipient’s Designated Representative: _______________________________________
Title: _________________________________________________________________
Signature: __________________________________________________________________
Address: __________________________________________________________________

Return to: Ascent Engineering Group
5228 Valleypointe Parkway, Suite 4
Roanoke, VA 24019
AEG # 16235
SECTION 27 0526
GROUNDING AND BONDING FOR COMMUNICATION SYSTEMS

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 WORK INCLUDED:
   A. Equipment Grounding Conductor (EGC)
   B. Grounding for Data and Telecommunications Systems (TMGB & TGB)

1.03 RELATED WORK:
   A. Section 26 05 26 – Grounding and Bonding for Electrical Systems

1.04 REFERENCES:
   A. NFPA 70 (NEC), Article 250

1.05 DESCRIPTION:
   A. An insulated equipment grounding conductor, color coded per section 26 05 19, and the NEC, shall be provided for each alternating current circuit without exception.

1.06 TESTS:
   A. The equipment grounding conductor shall be tested for continuity and proper bonding to metallic equipment enclosures, outlet boxes, wiring devices and similar items.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:
   A. Data Room Ground Bus Bar Kits: Isolate grounding bus bars shall be provided in the Main Data Distribution Room. Data grounding bus bars kit shall be by CPI or accepted equal. The main data distribution room shall have a (TMGB) 4” tall by 20” long by 0.25” thick pre-drilled copper bus bar with isolators and mounts (CPI #10622-020) & (CPI #10622-000).

PART 3 - EXECUTION

3.01 INSTALLATION:
   A. Equipment Grounding Conductor (EGC):
      1. Provide a separate insulated grounding conductor, color-coded as per Section 26 05 19, enclosed in the same raceway with the phase conductors for all alternating current circuits, even though not necessarily shown on the drawings.
      2. The equipment grounding conductor shall be secured to the equipment enclosure at the source of power and at the apparatus being served by the alternating current supply.
3. The minimum size for the grounding conductor shall be as specified in Table 250.122 of NEC.

B. Data Room Ground Bus Bars:

1. Provide a separate insulated grounding conductor (# 2/0 AWG) between the main data distribution room grounding bus bar (TMGB) to the BGES.

C. The communication ground shall provide a 5 ohms or less ground path to earth.

END OF SECTION
SECTION 27 0528
PATHWAYS FOR COMMUNICATIONS SYSTEMS

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 WORK INCLUDED:
   A. Empty conduit system for Communications Systems including telephone and data as indicated.

1.03 RELATED WORK:
   A. Section 26 05 00 – Common Work Results for Electrical
   B. Section 26 05 26 – Grounding and Bonding for Electrical Systems
   C. Section 26 05 33 – Raceway and Boxes for Electrical Systems
   D. Section 26 05 36 – Cable Management for Electrical Systems
   E. Section 26 05 43 – Underground Ducts and Raceways for Electrical Systems
   F. Section 26 05 53 – Identification for Electrical Systems
   G. Section 27 05 00 – Common Work Results for Communications
   H. Section 27 05 26 – Grounding and Bonding for Communications Systems
   I. Section 27 05 53 – Identification for Communications Systems

1.04 GENERAL OPERATION AND DESCRIPTION:
   A. General: The communications systems shall consist of a complete (partial) empty conduit system
      as indicated.
   B. The raceway for this system shall be furnished and installed by the Division 26 electrical contractor
      in accordance with all related specification sections in Division 26 and 27. The Communications
      System Trade shall coordinate the work with Division 26.

1.05 REFERENCES:
   A. The complete installation, including additions and modifications, shall be in accordance with:
      1. National Electrical Code Article 800.

PART 2 – PRODUCTS - NOT USED
PART 3 - EXECUTION

3.01 INSTALLATION:
   A. General: The Contractor shall provide all conduit, junction boxes, and materials required for the
      installation of an empty conduit Communications System in accordance with the specifications and
      drawings. Any material and/or equipment necessary for the proper operation of the system not
      specified or described herein shall be deemed part of this specification.
   B. Wiring:
      1. Partial Conduit Raceway System: All wiring methods (conduit only) shall be in accordance
         with NFPA-70, Article 800, and all other codes specified herein. All wiring to be installed
         under another contract.
      2. Communications Raceway System: Provide empty raceway system for telephone, data, and
         other communication systems outlets with conduit, boxes, cabinets, etc., as shown. Outlets,
         raceways and plates as specified in Division 26. All conduit runs to have long sweep radius
         elbows; condulets not permitted. There shall be a maximum of two 90° bends between
         outlets. Any run over 100'-0" in length shall have a pull box where approved by the
Communications System Trade. Provide fish wires as previously specified. Cabinets shall be flush or surface mounted as required.

3. Furnish and install a 1" conduit (or larger if scheduled) from each outlet to the nearest accessible ceiling void.

4. Communications systems service plywood panels shall be un-painted class "A" fire rated 4'-0" X 8'-0" X 3/4" thick plywood panels mounted at location shown on drawings with long dimension vertically. All conduits terminating at service panels shall be bushed 0'-6" above floor or 7'-6" above floor.

5. Provide a ground bar for each service panel as described in Section 27 05 26. Furnish and install #6 wire in 3/4" conduit from service plywood panel to cold water main for ground. Leave 6'-0" excess at panel and attach other end with ground clamp to cold water main. Bond this systems grounding electrode to the Section 26 05 26 building grounding electrode system (BGES) per NEC 800.

6. Provide two (2) four (4) inch underground service entrance conduits from the service entrance panels to the property line as shown on the drawings. The underground conduits shall be schedule 40 PVC with IMC or G.R.S. bushed stubs at the panel. Concrete encasement is not required unless the 24" minimum burial depth cannot be maintained. Refer to NEC and local utility company regulations for burial depths of less than 24".

7. All communications systems conduits, boxes, etc., shall be grounded to the building grounding electrode system (BGES) and properly bushed.

C. All boxes, conduits, etc., shall be of proper size, as determined by the Communications System Trade and shall be clearly marked for easy identification.

