Specifications
for
807 N. Upper Broadway
Corpus Christi, Texas

ARCHITECT COORDINATED SPECIFICATIONS
ENGINEERING SPECIFICATIONS WERE WRITTEN
BY THOSE DISCIPLINES

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Contractor

It is the responsibility of the contractor to obtain a certificate for insurability from the State Board of Insurance.

Before a project is started, the contractor must submit a notice of intent to build or repair a structure, or add an addition using the State Board of Insurance form # WPI-1 to:

State Board of Insurance
Windstorm Section
Property Division
P.O. Box 2360
Austin, Texas  78768
800-248-6032
512-463-3004

or contact the local office at the following (the forms may also be obtained at the local office) at:

State Board of Insurance
Corpus Christi Office
615 Leopard, Suite 418
Corpus Christi, Texas  78476
512-881-9463 (WIND) PHONE NUMBER
512-881-9479 FAX NUMBER

If you have any questions regarding the procedures, please contact the local State Board of Insurance office.

END OF SECTION
SECTION 01 20 00
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Schedule of values.
B. Applications for payment.
C. Change procedures.
D. Defect assessment.

1.2 SCHEDULE OF VALUES
A. Submit printed schedule on AIA Form G703 - Continuation Sheet for G702.
B. Submit Schedule of Values in duplicate within 20 days after date of Owner-Contractor Agreement.
C. Format: Utilize Table of Contents of this Project Manual. Identify each line item with number and title of major specification Section. Identify site mobilization, bonds and insurance.
D. Revise schedule to list approved Change Orders, with each Application For Payment.

1.3 APPLICATIONS FOR PAYMENT
A. Submit three copies of each application on AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702.
B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
C. Submit updated construction schedule with each Application for Payment.
D. Payment Period: Submit at intervals stipulated in the Agreement.
E. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
   1. Partial release of liens from major subcontractors and vendors.
   2. Construction progress schedules, revised and current.

1.4 CHANGE PROCEDURES
A. Submittals: Submit name of individual authorized to receive change documents, and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
B. The Architect/Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions.

C. The Architect/Engineer may issue a Notice of Change including a detailed description of proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change with stipulation of overtime work required and the period of time during which the requested price will be considered valid. Contractor will prepare and submit estimate within 14 days.

D. Contractor may propose changes by submitting a request for change to Architect/Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation.

E. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.

F. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.

G. Change Order Forms: AIA G701.

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

I. Correlation Of Contractor Submittals:
   1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
   2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
   3. Promptly enter changes in Project Record Documents.

1.5 DEFECT ASSESSMENT

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

B. If, in the opinion of the Architect/Engineer, it is not practical to remove and replace the Work, the Architect/Engineer will direct appropriate remedy or adjust payment.

C. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.

D. Authority of Architect/Engineer and Owner to assess defects and identify payment adjustments, is final.

E. Non-Payment For Rejected Products: Payment will not be made for rejected products 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 transporting vehicle.
4. Products placed beyond lines and levels of required Work.
5. Products remaining on hand after completion of the Work.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION
SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Coordination and project conditions.

B. Preconstruction meeting.

C. Progress meetings.

D. Pre-installation meetings.

E. Cutting and patching.

F. Special procedures.

1.2 COORDINATION AND PROJECT CONDITIONS

A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.

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

D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.

E. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.

F. 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.
1.3 PRECONSTRUCTION MEETING

A. Architect/Engineer will schedule meeting after Notice of Award.

B. Attendance Required: Owner, Architect/Engineer, and Contractor.

C. Agenda:
   1. Submission of executed bonds and insurance certificates.
   3. Submission of list of Subcontractors, list of products, schedule of values, and progress schedule.
   5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   7. Establish rules for workers within the building and use of premises.
   8. Designate locations for site dumpster, staging, smoking, etc.

1.4 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at maximum biweekly intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

C. Attendance Required: Job superintendent, major subcontractors and suppliers, Architect/Engineer, as appropriate to agenda topics for each meeting.

D. Agenda:
   1. Review minutes of previous meetings.
   2. Review of Work progress.
   3. Field observations, problems, and decisions.
   4. Identification of problems impeding 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. Record minutes and distribute copies within two days after meeting to participants, with electronic copies to Architect/Engineer, Owner, and those affected by decisions made.
1.5 PRE-INSTALLATION MEETINGS

A. When required in individual specification sections, convene pre-installation meetings at Project site prior to commencing work of specific section.

B. Require attendance of parties directly affecting, or affected by, Work of specific section.

C. Notify Architect/Engineer four days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of installation, preparation and installation procedures.
   2. Review coordination with related work.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 CUTTING AND PATCHING

A. Employ original installer to perform cutting and patching.

B. Submit written request in advance of cutting or altering elements affecting:
   1. Structural integrity of element.
   2. Integrity of weather-exposed or moisture-resistant elements.
   3. Efficiency, maintenance, or safety of element.
   5. Work of Owner or separate contractor.

C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
   1. Fit the several parts together, to integrate with other Work.
   2. Uncover Work to install or correct ill-timed Work.
   3. Remove and replace defective and non-conforming Work.
   4. Remove samples of installed Work for testing.
   5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.

D. Execute work by methods to avoid damage to other Work, and to provide proper surfaces to receive patching and finishing.

E. Cut masonry and concrete materials using masonry saw or core drill.
F. Restore Work with new products in accordance with requirements of Contract Documents.

G. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 90 00, to full thickness of penetrated element.

J. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.

K. Identify hazardous substances or conditions exposed during the Work to Architect/Engineer for decision or remedy.

3.2 SPECIAL PROCEDURES

A. Materials: As specified in product sections; match existing with new products for patching and extending work.

B. Employ original installer to perform alteration work.

C. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.

D. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.

E. Remove debris and abandoned items from area and from concealed spaces.

F. Prepare surface and remove surface finishes to permit installation of new work and finishes.

G. Close openings in exterior surfaces to protect work from weather and extremes of temperature and humidity.

H. Remove, cut, and patch Work in manner to minimize damage and to permit restoring products and finishes to original or specified condition.

I. Where new Work abuts or aligns with existing, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.

J. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Architect/Engineer for review.
K. Where change of plane of 1/4 inch or more occurs, submit recommendation for providing smooth transition; to Architect/Engineer for review.

L. Patch or replace portions of surfaces which are damaged, lifted, discolored, or showing other imperfections.

M. Finish surfaces as specified in individual product sections.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittal procedures.
B. Construction progress schedules.
C. Proposed products list.
D. Product data.
E. Shop drawings.
F. Samples.
G. Design data.
H. Test reports.
I. Certificates.
J. Manufacturer's instructions.
K. Manufacturer's field reports.
L. Erection drawings.

1.2 SUBMITTAL PROCEDURES

A. Transmit each submittal with Architect/Engineer accepted form.
B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
C. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.
D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.
E. Schedule submittals to expedite Project, and deliver to Architect/Engineer at business address or via email. Coordinate submission of related items.
F. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.

G. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of completed Work.

H. Allow space on submittals for Contractor and Architect/Engineer review stamps.

I. When revised for resubmission, identify changes made since previous submission.

J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

K. Submittals not requested will not be recognized or processed.

1.3 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial schedules within 15 days after date of Owner-Contractor Agreement. After review, resubmit required revised data within ten days.

B. Submit revised Progress Schedules with each Application for Payment.

C. Distribute copies of reviewed schedules to Project site file, subcontractors, suppliers, and other concerned parties.

D. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

E. Submit computer generated horizontal bar chart with separate line for each major portion of Work or operation, identifying first work day of each week.

F. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.

G. Indicate estimated percentage of completion for each item of Work at each submission.

H. Indicate delivery dates for Owner furnished products and products identified under Allowances.

I. Revisions To Schedules:
   1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
   2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
   3. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect including effect of changes on schedules of separate contractors.
1.4 PROPOSED PRODUCTS LIST

A. Within 15 days after date of Owner-Contractor Agreement, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.5 PRODUCT DATA

A. Product Data: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Submit number of copies Contractor requires, plus digital copies Architect/Engineer will retain.

C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

1.6 SHOP DRAWINGS

A. Shop Drawings: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Submit number of opaque reproductions Contractor requires, plus digital copies that Architect/Engineer will retain.

1.7 SAMPLES

A. Samples: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Samples For Selection as Specified in Product Sections:
   1. Submit to Architect/Engineer for aesthetic, color, or finish selection.
   2. Submit samples of finishes from full range of manufacturers' standard colors or, custom colors selected, textures, and patterns for Architect/Engineer selection.

C. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

D. Include identification on each sample, with full Project information.
E. Submit number of samples specified in individual specification sections; Architect/Engineer will retain one sample.

F. Reviewed samples which may be used in the Work are indicated in individual specification sections.

G. Samples will not be used for testing purposes unless specifically stated in specification section.

H. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01 70 00.

1.8 DESIGN DATA

A. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.

B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.9 TEST REPORTS

A. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.

B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.10 CERTIFICATES

A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Architect/Engineer, in quantities specified for Product Data.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect/Engineer.

1.11 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, adjusting, and finishing, to Architect/Engineer for delivery to Owner in quantities specified for Product Data.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
1.12 MANUFACTURER'S FIELD REPORTS

A. Submit reports for Architect/Engineer's benefit as contract administrator or for Owner.

B. Submit report within 30 days of observation to Architect/Engineer for information.

C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.13 ERECTION DRAWINGS

A. Submit drawings for Architect/Engineer's benefit as contract administrator or for Owner.

B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

C. Data indicating inappropriate or unacceptable Work may be subject to action by Architect/Engineer or Owner.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION
SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality control and control of installation.
B. Tolerances
C. References.
D. Labeling
E. Testing and Inspection Services
F. Manufacturers' field services.
G. Examination.
H. Preparation.

1.2 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
B. Comply with manufacturers' instructions, including each step in sequence.
C. When manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer 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. Perform Work by persons qualified to produce required and specified quality.
F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.
G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
1.3 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. When manufacturers’ tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date for receiving bids, except where specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. When specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

E. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.5 LABELING

A. Attach label from agency approved by authority having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.

B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label.
   1. Model number.
   2. Serial number.
   3. Performance characteristics.

1.6 TESTING AND INSPECTION SERVICES

A. Employ and pay for services of an independent testing agency or laboratory acceptable to Owner to perform specified testing.
   1. Prior to start of Work, submit testing laboratory 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 Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of deficiencies reported by inspection.
B. The independent firm will perform tests, inspections and other services specified in individual specification sections and as required by Architect/Engineer and Authority having jurisdiction.
   1. Laboratory: Authorized to operate at Project location.
   2. Laboratory Staff: Maintain full time specialist on staff to review services.
   3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.

C. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by Architect/Engineer or Owner.

D. Reports will be submitted by independent firm to Architect/Engineer, Contractor, and authority having jurisdiction, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
   1. Submit final report indicating correction of Work previously reported as non-compliant.

E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify Architect/Engineer and independent firm 24 hours prior to expected time for operations requiring services.
   2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

F. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

G. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by Architect/Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

H. Agency Responsibilities:
   1. Test samples of mixes submitted by Contractor.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Architect/Engineer and Contractor of observed irregularities or non-conformance of Work or products.
   6. Perform additional tests required by Architect/Engineer.
   7. Attend preconstruction meetings and progress meetings.

I. Agency Reports: After each test, promptly submit electronic copies of report to Architect/Engineer, Contractor, and authority having jurisdiction. When requested by Architect/Engineer, provide interpretation of test results. Include the following:
   1. Date issued.
   2. Project title and number.
   3. Name of inspector.
4. Date and time of sampling or inspection.
5. Identification of product and specifications section.
6. Location in Project.
7. Type of inspection or test.
8. Date of test.
9. Results of tests.

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

1.7 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.

C. Refer to Section 01 33 00 - SUBMITTAL PROCEDURES, MANUFACTURERS' FIELD REPORTS article.

PART 2 PRODUCTS
Not Used.

PART 3 EXECUTION

3.1 EXAMINATION
A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify 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. Verify utility services are available, of correct characteristics, and in correct locations.
3.2 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 new material or substance in contact or bond.

END OF SECTION
SECTION 01 45 00

WINDSTORM CONSTRUCTION REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including general and supplements/conditions and other Division 1 specification sections, apply to this section.

1.2 SUMMARY

A. All components and cladding must meet or exceed the wind load requirements as specified in this section and on structural drawings.

B. Exterior wall and roof openings shall be protected with impact resistant covers or designed to meet impact resistance requirements.

C. Owner will reimburse contractor for Texas Department of Insurance Inspection services for Windstorm Certification on the exterior components and the structure. Contractor is responsible for all other costs related to Windstorm Certification including but not limited to, removal of non-conforming construction, additional fasteners, blocking or supports required by windstorm engineer.

D. Contractor shall be responsible for coordinating and scheduling the site inspections of the Windstorm Engineer.

1.3 DEFINITIONS

A. Components and cladding: elements assembled to form the exterior wall and roof systems that are either directly loaded by the wind or receive wind loads originating at relatively close locations, and that transfer those loads to the main wind force resisting system. Examples: Curtain walls, exterior glass windows and panels, roof sheathing, studs, soffits, etc.

B. Exterior wall and roof openings: openings that are likely to be breached during high winds. Examples: windows, doors, roof hatches, louvers, etc.

1.4 DESIGN REQUIREMENTS

A. Wind loads shall be determined from the pressures developed by a 120 mph wind velocity, (per TWIA), 155 MPH wind speed (per IBC 2015), Exposure C, risk category II, and appropriate shape factor from the American Society of Civil Engineers (ASCE) 7-93 “Minimum Design Loads for Buildings and Other Structures”.

B. Impact resistance shall be as determined by the Texas Windstorm Code.
1.5 SUBMITTAL

A. All components and cladding listed in the Texas Windstorm Approved Materials catalog shall have the appropriate product evaluation number indicated on the submittal.

B. Components and cladding not listed will require certification that they meet or exceed the design requirements of the section by the manufacturer.

C. Installation instruction indicating fasteners, minimum attachment requirements, and other necessary pertinent information for installation shall be submitted.

1.6 EXECUTION

A. The contractor shall provide, and have available at the job site, all necessary installation instruction during construction.

B. Prior to covering or concealing the fasteners or connectors, the contractor shall notify the Windstorm Engineer in time to allow for visual structural inspections by the Windstorm Engineer for the multiple inspections as required for Windstorm Certification by the Windstorm Engineer.

C. Contractor shall furnish, upon completion, written confirmation of the installation and materials used of all components and cladding is in conformance with requirements of this section to the structural engineer.

D. Contractor shall include cost of windstorm observations by approved professional engineer in bid documents.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary Utilities:
   1. Temporary electricity.
   2. Temporary lighting for construction purposes.
   3. Temporary heating.
   4. Temporary cooling.
   5. Temporary ventilation.
   6. Telephone service.
   7. Temporary sanitary facilities.

B. Construction Facilities:
   1. Field offices and sheds.
   2. Vehicular access.
   3. Parking.
   4. Progress cleaning and waste removal.
   5. Project identification.

C. Temporary Controls:
   1. Barriers.
   2. Enclosures and fencing.
   4. Water control.
   5. Dust control.
   7. Noise Control.
   8. Pest control.
   9. Pollution control.
  10. Rodent control.

D. Removal of utilities, facilities, and controls.

1.2 TEMPORARY ELECTRICITY

A. Complement existing power service capacity and characteristics as required for construction operations.

B. Provide power outlets, with branch wiring and distribution boxes located as required for construction operations. Provide flexible power cords as required for portable construction tools and equipment.
C. Provide main service disconnect and over-current protection at convenient location.

D. Do not disrupt Owner's use of service.

1.3 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain lighting for construction operations

B. Maintain lighting and provide routine repairs.

1.4 TEMPORARY HEATING

A. Existing facilities shall not be used.

B. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations. Provide separate metering and reimburse Owner for cost of energy used.

C. Prior to operation of permanent equipment for temporary heating purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

D. Maintain minimum ambient temperature of as required in areas where construction is in progress, unless indicated otherwise in product sections.

1.5 TEMPORARY COOLING

A. Existing facilities shall not be used.

B. Provide and pay for cooling devices and cooling as needed to maintain specified conditions for construction operations. Provide separate metering and reimburse Owner for cost of energy used.

C. Prior to operation of permanent equipment for temporary cooling purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

D. Maintain maximum ambient temperature as required in areas where construction is in progress, unless indicated otherwise in specifications.

1.6 TEMPORARY VENTILATION

A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
1.7  TELEPHONE SERVICE
A. Provide, maintain, and pay for telephone service to field office at time of project mobilization.

1.8  TEMPORARY SANITARY FACILITIES
A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of project mobilization.

1.9  FIELD OFFICES AND SHEDS
A. Office: Weather tight, with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture and drawing display table.
B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
C. Locate offices and sheds minimum distance of 30 feet from new structures.
D. Do not use permanent facilities for field offices or for storage.
E. Construction: Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations with steps and landings at entrance doors.
   1. Construction: Structurally sound, secure, weather tight enclosures for office and storage spaces. Maintain during progress of Work; remove when no longer needed.
   2. Fire Extinguishers: Appropriate type fire extinguisher at each office and each storage area.
F. Environmental Control:
   1. Heating, Cooling, and Ventilating for Offices: Automatic equipment to maintain comfort conditions.
   2. Storage Spaces: Heating and ventilation as needed to maintain products in accordance with Contract Documents; lighting for maintenance and inspection of products.
G. Storage Areas And Sheds: Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products to requirements of Section 01 60 00.
H. Preparation: Fill and grade sites for temporary structures sloped for drainage away from buildings.
I. Installation:
   1. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.
J. Removal: At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.
1.10 VEHICULAR ACCESS

A. Construct temporary access roads from public thoroughfares to serve construction area, of width and load bearing capacity to accommodate unimpeded traffic for construction purposes.

B. Extend and relocate vehicular access as Work progress requires, provide detours as necessary for unimpeded traffic flow.

C. Location approved by Architect/Engineer.

D. Provide unimpeded access for emergency vehicles. Maintain 20 feet wide driveways with turning space between and around combustible materials.

E. Provide and maintain access to fire hydrants and control valves free of obstructions.

F. Provide means of removing mud from vehicle wheels before entering streets.

1.11 PARKING

A. Provide temporary surface parking areas to accommodate construction personnel.

B. Locate as approved by Architect/Engineer and Owner.

C. When site space is not adequate, provide additional off-site parking.

D. Do not allow heavy vehicles or construction equipment in parking areas except when approved by Architect and proper temporary protection of existing surfaces is provided.

E. Maintenance:
   1. Maintain traffic and parking areas in sound condition.

F. Removal, Repair:
   1. Remove temporary materials and construction when permanent paving is usable.
   2. Remove underground work and compacted materials to depth of 2 feet; fill and grade site as specified.
   3. Repair facilities damaged by use, to specified condition.

G. Mud From Site Vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.12 PROGRESS CLEANING AND WASTE REMOVAL

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in 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 spaces.
C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site.

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

1.13 TRAFFIC REGULATION

A. Signs, Signals, And Devices:
   1. Post Mounted and Wall Mounted Traffic Control and Informational Signs: As approved by authority having jurisdiction.
   2. Traffic Cones and Drums, Flares and Lights: As approved by authority having jurisdiction.
   3. Flagperson Equipment: As required by authority having jurisdiction.

B. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

C. Flares And Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

D. Haul Routes:
   1. Consult with authority having jurisdiction, establish public thoroughfares to be used for haul routes and site access.
   2. Confine construction traffic to designated haul routes.
   3. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

E. Traffic Signs And Signals:
   1. Provide signs at approaches to site and on site, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
   2. Relocate as Work progresses, to maintain effective traffic control.

F. Removal:
   1. Remove equipment and devices when no longer required.
   2. Repair damage caused by installation.
   3. Remove post settings to depth of 2 feet.

1.14 ENCLOSURES AND FENCING

A. Construction: Commercial grade chain link fence

B. Provide 6 feet high fence around construction site; equip with vehicular gates with locks.

C. Interior/Exterior Enclosures:
1. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks where required for owner access to space.

2. Provide temporary partitions/barriers at interior and exterior of building as required to separate and protect openings created in the existing building from work areas, and to prevent dust, debris, rain or moisture from entering the existing owner occupied areas and to prevent damage to existing materials and equipment.

1.15 SECURITY

A. Security Program:
   1. Protect Work from theft, vandalism, and unauthorized entry.

B. Entry Control:
   1. Restrict entrance of persons and vehicles into Project site and existing facilities.
   2. Allow entrance only to authorized persons with proper identification.
   3. Maintain log of workers and visitors, make available to Owner on request.

1.16 WATER CONTROL

A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water.

1.17 DUST CONTROL

A. Execute Work by methods to minimize raising dust from construction operations.

B. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

1.18 EROSION AND SEDIMENT CONTROL

A. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.

B. Minimize surface area of bare soil exposed at one time.

C. Provide temporary measures including berms, dikes, and drains, and other devices to prevent water flow.

D. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
E. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

1.19 NOISE CONTROL

A. Provide methods, means, and facilities to minimize noise from adjacent spaces and noise produced by construction operations.

1.20 PEST CONTROL

A. Provide methods, means, and facilities to prevent pests and insects from entering facility.

1.21 POLLUTION CONTROL

A. 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.

B. Comply with pollution and environmental control requirements of authorities having jurisdiction.

1.22 RODENT CONTROL

A. Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

1.23 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.

B. Remove underground installations to minimum depth of 2 feet. Grade site as indicated on Drawings.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION
SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES
A. Products.
B. Product delivery requirements.
C. Product storage and handling requirements.
D. Product options.
E. Product substitution procedures.
F. Equipment electrical characteristics and components.

1.2 PRODUCTS
A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.
B. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS
A. Transport and handle products in accordance with manufacturer's instructions.
B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS
A. Store and protect products in accordance with manufacturers' instructions.
B. Store with seals and labels intact and legible.
C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
D. For exterior storage of fabricated products, place on sloped supports above ground.
E. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

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

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

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

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

1.5 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.6 PRODUCT SUBSTITUTION PROCEDURES

A. Architect/Engineer will consider requests for Substitutions only within 7 days prior to date of bid opening.

B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that Bidder or Contractor:
   1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
   2. Will provide same warranty for Substitution as for specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.
   5. Will reimburse Owner and Architect/Engineer for review or redesign services associated with re-approval by authorities having jurisdiction.
E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.

F. Substitution Submittal Procedure:
   1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
   2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
   3. Architect/Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used.

END OF SECTION
SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Closeout procedures.
B. Final cleaning.
C. Protecting installed construction.
D. Project record documents.
E. Operation and maintenance data.
F. Manual for materials and finishes.
G. Spare parts and maintenance products.
H. Product warranties and product bonds.

1.2 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect/Engineer's review.
B. Provide submittals to Architect/Engineer required by authorities having jurisdiction.
C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.3 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.
B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
C. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.
D. Replace filters of operating equipment.
E. Clean debris from roofs, gutters, downspouts, and drainage systems.
F. Clean site; sweep paved areas, rake clean landscaped surfaces.

G. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.4 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic from landscaped areas.

1.5 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed Shop Drawings, Product Data, and Samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. 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 main 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.

G. Submit documents to Architect/Engineer with claim for final Application for Payment.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit data bound in 8-1/2 x 11 inch (A4) text pages, three D side ring binders with durable covers.

B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.

C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

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

E. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, 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 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.
1.7 MANUAL FOR MATERIALS AND FINISHES

A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review draft and return one copy with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.

C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy to be reviewed and returned after final inspection, with Architect/Engineer comments. Revise content of document sets as required prior to final submission.

D. Submit two sets of revised final volumes in final form within 10 days after final inspection.

E. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Include information for re-ordering custom manufactured products.

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


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

I. Include listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.8 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance, and extra products in quantities specified in individual specification sections.

B. Deliver to Project site and place in location as directed by Owner; obtain receipt prior to final payment.

1.9 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.

B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.
C. Verify documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Include Table of Contents and assemble in three D side ring binder with durable cover.

F. Submit prior to final Application for Payment.

G. Time Of Submittals:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
   2. Make other submittals within ten 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 ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION
SECTION 05 50 01
MISCELLANEOUS METALS

PART 1 - GENERAL

1.1 SCOPE

A. Furnish all labor, materials, and equipment to provide complete, erected, in-place all miscellaneous metals required for the project.

B. This section includes, but is not limited to: (refer to drawings to determine applicability)
   1. Miscellaneous Building Elements
      a. Loose bearing and leveling plates
      b. Loose steel lintels, shelf angles, hang rods, etc.
      c. Steel framing and supports for mechanical and electrical equipment
      d. Furring steel and miscellaneous items definitely connected with structural members or indicated on structural drawings, including clip angles or other shapes or devices for attachment of wood or other members to structural steel.
      e. Steel framing and supports for applications where framing and supports are not specified elsewhere.
      f. All fabricated anchors, anchor bolts, bearing plate and connectors required for attaching and anchoring structural steel or wood or timber to steel, wood, concrete, or masonry.

   2. Steel Fabrications
      a. Pipe bollards
      b. Steel cut shapes
      c. Sidewalk trench covers

   3. Anchors, Nails and Bolts

1.2 QUALITY ASSURANCE/CODES AND STANDARDS

A. Comply with all pertinent codes and regulations.

B. The latest edition of the following publications shall become a part of this specification and structural steel shall comply with:
   1. American Institute of Steel Construction
   2. American Welding Society

C. Anchorage: Furnish anchor bolts, plates, and other connectors required for securing miscellaneous metals to foundations, walls, ceilings, and other in-place work. Anchor bars welded to embedded plates, unless otherwise noted, shall be deformed bar anchors welded to the plate in a manner such that the full tensile strength of the bar will be developed without failure of the weld or surrounding heat affection metal.

1.3 CONTRACTOR’S RESPONSIBILITIES

A. As scope and performance documents, the Drawings and Specifications do not necessarily indicate or describe all the work required for the performance and completion of the Work. Contracts will be let on the basis of such documents with the understanding that the Contractor shall furnish and install the items required for proper completion of the Work without adjustment to price or schedule. Work shall be of sound, quality construction and the Contractor shall be solely responsible for the inclusions of adequate labor and materials to cover the proper and timely fabrication and installation of the miscellaneous metal items indicated, described, or implied.
B. As a performance specification, the criteria for the solution of structurally sound miscellaneous metal items indicated on the Drawings or specified herein are the sole purpose of defining the design intent and performance requirements. The details shown are intended to emphasize the acceptable profiles and performance requirements for this Project. To avoid any misunderstanding or lack of interpretation, the Contractor is hereby advised that the responsibility for the miscellaneous metal items are totally his and that designs and resolutions proposed in the Contractor’s shop drawings, structural calculations, and related documentation shall be demonstrated throughout the Work and warranty period specified or required.

C. Design proposal submissions which follow exactly the details indicated on the Drawings, will not relieve the Contractor of his responsibility for the design, fabrication, erection, or performance of the Work of this Section.

D. In the event of a controversy over the design, the decision of the Architect shall take precedence and be final.

1.4 SUBMITTALS
A. Submit under provisions of Section 01 33 00.
B. Shop Drawings: Detailed drawings showing complete dimensions, all materials, mounting attachments, and fabrication details of all specific items contained within this specification.

PART 2 - PRODUCTS

2.1 MATERIALS
A. STEEL SHAPES, BARS, AND PLATES: ASTM A36
B. STRUCTURAL STEEL TUBING: ASTM A500, Grade B
C. STEEL PIPE: ASTM A53, Grade B
D. STANDARD THREADED FASTENERS: Standard bolts and nuts, ASTM A325F1852, Le Jeune tension control bolts or approved equal.
E. EXPANSION BOLTS: Power Fastener Calk-Ins, or Hilti Kwik Bolt 3
F. FILLER METAL FOR WELDING: Shielded metal-arc welding of Fy 36 and 50 ksi steels. Mild steel electrodes, AWS D5.1, AWS-ASTM classification E70xx.
G. HEADED STUD TYPE CONCRETE ANCHORS: Cold-finished carbon steel ASTM A108 as manufactured by the Nelson Stud Division, Gregory Industries, Inc.
H. PAINT SHOP COATING, FABRICATION TYPE: Rust-Oleum X-60 or 960, non-asphaltic base or TNEMEC #99 red metal primer. Dry film thickness shall be not less than 2 mils. All steel must be clean and free of dirt, rust, and oil before shop paint application.
I. NON-SHRINKING METALLIC GROUT: Embeco “Premixed Grout”, A. C. Horn’s “Vibrofoil”, or equal.
J. ANCHOR BOLTS: Conform to Section 1C of ASTM A307, 3⁄4” unless other as noted on drawings.

K. WIDE FLANGE SECTIONS: ASTM A992, Fy=50,000 psi.

L. STAINLESS STEEL: Comply with ASTM standards. Type 302 or 304 as applicable. Concealed finish to be No. 2D; Exposed finish to be No. 4 unless noted otherwise.

M. ALUMINUM: Type 6061 or 6063 as applicable. Concealed finish to be mill finish. Exposed finish to be Anodized or Kynar 500 or Hylar 5000 finish color as specified by Architect from manufacturer’s standard colors.

2.2 MISCELLANEOUS METAL ITEMS

A. Miscellaneous Metal Items include:

1. Beams, plates, tube and pipe columns.
2. Furring steel and miscellaneous items definitely connected with structural members or indicated on structural drawings, including clip angles or other shapes or devices for attachment of wood or other members to structural steel.
3. All loose lintels, shelf angles, hang rods, etc.
4. Miscellaneous steel fabricated items: steel gates; woven wire mesh screens; steel pipe railings/handrails/guards; metal window headers.
5. All fabricated anchors, anchor bolts, bearing plate and connectors required for attaching and anchoring structural steel or wood or timber to steel, wood, concrete, or masonry.
6. Galvanize all steel which is fully or partially exposed to weather, regardless if scheduled to receive a finish coat of paint.

B. Loose Steel Lintels:

1. Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
2. Weld adjoining members together to form a single unit where indicated.
3. Size loose lintels for equal bearing of 1 inch per foot (85 mm per meter) of clear span but not less than 8 inches (200 mm) bearing at each side of openings, unless otherwise indicated.
5. Galvanize all steel which is fully or partially exposed to weather, regardless if scheduled to receive a finish coat of paint.

C. Refer to 05 51 33 – Fixed Metal Ladders

D. Guard Post & Bollards:

1. Provide 6.625 inch or 4.5 inch, Schedule 40, hot-dipped galvanized steel pipe at locations as shown on the drawings.
2. Fill with 2500 psi concrete after installation and round off concrete top. Place in concrete footing as detailed on the drawings.

F. Sidewalk Trench Covers and Frames: Provide trench covers and frames at sidewalks where shown on drawings or required. Approved Product/Manufacturers: Type TGLB-10 as manufactured by McKinley Iron Works, Fort Worth, Texas; (800) 792-2273; Barrycraft Pedestrian-Handicap/Bicycle Trench Grating B-PED-A2 as manufactured by Barry Pattern & Foundry Company, Inc. Birmingham, Alabama (800) 524-1809; or Architect approved equal.
I. Nails: Size, type and finish for use intended to produce adequate strength to joints; shall draw members into place and hold.
   1. Length of nails shall be sufficient to extend 1-1/2” into supports. In general, 12-penny or larger nails shall be used for nailing through 3/4” thick lumber and for toe nailing 1-1/2” thick lumber; 16-penny or larger nails shall be used for nailing through 1-1/2” thick lumber.
   2. All nails used on exterior or exposed to moisture in interior shall be galvanized.
   3. All other nails shall be standard bright wire nails.
   4. Double headed nails shall be used for temporary work.

J. Anchor Bolts: Size and type detailed.
   1. 3/4” diameter, unless otherwise indicated, long enough to penetrate back up support with adequate space for nut and washer. Use washer under embedment end and under nut.

K. Provide toggle bolts for attachment of light objects or loads in cellular masonry construction.

L. Use nails or wood screws for attachment into wood studs or blocking.

M. Use expansion bolts for attachment into solid masonry.
   1. The use of plastic shields is prohibited.

N. Use stainless steel anchors (ASTM A153) on the exterior or where exposed to moisture. At roofing, use mechanical fasteners with a coating to comply with FM 447 and TDI windstorm requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instruction, and directions for installing anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

B. Set sleeves in concrete with tops flush with finish surface elevations. Protect sleeves from water and concrete entry.

3.2 INSTALLATION, GENERAL:

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation with edges and surfaces level, plumb, true, and free of rack and measured from established lines and levels.

C. Provide temporary bracing or anchors in form work for items that are to be built into concrete masonry or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
5. Install level, plumb, securely anchored in accordance to approved shop drawings.

F. Anchorage shall be of appropriate type for structure/material to which attached.

G. Isolate and separate dissimilar metals from galvanic action.

3.3 PAINTING:

A. Shop prime all surfaces scheduled to receive paint; touch up after installation all surfaces damaged during installation procedures.

B. Touch Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
   a. Apply by brush or spray to provide a 2.0 mil (0.05 mm) minimum dry film thickness.
   b. Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Division 9, Section 09 90 00 - Painting.

C. For galvanized surfaces, clean welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 05 50 00
PART 1 GENERAL

1.1 SUMMARY

A. Section includes steel stair frame of structural sections, with closed risers and open grate stair treads and landings.

B. Related Sections:
   1. Section 03 30 00 - Cast-In-Place Concrete
   2. Section 05 50 00 - Metal Fabrications
   3. Section 05 73 13 – Glazed Decorative Metal Railing
   4. Section 06 20 00 - Finish Carpentry
   5. Section 09 90 00 - Painting and Coating

1.2 REFERENCES

A. American National Standards Institute:

B. ASTM International:
   6. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   7. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
   8. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   11. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
1.3 DESIGN REQUIREMENTS

A. Fabricate stair assembly to support uniform live load of 100 lb/sq ft and concentrated load of 300 lb/sq ft with deflection of stringer or landing framing not to exceed l/360 of span.

B. Railing assembly, wall rails, and attachments to resist lateral force of 75 lbs at any point and concentrated lateral load of 200 pounds in any direction without damage or permanent set. Test in accordance with ASTM E935.

C. Fabricate stair assembly to NAAMM AMP 510, Class Architectural.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal requirements.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

C. Shop Drawings: Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths. Shop drawings shall be sealed and designed by professional engineer in the State of Texas.

D. Design Data: Submit design calculations with P.E. seal.

E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM E985 - Permanent Metal Railing Systems and Rails for Buildings.

B. Finish joints in accordance with NOMMA Guideline 1.

1.6 QUALIFICATIONS

A. Prepare Shop Drawings under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Texas.

1.7 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.
PART 2 PRODUCTS

2.1 METAL STAIRS

A. Manufacturers:
   1. American Stair Corp.
   2. The Sharon Companies Ltd.
   3. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

A. Structural W-Shapes: ASTM A992/A992M.
B. Structural T-Shapes: Cut from structural W-shapes.
C. Channels and Angles: ASTM A36/A36M.
D. Round Hollow Structural Sections: ASTM A500/A500M, Grade B.
E. Square and Rectangular Hollow Structural Sections: ASTM A500/A500M, Grade B.
F. Structural Pipe: ASTM A53/A53M, Grade B.
G. Tubing: ASTM A513, Type 5, minimum 50 ksi yield strength.
H. Structural Plates: ASTM A36/A36M.
I. Sheet Steel: ASTM A653/A653M, galvanized with G60 coating class.
J. Tread and Landing Concrete Reinforcement: Flat mesh type.
K. Bolts: ASTM A325 Type 1.
   1. Finish: Unfinished.
L. Nuts: ASTM A563 heavy hex type.
   1. Finish: Unfinished.
M. Washers:
   1. For ASTM A325 Bolts: ASTM F436; Type 1.
N. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; consistent with design of stair structure.
O. Welding Materials: AWS D1.1; type required for materials being welded.
P. Shop Primer: SSPC Paint 15, Type 1, red oxide.
Q. Touch-Up Primer: Match shop primer.
R. Stair Treads: Welded galvanized metal grate type as indicated in drawings.

2.3 FABRICATION

A. Fit and shop assemble components in largest practical sections, for delivery to site.
B. Fabricate components with joints tightly fitted and secured.
C. Continuously seal joined pieces by continuous welds.
D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
H. Accurately form components required for anchorage of stairs, landings and railings to each other and to building structure.

2.4 FABRICATION - PAN STAIRS AND LANDINGS

A. Fabricate stairs and landings with closed risers and treads of metal pan construction, ready to receive concrete.
B. Form treads and risers with minimum 10 gage sheet steel stock.
C. Secure reinforced tread pans to stringers with clip angles; welded in place.
D. Form stringers with 2”x12” H.S.S. sections.
E. Form landings with minimum 10 gage sheet stock. Reinforce underside with angles to attain design load requirements.

2.5 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
B. Do not prime surfaces in direct contact with concrete or where field welding is required.
C. Prime paint items with one coat.
D. Galvanizing: ASTM A123/A123M; hot dip galvanize after fabrication.
E. Galvanizing for Fasteners, Connectors, and Anchors:
   1. Hot-Dipped Galvanizing: ASTM A153/A153M.
2. Mechanical Galvanizing: ASTM B695; Class 50 minimum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive work.

C. Verify concealed blocking and reinforcement is installed and correctly located to receive wall mounted handrails.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be [cast into concrete] [and] [or] [embedded in masonry] with setting templates.

3.3 INSTALLATION

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

B. Install anchors, plates, angles and hangers required for connecting stairs to structure.

C. Allow for erection loads. Install sufficient temporary bracing to maintain framing safe, plumb, and in alignment.

D. Field weld components indicated on shop drawings. Perform field welding in accordance with AWS D1.1.

E. Field bolt and weld to match shop bolting and welding. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

F. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.