3.02 FIELD QUALITY CONTROL:

A. The Contractor shall submit the following information to the Architect/Engineer.


END OF SECTION
SECTION 27 0553
IDENTIFICATION FOR COMMUNICATION SYSTEMS

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 WORK INCLUDED:
   A. Prepare and paint Division 27 equipment supports and miscellaneous materials located in Equipment Rooms, MDF and other utility areas housing mechanical, electrical, and communication equipment.
   B. Identification of cabinets, racks, equipment and other system enclosures.

1.03 WORK NOT INCLUDED:
   A. Painting of factory finished Division 27 Equipment such as Data Communications, Voice Communications, Audio-Video Communications, CATV Systems, etc.

1.04 RELATED WORK:
   A. Section 26 05 53 – Identification for Electrical Systems
   B. Section 27 05 00 – Common Work Results for Communications
   C. Section 27 05 28 – Pathways for Communications Systems

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:
   A. Except as otherwise specified, materials shall be the products of the following manufacturers:
      1. Sherwin-Williams
      2. Pratt and Lambert
      3. Devoe
      4. Benjamin Moore

2.02 MATERIALS:
   A. Deliver all paints and materials to the project site in their original containers with all labels intact and legible at the time of use.
   B. Sherwin-Williams Industrial Maintenance Coatings System 4000 products are listed below to establish color and a standard of quality.
      1. All Hangers and Supports: One coat Series 54 Gloss Black Alkyd Enamel.
      2. Factory Finished Equipment finishes shall be cleaned and properly touched up with equipment manufacturers touch-up paint unless finish is severely damaged or of
unacceptable quality. In the latter case, the entire finish shall be restored in accordance with painted procedures herein specified.

PART 3 - EXECUTION

3.01 WORKMANSHIP:
A. The work shall be accomplished by qualified mechanics skilled in the painting trade. Painting of equipment and other materials shall not commence until all testing is complete and systems are ready for operation. Materials shall be evenly spread, and smoothly flowed on without runs or sags. Each coat shall be thoroughly dry before application of succeeding coats.

3.02 PROTECTION OF WORK:
A. The painters shall protect all adjacent surfaces with drop covers during the process of painting. Upon completion, paint spots, if any, shall be removed from all surfaces not intended to be painted.

3.03 PREPARATION OF SURFACE:
A. Surfaces to be painted shall be completely dry before applying paint. Metal surfaces shall be cleaned with mineral spirits before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be chemically treated with crystalline zinc phosphate in strict accordance with the manufacturer’s recommendations. Surfaces shall not be painted when the temperature is, or is likely to be, near the freezing point, nor when they are exposed to hot sun.

3.04 IDENTIFICATION OF BOXES AND EQUIPMENT:
A. After all painting is completed, operating and control parts of the equipment and systems such as cabinets, racks, telephone cabinets, and system cabinets shall be properly identified with laminated engraved plastic nameplates fastened with sheet metal screws, bolts or permanent adhesive. Pressure sensitive tape is not acceptable. Identification symbols or designations shall be the same as shown on the contract documents.

B. Boxes; Concealed and Surface Mounted: Each enclosure shall be neatly identified by permanent marker, which shall indicate service contained, circuit numbers (or zone numbers). Letters shall be upper case (Capital) not less than one half inch high.

C. See Section 26 05 53 for Identification of Conduits associated with these systems.

D. The Division 27 Systems shall have an engraved informational laminated nameplate with the installing trade’s name, telephone number and address for the Owner to obtain preventive maintenance, service or parts. The nameplate shall include the job order number, shop number or other identification, which will identify the related equipment.

If the above address and telephone number is a branch office, the main office or manufacturer’s address and telephone number shall be included.

END OF SECTION
SECTION 28 0500
COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

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 WORK INCLUDED:

A. Every item of labor, material, devices and appurtenances for installing a complete Electronic Safety and Security System and other related systems included in Division 28 of the Specifications.

1. Section 28 05 26 – Grounding And Bonding For Electronic Safety And Security Systems
2. Section 28 05 28 – Pathway for Electronic Safety and Security
3. Section 28 05 53 – Identification for Electronic Safety And Security
4. Section 28 31 00 - Fire Detection And Alarm

1.03 RELATED WORK:

A. General: See all other portions of these Contract Documents and apply to those portions of work, relating to the following Electronic Safety and Security Systems: Electronic Access Control and Intrusion Detection, Fire Detection and Alarm, Electronic Surveillance, the same as if repeated herein in its entirety. The Division 28 Trades shall provide and install all wiring, all equipment, all electronics, all software and accessories as specified and shown on the drawings and as needed to provide complete and operational systems. Division 28 Trades shall provide to Division 26 special boxes, cabinets, racks, hangers, and etc. for installation.

B. Division 21 – Fire Suppression
C. Division 23 - Mechanical
D. Division 26 – Electrical
E. Division 27 - Communications

1.04 WORK NOT INCLUDED:

A. Provide roughing-in, including the empty boxes, conduit, pull strings, etc. under Division 26 for the following related Sections:

1. Section 28 10 00 – Electronic Access Control
2. Section 28 20 00 – Electronic Surveillance

1.05 DRAWINGS:

A. Where conduit, equipment, devices and other electrical appurtenances are shown on the drawings, the general arrangement of such items on the electrical drawings shall be followed as closely as actual building construction and the work of other trades will permit. Because of the small scale of the electrical drawings, it is not feasible to indicate all offsets, fittings and accessories which may be required. The Contractor shall investigate the construction conditions affecting the work and provide fittings and accessories as required to meet actual conditions.
1.06 QUALITY ASSURANCE:
A. Equipment and material used in the project shall be new and undamaged. The installation shall fit into the space allotted and shall allow adequate, acceptable, clearances for entry, servicing, safety, and maintenance. The Contractors shall coordinate the work to ensure that the equipment may be moved into place without altering building components or other installations. All electronic safety and security systems (above) work shall be performed by a Commonwealth of Virginia Class-A licensed Electrical Contractor(s) whose technicians, mechanics, or tradesmen shall be skilled and certified in the trade involved. All Division 28 work shall be performed under the direct supervision of the equipment systems’ authorized technician with a locally recognized and accepted master electrician’s license. All work under Division 28 shall be provided by a single-source Division 28 vendor/subcontractor approved by the Owner to be utilized for this work.

1.07 REFERENCES:
A. The complete installation and all materials and equipment under Division 28 shall conform to the current Commonwealth of Virginia Statewide Building Code including all applicable portions of the National Electrical Code (NEC) and all other governing codes, regulations and certifications. All wiring methods shall adhere to Division 28 specified wiring methods.
B. All equipment used shall bear the Underwriters Laboratory (U.L.) label for the intended application, or other organizations label if acceptable to the Authority having jurisdiction and concern with product evaluation.
C. In addition, the following codes, standards, and regulations shall apply to the complete installation and all materials and equipment. These are referred to by their accompanying abbreviations.
   1. National Electrical Code (NFPA No. 70) 2014 NEC
   2. National Electrical Manufacturers Association NEMA
   3. Underwriters Laboratories, Inc. UL
   4. Telecommunications Building Wiring Standards TIA/EIA
   5. All Systems’ Installation Certification Compliance Documents for Installing Trades
   7. Uniform Federal Accessibility Standards UFAS
   8. Americans with Disabilities Act Accessibility Guideline ADAAG
D. The above standards are intended as a minimum and shall be exceeded if required by the Contract Documents. In the event information contained in the Contract Documents conflicts with one of the above mentioned codes, the codes shall take precedence.

1.08 PERMITS, LICENSES, TAXES AND INSPECTION CERTIFICATES:
A. All permits, bonds, licenses, inspection fees and taxes required for the execution of the work shall be obtained and paid for by the Contractor. Under each phase of the Division 28 work, the Contractor shall furnish three copies of certificates of final acceptance to the Engineer from any inspection authority having jurisdiction.
B. At the completion of the job, provide the Engineer with three (3) copies of the fire alarm inspection certificate from the Authority having jurisdiction, if such inspection is provided and/or required by the locality.
1.09 REGULATIONS AND STANDARDS:

A. The completed installation and all materials and equipment shall conform to local ordinances and codes, other regulations and standards listed herein or in related sections. These are intended as a minimum and shall be exceeded if required by the specifications or the Drawings. In the event of conflict between the codes, standards, or regulations, and information contained in the Contract Documents, the applicable code, standards, or regulation shall take precedence.

1.10 SUBMITTALS:

A. Submit shop drawings, product data and samples in accordance with Division 1 for all items as specified in related sections of these specifications. One (1) electronic (PDF) copy of the submittal shall be submitted. If additional copies are required, they will be the responsibility of the Contractor. If drawings are submitted, the Contractor shall submit a minimum of two (2) sets of full scale prints. One (1) copy will be marked and returned to the Contractor, and the Contractor shall be responsible for all additional copies required for his use. All submittal data shall be correctly identified to show project name, and the exact model, style or size of item being submitted. Improperly identified submittals will not be reviewed by the Engineer. Each item submitted for review shall bear the Subcontractor's stamp which states that they have reviewed the submission, that it is complete, and that in their opinion it meets the contract requirements. Contractor's stamp shall identify the paragraph and page number for which the submittal is being made. Any submission which has not been reviewed and stamped by the Electrical Trade will not be reviewed by the Engineer. No reviews prior to award of Contract will be considered or accepted.

B. Shop drawings, diagrams, catalog data and such other data necessary to fully describe and substantiate compliance with these Contract Documents shall be submitted as follows:
   1. All the equipment and materials where submissions are specifically required by other Divisions of these Contract Documents.
   2. All the equipment and materials that are indicated with a [S] behind the product title. This shall include submission of the specified products equipment and materials.
   3. All the equipment and materials that are acceptable equal substitution.
   4. If submission is NOT required for the SPECIFIED products "shop drawings and product data" under 1. and 2. above, the Contractor shall NOT submit the SPECIFIED products "shop drawings and product data".
   5. Samples, in good working order, shall be submitted in accordance with Division 1, complete with all installation and service drawings and instructions. All samples will be returned at the submitter's expense unless otherwise indicated. Samples may be subject to destructive testing by Engineer.

C. Operation and Maintenance manuals shall be submitted in accordance with Division 1 and shall include a copy of all accepted shop drawings, installation and maintenance data, operation instructions, parts lists, and the name, address and telephone number of supplier or nearest representative. All electrical and electronic devices, equipment and systems marked [O/M] in these specifications shall be included and all other such electrical and electronic items which will require servicing before the duration of its useful life has been reached. Manuals shall be presented to the Engineer for review and transmitted to the Owner before the final payment is recommended.

D. Equivalents:
   1. Not all of the Manufacturers, trade names and/or model numbers are indicated herein, or on the drawings.
2. Unless definitely stated otherwise and upon complying with Division 1, the Contractor may use any article of equal appearance, which in their judgment is equal to the article that is specified and is accepted by the Engineer.

3. Where three (3) or more manufacturers are named in the specifications for any item, the Contractor shall use one of the three (3) listed manufacturers. **No other manufacturers shall be reviewed or accepted.** Manufacturers that are listed first in these specifications and on drawings were used as a basis of design.

4. It will be the responsibility of the Contractor to verify all connections, physical sizes and capacities of all other manufacturer's items, both named or proposed. If the equipment necessitates changes in power distribution, conduit, wiring, lighting, wiring, or any other building systems from that indicated on the drawings, the Contractor shall be responsible for all additional costs included and notify other trades of the changes. Where such changes are required, detail drawings indicating all required changes shall be submitted for review at the same time the manufacturers drawings are submitted for approval.

5. Refer to Division 1 for substitutions.

E. The ten day prior approval requirements of The Instructions to Bidders, AIA 701, are waived for this Division of the Specifications, and unless stated otherwise, the Contractor may use items that he deems as equivalent in quality and performance to the specified item subject to final acceptance of substituted items by the Engineer upon his review of shop drawings.