G. Obtain approval of Architect/Engineer prior to site cutting or creating adjustments not scheduled.

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

3.4 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

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

C. Maximum Offset From Alignment: 1/4 inch.
3.5 FIELD QUALITY CONTROL

A. Welding: Inspect welds in accordance with AWS D1.1.

END OF SECTION
SECTION 05 52 00

METAL RAILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes steel pipe and tube railings, balusters, and fittings; and handrails.

B. Related Sections:
   1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for placement of anchors specified in this section in concrete.
   2. Section 05 50 00 – Miscellaneous Metals
   3. Section 05 51 00 - Metal Stairs: Handrails other than those specified in this section.
   4. Section 09 90 00 - Painting and Coating: Paint finish.

1.2 REFERENCES

A. Aluminum Association:
   2. AA ASM 35 - Aluminum Sheet Metal Work in Building Construction.

B. American Architectural Manufacturers Association:
   1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.

C. ASTM International:
   3. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   6. ASTM B177 - Standard Guide for Chromium Electroplating on Steel for Engineering Use.

D. SSPC: The Society for Protective Coatings:
   1. SSPC - Steel Structures Painting Manual.
   2. SSPC Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
   3. SSPC Paint 20 - Zinc-Rich Coating, Type I - Inorganic and Type II - Organic.

1.3 DESIGN REQUIREMENTS

A. Design handrail, guardrail, and attachments to resist forces as required by applicable code. Apply loads non-simultaneously to produce maximum stresses.
   1. Guard Top Rail and Handrail Concentrated Load: 200 pounds applied at any point in any direction.
   2. Guard Top Rail Uniform Load: 50 pounds per linear foot applied in any direction.
   3. Intermediate Rails, Panels, and Baluster Concentrated Load: 50 pounds applied to 1 sf area.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal requirements.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1.5 QUALITY ASSURANCE

A. Perform Work for structural aluminum in accordance with AA ADM 1.

B. Finish joints in accordance with NOMMA Guideline 1.

C. Perform Work in accordance with State of Texas.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 HANDRAILS AND RAILINGS

A. Manufacturers:
   1. Blumcraft of Pittsburgh
   2. Hollaender Manufacturing Co.
   3. Substitutions: Section 01 60 00 - Product Requirements
2.2 STEEL RAILING SYSTEM COMPONENTS

A. Tubing: ASTM A513, Type 5, minimum 50 ksi yield strength.
B. Hollow Structural Sections: ASTM A500/A500M, Grade B.
D. Rails and Posts: Reference drawings for size thickness and types.
E. Fittings: Elbows, T-shapes, wall brackets, escutcheons; cast steel.
F. Mounting: Brackets and flanges, prepare backing plate for mounting in stud wall construction.
G. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.
H. Shop Primer: SSPC Paint 15, Type 1, red oxide.
I. Touch-Up Primer: Match shop primer.

2.3 FABRICATION

A. Fit and shop assemble components in largest practical sizes for delivery to site.
B. Fabricate components with joints tightly fitted and secured. Furnish spigots and sleeves to accommodate site assembly and installation.
C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
E. Interior Components: Continuously seal joined pieces by continuous welds.
F. 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.
G. Accurately form components to suit stairs and landings, to each other and to building structure.
H. Accommodate for expansion and contraction of members and building movement without damage to connections or members.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements : Coordination and project conditions.
B. Verify field conditions are acceptable and are ready to receive work.

C. Verify concealed blocking and reinforcement is installed and correctly located to receive wall mounted handrails.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete with setting templates, to appropriate sections.

3.3 INSTALLATION

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

B. Anchor railings to structure with anchors, plates.

C. Field weld anchors as indicated on shop drawings. Touch-up welds with primer. Grind welds smooth.

D. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

E. Assemble with spigots and sleeves to accommodate tight joints and secure installation.

3.4 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

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

C. Maximum Offset From Alignment: 1/4 inch.


3.5 SCHEDULES

A. Stairs 2 and 3: Round steel tube and pipe railing system, steel handrails, closed risers, primed finish.

B. Stair 1: Structural glass handrail and guardrail system. Precast terrazzo treads, open risers with metal screen infill.

END OF SECTION
SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY
A. Section includes miscellaneous framing and sheathing; telephone and electrical panel backboards; and concealed wood blocking for support of toilet and bath accessories, wall cabinets, wood trim, and other items of finish carpentry.

1.2 REFERENCES
A. ASTM International:
B. Southern Pine Inspection Bureau:
   1. SPIB - Standard Grading Rules for Southern Pine Lumber.
C. U.S. Department of Commerce National Institute of Standards and Technology:
   1. DOC PS 1 - Construction and Industrial Plywood.
   2. DOC PS 2 - Performance Standard for Wood-Based Structural-Use Panels.

1.3 QUALITY ASSURANCE
A. Perform Work in accordance with the following:
   4. Wood Structural Panels: DOC PS 1 or DOC PS 2.
B. In lieu of grade stamping exposed to view lumber and wood structural panels, submit manufacturer's certificate certifying Products meet or exceed specified requirements.
C. Fire Rated Wall Construction: Rating as indicated on Drawings.
D. Surface Burning Characteristics:
   1. Fire Retardant Treated Materials: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
PART 2 PRODUCTS

2.1 LUMBER MATERIALS
   
   A. Lumber Grading Rules: SPIB.
   
   B. Miscellaneous Framing: Stress Group D, Southern Yellow Pine species, 19 percent maximum moisture content.

2.2 SHEATHING MATERIALS
   
   A. Telephone and Electrical Panel Boards: ¾” thick Plywood.

2.3 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. Expansion shield and lag bolt type for anchorage to solid masonry or concrete. Bolt or ballistic fastener for anchorages to steel.

2.4 FACTORY WOOD TREATMENT
   
   A. Wood Preservative Pressure Treatment: AWPA U1, Commodity Specification A-Sawn Products or F-Wood Composites using water-borne SBX preservative.
   
   B. Wood Preservative (Surface Application); Clear type.
   
   C. Fire Retardant Treatment: Chemically treated and pressure impregnated, having flame spread of 25 or less when tested in accordance with ASTM E 84 and showing no evidence of significant progressive combustion when test is continued for an additional 20 minute period, Interior Type.
   
   D. Moisture Content After Treatment: Kiln dried (KDAT).
      1. Lumber: Maximum 19 percent.

PART 3 EXECUTION

3.1 SHEATHING
   
   A. Install telephone and electrical panel back boards with wood structural panel sheathing material where required. Size back boards a minimum 12 inches beyond size of electrical panel.
   
   B. Install ¾” thick plywood at walls of IT closets as directed by owner/telecom.
PART 1 – GENERAL

A. SECTION INCLUDES
   a. Related Requirements
   b. Reference Standards
   c. Submittals
   d. Quality Assurance
   e. Project Conditions
   f. Delivery, Storage and Handling
   g. Warranty
   h. ArmorWall – Manufacturer, Components, and Accessories
   i. Sequencing and General Execution
   j. Examination, Preparation and Installation
   k. Adjusting
   l. Field Quality Control
   m. Tolerance
   n. Protection

B. RELATED REQUIREMENTS
   a. Section 05 40 00 – Cold-Formed Metal Framing
   b. Section 07 21 16 – Blanket Insulation
   c. Section 07 62 00 – Sheet Metal Flashing and Trim
   d. Section 09 30 00 - Tiling
   e. Section 09 21 16 – Gypsum Board Assemblies

C. REFERENCE STANDARDS
   c. ASTM E2357, “Air Leakage of Building Assemblies”.
   h. Testing Application Standard (TAS) 203-94, “Criteria for Testing Products Subject to Cyclic Wind Pressure Loading”.

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D. SUBMITTALS
   a. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
   b. Manufacturer’s Product Data: Submit data for structural insulating sheathing and accessories. Include instructions for handling, storage, installation, and protection.
   c. Shop Drawings: Submit drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
   d. Manufacturer’s Installation Instructions: Indicate special handling criteria, installation sequence, cleaning procedures.
   e. Sample product warranty.

E. QUALITY ASSURANCE
   a. Field Quality Control Plan:
      i. Visually inspect fasteners, flashings, and waterproofing.
      ii. Photo document observations and maintain record of observations.
   b. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years’ experience.

F. PROJECT CONDITIONS
   a. Sheathing panels may be installed at any temperature.
   b. Special consideration shall be followed for accessory sealants. Follow manufacturer’s instructions for temperature limitations on seam sealant requirements.

G. DELIVERY, STORAGE AND HANDLING
   a. Transport and handle items in accordance with manufacturer’s instructions.
   b. Coordinate deliveries in order to avoid delay in, or impediment of, progress of the Work.
   c. Store packaged materials in original containers with seals unbroken and labels, including grade seal, intact until time of use, in accordance with manufacturer’s instructions. Do not stack.
   d. Store installation system materials in a dry location and handle in a manner to prevent chipping, breakage, and contamination.
   e. Store ArmorWall structural insulating sheathing boards off ground, under cover, and keep dry. Pallets shall sit on even gravel or concrete surface when able.
   f. Maximum panel stack height 30 panels. Do not double stack pallets.
   g. Long term panel storage shall be kept in a warehouse condition.
h. Protect latex additives, organic adhesives, epoxy adhesives and sealants from freezing or overheating in accordance with manufacturer’s instructions; store at room temperature when possible

H. WARRANTY
   a. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
   b. Provide manufacturer’s Limited Ten Year Warranty.

PART 2 – PRODUCTS

A. MANUFACTURERS
   a. MaxLife Industries: 4995 South Main Street, Salisbury, NC 28147;
      www.maxlifeindustries.com; 1-844-629-4968

B. COMPONENT BASIS OF DESIGN
   a. ArmorWall VP
      i. Magnesium Oxide Board (MgO) Facer; 1/2” thickness
      ii. Polyurethane Rigid Foam Insulation:
          1. Class 1 Rated Polyurethane R-Value 6.5/inch
          2. 2” thickness, R-10
      iii. Air and Weather Resistant Barrier: Factory applied Vapor Permeable Coating.
          1. Permeance when tested to ASTM E96 Method B: 18 Perms at 10 mils
      v. NFPA 285 approved test assembly demonstrating passing of sheathing directly to exterior of stud facing allowing any exterior non-combustible veneer application.

C. PANEL SIZE
   a. 4 feet by 8 feet
   b. Custom panels special order. Contact MaxLife Industries office at 704-636-2411.

D. ACCESSORIES
   a. Fasteners
      i. For attachment to Cold Formed Steel Studs
         1. Type: #14-13, self-drilling, pancake head fastener.
         2. Min embedment: Depth of steel stud plus three (3) threads.
         3. Supplied by structural insulating sheathing manufacturer.
      ii. For attachment to Wood Studs
         1. Type: #14-13, self-drilling, pancake head fastener.
         2. Min embedment: One (1) inch penetration into wood stud.
         3. Supplied by structural insulating sheathing manufacturer.
      iii. For attachment to Masonry Substrate
         1. Masonry Type with weather resistant coating.
         2. Min Embedment: One (1) inch into concrete or masonry.
         3. Supplied by structural insulating sheathing manufacturer.
   b. Joint and Fastener Head Treatment:
      i. ArmorSeal Sealant polyether gunnable sealant to grade and above applications.
      ii. ArmorSeal BG Sealant polyether below grade blends gunnable sealant for grade and below.
   c. Flashing:
i. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage (0.0239) inch (0.61 mm) 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.

d. Rough Openings:
   i. ArmorWall VP Return to be applied to all rough openings prior to waterproofing application.

PART 3 – EXECUTION

A. EXAMINATION
   a. Verify that surfaces and conditions are ready to accept the work of this section.
   b. Verify built-in items, penetrations and rough openings are correct and properly located.

B. PREPARATION
   a. Protect surrounding area from possible damage during installation of structural insulating sheathing.
   b. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
   c. If deficiencies exist, consult Architect. Correct deficiencies in accordance with manufacturer’s recommendations.
   d. Beginning installation constitutes Contractor’s acceptance of existing conditions.

C. SEQUENCING
   a. Material may be cut to using standard power hand tools prior to final installation.
   b. Coordinate installation of the structural insulating sheathing with related work.
   c. Proceed with the Work only when substrate construction and framing of openings have been completed.

D. GENERAL
   a. Structural insulating sheathing to be applied directly to exterior face of steel or wood studs with the rigid structural facing out and the insulation placed directly against the studs.
   b. Structural insulating sheathing may be attached to concrete and masonry foundation walls. Rigid structural exterior surface is designed to receive direct application of siding, synthetic stone, thin brick, or other exterior finish systems with mechanical attachment directly to sheathing up to 13 psf. Consult with manufacturer’s technical services for assemblies of heavier weights prior to installation.
   c. Do not install structural sheathing on to slopes less than a forty-five degree (12 inches of rise per 12 inches of run).

E. INSTALLATION
   a. Install materials in accordance with manufacturer’s instructions. No insulation shall be exposed after installation.
   b. Sheathing panels shall be installed in butt joint fashion with no gaps greater than 1/8”. Gaps greater than 1/8” require installation of low rise foam to maintain continuous insulation requirements of wall assembly.
   c. ArmorWall – Structural Insulating Sheathing
      i. Metal Studs
Install panels vertically or horizontally to stud with butt joints at all locations.

2. Layout should permit panel joints to occur on the face of a stud of butt joints that are parallel to panel edge.

3. Panel Perimeter Fasteners at four (4) inches O.C. minimum on the panel edge or as required by windstorm engineer.

4. Field fasteners shall be installed with square drive head:
   a. Studs at 16 inches O.C. or less: Minimum twelve (12) inches on each stud line.
   b. Studs at 24 inches O.C.: Minimum twelve (12) inches on each stud line.
   c. Fasteners shall be installed with inward face of fastener flush to face of structural sheathing with fastener slightly protruding outboard of board facing.
      i. Do not overtighten fasteners to a point that board face shows a visible dimple or crack.
      ii. Consult manufacturer’s technical services if countersinking of fasteners is desired.

5. Corner Condition; coordinate inside and outside corner installation for interlocking panel seam layout.
   a. Outside Corners- Miter both panels with power saw prior to installation so that outer structural face meets on each panel leaving no exposed insulation. Seal joints, seams, and all fastener penetrations with ArmorWall Sealant.
   b. Inside Corner- Weave one corner behind and then butt joint following panel and seal with ArmorWall Sealant.

6. All joints, seams and fasteners shall be sealed.
   a. Gunnable Polyether Sealant Method
      i. At grade and above with ArmorWall Sealant.
      ii. At grade and below with ArmorWall BG Sealant.
      iii. Exception: Do not seal control joints, expansion joints, and intentional flashing weeps.
      iv. Apply gunnable sealant to seam with zig zag pattern across entire joint line and immediately strike with six inch drywall knife.
         1. Ensure that sealant is continuous with no voids or holidays through the entire seam line.
         2. Maintain at least 1” continuous bead of sealant on to each panel face surface to create a minimum of 2” wide seam joint.
         3. Seams greater than 1/8” in width require backer rod material to be installed prior to application of sealant.
      v. Apply gunnable sealant to all exposed fastener heads with sufficient sealant to fully encapsulate fastener upon completion.
1. Immediately strike each fastener head with six inch drywall knife to fully cover fastener penetration.

b. Sealants and/or coatings shall be applied in smoothest way possible to buck as little water as possible shedding down vertical facing of sheathing.

7. Rough Opening and Large Penetration Conditions
   a. ArmorWall Return to surround all rough openings through the entire face of exposed structural member with no insulation left exposed.
   b. Form butt joint with new structural insulated sheathing to return rigid face around the entire rough opening.
   c. Mechanically attach return to structural face of rough opening in offset fastening for entire run of opening face at eight (8) inches on center.
   d. Treat outer face seam with sealant on return and outer structural insulating sheathing with a minimum of one (1) inch of sealant on to each face.
   e. No insulation shall be left exposed and returns shall be installed at all rough openings or any openings that can’t be immediately flashed with liquid flashing materials.

8. Small Penetration Condition
   a. Small Penetration (6” dia. or less): Liquid flashing with polyether sealant in a cove joint sealing penetration to surface face of structural insulating sheathing.

9. At Grade and Below Grade
   a. Use only manufacturer approved below grade materials capable of withstanding constant hydrostatic water pressure. Materials must be specifically labeled for Below Grade use.

d. Veneer cladding system installation
   i. Mechanical Attachment
      1. Install materials in accordance with manufacturer’s instructions.
      2. Cladding attachment shall be applied per project specific ASCE 7 calculations provided by Designer of Record for wind loading and deflection criteria.
      3. Lightweight Claddings (three (3) to seven (7) pounds per square foot)
         a. Attach anchors directly to structural insulating sheathing with ArmorWall Attachment Screw.
         b. Screw shall penetrate structural face of insulating sheathing with a minimum embedment of one-half (1/2) inch into polyurethane insulation.
         c. Attach a minimum of one (1) screw per square foot.
         d. Other systems should consult manufacturer’s technical services prior to installation.

F. ADJUSTING
   a. Cutting and Fitting: Cut and fit for chases, pipes, conduit, sleeves and grounds. Coordinate with other sections of work to provide correct size, shape and
location. Maximum 1/8 “gap. Seal gap with appropriate sealant per location requirements.

G. FIELD QUALITY CONTROL/ TOLERANCES
   a. See Section 01 40 00 – Quality Requirements, for additional requirements.
   b. Perform field quality control inspection as specified in Part 1, Quality Assurance.

H. TOLERANCE
   a. Joint thickness: No gaps greater than ¼ inch allowed without installation of supplemental low rise field applied foam insulation and backer rod for sealants.

I. PROTECTION
   a. During erection, cover top of walls with waterproof sheeting at end of each work day. Cover partially completed walls when work is not in progress.
   b. Do not leave factory coated air and weather barrier surfaces exposed to weather longer than one hundred eighty (180) days without approval from manufacturer.
   c. Structural Insulating Sheathing boards without a factory applied air and water barrier shall be covered within sixty (60) days after installation.
   d. Do not permit installed materials to be damaged prior to concealment.

END OF SECTION 06 16 13
SECTION 06 41 00
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SUMMARY

A. Section includes custom-fabricated cabinet units; counter tops; cabinet hardware; preparation for installing utilities in cabinets; and site finishing.

B. Related Sections:
   1. Section 06 10 53 – Miscellaneous Rough Carpentry.
   2. Section 09 90 00 - Paints and Coatings: Site finishing of cabinet exterior and interior.
   3. Division 22 Sections: Plumbing utilities and fixtures.
   4. Division 26 Sections: Power, signal, and data wiring.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A156.9 - Cabinet Hardware.
   2. ANSI A208.1 - Mat-Formed Wood Particleboard.

B. Architectural Woodwork Institute:
   1. AWI - Quality Standards Illustrated.

C. Federal Specification Unit:

D. National Electrical Manufacturers Association:
   1. NEMA LD 3 - High Pressure Decorative Laminates.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.

C. Product Data:
   1. Submit data for hardware accessories.
   2. Submit data for high pressure decorative laminates.
1.4 QUALITY ASSURANCE
   A. Perform work in accordance with AWI (Architectural Woodwork Institute) Architectural
      Woodwork Quality Standards Illustrated, Custom Grade.

1.5 QUALIFICATIONS
   A. Fabricator: Company specializing in performing Work of this section with minimum
      three years documented experience.