F. Guarantee: Electronic safety and security systems equipment, materials and labor required by these specifications and accompanying drawings shall be guaranteed to be free from defective materials or workmanship for a period of one year after final acceptance of the project except extended warranties as specified elsewhere in these documents on specific items of equipment will be furnished by the Trade providing the equipment. Defects in material or workmanship occurring during this period shall be corrected with new material and equipment or additional labor at no cost to the Owner. Manufacturer's certificates of warranty shall be transmitted to the Owner before final payment is recommended.

1.11 **WARRANTIES:**

A. The Contractor shall warrant for a period of one year all work provided under the Contract to include, but not necessarily limited to, all systems, equipment, materials, and workmanship. This shall not be construed to limit any extended warranty periods of longer than one year for specific items or systems specified elsewhere in the Contract Documents.

B. The warranty period shall commence on the date of acceptance by the Owner and shall cover all parts and labor as required to fulfill the warranty at no cost to the Owner.

C. Refer to Division 1 for additional warranty requirements.

D. Information on all warranties shall be included in the O&M manuals specified herein to be provided to the Owner.

1.12 **COORDINATION OF WORK:**

A. General: The contract documents indicate the extent and general arrangement of the electronic safety and security systems. The Contractor shall be responsible for the coordination and proper relation of the electronic safety and security system work to the building structure and to the work of other trades. No additional compensation or extension of completion time will be granted for extra work caused by the lack of coordination.
B. Cooperation: The Contractor shall provide dimensions and locations of all openings, shafts and similar items to the proper trades and install work as required so as not to interfere with, or delay, installation of systems under construction in the buildings.

C. Locations of lines and equipment shall be determined from actual field measurements. The outlines of the building shown on the electrical drawings are intended only as a guide to indicate relative locations of the electronic safety and security work. Refer to the existing buildings and structural components to determine actual measurements. If conflicts prevent installation of electronic safety and security work at the locations indicated, minor deviations shall be made subject to acceptance by the Engineer, and without additional compensation.

D. Cutting and Patching: See Division 1 and Division 26.

E. Roughing-In: Equipment, racks, cabinets, manual pull stations, smoke detectors, devices, and other similar items shall align vertically or horizontally with each other, the building structure and features thereof when it appears obvious and logical that they should. All mounting heights shall be within the limits of Commonwealth of Virginia USBC and ADAAG.

F. Damage to Other Work: The Division 28 Trades are responsible for damage to other work caused by his work or workmen. Repairing of damaged work shall be done by the Trade who installed the work, and as directed by the Engineer; the cost of which shall be paid for by the Division 28 Trades.

1.13 ASBESTOS:

A. Asbestos Free Materials: The intention of these drawings and specifications is that there be no asbestos containing materials installed on this project. To the best of the Engineers' knowledge, none of the material or equipment specified herein or shown on the drawings contain asbestos. The Contractor shall make every effort to prevent any asbestos materials from being installed in or used on the construction of the project. At the completion of the project, the Contractor shall certify by letter that to the best of his knowledge, no asbestos containing materials were used for or in the construction of this project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS AND MATERIALS:

A. General: Manufacturers and materials shall be as specified in subsequent sections of these specifications and as noted on the drawings. Similar types of equipment shall be the products of the same manufacturer unless specified otherwise.

2.02 SLEEVES AND INSERTS:

A. General: Sleeves and inserts shall be provided and correctly located in the structure, as required for the work.

B. Inserts shall be steel and of proper size for loads encountered.

2.03 ACCESS DOORS:

A. Provide for all junction boxes or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for work shall be furnished as a part of this Division to the General Contractor for installation. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable. Doors shall be metal access doors with cam lock, style to match ceiling or wall construction. Doors occurring in rated construction shall
be fire rated U.L. labeled access doors correlated to preserve the integrity of the rated construction. Doors shall be prime finish steel except those in toilets, shower rooms, locker rooms, kitchens and other similar areas shall be aluminum with natural anodized finish. Doors shall match the access doors in Division 23 and meet the acceptance of the Architect.

PART 3 – EXECUTION

3.01 INSTALLATION:

A. General: Materials and equipment shall be installed in accordance with manufacturer's instructions to conform with the details and application as specified in subsequent sections of these specifications and indicated on the drawings.

B. Supports: Provide necessary supports for all equipment and appurtenances as required; this includes, but is not limited to, frames or supports for items such as cabinets, junction boxes, conduit, outlet boxes, and other similar items requiring supports. Foundation drawings, bolt setting information and foundation bolts shall be furnished by the subcontractors furnishing the equipment for all equipment required to be bolted to the floor, wall or above ceiling structure.

C. Sleeves: Provided by Division 26.

D. Temporary Requirements: Openings in equipment shall be kept capped at all times until connection is made to the system. The ends of all conduits and equipment openings shall be kept capped properly with approved devices. Approved devices are items such as specially molded plastic caps and sheet metal caps.

E. Access Doors: Provide access doors for all concealed electric equipment, pull boxes, junction boxes or any item requiring access. Doors shall be of sufficient size and so located that the concealed items may be serviced or completely removed and replaced. Doors required for Division 28 work shall be furnished by Electrical Trade to the Contractor for installation. Doors in acoustic tile ceilings shall be furnished in multiples of tile sizes. Doors are not required in exposed grid type ceilings where tiles are removable.

F. Painting: All work under this Division shall be painted in accordance with Section 28 05 53, Identification for Electronic Safety and Security Systems.

3.03 FIELD QUALITY CONTROL:

A. Verification [V]: Upon completion of the project, the Contractor shall submit a separate letter of certification (or compliance) to the Owner/Engineer that each of the following systems or equipment functions properly, conforms to all requirements of these specifications and all requirements of the manufacturer of the systems.

1. Section 28 31 00 - Fire Detection and Alarm

3.04 MANUFACTURER’S ASSISTANCE:

A. Qualified technical representatives of manufacturers shall be available to visit the project and provide required assistance for any problems or trouble areas of any systems, material or equipment used in the project. Manufacturer's engineering assistance shall also be available for above problems or trouble areas. The Contractor shall purchase all materials, equipment or systems with these services included in the purchase price or otherwise be prepared to have the above service provided when needed or requested by the Engineer without additional compensation. Where one manufacturer's equipment constitutes the majority of the components or devices to make a system,
the manufacturer’s technically qualified representative shall inspect and accept the completed installation whether or not especially requested by the Engineer.

3.05 INSTRUCTION AND TRAINING OF OWNER'S REPRESENTATIVE:

A. The Division 28 Trades shall instruct and train the representatives of the Owner in the proper operation and maintenance of all elements of the Electronic safety and security systems. Competent representatives of the Contractor shall spend one (1) week for each Division 28 system. The times and locations for instruction and training to the Owner’s personal shall be set by the Owner at times and locations determined by the Owner over a period once the systems are functional for instruction and training. The instruction and training shall be given to all personal as deemed necessary by the Owner. The instruction and training shall prepare the Owner to fully operate and maintain all of the above systems.

3.06 CONSTRUCTION STATUS REPORT:

A. Each item of discrepancies noted on Construction Status Report prepared by the Architect/Engineer shall be answered in detail in writing by the Contractor before payment can be recommended.

END OF SECTION
SECTION 28 0526
GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY SYSTEMS

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 WORK INCLUDED:
A. Equipment Grounding Conductor (EGC)

1.03 RELATED WORK:
A. Section 26 05 26 – Grounding and Bonding for Electrical Systems
B. Section 27 05 26 – Grounding and Bonding for Communication Systems

1.04 REFERENCES:
A. NFPA 70 (NEC), Article 250

1.05 DESCRIPTION:
A. An insulated equipment grounding conductor, color coded per section 26 05 19, and the NEC, shall be provided for each alternating current circuit without exception.

1.06 TESTS:
A. The equipment grounding conductor shall be tested for continuity and proper bonding to metallic equipment enclosures, outlet boxes, wiring devices and similar items.

PART 2 – PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 INSTALLATION:
A. Equipment Grounding Conductor (EGC):
   1. Provide a separate insulated grounding conductor, color-coded as per Section 26 05 19, enclosed in the same raceway with the phase conductors for all alternating current circuits, even though not necessarily shown on the drawings.
   2. The equipment grounding conductor shall be secured to the equipment enclosure at the source of power and at the apparatus being served by the alternating current supply.
   3. The minimum size for the grounding conductor shall be as specified in Table 250.122 of NEC.

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 WORK INCLUDED:

1.03 RELATED WORK:
   A. Section 26 05 00 – Common Work Results for Electrical
   B. Section 26 05 26 – Grounding and Bonding for Electrical Systems
   C. Section 26 05 33 – Raceway and Boxes for Electrical Systems
   D. Section 26 05 36 – Cable Management for Electrical Systems
   E. Section 26 05 33 – Identification for Electrical Systems
   F. Section 28 05 00 – Common Work Results for Electronic Safety and Security
   G. Section 28 05 26 – Grounding and Bonding for Electronic Safety and Security Systems
   H. Section 28 05 28 – Identification for Electronic Safety and Security

1.04 GENERAL OPERATION AND DESCRIPTION:
   A. General: The Electronic Access Control and Intrusion Detection and Electronic Surveillance systems shall consist of a complete (partial) empty conduit system as indicated.
   B. The raceway for this system shall be furnished and installed by the Division 26 electrical contractor in accordance with all related specification sections in Division 26 and 28. The Electronic Safety and Security System Trade shall coordinate this work with Division 26.

1.05 REFERENCES:
   A. The complete installation, including additions and modifications, shall be in accordance with:
      1. National Electrical Code Article 800.

PART 2 – PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 INSTALLATION:
   A. General: The Contractor shall provide all conduit, junction boxes, and materials required for the installation of an empty conduit Electronic Safety and Security System in accordance with the specifications and drawings. Any material and/or equipment necessary for the proper operation of the system not specified or described herein shall be deemed part of this specification.
   B. Wiring:
      1. Partial Conduit Raceway System: All wiring methods (conduit only) shall be in accordance with NFPA-70, Article 800, and all other codes specified herein. All wiring to be installed under another contract.
      2. Electronic Safety and Security Raceway System: Provide empty raceway system for motion detection, card readers, key pads, camera, and other electronic safety and security systems outlets and/or devices with conduit, boxes, cabinets, etc., as shown. Outlets, raceways and plates as specified in Division 26. All conduit runs to have long sweep radius elbows; condulets not permitted. There shall be a maximum of two 90° bends between outlets. Any run over 100'-0" in length shall have a pull box where approved by the Electronic Safety and Security...
Security System Trade. Provide fish wires as previously specified. Cabinets shall be flush or surface mounted as required.

3. Furnish and install a 1" conduit from each outlet/device to the nearest accessible ceiling void.

4. All Electronic Safety and Security systems conduits, boxes, etc., shall be grounded to the building grounding electrode system (BGES) and properly bushed.

C. All boxes, conduits, etc., shall be of proper size, as determined by the Electronic Safety and Security Trade and shall be clearly marked for easy identification.

3.02 FIELD QUALITY CONTROL:

A. The Contractor shall submit the following information to the Architect/Engineer.


END OF SECTION
SECTION 28 0553
IDENTIFICATION FOR ELECTRONIC SAFETY AND SECURITY

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 WORK INCLUDED:
   A. Prepare and paint Division 28 equipment supports and miscellaneous materials located in Equipment Rooms, IDF’s, MDF and other utility areas housing mechanical, electrical, safety and security equipment.
   B. Identification of cabinets, racks, equipment and other system enclosures.

1.03 WORK NOT INCLUDED:
   A. Painting of factory finished Division 28 Equipment such as Access Control, Electronic Surveillance, Fire Detection and Alarm, etc.