1.6 PRE-INSTALLATION MEETINGS
   A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
   B. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING
   A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
   B. Protect units from moisture damage.

1.8 ENVIRONMENTAL REQUIREMENTS
   A. Section 01 60 00 - Product Requirements.
   B. During and after installation of Work of this section, maintain same temperature and
      humidity conditions in building spaces as will occur after occupancy.

1.9 FIELD MEASUREMENTS
   A. Verify field measurements prior to fabrication. Indicate field measurements on shop
      drawings.

PART 2 PRODUCTS

2.1 MATERIALS
   A. General: Provide materials that comply with requirements of the AWI quality standard
      for each type of woodwork and quality grade specified, unless otherwise indicated.

   B. Wood Products: Comply with the following:
      1. Hardboard: AHA A135.4
      3. Particleboard: ANSI A208.1, Grade M-2

   C. Hardwood Lumber
1. Quality standard: FS MM-L-736C
2. Grading standard: AWI custom grade.
4. Species and Grain: Refer to Finish Schedule

D. Hardwood Plywood
1. Quality standard: PS51.
3. Core material: Lumber.
4. Face veneer and Grain: Refer to Finish Schedule
5. Ply Construction:
   a. 3 ply: 3/8 inch
   b. 5 ply: 1/2 inch
   c. 7 ply: 3/4 inch

E. Thermoset Decorative Overlay (Melamine): Particleboard complying with ANSU A208.1, Grade M-2, or medium-density fiberboard complying with ANSU A208.2, Grade MD, with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
   a. Arpa USA.
   b. Formica.
   c. Pionite.
   d. Nevamar.
   e. Wilsonart.

G. Quartz Countertop Surfaces: Reference drawings for quartz countertop locations. See related specification section 12 36 61.

H. Edging for Door and Drawer Fronts and Plastic Laminate Countertops: 3mm color coordinated PVC, unless noted otherwise; adhesive applied.

I. Sheet Metal Components: Stainless steel, Type 304 with #4 satin finishes.

J. Casework Construction Details:
2. Drawer and Door Edge Profile: Square with thin applied band.
3. Toe Base Finish: to match doors or adjacent material.

2.2 ACCESSORIES

A. Adhesive for High Pressure Decorative Laminates: Type recommended by laminate manufacturer to suit application.
B. Veneer Edge Band: Standard wood veneer edge band matching face veneer or as indicated on the drawings.

C. Fasteners: Size and type to suit application.

D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application

E. Concealed Joint Fasteners: Threaded steel.

F. Grommets: Plastic material typical for cut-outs at work counters.
   1. Provide 6” diameter stainless steel grommet at trash holes in restrooms.

G. Shelf Standards and Rests: Drilled holes for spoon shaped rests spaced at 1 inch centers; satin finish.

H. Shelf Brackets: Formed steel brackets, formed for attachment with lugs; satin finish.

I. Drawer and Door Pulls: "U" shaped pull, aluminum with satin finish, 4 inch centers.

J. Sliding Door Pulls: Circular shape, aluminum with satin finish.

K. Cabinet Locks: Keyed cylinder, two keys for each lock, master keyed, steel with satin finish.

L. Catches: Magnetic.

M. Drawer Slides: Galvanized steel construction, ball bearings separating tracks, full extension type.

N. Hinges: Concealed type hinge for overlay door, by Blum or approved equal, chrome satin finish.

O. Sliding Door Track Assemblies: Galvanized steel construction, ball bearing carriers fitted within tracks, multiple pendant suspension attachments for door.

2.3 FABRICATION

A. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.

B. Fit shelves, doors, and exposed edges with matching veneer edging. Use one piece for full length only.

C. Cap exposed high pressure decorative laminate finish edges with material of same finish and pattern.

D. Door and Drawer Fronts: 3/4 inch thick; overlay style.
E. When necessary to cut and fit on site, fabricate materials with ample allowance for cutting. Furnish trim for scribing and site cutting.

F. Apply high pressure decorative laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

G. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.

H. Fabricate cabinets and counter tops with cutouts for plumbing fixtures, inserts, appliances, outlet boxes, fixtures and fittings, and bank equipment. Verify locations of cutouts from on-site dimensions. Seal cut edges.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify adequacy of backing and support framing.

C. Verify location and sizes of utility rough-in associated with work of this section.

3.2 INSTALLATION

A. Set and secure casework in place; rigid, plumb, and level.

B. Use fixture attachments in concealed locations for wall mounted components.

C. Use concealed joint fasteners to align and secure adjoining cabinet units and counter tops.

D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

E. Secure cabinet and counter bases to floor using appropriate angles and anchorages.

F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.3 ADJUSTING

A. Section 01 70 00 - Execution Requirements: Testing, adjusting and balancing.

B. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

A. Section 01 70 00 - Execution Requirements: Final cleaning.
B. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section includes rigid board insulation at roofs behind cover board/roof finish.

B. Related Sections:
   1. Section 06 16 43 – Gypsum Sheathing
   2. Section 07 21 16 - Blanket Insulation.
   3. Section 07 27 00 - Air Barriers: Air seal materials to adjacent insulation.

1.2 REFERENCES

A. ASTM International:

1.3 SYSTEM DESCRIPTION

A. Materials of This Section: Provide continuity of thermal barrier at building enclosure elements in conjunction with thermal insulating materials in Section 07 21 16.

B. Materials of This Section: Provide thermal protection to air seal materials at building enclosure elements in conjunction with air barrier materials in Section 07 27 00.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on product characteristics, performance criteria, limitations and adhesives.

C. Manufacturer's Installation Instructions: Submit special environmental conditions required for installation and installation techniques.

1.5 QUALITY ASSURANCE

A. Insulation Installed in Concealed Locations Surface Burning Characteristics:
   1. Foam Plastic Insulation: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
2. Other Insulation: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

B. Insulation Installed in Exposed Locations Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

C. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install adhesives when temperature or weather conditions are detrimental to successful installation.

1.7 SEQUENCING

A. Sequence Work to ensure air and vapor barrier materials are in place before beginning Work of this section.

1.8 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with Section 07 27 00 for air seal materials.

PART 2 PRODUCTS

2.1 BOARD INSULATION

A. Manufacturers:
   1. DiversiFoam Products - Extruded-Polystyrene Insulation
   2. Dow Chemical - Extruded-Polystyrene Insulation
   3. Tenneco Foam Products - Extruded-Polystyrene Insulation
   4. UC Industries/Owens Corning - Extruded-Polystyrene Insulation
   5. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

A. Extruded Polystyrene Insulation: ASTM C578 Type VI; cellular type, conforming to the following:
   1. Board Size: 4 feet x 8 feet
   2. Board Thickness:
      a. 4.5 inches total thickness for roof
   3. Thermal Resistance:
      a. R 25 minimum total thermal resistance at roof
4. Water Absorption: In accordance with ASTM D2842; 0.3 percent by volume maximum.

2.3 ACCESSORIES

A. Adhesive Type 1: Type recommended by insulation manufacturer for application.

B. Insulation Fasteners: Steel fasteners with polymer coated finish and metal plate washer, to be mechanically fastened to surface to receive board insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place and meeting windstorm requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify substrate, adjacent materials, and insulation boards are dry and ready to receive insulation.

C. Verify substrate surface is flat, free of materials or substances affecting adhesive bond.

3.2 INSTALLATION - ROOFS

A. Install boards on roof surface using adhesive and mechanical fasteners to affix insulation to metal roof deck. Installation shall be approved by wind storm inspector.

B. Place boards in method to maximize contact bedding. Stagger end joints. Butt edges and ends tight to adjacent board and to protrusions.

C. Cut and fit insulation tight to protrusions or interruptions to insulation plane.

3.3 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Do not permit damage to insulation prior to covering.

END OF SECTION
SECTION 07 21 16
BLANKET INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes batt insulation in exterior wall, acoustical interior walls and batt insulation for filling perimeter window and door shim spaces, crevices in exterior wall and roof.

B. Related Sections:
   1. Section 07 21 13 – Board Insulation
   2. Section 07 27 00 - Air Barriers: Air barrier materials adjacent to insulation.
   3. Section 07 84 00 - Firestopping

1.2 REFERENCES

A. American Society for Testing and Materials:

B. Underwriters Laboratories Inc.:

1.3 SYSTEM DESCRIPTION

A. Materials of This Section: Provide continuity of thermal barrier at building enclosure elements in conjunction with thermal insulating materials in Section 07 21 13.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on product characteristics, performance criteria, limitations.

1.5 QUALITY ASSURANCE

A. Insulation Installed in Concealed Locations Surface Burning Characteristics:
   1. Batt Insulation: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

B. Insulation Installed in Exposed Locations Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
1.6 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate the Work with Section 07 27 00 for air seal materials.

PART 2 PRODUCTS

2.1 BATT INSULATION

A. Manufacturers:
   1. CertainTeed Insulation.
   2. Johns Manville.
   4. Owens Corning Fiberglas.
   5. U.S. Gypsum Co. Thermafiber LLC.
   6. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

A. Batt Insulation: ASTM C665; preformed glass fiber batt; friction fit, conforming to the following:
   1. Thermal Resistance: R as indicated in schedule below.
   2. Batt Size: 16 x 96 inch.
   4. Flame/Smoke Properties: 25/50 in accordance with UL 723.

B. Sound Attenuation Batts:
   1. Thermal Resistance: R as indicated in schedule below.
   2. Batt Size: 16 x 96 inch.
   4. Flame/Smoke Properties: 25/50 in accordance with UL 723.

C. Insulation Fasteners: Steel impale spindle and clip on flat metal base, self adhering backing, length to suit insulation thickness, capable of securely and rigidly fastening insulation in place.

D. Wire Mesh (where required): Galvanized steel, hexagonal wire mesh.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify substrate, adjacent materials, and insulation are dry and ready to receive insulation.
3.2 INSTALLATION

A. Install in exterior walls and roof spaces without gaps or voids. Do not compress insulation. Install sound control insulation in interior walls of toilet rooms, mechanical rooms and as indicated on drawings.

B. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

C. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within plane of insulation.

D. Where required, retain in place with wire mesh secured to framing members.

E. Coordinate Work of this section with construction of air barrier seal specified in Section 07 27 00.

3.3 SCHEDULES

A. Exterior Wall Insulation: R13 roll, unfaced.

B. Interior Wall Insulation: R11 batt, unfaced; sound attenuation batts.

END OF SECTION
SECTION 07 54 00
THERMOPLASTIC MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Installation of one layer of roof high thermal insulation, tapered crickets and high density cover board, all mechanically attached to a metal roof deck.

2. New mechanically fastened 60 mil reinforced TPO thermoplastic single ply system utilizing heat-welded seams and prefabricated flashing accessories. TPO-coated sheet metal flashing where recommended by manufacturer and required for proper termination.

3. Applicator is solely responsible for accuracy of all measurements and estimates of material, quantities, and sizes.

B. Related Sections include the following:

1. Section 06 10 53 - Miscellaneous Rough Carpentry
2. Section 07 62 00 - Sheet Metal Flashing and Trim
3. Section 07 71 23 – Manufactured Gutters and Downspouts
4. Section 07 72 00 - Roof Accessories

1.2 DEFINITIONS


1.3 PERFORMANCE REQUIREMENTS

A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
C. Jobsite Safety: Execute all operations and provide a safe work environment in accordance to OSHA standards and regulations. This requirement applies to all contractor personnel, associated subcontractors, workers in other trades, and jobsite visitors.

1. Follow all industry fire prevention guidelines for storage of materials, staging areas, roof access, and application means and methods.

2. Any applicable local fire codes supersede industry guidelines.

D. Roofing System Design: Provide a roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE 7-10.

1. Provide roof systems in conformance with the following wind uplift values:
   a. Field: 41.8 psf
   b. Perimeter: 70.1 and 60.2 psf
   c. Corners: 105.6 and 99.2 psf

2. Reference structural drawings for additional load and design criteria.

E. Hail Resistance Characteristics: Provide roofing materials with the hail resistance characteristics indicated as determined by testing identical products per test method indicated below by UL, FM, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate marking of applicable testing and inspection agency.


1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Manufacturer’s recommended methods of installation and data to demonstrate compliance with specified requirements.

C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.

1. Base flashings, cants, and membrane terminations.

2. Tapered insulation, including slopes.

3. Crickets, saddles, and tapered edge strips, including slopes.

4. Insulation fastening patterns.

D. Samples for Verification: For the following products:
1. Manufacturer’s standard sample size of smooth-surfaced roofing membrane sheet & flashing backer sheet.

2. Manufacturer’s standard sample size of walkway pad or cap sheet walkway.

E. Qualification Data: Letter from manufacturer referencing project and stating that the specified system will qualify for all specified guarantees / warranties when the system is installed by the roofing contractor.

F. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is currently approved, authorized, or licensed by roofing system manufacturer, in writing, to install manufacturer's product and that is eligible to receive manufacturer's warranty.

B. Manufacturer Qualifications: A qualified manufacturer that has UL listing for roofing system identical to that used for this Project.

1.6 PRE-ROOFING CONFERENCE

A. Before starting roof deck construction, conduct conference at Project site. Comply with requirements for preinstallation conferences in Division 01 Section "Project Management and Coordination." Review methods and procedures related to roof deck construction and roofing system including, but not limited to, the following:

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.

2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.

3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.

5. Review structural loading limitations of roof deck during and after roofing.

6. Require that all complimentary trades be present at conference. Including, but not limited to; electrical, plumbing, HVAC, and framing contractors.

7. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

8. Review governing regulations and requirements for insurance and certificates if applicable.
9. Review temporary protection requirements for roofing system during and after installation.

10. Review roof observation and repair procedures after roofing installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Provide manufacturer's system guarantee equal to Johns Manville's Fifteen (15) Year Peak Advantage No Dollar Limit Roofing System Guarantee.

1. Guarantee to cover all components in the roofing system, including, but not limited to roof insulation, insulation fasteners, adhesives, sealants, field and flashing membrane, and primary manufacturer-supplied roof expansion joints.

2. Warranty Period: 15 years from date of Substantial Completion.

B. Installer’s Guarantee: Submit roofing Installer's warranty, signed by Installer, covering Work of this Section, including all components of roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Approved manufacturers

2. Versico Inc – Versiweld TPO Roof Membrane
3. Substitutions: Section 01 60 00 – Product Requirements.

2.2 MATERIALS

A. Insulation Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470. Screws and metal plates shall be tested and approved by Dade County in accordance with their standard and listed in the current Approval Guide as such. Shall be approved by membrane manufacturer.

B. Tapered Insulation: ASTM C 1289, provide factory-tapered insulation boards fabricated to slope of 1/4” per foot. Basis of Design: Tapered ENRGY 3.

C. Roof Insulation: Preformed roof insulation boards that comply with requirements and referenced standards. Polyisocyanurate board insulation. ASTM C 1289. Roof shall have a minimum R-Value of 25. Approximate thickness of 4.5 inches, verify with manufacturer. JM ENERGY 3.

D. Cover Board: High density polyisocyanurate foam cover board as approved by primary roofing manufacturer. 5/8 inch thickness.

E. Membrane Roofing:

1. Cover areas with mechanically attached roof system. Seams shall be completed by heat-welding in strict compliance with manufacturer’s published recommendations. Flashings shall be JM TPO Membrane or JM TPO=Clad Metal as required and illustrated in Johns Manville’s published specifications.


3. Initial Solar Reflectivity of 0.77 minimum. 3 Year aged solar reflectivity of 0.70 minimum.


5. Field Seams shall be heat welded.

6. Edge Sealant: To be used at all non-factory edges and at endlaps. Johns Manville TPO Sealant.
F. Base Flashing:
   1. Flashings shall be Johns Manville TPO reinforced 60 mil field membrane along with the appropriate JM TPO accessories. Pre-formed inside and outside corners are required.
   2. Pipe Boots shall be Johns Manville TPO Vent Pipe Boots.
   3. Adhesives and miscellaneous sealants should be used as called for in the manufacturer’s specifications.

G. Roof Walk: Pre-formed TPO walkpads as supplied by roofing manufacturer.


I. All other materials not specifically described, but required for a complete and proper installation of roofing, shall be selected by approved manufacturer and subject to approval of Architect/Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
   1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
   2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
   3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."

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

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.
3.3 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck according to recommendations in FMG's "Approval Guide" for specified Windstorm Resistance Classification.

2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturer's written instructions.

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

3.4 INSULATION AND COVER BOARD INSTALLATION

A. Coordinate installing roof system components so insulation and cover board is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system manufacturer's written instructions for installing tapered roof insulation.

C. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing membrane system with vertical surfaces or angle changes greater than 45 degrees per manufacturer's instruction.

D. Install tapered insulation under area of roofing to conform to slopes indicated.

E. Install boards with long joints in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with like material.

1. Cut and fit boards within 1/4 inch (6 mm) of nailers, projections, and penetrations.

F. Trim surface of boards where necessary at roof drains so completed surface is flush and does not restrict flow of water.

G. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

H. Mechanically Fastened Insulation and Cover Board: Secure uppermost layer to deck using mechanical fasteners specifically designed and sized for fastening specified board-type to deck type. Loose lay all other layers below with staggered joints.

1. Fasten according to requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification.

2. Fasten to resist uplift pressure at corners, perimeter, and field of roof.

I. Proceed with installation only after unsatisfactory conditions have been corrected.
3.5 ROOFING MEMBRANE INSTALLATION, GENERAL

A. Install roofing system specification according to roofing system manufacturer's written instructions, applicable recommendations of Johns Manville, and requirements in this Section.

B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.

C. Where roof slope exceeds 1/2 inch per 12 inches (1:24), contact the membrane manufacturer for installation instructions regarding installation direction and backnailing.

D. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.

E. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is imminent.
   1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt with joints and edges sealed.
   2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
   3. Remove and discard temporary seals before beginning work on adjoining roofing.

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

3.6 FLASHING AND STRIPPING INSTALLATION

A. Preparation: Inspect walls, curb heights, counterflashings, etc., and check for conformance with minimum base flashing height of eight (8) –inches. Non-conforming areas must be corrected prior to installation of flashing.

B. All metal edging, scuppers and overflows must be constructed with JM TPO-Clad Metal. All TPO-Clad metal shall be fabricated to form hemmed edges to prevent sharp metal edges from cutting the membrane, except when in conjunction with wood nailers.

C. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.

D. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

E. Roof Drains: Flash drain using PermaFlash system. Clamp roofing membrane, flashing, and stripping into roof-drain clamping ring.
   1. Install stripping according to roofing system manufacturer's written instructions.

F. Proceed with installation only after unsatisfactory conditions have been corrected.
3.7 WALKWAY INSTALLATION

A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size according to walkway pad manufacturer's written instructions.
   1. Set walkway pads in cold-applied adhesive.

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

3.8 ROOF MOUNTED CURBS AND EQUIPMENT

A. All roof mounted equipment supports shall be mechanically fastened to the roof deck in accordance with the requirements of the Texas Department of Insurance Windstorm requirements.

B. Conduits and refrigerant lines shall be mounted off of the roofing surface with appropriate mechanically fastened supports.

3.9 FIELD QUALITY CONTROL

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

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
   1. Notify Architect or Owner 48 hours in advance of date and time of inspection.

C. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.

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

3.10 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION
SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SUMMARY

A. Section includes flashings, counterflashings, and other fabricated sheet metal items.

B. Related Sections:
   1. Section 06 10 00 - Miscellaneous Rough Carpentry
   2. Section 07 54 00 – Thermoplastic Membrane Roofing
   3. Section 07 71 23 - Manufactured Gutters and Downspouts
   4. Section 07 90 00 - Joint Protection
   5. Section 09 90 00 - Painting and Coating: Field painting

1.2 DESIGN REQUIREMENTS

A. Sheet Metal Flashings: Conform to SMACNA "Architectural Sheet Metal Manual."

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on manufactured components metal types, finishes, and characteristics. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

C. Provide samples for initial selection for each type of sheet metal and accessory indicated with factory-applied finishes.

1.4 QUALIFICATIONS

A. Fabricator and Installer: Employ skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this project and whose products have a record of successful in-service performance.
   1. For copings and roof edge flashing that require FM approvals, shop shall be listed as able to fabricate required details as tested and approved.

1.5 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials causing discoloration or staining.

1.7 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

C. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.8 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed panel finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 SHEET METAL FLASHING AND TRIM

A. Manufacturers:
   1. Cheney Flashing Co.
   3. Metal-Era Inc.
   4. Substitutions: Section 01 60 00 - Product Requirements.


2.2 ACCESSORIES

A. Fasteners: Same material and finish as flashing metal.

B. Underlayment: Self-adhering modified bitumen waterproofing membrane.
C. Slip Sheet: Rosin sized building paper.
D. Protective Backing Paint: Zinc molybdate alkyd.
E. Sealant: Type sealant specified in Section 07 90 00.
F. Plastic Cement: ASTM D4586, Type I.
G. Reglets: Recessed type, galvanized steel.
H. Splash Pads: Precast concrete type, of sizes and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.

2.3 FABRICATION

A. Form sections shape indicated on Drawings, accurate in size, square, and free from distortion or defects.
B. Fabricate cleats of same material as sheet metal, interlocking with sheet.
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 vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
H. Fabricate flashings to allow toe to extend 2 inches over roofing [gravel] [paver]. Return and brake edges.
I. Seal metal joints.

2.4 FACTORY FINISHING

A. PVDF (polyvinylidene fluoride) coating: Multiple coat, thermally cured, fluoropolymer system to match manufactured sheet metal roofing.
B. Primer Coat: Finish concealed side of metal sheets with primer compatible with finish system, as recommended by finish system manufacturer.
PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

C. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Install surface mounted reglets to lines and levels indicated on Drawings. Seal top of reglets with sealant.

C. Paint concealed metal surfaces with protective backing paint to minimum dry film thickness of 15 mil.

3.3 INSTALLATION

A. See Section 03 10 00 and Section 04 20 00 for installation of concealed reglets.

B. Secure flashings in place using concealed fasteners. 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. Secure gutters and downspouts in place using [concealed] fasteners.

F. Set splash pads under downspouts.

G. Seal metal joints watertight.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements, 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspection will involve surveillance of Work during installation to ascertain compliance with specified requirements.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section includes finishing and installing of factory fabricated coping systems.

B. Related Sections:
   1. Section 07 54 00 – Thermoplastic Membrane Roofing
   2. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings.
   3. Section 07 71 23 - Manufactured Gutters and Downspouts.

1.2 REFERENCES

A. American National Standards Institute:
   1. ASNI/SPRI ES-1 Test Method RE-3 for Coping: Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems

B. National Roofing Contractors Association:
   1. NRCA - The NRCA Roofing and Waterproofing Manual.

C. Sheet Metal and Air Conditioning Contractors:

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.

C. Product Data: Submit data on shape of components, materials and finishes, anchor types and locations.

D. Samples:
   1. Submit two samples, in size capable of illustrating component shape, finish, and color.

E. Manufacturer's Installation Instructions: Submit instructions for special procedures and perimeter conditions requiring special attention.

1.4 QUALITY ASSURANCE

A. Coping shall be certified to meet performance design criteria. Coping system shall be tested on horizontal and vertical surfaces and shall exceed horizontal and vertical design wind pressure as

B. Coping system shall be listed in current Factory Mutual Research Corporation Approval Guide approved for Class FM 1-90.

1.5 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish twenty-year manufacturer warranty for finish of exposed surfaces.

PART 2 PRODUCTS

2.1 MANUFACTURED ROOF SPECIALTIES

A. Manufacturers:
   1. GAF Material Corp.
   2. Firestone Building Products
   3. Petersen Aluminum Corp.
   4. Substitutions: Section 01 60 00 - Product Requirements

2.2 PARAPET COPING SYSTEM

A. Metal coping cap with galvanized steel anchor/support cleats for capping all parapet walls. The system shall be watertight, maintenance free, and not require exposed fasteners. Joints shall be a butt type with concealed splice plates.

B. Coping sections shall expand and contract freely while locked in place on anchor cleats.

C. Formed, 0.05 inch minimum thick aluminum with Kynar coatings. Shaped as indicated on Drawings. Include cover plates to conceal and weather seal joints and attachment flanges.

D. Coping vertical face and back leg to be 4” tall minimum or as indicated in drawings.

E. Concealed splice plates: 8” wide. Finish to match finish of coping cap with factory applied dual non-curing sealant strips.

2.3 ACCESSORIES

A. Corner pieces and end caps shall be fabricated by the coping manufacturer.

B. Sealant: Manufacturer's standard type suitable for use with installation of system; non-staining, non-curring sealant, color as selected.
2.4 FINISHES

A. Galvanized Steel: Manufacturer’s pre-coated Kynar finish, color as selected by Architect from manufacturers standard colors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify deck, curbs, roof membrane, base flashing, and other items affecting Work of this section are in place and positioned correctly.

3.2 INSTALLATION

A. Coordinate installation of components of this section with installation of roofing membrane and base flashings.

B. Coordinate installation of sealants and roofing cement with Work of this section to ensure watertightness.

C. Coordinate installation of flashing flanges into reglets.

D. Verify as-built conditions and verify the coping will fit wall assembly prior to fabrication.

E. Comply with manufacturers installation guide when installing and setting copings.

END OF SECTION
SECTION 07 84 00
FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Firestopping through-penetrations of fire rated assemblies.
   2. Firestopping joints in fire rated assemblies.
   3. Firestopping tops of fire rated walls.
   4. Smoke sealing penetrations and joints of smoke partitions.

B. Related Sections:
   1. Section 09 21 16 - Gypsum Board Assemblies

1.2 REFERENCES

A. ASTM International:

B. Underwriters Laboratories Inc.:
   2. UL 1479 - Fire Tests of Through-Penetration Firestops.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 PERFORMANCE REQUIREMENTS

A. Conform to applicable code for fire resistance ratings and surface burning characteristics.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
B. Product Data: Submit data on product characteristics, performance and limitation criteria.

C. Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

D. Manufacturer's Installation Instructions: Submit preparation and installation instructions.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.6 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire ratings as indicated on Drawings.
   1. Wall Penetrations: Fire Rating as indicated on Drawings but not less than one hour.
   2. Ceiling Penetrations: Fire Rating as indicated on Drawings but not less than one hour.

B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
   2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Fire Resistant Joints in Fire Rated Ceiling and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
   1. Smoke Barrier Joints Air Leakage: Maximum 5 cfm per foot at 0.30 inches water gage pressure differential.

D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

E. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience, and approved by manufacturer.
1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements

B. Do not apply materials when temperature of substrate material and ambient air is below 60 degrees F.

C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of materials.

D. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.1 FIRESTOPPING

A. Manufacturers:
   2. Hilti Corp.
   3. 3M Fire Protection Products
   4. Nelson Firestop Products
   5. Specified Technologies
   6. United States Gypsum Co.
   7. Substitutions: Section 01 60 00 - Product Requirements

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
   1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
   2. Foam Firestopping Compounds: Single component foam compound.
   3. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
   4. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
   5. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.

2.2 ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:
   1. Mineral fiberboard.
C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
B. Remove incompatible materials affecting bond.
C. Install backing/damming materials to arrest liquid material leakage.

3.3 APPLICATION

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
D. Compress fibered material to maximum 40 percent of its uncompressed size.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements, 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.5 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
B. Clean adjacent surfaces of firestopping materials.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.
B. Protect adjacent surfaces from damage by material installation.

END OF SECTION
SECTION 07 90 00

JOINT PROTECTION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes sealants and joint backing, precompressed foam sealers, hollow gaskets, and accessories.

B. Related Sections:
   1. Section 07 27 00 - Air Barriers: Sealants required in conjunction with air barriers:
   2. Section 07 84 00 - Firestopping: Firestopping sealants.
   3. Section 08 40 00 - Aluminum Entrances and Storefronts
   5. Section 09 30 00 - Tiling: Sealant used as tile grout.

1.2 REFERENCES

A. ASTM International:
   2. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Products Data: Submit data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
   1. Indicate general location or use for of sealant type with product data.

C. Samples: Submit two samples, illustrating sealant colors for selection.

D. Manufacturer's Installation Instructions: Submit special procedures, surface preparation, and perimeter conditions requiring special attention.

E. Warranty: Include coverage for installed sealants and accessories failing to achieve airtight seal, watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure.
1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years experience, and approved by manufacturer.

1.5 MOCKUP

A. Section 01 40 00 - Quality Requirements: Requirements for mockup.

B. Construct mockup with specified sealant types and with other components noted.
   1. Determine preparation and priming requirements based on manufacturers recommendations; take action necessary for correction of failure of sealant tests on mock-up.
   2. Verify sealants, primers, and other components do not stain adjacent materials.

C. Locate as directed by Architect/Engineer.

D. Remove mockup when directed by Architect/Engineer.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.7 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with sections referencing this section.

PART 2 PRODUCTS

2.1 JOINT SEALERS

A. Manufacturers:
   1. Dow Corning Corp.
   2. GE Silicones
   3. Sika Corp.
   4. Tremco Sealants & Waterproofing
   5. Substitutions: Section 01 60 00 - Product Requirements.

B. Products Description:
1. **Type:** Sikaflex-2c NS manufactured by Sika.
   **Color:** Standard colors matching adjacent finished surfaces and as selected by Architect.
   **Applications:** Use for:
   1) Control, expansion, and soft joints in masonry.
   2) Joints between concrete and other materials.
   3) Joints between metal frames and other materials.
   4) Other exterior nontraffic joints for which no other sealant is indicated.

2. **General Purpose Traffic Bearing Sealant:** Polyurethane or Polysulfide; ASTM C920, Grade P, Class 25, Use T; single component.
   **Type:** Sikaflex-1c SL manufactured by Sika.
   **Color:** As selected by Architect.
   **Applications:**
   1) Use for exterior and interior pedestrian and vehicular traffic bearing joints.
   2) Not intended for use on asphalt.

3. **Exterior Metal Lap Joint Sealant:** Butyl or polyisobutylene, non-drying, non-skinning, non-curing.
   **Applications:**
   1) Use for concealed sealant bead in sheet metal work and concealed sealant bead in siding overlaps.

4. **General Purpose Interior Sealant:** Acrylic emulsion latex; ASTM C834, single component, paintable.
   **Color:** Colors as selected.
   **Applications:**
   1) Use for interior wall and ceiling control joints, joints between door and window frames and wall surfaces, and other interior joints for which no other type of sealant is indicated.

5. **Bathroom/Tile Sealant:** Silicone; ASTM C920, Uses M and A; single component, mildew resistant.
   **Applications:**
   1) Use for joints between plumbing fixtures and floor and wall surfaces, and joints between food serving area, bathrooms, toilet rooms, counter tops and wall surfaces.

6. **Acoustical Sealant:** Butyl or acrylic sealant; ASTM C920, Grade NS, Class 12-1/2, Uses M and A; single component, solvent release curing, non-skinning.
   **Applications:**
   1) Provide sealant bead between top stud runner and structure and between bottom stud track and floor.

2.2 **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 D1056, sponge or expanded rubber; 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

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify substrate surfaces and joint openings are ready to receive work.

C. Verify joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

A. Remove loose materials and foreign matter impairing adhesion of sealant.

B. Clean and prime joints.

C. Perform preparation in accordance with ASTM C1193.

D. Protect elements surrounding Work of this section from damage or disfiguration.

3.3 INSTALLATION

A. Perform installation in accordance with ASTM C1193.

B. Perform acoustical sealant application work in accordance with ASTM C919.

C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer.

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.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean adjacent soiled surfaces.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.
B. Protect sealants until cured.

END OF SECTION
SECTION 08 12 13

STANDARD STEEL FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes non-rated and thermally insulated steel frames.

B. Related Sections:
   1. Section 08 13 13 - Standard Steel Doors.
   2. Section 08 71 00 - Door Hardware: Hardware, silencers and weatherstripping.
   3. Section 08 80 00 - Glazing.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.

B. ASTM International:
   1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. National Fire Protection Association:
   2. NFPA 105 - Standard for the Installation of Smoke Door Assemblies and other Opening Protectives.

D. Underwriters Laboratories Inc.:
   1. UL 10B - Fire Tests of Door Assemblies.
   2. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
   3. UL 1784 - Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate frame elevations, reinforcement, anchor types and spacing, location of cut-outs for hardware, and finish.

C. Product Data: Submit frame configuration and finishes.

D. Manufacturer's Installation Instructions: Submit special installation instructions.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
1.4 QUALITY ASSURANCE
   A. Conform to requirements of ANSI A250.8.

1.5 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing products specified in this section with
   minimum three years experience.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
   B. Accept frames on site in manufacturer's packaging. Inspect for damage.
   C. Break seal on-site to permit ventilation.

1.7 COORDINATION
   A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
   B. Coordinate Work with frame opening construction, door, and hardware installation.
   C. Sequence installation to accommodate required door hardware electric wire connections.

PART 2 PRODUCTS

2.1 STANDARD STEEL FRAMES
   A. Manufacturers:
      1. Amweld Building Products, Inc.
      2. Ceco Door Products
      3. Republic Builders Products
      4. Steelcraft
      5. Substitutions: Section 01 60 00 - Product Requirements.
   B. Product Description: Standard shop fabricated steel frames, non-rated types.
      1. Frames: To suit ANSI A250.8 Grade and Model of door specified in Section 08 13 14.

2.2 ACCESSORIES
   A. Removable Stops: Rolled steel channel shape, butted corners; prepared for countersink style
      tamper proof screws.
   B. Bituminous Coating: Non-asbestos fibered asphalt emulsion.
   C. Primer: ANSI A250.10 rust inhibitive type.
   D. Silencers: Specified in Section 08 71 00.
E. Weatherstripping: Specified in Section 08 71 00.

2.3 FABRICATION

A. Fabricate frames as welded unit.

B. Mullions for Double Doors: Removable type, of same profiles as jambs.

C. Fabricate frames with hardware reinforcement plates welded in place. Provide mortar guard boxes.

D. Reinforce frames wider than 48 inches with roll formed steel channels fitted tightly into frame head, flush with top.

E. Prepare frames for silencers. Provide three single silencers for single doors and mullions of double doors on strike side. Provide two single silencers on frame head at double doors without mullions.

F. Configure exterior frames with special profile to receive recessed weatherstripping.

2.4 SHOP FINISHING

A. Steel Sheet: Galvanized to ASTM A653/A653M A40.

B. Primer: Baked.

C. Coat inside of frame profile with bituminous coating to minimum thickness of 1/16 inch.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify opening sizes and tolerances are acceptable.

3.2 INSTALLATION

A. Install frames in accordance with ANSI A250.8.

B. Coordinate with gypsum board wall construction for anchor placement.

C. Coordinate installation of frames with installation of hardware specified in Section 08 71 00 and doors in Section 08 13 14.

D. Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.
3.3 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edges, crossed corner to corner.

3.4 SCHEDULE

A. Refer to Door and Frame Schedule in construction drawings.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section includes thermally insulated steel doors and panels.

B. Related Sections:
   1. Section 08 12 14 - Standard Steel Frames.
   2. Section 08 71 00 - Door Hardware.
   3. Section 09 90 00 - Painting and Coating: Field painting of doors.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.

B. ASTM International:
   1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   4. ASTM E413 - Classification for Rating Sound Insulation.

C. Hollow Metal Manufacturers Association:
   1. HMMA 810 - Hollow Metal Doors.

D. National Fire Protection Association:
   2. NFPA 105 - Standard for the Installation of Smoke Door Assemblies and other Opening Protective.

E. Steel Door Institute:

F. Underwriters Laboratories Inc.:
   1. UL 10B - Fire Tests of Door Assemblies.
   2. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
   3. UL 1784 - Air Leakage Tests of Door Assemblies.
1.3 SUBMITTALS
   A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
   B. Shop Drawings: Indicate door elevations, internal reinforcement, closure method, and finishes.
   C. Product Data: Submit door configurations, location of cut-outs for hardware reinforcement.
   D. Manufacturer's Installation Instructions: Submit special installation instructions.

1.4 QUALITY ASSURANCE
   A. Perform Work in accordance with ANSI A250.8.

1.5 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years' experience.
   B. Installer: Company specializing in performing work of this section with minimum three years’ experience approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
   B. Accept doors on site in manufacturer's packaging. Inspect for damage.
   C. Break seal on site to permit ventilation.

1.7 COORDINATION
   A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
   B. Coordinate Work with door opening construction, door frame, and door hardware installation.
   C. Coordinate installation to accommodate door hardware electric wire connections.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS
   A. Manufacturers:
      1. Amweld Building Products, Inc.
      2. Ceco Door Products
      3. Republic Builders Products
      4. Steelcraft
      5. Substitutions: Section 01 60 00 - Product Requirements
B. Product Description:
      a. Level 1 - Standard Duty, Model 1, full flush design.

2.2 COMPONENTS
A. Face: Steel sheet in accordance with ANSI A250.
B. End Closure: Channel, 0.04 inches thick, flush.
C. Core: polyurethane or polystyrene foam
D. Thermal Insulated Door: Total insulation R-Value of 2.4, measured in accordance with ASTM C1363. U-Factor of 0.416 minimum.

2.3 ACCESSORIES
A. Astragals for Double Doors: reference section 08 71 00.
B. Primer: ANSI A250.10 rust inhibitive type.

2.4 FABRICATION
A. Fabricate doors with hardware reinforcement welded in place.

2.5 SHOP FINISHING
A. Steel Sheet: Galvanized to ASTM A653/A653M A40.
B. Primer: Baked.

2.6 FINISHING
A. Filed paint in color as selected by Architect. Reference section 09 90 00 for paint type and finish.

PART 3 EXECUTION
3.1 EXAMINATION
A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
B. Verify opening sizes and tolerances are acceptable.

3.2 INSTALLATION
A. Install doors in accordance with ANSI A250.8.
B. Coordinate installation of doors with installation of frames specified in Section 08 12 14 and hardware specified in Section 08 71 00.