1.04 RELATED WORK:
   A. Section 26 05 53 – Identification for Electrical Systems
   B. Section 27 05 53 – Identification for Communications
   C. Section 28 05 00 – Common Work Results For Electronic Safety And Security
   D. Section 28 31 00 - Fire Detection and Alarm

PART 2 - PRODUCTS
2.01 ACCEPTABLE MANUFACTURERS:
   A. Except as otherwise specified, materials shall be the products of the following manufacturers:
      1. Sherwin-Williams
      2. Pratt and Lambert
      3. Devoe
      4. Benjamin Moore

2.02 MATERIALS:
   A. Deliver all paints and materials to the project site in their original containers with all labels intact and legible at the time of use.
   B. Sherwin-Williams Industrial Maintenance Coatings System 4000 products are listed below to establish color and a standard of quality.
      1. All Hangers and Supports: One coat Series 54 Gloss Black Alkyd Enamel.
      2. Factory Finished Equipment finishes shall be cleaned and properly touched up with equipment manufacturers touch-up paint unless finish is severely damaged or of unacceptable quality. In the latter case, the entire finish shall be restored in accordance with painted procedures herein specified.

PART 3 - EXECUTION
3.01 WORKMANSHIP:
   A. The work shall be accomplished by qualified mechanics skilled in the painting trade. Painting of equipment and other materials shall not commence until all testing is complete and systems are ready for operation. Materials shall be evenly spread, and smoothly flowed on without runs or sags. Each coat shall be thoroughly dry before application of succeeding coats.
3.02 PROTECTION OF WORK:
   A. The painters shall protect all adjacent surfaces with drop covers during the process of painting. Upon completion, paint spots, if any, shall be removed from all surfaces not intended to be painted.

3.03 PREPARATION OF SURFACE:
   A. Surfaces to be painted shall be completely dry before applying paint. Metal surfaces shall be cleaned with mineral spirits before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be chemically treated with crystalline zinc phosphate in strict accordance with the manufacturer’s recommendations. Surfaces shall not be painted when the temperature is, or is likely to be, near the freezing point, nor when they are exposed to hot sun.

3.04 IDENTIFICATION OF BOXES AND EQUIPMENT:
   A. After all painting is completed, operating and control parts of the equipment and systems shall be properly identified with laminated engraved plastic nameplates fastened with sheet metal screws, bolts or permanent adhesive. Pressure sensitive tape is not acceptable. Identification symbols or designations shall be the same as shown on the contract documents.
   B. Boxes; Concealed and Surface Mounted: Each enclosure shall be neatly identified by permanent marker, which shall indicate service contained, circuit numbers (or zone numbers). Letters shall be upper case (Capital) not less than one half inch high. All fire alarm system boxes, conduit, and box covers shall be painted red.
   C. See Section 26 05 53 for identification of conduit associated with these systems.
   D. The Division 28 Systems shall have an engraved informational laminated nameplate with the installing trade’s name, telephone number and address for the Owner to obtain preventive maintenance, service or parts. The nameplate shall include the job order number, shop number or other identification, which will identify the related equipment.

If the above address and telephone number is a branch office, the main office or manufacturer’s address and telephone number shall be included.
SECTION 28 3100
FIRE DETECTION AND ALARM

PART 1 – GENERAL

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

1.02 WORK INCLUDED:
A. Extend existing Edwards System 3 Voice Fire Alarm system with programming, devices, wiring, conduits, boxes and test system after adding new devices.
B. Program system to show fire alarm status and alarms at existing remote command center annunciator at the school's front vestibule and main fire alarm in the school’s MDF room. Indicated status and alarms on the new remote command center in the clinic.

1.03 RELATED WORK:
A. Division 23 – Heating, Ventilation, and Air Conditioning
B. Division 26 – Electrical
C. Division 27 - Communications
D. Section 28 05 00 – Common Work Results For Electronic Safety And Security
E. Section 28 05 26 – Grounding And Bonding For Electronic Safety And Security Systems
F. Section 28 05 53 – Identification For Electronic Safety And Security

1.04 GENERAL DESCRIPTION:
A. General: Provide parts and connections to extend an existing Edwards System 3 fire alarm system.
B. Provide the duct mounted smoke detectors indicated on Division 23 drawing.
C. Extend circuit for pull stations, speaker / strobes, strobes as shown on the drawings.
D. Provide wiring and programming for new devices.
E. Connect to new flow switches (FS) and Electrically Supervised Valves (ESVs).

1.05 SYSTEM OPERATION:
A. System operation is existing. Only extending horn strobes, strobes, heat detectors, smoke detectors, and etc., for a complete and functioning system with programming.

1.06 QUALITY ASSURANCE
A. Source Quality Control: Materials and equipment shall be new, unused and U.L listed for use as a Fire Protective Signalizing System. The Fire Alarm System shall be listed and on file with the U.L. “Certificate of Compliance” upon completion of the system.
B. The system and components shall be supplied by one single manufacturer of established reputation and experience who shall have produced similar apparatus and who shall be able to refer to similar installations rendering satisfactory service.
C. The installing trade shall furnish the services of the Fire Alarm System manufacturer’s authorized technical representative who is qualified in the installation ad operation of the system being provided, and who shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. This local authorized technical representative shall be:
   1. Factory trained and certified by manufacturer of the system being installed. Fire Alarm Trade shall submit “letter of certification” and proof of continuing education.
   2. An on-site National Institute for Certification in Engineering Technologies (NICET) Fire Alarm certified Level 3 Senior Engineering Technician to supervise on site NICET certified personnel.
3. Trained and qualified personnel employed by and organization listed by a national and Virginia recognized testing laboratory (U.L.) for the servicing of maintaining and testing of fire alarm systems.

D. Certification shall be submitted verifying the ‘Fire Alarm Trade’ is the manufacturer’s authorized dealer and installer has NICET certified personnel (indicate levels) and whose local project office is listed in the U.L. “Fire Protection Equipment Directory”.