C. Touch-up damaged shop finishes.

3.3 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Diagonal Distortion: 1/16 measured with straight edge, corner to corner.

3.4 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for adjusting.

B. Adjust door for smooth and balanced door movement.

3.5 SCHEDULE

A. Refer to Door and Frame Schedule in construction drawings.

END OF SECTION
SECTION 08 14 16

FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Flush wood doors.

B. Related Requirements:
   1. Section 08 41 13 – Aluminum-Framed Entrances and Storefronts
   2. Section 08 51 13 – Aluminum Windows
   3. Section 08 71 00 - Door Hardware.
   4. Section 08 80 00 - Glazing.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A135.4 - Basic Hardboard.

B. Architectural Woodwork Institute:
   1. AWI AWS - Architectural Woodwork Standards.

C. Hardwood Plywood and Veneer Association:
   1. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.

D. National Electrical Manufacturers Association:
   1. NEMA LD 3 - High Pressure Decorative Laminates.

E. National Fire Protection Association:
   2. NFPA 105 - Standard for the Installation of Smoke Door Assemblies and other Opening
      Protectives.

F. Underwriters Laboratories Inc.:
   1. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
   2. UL 1784 - Air Leakage Tests of Door Assemblies.

G. Wood Window and Door Manufacturers Association:
   1. WDMA I.S 1A - Architectural Wood Flush Doors.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
B. Coordinate Work with door opening construction, door frame and door hardware installation.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data:
   1. Submit data for door core materials and construction.
   2. Submit data for veneer species, type and characteristics.

C. Shop Drawings:
   1. Indicate door opening criteria, elevations, sizes, types, swings, undercuts required, special blocking for hardware.
   2. Indicate cutouts for glazing and louvers.

D. Samples:
   1. Submit two samples of door construction, 12 x 12 inch in size cut from corner of door.
   2. Submit two samples of door veneer, 8 x 8 inch in size illustrating plastic laminate pattern and color.

E. Manufacturers' Instructions: Submit special installation instructions.

F. Qualification Statements:
   1. Submit manufacturer experience qualifications.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AWI AWS Section 9, Custom Grade.

B. Fire Rated Door Construction: Conform to one of the following:
   1. NFPA 252; with neutral pressure level at 40 inches maximum above sill at 5 minutes into test.
   2. UL 10C.

C. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated on Drawings.

D. Smoke and Draft Control Doors: Tested in accordance with UL 1784 and installed in accordance with NFPA 105.
   1. Air Leakage: Maximum 3.0 cfm/sf of door opening with 0.10 inch water gage pressure differential.

E. Attach label from agency approved by authority having jurisdiction to identify each fire rated door.
1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Package, deliver and store doors in accordance with AWI AWS Section 2.

C. Accept doors on site in manufacturer's packaging. Inspect for damage.
   1. Break seal on site to permit ventilation.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

C. Interior Doors:
   1. Factory Finished Doors: Furnish manufacturer’s life of installation warranty.

PART 2 PRODUCTS

2.1 FLUSH WOOD DOORS

A. Manufacturer and Product List:
   1. Algoma Hardwoods Inc.
   2. Eggers Industries
   3. Marshfield Door Systems
   4. Graham Wood Doors
   5. The Maiman Company
   6. Section 01 60 00 - Product Requirements: Requirements for substitutions for other manufacturers and products.

B. Flush Interior Doors: Solid core.
   2. Face Construction: Five ply.
   4. Quality Grade: Custom.

C. Performance / Design Criteria:
   1. Performance Duty Level: WDMA I.S. 1A.
   2. Fire Resistance: As indicated on Drawings.
2.2 MATERIALS

A. Solid Core, Non-Rated: AWI Section 1300, Type FS LC - Framed Non-Glued (Drop In) Stave Lumber.

B. Plastic Laminate Facing (Interior): NEMA LD-3, General Purpose Type, 0.125 inch thick, finish, color and pattern, as indicated in finish schedule 09 00 00.

C. Cross Banding Behind Laminate Finish: manufacturer’s standard construction.

D. Facing Adhesive: Type II - water resistant.

2.3 FABRICATION

A. Fabricate doors in accordance with AWI AWS Section 9 requirements.

B. Furnish lock blocks at lock edge and top of door for closer for hardware reinforcement.

C. Vertical Exposed Edge of Stiles: Of same laminate matching door facing.

D. Fit door edge trim to edge of stiles after applying veneer facing.

E. Bond edge banding to cores.

F. Provide edge clearances in accordance with AWI AWS Section 9.

2.4 FINISHES

A. Finish work in accordance with AWI AWS Section 5; Custom Grade.

B. Plastic laminate finish is described in related sections and drawing finish schedule.

C. Factory finish doors in accordance with approved sample.

2.5 ACCESSORIES

A. Flashing: Extruded aluminum, size and configuration to suit application, single piece full length.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify 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.
3.2 INSTALLATION

A. Install doors in accordance with AWI AWS Section 9 and manufacturer's instructions.

B. Field Fitting and Trimming:
   1. Trim non-rated door width by cutting equally on both jamb edges.
   2. Trim door height by cutting bottom edges to maximum of 3/4 inch.
      a. Trim fire door height at bottom edge only, in accordance with fire rating requirements.

C. Coordinate installation of doors with installation of frames specified in Section 08 12 16 and hardware specified in Section 08 71 00.

3.3 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Diagonal Distortion (Warp): 1/8 inch measured with straight edge or taut string, corner to corner, over imaginary 36 x 84 inches surface area.

C. Maximum Vertical Distortion (Bow): 1/8 inch measured with straight edge or taut string, top to bottom, over imaginary 36 x 84 inches surface area.

D. Maximum Width Distortion (Cup): 1/8 inch measured with straight edge or taut string, edge to edge, over imaginary 36 x 84 inches surface area.

3.4 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.

B. Adjust door for smooth and balanced door movement.

C. Adjust door closer for full closure.

3.5 SCHEDULE

A. Refer to Door and Frame Schedule in drawings.

END OF SECTION
SECTION 08 31 00

ACCESS DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes fire resistive rated and non-rated access doors and panels with frames.
   1. Provide for access to controls, valves, traps, dampers, cleanouts, and similar items requiring operation behind inaccessible finished surfaces.
   2. Coordinate exact locations with various trades to assure proper placement of access doors and panels.

1.2 REFERENCES


1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: indicate exact location and proposed position of all access door units.

C. Product Data: Submit literature indicating sizes, types, finishes, hardware, scheduled locations, fire resistance listings, and details of adjoining Work.

D. Manufacturer's Installation Instructions: Submit installation requirements and rough-in dimensions.

1.4 QUALITY ASSURANCE

A. Fire Resistance Ratings: Where indicated as fire rated provide assemblies from manufacturers listed in UL Directory or Intertek Testing Services (Warnock Hersey Listed) Directory.

B. Fire Rated Access Doors: Rating as indicated on Drawings.
   1. Tested Rating: Determined in accordance with ASTM E119.

C. Attach label from agency approved by authority having jurisdiction to identify each fire rated access door.

1.5 COORDINATION

A. Coordinate Work with work requiring controls, valves, traps, dampers, cleanouts, and similar items requiring operation being located behind finished surfaces.

B. Utilize, to the greatest extent possible, adjacent light fixtures and other removable items that can be removed for access to items in concealed spaces.
PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers listed whose product meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years’ experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
1. J. L. Industries.
3. Milcor LTD, Partnership.
4. Nystrom Products Co.
5. Bilco Co.
6. Substitutions: Section 01 25 13 - Product Substitution Procedures

B. Access Doors in all exterior or non-conditioned spaces: Provide ANODIZED aluminum access doors of same type and gauge as steel access doors.

C. Flush Framed Access Doors: Frames and nominal 1-inch wide exposed flanges of 16 gage steel and door panels of 14 gage steel.

D. Gypsum Board Access Doors: Frames and nominal 1-inch wide flanges of 16 gage steel and door panels of 14 gage steel. Design flanges to be concealed by gypsum board joint finishing compound specified in Section 09 21 16.

E. Fire Rated Access Doors: Frames and nominal 1-inch wide exposed flanges of minimum 16 gage steel and door panels of 20 gage steel. Provide self closing and latching doors with keyed lock.

G. Gypsum Board Fire Rated Access Doors: 16 gage steel frames with minimum 22 gage galvanized steel drywall bead flanges and door panels of 20 gage steel. Design flanges to be concealed by gypsum board joint finishing compound specified in Section 09 21 16. Provide self closing and latching doors with keyed lock.

2.2 FABRICATION

A. Fabricate units of continuous welded construction; weld, fill, and grind joints to assure flush and square unit.

B. Wall and Ceiling Access Door and Panel Hardware:
1. Hinge: Standard continuous or concealed spring pin type, 175 degree steel hinges.
2. Lock: Self-latching lock. Screw driver slot for quarter turn cam lock.

C. Size Variations: Obtain acceptance of manufacturer's standard size units which vary slightly from sizes shown or scheduled.

2.3 SHOP FINISHING

A. Base Metal Protection: Galvanized, hot dipped wiped coat finish.

B. Finish: One coat baked enamel, color as selected by Architect from manufacturer’s full range of colors.

C. Aluminum Doors (for exterior or non-conditioned locations only): Clear anodized finish.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Section 01 31 00 - Administrative Requirements: Coordination and project conditions.

B. Verify rough openings for access doors and panels are correctly sized and located.

3.02 INSTALLATION

A. Secure frames rigidly in place, plumb and level in opening, with plane of door and panel face aligned with adjacent finished surfaces.
   1. Set concealed frame type units flush with adjacent finished surfaces.

B. Position unit to provide convenient access to concealed work requiring access,

C. Install fire rated units in accordance with NFPA 80 and requirements for fire listing.

END OF SECTION 08 31 00
SECTION 08 40 00
ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes aluminum-framed impact resistant exterior storefront systems with reinforcing, shims, anchors, and attachment devices.

B. Related Sections:
   1. Section 07 27 26 – Fluid Applied Membrane Air Barriers
   2. Section 07 84 00 - Firestopping
   3. Section 07 90 00 - Joint Sealers: System perimeter sealant and back-up materials.
   4. Section 08 80 00 - Glazing.

1.2 REFERENCES

A. Aluminum Association:
   1. AA DAF-45 - Designation System for Aluminum Finishes.

B. American Architectural Manufacturers Association:
   1. AAMA 501 - Methods of Test for Exterior Walls.

C. American Society of Civil Engineers:

D. American Society for Testing and Materials:

E. SSPC: The Society for Protective Coatings:
   1. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
   2. SSPC Paint 25 - Red Iron Oxide, Zinc Oxide, Raw Linseed Oil, and Alkyd Primer.

1.3 SYSTEM DESCRIPTION

A. Aluminum-framed storefront system includes tubular aluminum sections with supplementary internal support framing, shop fabricated, factory finished, related flashings, anchorage and attachment devices.
1.4 PERFORMANCE REQUIREMENTS

A. Impact resistant storefront framing system must meet the Texas Department of Insurance product evaluation for framing system.

B. Impact resistant storefront framing system must achieve notice of acceptance from Miami-Dade County.

C. System Design: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall, including building corners.
   1. As calculated in accordance with applicable code, as measured in accordance with ASTM E330.
   2. Design wind loads of 150 mph, three second gust.

D. Deflection: Limit mullion deflection to 1/175 for spans under 13'-6” and 1/240 plus 1/4 inch for spans over 13'-6” of span; with full recovery of glazing materials.

E. System Assembly: Accommodate without damage to components or deterioration of seals, movement within system, movement between system and peripheral construction, dynamic loading and release of loads, deflection of structural support framing.

F. Air Infiltration: Limit air leakage through assembly to 0.06 cfm/min/sq ft of wall area, measured at reference differential pressure across assembly of 1.57 psf as measured in accordance with AAMA 501.

G. Vapor Seal: Limit vapor seal with interior atmospheric pressure of 1 inch sp, 72 degrees F, 40 Percent RH without seal failure.

H. Water Leakage: None, when measured in accordance with AAMA 501 with test pressure difference of 20 percent of design pressure, with minimum differential of 2.86 lbf/sq ft and maximum of 12.00 lbf/sq ft.

I. Expansion / Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over 12 hour period without causing detrimental effect to system components and anchorage.

J. System Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior by weep drainage network.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work and expansion and contraction joint location and details.
C. Product Data: Submit component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, and internal drainage details.

D. Design Data: Indicate framing member structural and physical characteristics, calculations, dimensional limitations.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 QUALIFICATIONS

A. Manufacturer and Installer: Company specializing in manufacturing aluminum glazing systems with minimum ten years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum ten years documented experience and approved by manufacturer.

C. Design structural support framing components under direct supervision of Professional Engineer licensed at project location.

1.7 MOCKUP

A. Section 01 43 39 – Mockups

B. Construct mockup as directed by Architect. Include section of storefront framing and insulated impact glazing. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.

C. Locate where directed by Architect.

D. Remove mockup when directed by Architect/Engineer.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect finished aluminum surfaces. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install sealants or glazing materials when ambient temperature is less than 40 degrees F during and 48 hours after installation.

1.10 COORDINATION

A. Section 01 31 00 – Project Management and Coordination: Coordination and project conditions.
B. Coordinate the Work with installation of other trades.

1.11 WARRANTY

A. Furnish five-year manufacturer warranty for glazed units.

PART 2 PRODUCTS

2.1 ALUMINUM-FRAMED STOREFRONTS

A. Manufacturers:
   1. Oldcastle Building Envelope
   2. Arch Aluminum & Glass LC
   3. Kawneer Co., Inc.
   4. Vistawall Architectural Products
   5. YKK AP America
   6. Substitutions: Section 01 25 00 – Substitution Procedures.

B. Basis of Design:
   1. Interior Storefront System: Kawneer InFrame – Interior Framing System (1/4” infills minimum unless noted otherwise).
   2. Exterior Storefront System: Kawneer IR501 Impact Resistant (1-5/16” infill)
   4. Exterior Curtainwall System: Kawneer 1600 System 1 Impact Resistant (1-5/16” infill)

C. Product Description:
   1. Aluminum Frame: Large-missile impact-resistant, thermal; center glazed; drainage holes; internal weep drainage system. Interior structural silicone glazed.
   2. Mullions: Profile of extruded aluminum with internal reinforcement of aluminum or shaped steel structural section.

2.2 COMPONENTS

A. Extruded Aluminum: ASTM B221; 6063 alloy, T5 temper typical, 6061 alloy, T6 temper for extruded structural members.

B. Sheet Aluminum: ASTM B209, 5005 alloy, H15 or H34 temper.

C. Sheet Steel: ASTM A653/A653M; galvanized to minimum G90.

D. Steel Sections: ASTM A36/A36M; shaped to suit mullion sections, galvanized to G90.

E. Glass: Specified in Section 08 80 00

F. Glazing Materials: Storefront manufacturer’s standard types to suit application and to achieve weather, moisture, and air infiltration requirements.
G. Flashings: Minimum 0.032-inch-thick aluminum to match mullion sections where exposed.

H. Air Barrier: Specified in Section 07 27 00.

I. Sealant and Backing Materials:
   1. Sealant Used Within System (Not Used for Glazing): Manufacturer’s standard materials to achieve weather, moisture, and air infiltration requirements.
   2. Perimeter Sealant: Specified in Section 07900.

J. Fasteners:
   1. Non-magnetic stainless steel or cadmium plated steel coated with yellow or silver iridescence plating, compatible with materials being fastened.
   2. Series 300 stainless steel for exposed locations. Cadmium plated steel with 0.0005 inch plating thickness and color chromate coated for concealed locations.
   3. Provide nuts or washers of design having means to prevent disengagement; deforming of fastener threads is not acceptable.
   4. Provide concealed fasteners wherever possible.
   5. For exposed locations, provide countersunk flathead fasteners with finish matching item fastened.

K. Inserts and Anchorage Devices:
   1. Manufacturer’s standard formed or fabricated assemblies, steel or aluminum, of shapes, plates, bars or tubes.
   2. Hot-dip galvanize steel assemblies after fabrication; comply with ASTM A123, 2.0 ounce minimum coating.

L. Spandrel Panels and Exterior Column Covers:
   1. Type: Aluminum sheet, 1/8 inch thick, suitably reinforced on concealed surface for surface flatness, or prefabricated sandwich panels at manufacturer’s option.
   2. Finish to match mullion sections.
   3. Surface flatness: 0.015 inch maximum deviation when measured with 6 inch rule.
   4. Squareness: 0.002 inch maximum for each inch of length at panel edge.
   5. Anchorage: Allow for expansion and contraction, to minimize oilcanning and distortion

2.3 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. Arrange fasteners and attachments to conceal from view.
E. Reinforce interior horizontal head rail to receive blind track brackets and attachments.
F. Prepare components with internal reinforcement for door hardware.
G. Reinforce framing members for imposed loads.

2.4 FACTORY FINISHING

A. Anodized Aluminum Surfaces: AAMA 611, AA-M12C22A44 non-specular as fabricated mechanical finish, medium matte chemical finish, and Architectural Class I, 0.7 mils color anodized coating. Color selected by Architect.
B. Concealed Steel Items: Galvanized in accordance with ASTM A123/A123M to thickness Grade 85, 2.0 oz/sq ft.
C. Apply bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar metals.
D. Shop and Touch-Up Primer for Steel Components: SSPC Paint 25 red oxide.
E. Touch-Up Primer for Galvanized Steel Surfaces: SSPC Paint 20 zinc rich.
F. Extent of Finish:
   1. Apply factory coating to surfaces exposed at completed assemblies.
   2. Apply finish to surfaces cut during fabrication so no natural aluminum is visible in completed assemblies, including joint edges.
   3. Apply touch-up materials recommended by coating manufacturer for field application to cut ends and minor damage to factory applied finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 31 00 – Project Management and Coordination: Coordination and project conditions.
B. Verify dimensions, tolerances, and method of attachment with other Work.
C. Verify wall openings and adjoining air and vapor seal materials are ready to receive Work of this Section.

3.2 INSTALLATION

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent Work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent Work to form water tight dam.

G. Coordinate attachment and seal of perimeter air and vapor barrier materials.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Install integral flashings and integral joint sealers.

J. Coordinate installation of glass with Section 08 80 00; separate glass from metal surfaces.

K. Coordinate installation of perimeter sealants with Section 07 90 00.

3.3 ERECTION 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.

3.4 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by method acceptable to sealant manufacturer.

END OF SECTION
SECTION 08 71 00
FINISH HARDWARE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Work under this section comprises of furnishing hardware specified herein and noted on drawings for a complete and operational system, including any electrified hardware components, systems, controls and hardware for aluminum entrance doors. Any door shown on the drawing and not specifically referenced in the hardware sets shall be provided with identical hardware as specified on other similar openings and shall be included in the General Contractor’s base bid. All fire rated door shall be provided with fire rated hardware as required by local code Authority as part of the General Contractor’s base bid. The hardware supplier shall verify all cylinder types specified for locking devices supplied as part of the door system with the door manufacturer and/or door supplies. 

   a. All hardware for aluminum storefront swinging doors, exterior doors, and interior doors shall be supplied by this sections supplier if not specifically specified in another section.

B. The General Contractor shall notify the Architect in writing of any discrepancies (five (5) days prior to bid date) that could and/or would result in hardware being supplied that is none functional, hardware specified and/or hardware that has not been specified that will result in any code violations and any door that is not covered in this specification. Failure of the General Contractor to address any such issue could be considered acceptance of the hardware specified and any and/or all discrepancies could be corrected at the General Contractor’s expense.

C. Items include but are not limited to the following:

   1. Hinges - Pivots
   2. Flush Bolts
   3. Exit Devices
   4. Locksets and Cylinders
   5. Push Plates - Pulls
   6. Coordinator
   7. Closers
   8. Kick, Mop and Protection Plates
   9. Stops, Wall Bumpers, Overhead Controls
   10. Electrified Hold Open Devices
   11. Thresholds, Seals and Door Bottoms
   12. Silencers
   13. Miscellaneous Trim and Accessories

1.02 RELATED DOCUMENTS, drawings and general provisions of contract, including General and Supplementary Conditions, and Division 1 Specification sections, apply to this section.

1.03 RELATED WORK specified elsewhere that should be examined for its effect upon this section:

   A. Section 06 20 00 - Finish Carpentry
   B. Section 08 11 13 – Steel Doors and Frames
C. Section 08 14 16 – Flush Wood Doors  
D. Sections 08 31 13 – Access Doors  
E. Section 08 39 00 – Watertight Doors  
E. Section 08 41 13 – Aluminum Entrances, Storefront and Window Framing  
F. Sections 08 80 00 – Glass and Glazing  
G. Sections 09 91 00 - Painting  
H. Division 26 – Electrical  
I. Division 28 – Access Control

1.04 REFERENCES SPECIFIED in this section subject to compliance as directed:

A. NFPA-80 - Standard for Fire Doors and Windows  
C. ADA - The Americans with Disabilities Act - Title III - Public Accommodations  
E. ANSI-A 156.5 - American National Standards Institute - Auxiliary Locks and Associated Products  
F. UFAS - Uniform Federal Accessibility Standards  
G. UL - Underwriter’s Laboratories  
H. WHI - Warnock Hersey International, Testing Services  
I. State and Local Codes including Authority Having Jurisdiction  
J. UL10C – Positive Pressure  
L. NFPA-70 – International Electrical Code

1.05 SUBMITTALS

A. HARDWARE SCHEDULES submit copies of schedule in accordance with Division 1, General Requirements. Schedule to be in vertical format, listing each door opening, including: handing of opening, all hardware scheduled for opening or otherwise required to allow for proper function of door opening as intended, and finish of hardware. At doors with door closers or door controls include degree of door opening. Supply the schedules all Finish Hardware within two (2) weeks from date purchase order is received by the hardware supplier.

B. Submit manufacturer’s cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.

C. Certification of Compliance:
   1. Submit any information necessary to indicate compliance to these specifications as required.
   2. Submit a statement from the manufacturer that electronic hardware and systems being supplied comply with the operational descriptions exactly as specified.

D. Submit any samples necessary as required by the Architect.

E. Templates for finish hardware items to be sent to related door and frame suppliers within three (3) working days of receipt of approved hardware schedule.

F. Doors and Frames used in positive pressure opening assemblies shall meet UL10C in areas where this specification includes Seals for smoke door.

1.06 QUALITY ASSURANCE
A. Hardware supplier to be a qualified, Factory Authorized, direct distributor of the products to be furnished. In addition, the supplier to have in their regular employment an AHC or AHC /CDC and/or a person of equivalent experience (minimum fifteen (15) years in the industry) who will be made available at reasonable times to consult with the Architect/Contractor and/or the Owners Representative regarding any matters affecting the finish hardware on this project.

B. All hardware used in labeled fire or smoke rated openings to be listed for those types of openings and bear the identifying label or mark indicating UL. (Underwriter’s Laboratories) approved for fire. Exit devices in non-labeled openings to be listed for panic.

1.07 DELIVERY, HANDLING AND PACKAGING

A. Furnish all hardware with each unit clearly marked and numbered in accordance with the hardware schedule. Include door and item number for each.

B. Pack each item of hardware completes with all necessary parts and fasteners.

C. Properly wrap and cushion each item to prevent scratches and dents during delivery and storage.

1.08 SEQUENCING AND SCHEDULING

Any part of the finish hardware required by the frame or door manufacturers or other suppliers that is needed to produce doors or frames is to be sent to those suppliers in a timely manner, so as not to interrupt job progress.

1.09 WARRANTY

All finish hardware shall be supplied with a one- (1) year warranty against defects in materials and workmanship, commencing with substantial completion of the project except as follows:

1. All Closers shall have a thirty- (30) year written warranty.
2. All Grade 1 “L9000” Locksets shall have a three- (3) year written warranty.
3. All Exit Devices shall have a three (3) year written warranty.
4. All Continuous Hinges shall have a ten-(10) year written warranty.

PART 2 – PRODUCTS

2.01 FASTENERS

A. Furnish with finish hardware all necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position for a long life under hard use.

B. Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors designated by the Architect according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer. All closers and exit devices on labeled wood doors shall be through-bolted if required by the door manufacturer. All thresholds shall be fastened with wood screws and plastic anchors. Where specified in the hardware sets, security type fasteners of the type called for are to be supplied.
C. Design of all fastenings shall harmonize with the hardware as to material and finish.

D. All hardware shall be installed with the Manufacturers standard screws as provided. The use of any other type of fasteners shall not be permitted. The general contractor shall provide wood blocking in all stud walls specified and/or scheduled to receive wall stops, No Exception.

2.02 ENVIRONMENTAL CONCERN FOR PACKAGING

The hardware shall ship to the job site is to be packaged in biodegradable packs such as paper or cardboard boxes and wrapping.

2.03 HINGES

A. All hinges to be of one manufacturer as hereafter listed for continuity and consideration of warranty. Provide one of the following manufacturers Ives, Hager, Mc Kinney or Stanley.

B. Unless otherwise specified provide five-knuckle, heavy-duty, button tip, full mortise template type hinges with non-rising loose pins. Provide non-removable pins for out swinging doors at secured areas or as called for in this specification (Refer to 3.02 Hardware Sets).

C. Provide all out-swinging doors with non-removable pins or security studs as called for in 3.02 Hardware Sets. Furnish three (3) hinges up to 90 inches high and one (1) additional hinge for every 30 inches or fraction thereof.

D. Furnish three (3) hinges up to 90 inches high and one (1) additional hinge for every 30 inches or fraction thereof.

E. Provide size 4½” x 4½” for all 1¾” thick doors up to and including 36 inches wide. Doors over 1¾” through 2¼” thick, use 5” x 5” hinges. Doors over 36 inches use 5” x 4½” unless otherwise noted in 3.02 Hardware Sets.

F. Were required to clear the trim and/or to permit the doors to swing 180 degrees furnish hinges of sufficient throw.

G. Provide heavy weight hinges on all doors over 36 inches in width.

H. At labeled door’s steel or stainless steel, bearing-type hinges shall be provided. For all doors equipped with closers provide bearing-type hinges.

2.04 LOCK AND LOCK TRIM

A. All locksets, latch sets, and trim to be of one manufacturer as hereafter listed for continuity of design and consideration of warranty. Locksets specified are Schlage “L9000” series with the 17A levers. Schlage locks have been specified as to set a high level of quality, the hardware supplier shall match the existing locks, key system and lever design.

B. Provide metal wrought box strike boxes and curved lip strikes with proper lip length to protect trim of the frame, but not to project more than 1/8 inch beyond frame trim or the inactive leaf of a pair of doors.
C. Mechanical Locks shall meet ANSI Operational Grade 1, Series 1000 as specified.
   1. Hand of lock is to be field reversible or non-handed.
   2. All lever trim is to be through-bolted through the door.

2.05 CYLINDERS AND KEYING

A. Provide all exterior and interior locks or Exit Devices requiring cylinders keyed to the Existing Mater Key System as instructed by the Owners Representative. Cylinders shall comply with performance requirements of ANSI A156.5. All keys shall be of nickel silver material only. The hardware supplier shall meet with the General Contractor, the Architect and the Owners Representative at the project jobsite to determine all permanent keying requirements.

B. Cylinders shall be factory keyed and factory maintained as directed by the owners Representative and the Architect. Provide two- (2) keys per cylinder and four- (4) master keys per master used.

C. Factory stamp all keys “Do not duplicate” and with key symbol as directed by the Owners Representative. Visual key control shall be provided on all permanent keys and cylinders.

D. Provide temporary keyed construction cores for the duration of the construction phase. Provide ten (10) construction keys and two (2) construction control keys. All construction cores shall be returned to the hardware supplier upon installation of permanent cores.

2.06 EXIT DEVICES

A. All exit devices and trim, including electrified items, to be of one manufacturer as hereafter listed and in the hardware sets for continuity of design and consideration of warranty; electrified devices and trim to be the same series and design as mechanical devices and trim.

B. Exit Devices to be “UL” listed for life safety. All exit devices for labeled doors shall have “UL” label for “Fire Exit Hardware”. All devices mounted on labeled wood doors are to be through-bolted or per the manufacturer’s listing requirements. All devices shall conform to NFPA 80 and NFPA 101 requirements.

C. All exit devices to be of a heavy duty, chassis mounted design, with a one-piece removable cover, eliminating necessity of removing the device from the door for standard maintenance and keying requirements.

D. All trims to be through-bolted to the lock stile case. Lever design to be the same as specified with the lock sets (#17).

E. Exit Devices shall be the modern push rail design. All exit devices shall be mounted with sex bolts and installed with the manufactures standard screws. Exit Hardware Devices found to be installed with self-drilling and self-tapping screws shall be removed and reinstalled at the installer expenses.

F. All devices shall carry a three- (3) year warranty against manufacturing defects and workmanship.
G. Furnish roller strikes for all rim and surface vertical rod exit devices. Internal springs shall be coil compression type. Furnish security dead latching for all active latch bolts.

H. All Exit Devices shall be field modifiable as incorporate an Electric Latch Retraction Feature without the purchase of new Panic Exit Hardware.

J. Exit Devices shall be the Von Duprin “99 & 33A” series as specified

2.07 SURFACE MOUNTED DOOR CLOSERS

A. All closers for this project shall be the products of a single manufacturer for continuity of design and consideration of warranty. All door closers shall be mounted as to achieve the maximum degree of opening (trim permitting).

B. All closers to be heavy duty, surface-mounted, fully hydraulic, rack and pinion action with high strength case iron cylinder to provide control throughout the entire door opening and closing cycle.

C. Size all closers in accordance with the manufacturer’s recommendations at the factory.

D. All closers to have adjustable spring power sizes 1 or 2 through 4 or 6 and non-critical regulating screw valves for closing speed, latching speed and back-check control as a standard feature unless specified otherwise.

E. Provide closer covers only if provided as a standard part of the door closer package.

F. The hardware supplier shall provide all required brackets, spacers or filler plates as required by the manufacturer for a proper and functional installation as part of their base bid.

G. Supply appropriate arm assembly for each closer so that closer body and arm are mounted on non-public side of door opening and on the interior side of exterior openings, except where required otherwise in the hardware sets.

H. Provide drop plates and any additional mounting brackets required for the proper installation of the door closer shall be included in the hardware supplier’s base bid.

I. Finish: Baked on Powder Coated finish shall match other hardware.

J. Provide and mount all door closers with sex bolts as provided by the manufacturer.

K. Closers shall be LCN “4040 XP & 1461” series as specified or acceptable products manufactured by Sargent “281” series.

2.08 DOOR STOP AND HOLDERS

A. Door stops are to be furnished for every door leaf. Every door is to have a floor, wall, or an overhead stop.
B. Place doorstops in such a position that they permit maximum door swing, but do not present a hazard of obstruction. Furnish floor strikes for floor holders of proper height to engage holders of doors.

C. Where overhead stops and holders are specified, or otherwise required for proper door operation, they are to be heavy duty and of extruded brass, bronze or stainless steel with no plastic parts as specified. The General Contractor shall provide wood blocking in all stud walls specified and scheduled to receive wall stops.

D. Finish: Shall match other hardware where available.

E. Acceptable Products

1. Floor and wall stops as listed in hardware sets. Equivalent products as manufactured by Ives, ABH and Trimco are acceptable.

2.09 PUSH PLATES, DOOR PULLS, AND KICKPLATES

A. All push plates, door pull, kick plates and other miscellaneous hardware as listed in hardware sets. Equivalent products as manufactured by Ives, Hager and Trimco are acceptable.

B. Kick plates to be 10 inches high and Mop plates to be 6 inches high, both by 1-½ inches or 1 inch less than door width (LDW) as specified. They are to be of 16-gauge thick base metal. For door with louvers or narrow bottom rails, kick plate height to be 1 inch less dimension shown from the bottom of the door to the bottom of the louver or glass.

C. Where required armor plates, edge guards and other protective hardware shall be supplied in sizes as scheduled in the hardware sets.

D. Finish: Same as other hardware where available.

2.10 FLUSH BOLTS AND COORDINATORS

A. Provide Flush bolts with Dust Proof Strikes as indicated in the individual hardware sets by Ives, Hager and Trimco are acceptable. Finish shall match the adjacent hardware.

2.11 THRESHOLDS AND SEALS

A. Provide materials and finishes as listed in hardware sets. Zero products have been specified to set a high level of quality, equivalent product by manufactured by National Guard Products and Pemko shall be acceptable. All thresholds must be in accordance with the requirements of the ADA and ANSI A117.1.

B. Provide thresholds with Zero 226 anchoring application. Supply all necessary anchoring devices as supplied by the product manufacturer for the installation of weather strip and sound seal.

C. Seals shall comply with requirements of UL10C. All thresholds, door bottoms and weather strip inserts shall be a silicone based product as specified in 3.02 Hardware Sets. Other materials used shall be rejected, unless originally specified.
D. Seals shall comply with the requirements of the Wood Door Manufacturer’s certification requirements.

E. Install all Threshold in a full bed of sealant as to prevent water & insect penetration inside of the building.

2.12 FINISHES

A. Finishes for all hardware are as required in this specification and the hardware sets.

B. Special care is to be taken to make uniform the finish of all various manufactured items.

2.13 DOOR SILENCERS

A. Provide door silencers at all openings without gasket. Provide two- (2) each at pair of doors and three- (3) or four- (4) each for each single door (coordinate with the frame manufacturer).

2.14 PROPRIETARY PRODUCTS

A. References to specific products are used to establish quality standards of utility and performance. Unless otherwise approved provide only the specified product.

B. All other materials, not specifically described, but required for a complete and proper finish hardware installation, are to be selected by the Contractor, subject to the approval of the Architect and the Owners Representative.

C. Architect and the Owners Representative reserve the right to approve all the substitutions proposed for this specification. All requests for substitution to be made prior to bid in accordance with Division 1, General Requirements, and are to be in writing, hand delivered to the Architect. Two (2) copies of the manufacturer’s brochures and a physical sample of each item in the appropriate design and finish shall accompany requests for substitution.

PART 3 - EXECUTION

3.01 INSTALLATION AND SERVICE ITEMS OF FINISH HARDWARE

A. All finish hardware shall be installed by an experienced finish hardware installer with at least ten (10) years of experience after a pre-installation meeting between the contractor, hardware Manufacturers representative, the hardware supplier, the hollow metal supplier and the wood door supplier. The finish hardware installer shall be responsible for the proper installation and function of all doors and hardware.

B. The hardware supplier’s office and/or warehouse shall be located within a one seventy-five (75) mile radius of the project site as to better service the general contractor and the Owners Representative during this project.

C. Check hardware against the reviewed hardware schedule upon delivery. Store the hardware in a dry and secure location to protect against loss and damage.

D. Install finish hardware in accordance with approved hardware schedule and manufacturers’ printed instructions. Pre-fit hardware before finish is applied to
door; remove and reinstall after finish is complete and dry. Install and adjust hardware so that parts operate smoothly, close tightly, and do not rattle.

E. Mortise and cutting to be done neatly, and evidence of cutting to be concealed in the finished work. Protect all Finish hardware from scratching or other damage.
3.02 HARDWARE SETS

Hardware Group No. 002

For use on Door #\(\text{s}\):
008 333A 333B

Provide each CO door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HARDWARE CASED OPENING, NO HARDWARE REQUIRED</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hardware Group No. 003

For use on Door #\(\text{s}\):
100 110B 111

Provide each PR door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>CYLINDER</td>
<td>20-079/20-061 ICX W/CONST. CORE AS REQD</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>3</td>
<td>FSIC CORE BALANCE HARDWARE</td>
<td>23-030</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>POWER SUPPLY</td>
<td>GC PROVIDED, COORDINATE W/ OWNERS SECURITY COMPANY</td>
<td>⚫</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>CARD READER</td>
<td>BY SECURITY CONTRACTOR G.C. TO COORDINATE WITH OWNER/ARCHITECT FOR INSTALLATION OF CONDUIT AND BACK BOX</td>
<td>⚫</td>
<td></td>
</tr>
</tbody>
</table>

TDI CERTIFIED DOOR/HARDWARE PACKAGE - EXISTING TO REMAIN. ALL SECURITY DEVICES TO BE PROVIDED BY OWNER'S SECURITY VENDOR.

Hardware Group No. 003.1

For use on Door #\(\text{s}\):
110A

Provide each PR door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>CYLINDER</td>
<td>20-079/20-061 ICX W/CONST. CORE AS REQD</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>3</td>
<td>FSIC CORE BALANCE HARDWARE</td>
<td>23-030</td>
<td>626</td>
<td>SCH</td>
</tr>
</tbody>
</table>

Hardware Group No. 003.2

For use on Door #\(\text{s}\):
316 317 318 319 321 322
323 324 325 326 327 329A
Provide each SL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CYLINDER</td>
<td>20-079/20-061 ICX W/CONST.</td>
<td>626 SCH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CORE AS REQD</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>FSIC CORE</td>
<td>23-030</td>
<td>626 SCH</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>CRL 24” Extra Length Ladder Style Back-toBack Pulls</td>
<td>24LPBS CRL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BALANCE OF HARDWARE BY SLIDING DOOR/FRAME MFG.