E. The installing Trade shall furnish the services of the Fire Alarm System manufacturer’s authorized technical representative who is qualified in the installation and operation of the system being provided, and who is listed and on file with the Underwriters Laboratories (U.L.) Inc. The above Fire Alarm System manufacturers authorized technical representative shall be hereinafter known as the “Fire Alarm Technician” and his employer as the “Fire Alarm Trade”. The Fire Alarm Technician and his employer shall be capable of providing Underwriters Laboratories “Follow-Up Service” to identify that the fire alarm system is installed, tested and maintained in accordance with U.L.’s requirements and issue a U.L. “Certificate of Compliances” and NFPA-72 “Record of Completion”. The Fire Alarm Technician shall supervise the hook-up, final testing and adjustment of the system, and provide instruction to the Owner’s representative. The Fire Alarm System installation shall include wiring, components, connections, adjustment, testing and certification. The Installing Trade shall provide conduit, junction boxes and pull boxed as indicated; and required by Fire Alarm System manufacturer drawings or Fire Alarm Trade instructions. The Fire Alarm Trade shall furnish a low voltage wiring, special back boxes, cabinets, enclosures and similar items to the Electrical Trade for installation by the electrical trade in accordance with the fire alarm system manufacturer’s drawings, Fire Alarm Trade instructions, and as indicated.

F. The Fire Alarm Trade shall also furnish a list of similar or equal installations and shall show company experience in this type of work.

1.07 REFERENCES:

A. The complete installation, including additions and modifications, shall be in accordance with:
   5. Listed by Underwriters Laboratories, Inc.
   7. All of the above references shall be current issue in effect at time of bid.
   8. Authority having jurisdiction’s regulations, mandates and certification processes that are either part of applicable local government ordinance or applicable state law.

1.08 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 28 31 00.
   1. Shop Drawings: The Fire Alarm System manufacturer and Fire Alarm Trade shall provide a partial one-line riser diagram indicating route and conduit size, external wiring and connections of system proposed; furnish complete operating instructions, including schematic and wiring diagrams of the systems, engineering data sheets on each component and complete servicing data including part numbers of the various components. A schematic diagram of the complete systems is not shown on the contract documents.

   2. Product Data: Submit application, technical, and installation data.

B. Submit Operation and Maintenance Manuals in accordance with Section 28 31 00. The Operation and Maintenance Manuals’ shall include the documentation as described in the 2013 NFPA 72.

C. Substitution: Substitution not allowed due to the existing system extension.

1.09 WARRANTY, SERVICES:
A. The Fire Alarm System manufacturer and Fire Alarm Trade shall warrant this system for a minimum of one (1) year from date of acceptance by the Design Engineer and Owner against defective parts and/or workmanship and shall provide parts and labor to fulfill this warranty at no cost to Owner.

B. Refer to Division 1 for submission of warranty.

C. Qualified service and parts shall be available to call on within a 100 mile basis and respond within 72 hours.

D. The installing Trade shall include the cost of the above Fire Alarm System manufacturer’s authorized technical representative providing maintenance of the installed system for a period of one (2) years, after final acceptance, in compliance with the Underwriters Laboratories (U.L.) Guidelines. On-the-premises service furnished at other than normal working hours shall also be available and shall be charged at normal hour labor rates. The above representative shall be prepared to offer Owner a service contract after the warranty period has ended through the Owner’s procedural method and in accordance with NFPA 72.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:
A. The system specified herein is based on the arrangement of an existing Edwards System 3. The existing main fire alarm is located in the school’s existing MDF.

2.02 MAIN FIRE ALARM CONTROL PANEL:
A. Main FACP existing.

2.03 SYSTEM COMPONENTS:
A. Programmable Electronic speakers:
   1. Electronic sounders shall operate on 24 VDC nominal.
   2. Electronic audio sounders shall be field programmable without the use of special tools, at a sound level of at least 89 dBA measured at 10 feet from the device.
   3. Shall be flush mounted as shown on plans.

B. Strobe lights shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, 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.

C. Horn / Visual Combination Devices:
   1. Shall meet the applicable requirements of Section A listed above for audibility.
   2. Shall meet the requirements of Section B listed above for visibility.
   3. Horn / Visual devices shall be SpectrAlert series.

F. Heat Detectors addressable.
G. Duct Smoke Detector addressable.
H. Smoke Detectors addressable.
E. Field Wiring Terminal Blocks
   1. For ease of service 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 that are permanently fixed are not acceptable.

2.04 SYSTEM COMPONENTS - ADDRESSABLE DEVICES
A. Addressable Devices – General:
   1. Addressable devices shall use simple to install and maintain decade, decimal address
switches.

B. Addressable Double-Action Manual Fire Alarm Box (manual station)

1. Addressable manual fire alarm 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. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

3. Manual fire alarm boxes shall be 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, 1.75 inches (44 mm) or larger.

C. Intelligent Photoelectric Smoke Detector:

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.

D. Intelligent Smoke Detectors and Duct Smoke Detectors:

1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.

2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

E. Addressable Dry Contact Monitor Module:

1. Addressable monitor modules 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.

2. 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.

3. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

F. Two Wire Detector Monitor Module:

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).

2. The IDC zone may be wired for Class A or B (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.

G. 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.

2. 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.

3. 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.

4. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.
H. Addressable Relay Module:
   1. Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1.0 Amps inductive. 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.

I. 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 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 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.

J. 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.
   8. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

2.05 BATTERIES
   A. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.
   B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.
   C. If necessary to meet standby requirements, external battery and charger systems may be used.
   D. Verify current batteries and add as needed or replace existing batteries.

2.06 Programming of Fire Status: Program system to show fire alarm status and alarms at existing main fire alarm panel and remote command center displays. Units are in main school MDF room and main school front vestibule.
PART 3- EXECUTION

3.01 INSPECTION:
A. The Fire Alarm Trade shall be responsible for all arrangements for testing and approval of the Fire Alarm System by the Authority having jurisdiction before the Fire Alarm System is accepted by the Project Manager. Provide 48 hours notice to project manager prior to fire marshal inspection of the fire alarm system.

3.02 INSTALLATION
A. General: The Fire Alarm Trade shall provide all new equipment, accessories and material required for the installation of the fire alarm system in accordance with the specifications and drawings. Any material and/or equipment necessary for the proper operation of the system that is not specified or described herein shall be deemed part of this specification.

B. Wiring Methods:
1. All wiring methods shall be in accordance with NFDA-70, Article 760, and all other codes specified herein.
2. Provide proper number and size of wires as required for proper operation of the system in accordance with the system’s manufacturer’s instructions and the above codes.
3. All non-power limited wiring shall be installed in a separate conduit system, as specified in Section 26 05 19.
4. All shielded power limited cable shall be installed in a partial conduit system per NEC Article 760 and as specified in Section 26 05 23 for plenum and non-plenum applications.
5. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary fire protection functions shall be permitted in fire alarm conduits, (except in the cable hangers, in accordance with the NEC and if permitted by the TIA/EIA standards for compatibility with other listed TIA/EIA systems).
6. Wiring splices are to be avoided to the extent possible, and if needed they must be made only in junction boxes and shall be crimp connected.
7. Transposing or changing color coding of wires shall not be permitted.
8. Crimped type connections are not acceptable for final connections at terminating locations.
9. All conductors shall be labeled on each end with "E-Z markers" or equivalent.
10. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its termination.
11. Cabinet terminals shall be numbered. All controls, function switches, etc., shall be clearly labeled on all equipment panels.
12. All connections to panels, devices and detectors shall be made with screw terminal connections, or method approved by fire alarm manufacturer.
13. All wiring shall be checked and tested to insure that there are no grounds, opens or shorts.
14. All fire alarm addressable signal line circuits (SLC) shall be Style 6 (pre-1988 Class A). Return circuit route shall not be in the same conduit.
15. The wiring for the fire alarm system is not shown on the drawings. The actual circuit routing of the fire alarm system shall be by the Fire Alarm Trade based on the location of the devices, circuit limitations and wire limitations.
16. All fire alarm hard wired indicating appliance circuits (IAC) shall be style Z (pre-1988 Class A).
17. All fire alarm signal line circuits, and other wiring leaving the building location shall have surge arresters or transient protectors as required by U.L., NEC and equipment manufacturer.
18. All fire alarm systems' wiring 100 volts and less is part of Section 26 05 23. All fire alarm systems' wiring 101 volt and above is part of Division 26.
19. All boxes, conduits, etc., shall be of proper size, as determined by the Fire Alarm System Trade, shall be clearly marked for easy identification, continuously grounded together and bonded to the existing building grounding electrode system (BGES). The Fire Alarm Trade shall furnish special boxes to the Electrical Trade for installation by the Electrical Trade.

C. All smoke sensors shall be installed only after the final clean up by all of the Trades, but before inspection by the Local Authority Having Jurisdiction. No compensation shall be given for smoke sensors that are required to be replaced if installed before this date.

D. Each application for visual indicating appliances (strobe) intensity requirements shall meet or exceed ADAAG guidelines.

E. Programming of Fire Status: Program system to show fire alarm status and alarms at existing key by front vestibule.

3.03 TECHNICAL ASSISTANCE:

A. Instruction: The Fire Alarm Technician shall instruct the Authority having jurisdiction and the Owner and Fire Department personnel on the correct operation of the system after the installation is completed.

3.04 FIELD QUALITY CONTROL:

A. General: Upon completion of the installation, the Fire Alarm Systems Technician shall perform all necessary NFPA tests and adjustments. The above representative shall then submit a Record of Completion and an Underwriters Laboratories (U.L.) Certificate of Compliance to the Owner and Design Engineers that each system and the network functions and conforms to all the requirements of the manufacturer of the equipment, the Contract Documents, and all requirements of the Uniform Statewide Building Code including IBC 2015 acceptance test for the type of building in which the system is installed. The U.L. "Certificate of Compliance" shall be filed at U.L. for inspection by the insurance underwriters and all other authorities. The NFPA 72 "Record of Completion" shall be filed with the Local Authority having jurisdiction.

B. The Fire Alarm Technician shall perform all electrical and mechanical tests required by the fire alarm systems manufacturer's form. All test and report costs shall be in the Contract price. A checkout report shall be prepared by the installation technicians and submitted in triplicate, one copy of which will be registered with the equipment manufacturer. The report shall include, but not be limited to:

1. A complete list of equipment installed and wired.
2. Indication that all equipment is properly installed and functions and conforms with these specifications.
3. Tests of individual zones and addressable devices as applicable.
4. Serial numbers, locations by zone and model number for each installed detector.
5. Voltage (sensitivity) settings for each photoelectric detector as measured in place with the HVAC system operating.
6. IBC Acceptance Test
7. Technician's name, certificate number and date.

D. After completion of all tests and adjustments listed above, the Fire Alarm Trade shall submit the following information to the Design Engineers.

1. "As-built" conduit layout diagrams including wire color code and/or tag number.
2. Complete "as-built" wiring diagrams.
3. Detailed catalog data on all installed system components.
4. Copy of the test report described in Par. B.

E. Final tests and inspection shall be held in the presence of the Project Manager and to his or her satisfaction. The Fire Alarm Trade shall supply personnel and required auxiliary equipment for this test without additional cost.
F. The completed smoke detection system shall be tested to insure that it is operating properly. This test will consist of exposing the installed units to a standard fire test. Failure of the devices to sense the smoke shall be considered a failure of the system and all detectors in that system shall be readjusted or replaced. Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a ninety (90) day test period without any unwarranted alarms. Should an unwarranted alarm(s) occur, the Fire Alarm Trade shall readjust or replace the detector(s) and begin another ninety (90) day test period. As required by the Design Engineers, the Fire Alarm Trade shall recheck the detectors using the fire test after each readjustment or replacement of detectors. This test shall not start until Owner has obtained beneficial use of the building under tests.

G. If the requirements provided in the paragraph above are not completed within one (1) year after beginning the tests described therein, the Fire Alarm Trade shall replace the system with another acceptable manufacturer and the process repeated until acceptance of the equipment by the Design Engineers, Owner and Project Manager.

H. After completion of all tests and adjustments listed above, the Fire Alarm Trade shall turn over the Fire Alarm System data disk to the Owner. The data disk will be considered to be the property of the Owner upon acceptance of the Fire Alarm System by the Project Manager.

END OF SECTION