Hardware Group No. 101A

For use on Door #():
112 113

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652 IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ENTRANCE LOCK</td>
<td>ND53TD SPA</td>
<td>626 SCH</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>FSIC CORE</td>
<td>23-030</td>
<td>626 SCH</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>1461 RW/PA FC TBSRT</td>
<td>689 LCN</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>PROTECTION PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630 IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630 IVE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PERIMETER SEAL</td>
<td></td>
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Hardware Group No. 103

For use on Door #():
329B 331

Provide each SGL door(s) with the following:

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<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652 IVE</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ENTRANCE LOCK</td>
<td>ND53TD SPA</td>
<td>626 SCH</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>FSIC CORE</td>
<td>23-030</td>
<td>626 SCH</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>CRL 24” Extra Length Ladder Style Back-toBack Pulls</td>
<td>24LPBS CRL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630 IVE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PERIMETER SEAL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hardware Group No. 201

For use on Door #():
011 406

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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<td>DESCRIPTION</td>
<td>CATALOG NUMBER</td>
<td>FINISH</td>
<td>MFR</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------</td>
<td>----------------</td>
<td>--------</td>
<td>-----</td>
</tr>
<tr>
<td>3</td>
<td>HINGE 5BB1 4.5 X 4.5 NRP</td>
<td>652 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK ND80TD SPA</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>FSIC CORE 23-030</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER 1461 RW/PA FC TBSRT</td>
<td>689 LCN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>PROTECTION PLATE 8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP WS406/407CCV</td>
<td>630 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SILENCER SR64</td>
<td></td>
<td>GRY</td>
<td>IVE</td>
</tr>
</tbody>
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Hardware Group No. 201A
For use on Door #(s):
004 104 204 304
Provide each SGL door(s) with the following:
<table>
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<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE 5BB1 4.5 X 4.5 NRP</td>
<td>652 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK ND80TD SPA</td>
<td>626 SCH</td>
<td></td>
<td></td>
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<tr>
<td>1</td>
<td>FSIC CORE 23-030</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER 1461 RW/PA FC TBSRT</td>
<td>689 LCN</td>
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<td></td>
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<tr>
<td>1</td>
<td>PROTECTION PLATE 8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>WALL STOP WS406/407CCV</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>PERIMETER SEAL BY FRAME MANUFACTURER</td>
<td></td>
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Hardware Group No. 201C
For use on Door #(s):
109 209 309 334 335 404
Provide each SGL door(s) with the following:
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<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE 5BB1 4.5 X 4.5 NRP</td>
<td>652 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK ND80TD SPA</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>FSIC CORE 23-030</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER 1461 SCUSH FC TBSRT</td>
<td>689 LCN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>PROTECTION PLATE 8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>WALL STOP WS406/407CCV</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>PERIMETER SEAL BY FRAME MANUFACTURER</td>
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</table>

Hardware Group No. 201R
For use on Door #(s):
005
Provide each SGL door(s) with the following:
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<th>QTY</th>
<th>DESCRIPTION</th>
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<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE 5BB1 4.5 X 4.5 NRP</td>
<td>652 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK ND80TD SPA</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>FSIC CORE 23-030</td>
<td>626 SCH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER 1461 RW/PA FC TBSRT</td>
<td>689 LCN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>PROTECTION PLATE 8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630 IVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QTY</td>
<td>DESCRIPTION</td>
<td>CATALOG NUMBER</td>
<td>FINISH</td>
<td>MFR</td>
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</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SMOKE GASKETING</td>
<td>8145S-BK-HEAD &amp; JAMBS</td>
<td>S-Bk</td>
<td>ZER</td>
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</table>

Hardware Group No. 202

For use on Door #(s):
012A 012B

Provide each SGL door(s) with the following:

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<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
<td>4</td>
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<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PANIC HARDWARE</td>
<td>99-L-NL-17-SNB</td>
<td>628</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>RIM CYLINDER</td>
<td>20-057 ICX W/CONST. CORE</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>FSIC CORE</td>
<td>23-030</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>1461 RW/PA FC TBSRT</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>PROTECTION PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
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Hardware Group No. 203

For use on Door #(s):
313

Provide each SGL door(s) with the following:

<table>
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<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80TD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>FSIC CORE</td>
<td>23-030</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>OH STOP</td>
<td>100S-SIZE REQD</td>
<td>630</td>
<td>GLY</td>
</tr>
</tbody>
</table>

Hardware Group No. 203S

For use on Door #(s):
002 102 202 302

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80TD SPA</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>FSIC CORE</td>
<td>23-030</td>
<td>626</td>
<td>SCH</td>
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<tr>
<td>1</td>
<td>OH STOP</td>
<td>100S-SIZE REQD</td>
<td>630</td>
<td>GLY</td>
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</table>

Hardware Group No. 711C

For use on Door #(s):
006 106 206 306
Provide each SGL door(s) with the following:

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<th>DESCRIPTION</th>
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<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
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<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EXIT HARDWARE</td>
<td>99-L-BE-17-SNB</td>
<td>628</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>RIM CYLINDER</td>
<td>20-057 ICX W/CONST. CORE</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>FSIC CORE</td>
<td>23-030</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>1461 SCUSH FC TBSRT</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>PROTECTION PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td></td>
<td>PERIMETER SEAL</td>
<td>BY FRAME MANUFACTURER</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Hardware Group No. 731**

For use on Door #(#): 107C

Provide each SGL door(s) with the following:

<table>
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<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
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<tbody>
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<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>EXIT HARDWARE</td>
<td>99-L-BE-17-SNB</td>
<td>628</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>1461 RW/PA FC TBSRT</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>PROTECTION PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td></td>
<td>PERIMETER SEAL</td>
<td>BY FRAME MANUFACTURER</td>
<td></td>
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**Hardware Group No. 731R**

For use on Door #(#): 007 107A 207 307 407

Provide each SGL door(s) with the following:

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<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>FIRE EXIT HARDWARE</td>
<td>99-L-BE-F-17-SNB</td>
<td>628</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>1461 RW/PA FC TBSRT</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>PROTECTION PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SMOKE GASKETING</td>
<td>8145S-BK-HEAD &amp; JAMBS</td>
<td>689</td>
<td>ZER</td>
</tr>
</tbody>
</table>

**Hardware Group No. 801**

For use on Door #(#): 003 103 203 303 403

Provide each SGL door(s) with the following:

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<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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</thead>
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<td>3</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PUSH PLATE</td>
<td>8200 8&quot; X 16&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PULL PLATE</td>
<td>8305 8&quot; 3.5&quot; X 15&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>1461 RW/PA FC TBSRT</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>QTY</td>
<td>DESCRIPTION</td>
<td>CATALOG NUMBER</td>
<td>FINISH</td>
<td>MFR</td>
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</tr>
<tr>
<td>1</td>
<td>PROTECTION PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td></td>
<td>PERIMETER SEAL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BY FRAME MANUFACTURER</td>
<td></td>
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Hardware Group No. 801F

For use on Door #s:
001 101 201 301 401

Provide each SGL door(s) with the following:

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<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PUSH PLATE</td>
<td>8200 8&quot; X 16&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PULL PLATE</td>
<td>8305 8&quot; 3.5&quot; X 15&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>1461 RW/PA FC TBSRT</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>PROTECTION PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>FLOOR STOP</td>
<td>FS441</td>
<td>626</td>
<td>IVE</td>
</tr>
<tr>
<td>3</td>
<td>SILENCER</td>
<td>SR64</td>
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<td></td>
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</table>

Hardware Group No. W715

For use on Door #s:
000B

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1HW 4.5 X 4.5 NRP</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PANIC HARDWARE</td>
<td>HH-99-NL-299F</td>
<td>628</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>RIM CYLINDER</td>
<td>20-057 ICX W/CONST. CORE</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>FSIC CORE</td>
<td>23-030</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP SCUSH TBSRT</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>PROTECTION PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>FLOOR STOP</td>
<td>FS18L</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>RAIN DRIP</td>
<td>142A DW + 4&quot;</td>
<td>628</td>
<td>VON</td>
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<tr>
<td>1</td>
<td>GASKETING</td>
<td>328S-2 PCS JAMB HEIGHT</td>
<td>626</td>
<td>SCH</td>
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<tr>
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<td>GASKETING</td>
<td>429S-1 PC HERDER WIDTH</td>
<td>626</td>
<td>SCH</td>
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<td>39A-DOOR WIDTH</td>
<td>655A-V3-226 FRAME WIDTH</td>
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<td>THRESHOLD</td>
<td>655A-V3-226 FRAME WIDTH</td>
<td>A</td>
<td>ZER</td>
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</table>

ALL HARDWARE SHALL BE CERTIFIED AS TDI COMPLIANT AND COORDINATED BY THE GENERAL CONTRACTOR/HARDWARE SUPPLIER PRIOR TO BID WITH THE DOOR SUPPLIER/MANUFACTURER BEING PRICED TO INSURE TDI COMPLIANCE. LACK OF COORDINATION BETWEEN THE GENERAL CONTRACTOR, HARDWARE SUPPLIER AND DOOR SUPPLIER TO COORDINATE TDI COMPLIANCE PRIOR TO BID SHALL BE CONSIDERED ACCEPTANCE OF DOOR HARDWARE SPECIFIED AS BEING IN FULL COMPLIANCE WITH TDI. CHANGES RESULTING IN ADDED COST DUE TO A LACK OF COORDINATION SHALL BE THE RESPONSIBILITY OF THE GENERAL CONTRACTOR, HARDWARE SUPPLIER AND DOOR SUPPLIER.
Hardware Group No. W715A

For use on Door #(s):
000A

Provide each SGL door(s) with the following:

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<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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<td>3</td>
<td>HINGE</td>
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<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PANIC HARDWARE</td>
<td>KAW-HH-99-NL-OP</td>
<td>628</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>RIM CYLINDER</td>
<td>20-057 ICX W/CONST. CORE</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>FSIC CORE</td>
<td>23-030</td>
<td>626</td>
<td>SCH</td>
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PERIMETER SEAL BY FRAME MANUFACTURER

BALANCE HARDWARE BY DOOR MANUFACTURER

ALL HARDWARE SHALL BE CERTIFIED AS TDI COMPLIANT AND COORDINATED BY THE GENERAL CONTRACTOR/HARDWARE SUPPLIER PRIOR TO BID WITH THE DOOR SUPPLIER/MANUFACTURER BEING PRICED TO INSURE TDI COMPLIANCE. LACK OF COORDINATION BETWEEN THE GENERAL CONTRACTOR, HARDWARE SUPPLIER AND DOOR SUPPLIER TO COORDINATE TDI COMPLIANCE PRIOR TO BID SHALL BE CONSIDERED ACCEPTANCE OF DOOR HARDWARE SPECIFIED AS BEING IN FULL COMPLIANCE WITH TDI. CHANGES RESULTING IN ADDED COST DUE TO A LACK OF COORDINATION SHALL BE THE RESPONSIBILITY OF THE GENERAL CONTRACTOR, HARDWARE SUPPLIER AND DOOR SUPPLIER.

Hardware Group No. W715R

For use on Door #(s):
107B 205 305

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END OF SECTION
SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Glass glazing for metal frames, doors, and windows.

B. Related Sections:
   1. Section 07 90 00 - Joint Protection: Sealant and back-up material other than glazing sealants.
   2. Section 08 14 16 – Flush Wood Doors
   3. Section 08 40 00 – Aluminum Framed Entrances and Storefronts
   4. Section 08 52 00 – Wood Windows
   5. Section 08 80 00 - Glazing

1.2 REFERENCES

A. American National Standards Institute:

B. ASTM International:
   10. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.

C. Glass Association of North America:
   1. GANA - Sealant Manual.
D. National Fenestration Rating Council Incorporated:
   1. NFRC 100 - Procedures for Determining Fenestration Product U-Factors.

E. Underwriters Laboratories Inc.:
   1. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
   2. UL - Building Materials Directory.

1.3 PERFORMANCE REQUIREMENTS

A. Provide glass and glazing materials for continuity of building enclosure weather barrier:
   1. To maintain continuous weather barrier throughout glazed assembly from glass pane to heel bead of glazing sealant.

B. Glass Thickness: Select minimum thickness in accordance with ASTM E1300 to resist specified design loads.
   1. Minimum Thickness: 3/8 inch for interior glass (or as indicated on drawings)
   2. Minimum Thickness: 1-5/16 inch for exterior glass at storefront and curtain wall framing

C. Wind Loads: Design and size glass to withstand positive and negative wind loads acting normal to plane of wall, including increased loads at building corners.
   1. Design Wind Load: As calculated in accordance with ASCE 7-10 with 155 mph basic wind speed, exposure C.
   2. Reference structural drawings for additional load and design criteria.

D. Wind-Borne Debris Loads: Design and size glass located less than 60 feet above grade to withstand the following loads:
   1. ASTM E1886 and ASTM E1996; large missile impact test.

E. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable code.

F. Exterior Glass Deflection: Maximum of 1/175 of glass edge length or 3/4 inch, whichever is less with full recovery of glazing materials.

G. Interior Glass Deflection: Maximum differential deflection for two adjacent unsupported edges when 50 plf force is applied to one panel at any point up to 42 inches above finished floor less than thickness of glass.

H. Thermal and Solar Optical Performance: Measured or calculated in accordance with the following:
   1. Maximum U-Values: Comply with ICC IEEC 2015 for climate zone in which project is located.
   2. Maximum SHGC: Comply with ICC IEEC 2015 for climate zone in which project is located.
1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Signed and sealed by professional engineer.
   1. Indicate sizes, layout, thicknesses, and loading conditions for glass.

C. Product Data:
   1. Glass: Provide structural, physical, and thermal and solar optical performance
      characteristics, size limitations, and special handling or installation requirements.
   2. Glazing Sealants, Compounds and Accessories: Provide chemical, functional, and
      environmental characteristics, limitations, special application requirements. Identify
      available colors where exposed.

D. Design Data: Signed and sealed by professional engineer.
   1. Submit design calculations for glass thicknesses.

E. Samples:
   1. Glass: Submit two samples 12x12inch in size
   2. Glazing Materials: Submit 6 inch long bead of glazing sealant and gaskets, color as selected.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with GANA Glazing Manual, GANA Sealant Manual, GANA
   Laminated Glass Design Guide for glazing installation methods.

B. Smoke Developed Index: Maximum 450 when tested in accordance with ASTM E84

1.6 QUALIFICATIONS

A. Installers: An experienced installer who has completed glazing similar in material, design, and
   extent to that indicated for the Project; whose work has resulted in glass installations with a
   record of successful in-service performance and who employs glass installers for this project with
   a minimum of three years experience.

1.7 MOCKUP

A. Section 01 43 39 – Mockups

B. Construct mockup as directed by Architect to include glass and air barrier seal.

C. Remove mockup when directed by Architect.

1.8 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week before starting Work of this section.
1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install glazing when ambient temperature is less than 50 degrees F.

C. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish ten-year warranty to include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same. Include coverage for delamination of laminated glass and replacement of same.

1.11 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Supply two of each glass size and each glass type.

PART 2 PRODUCTS

2.1 FLOAT GLASS MATERIALS

A. Annealed Glass: ASTM C1036, Type 1 transparent flat, Quality Q3, float glass.
   1. Furnish annealed glass except where heat strengthened or tempered glass is required to meet specified performance requirements.

B. Heat Strengthened Glass: ASTM C1048, Type 1 transparent flat, Quality Q3, Kind HS heat strengthened, Condition A uncoated, float glass.
   1. Furnish heat strengthened glass where annealed glass cannot meet specified performance requirements.

C. Tempered Glass: ASTM C1048, Type 1 transparent flat, Quality Q3, Kind FT fully tempered, Condition A uncoated, float glass with horizontal tempering.
   1. Furnish tempered glass where heat strengthened glass cannot meet specified performance requirements.
   2. Furnish tempered glass conforming to CPSC 16 CFR 1201 Category II at locations where safety glass is required by code and where indicated on Drawings.

2.2 FLOAT GLASS PRODUCTS

A. Float Glass Manufacturers:
   1. ACH Glass Operations
   2. AFG Industries, Inc.
3. Guardian Industries Corp.
4. PPG Industries
5. Pilkington North America, Inc.
6. Substitutions: Section 01 60 00 - Product Requirements

B. Clear Glass: Annealed, Heat strengthened, and Tempered float glass as specified; Class 1 clear.
   1. Clear annealed glass (FG-CA).
   2. Clear heat strengthened glass (FG-CH).
   3. Clear tempered glass (FG-CT).
   4. Minimum Thickness: 1/4 inch unless otherwise indicated.

2.3 IMPACT RESISTANT INSULATING LAMINATED GLASS PRODUCTS

A. Impact Insulating Glass Manufacturers:
   1. PPG Industries
   2. Cardinal Glass Industries
   3. Substitutions: Section 01 60 00 - Product Requirements

B. Triple Pane Impact Resistant Tinted Insulating Vision Glass (Exterior Storefront Windows):
   1. Total Unit Thickness: 1-5/16 inch.
   2. Product: Solarban 70xl Solar Control Lowe-E Glass with Tint manufactured by PPG.
   3. Color (Basis of Design): SOLARBAN 70XL (2) Atlantica + Clear (to match building windows)
   4. U-Factor: 0.28 maximum.
   5. Solar Heat Gain Coefficient: 0.25 maximum.
   6. UV Transmittance: 9%
   7. Visible Light Transmittance: 52

2.4 MATERIALS

A. Sealed Insulating Glass: ASTM E 1300-04, The sealed insulating glass unit is comprised of a laminated glass unit and a 1/4” heat strengthened glass lite separated by a desiccant-filled spacer system. The laminated glass unit is comprised of two 1/4” heat strengthened glass lites with a 0.075” Vanceva/Stormglass interlayer.

2.5 GLAZING SEALANTS

A. Elastomeric Glazing Sealants: Materials compatible with adjacent materials including glass, and glazing channels.
   1. Silicone Glazing Sealant: ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated; single component; solvent curing; capable of water immersion without loss of properties; non-bleeding, non-staining, cured Shore A hardness of 15 to 25.
      a. Structural Silicone: Furnish high-modulus structural silicone glazing materials where sealant bonds glass to substrate.
    2. Polyurethane Glazing Sealant: ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated; single component, chemical curing, non-staining, non-bleeding, Shore A Hardness Range 20 to 35.

B. Glazing Putty: Match existing.
1. Glazing Putty: Oil and resin base caulking compound, hardening type; knife grade consistency; manufacturer’s standard white color.

C. Dense Gaskets: Resilient extruded shape to suit glazing channel retaining slot; color as selected.
   2. EPDM: ASTM C864.

D. Soft Gaskets: ASTM C509; resilient extruded shape to suit glazing channel retaining slot; color as selected.
   1. Neoprene.
   2. EPDM.

2.6 GLAZING ACCESSORIES

   A. Setting Blocks: Elastomeric material recommended by glass manufacturer, 80 to 90 Shore A durometer hardness, length of 0.1 inch for each square foot of glazing or minimum 4-inch x width of glazing rabbet space minus 1/16-inch x height to suit glazing method and pane weight and area.

   B. Spacer Shims: Elastomeric material recommended by glass manufacturer, 50 to 60 Shore A durometer hardness, minimum 3-inch-long x one half the height of glazing stop x thickness to suit application.

   C. Glazing Clips: Manufacturer's standard type.

   D. Plastic Film: Frosted Film for interior glazing.
      1. Product: Essen plastic film, manufactured by 3M

PART 3 EXECUTION

3.1 EXAMINATION

   A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

   B. Verify openings for glazing are correctly sized and within acceptable tolerance.

   C. Verify surfaces of glazing channels or recesses are clean, free of obstructions impeding moisture movement, weeps are clear, and ready to receive glazing.

3.2 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.
3.3 INSTALLATION

A. Perform installation in accordance with GANA Glazing Manual and Texas Department of Insurance glazing method for approved storefront system.

B. Exterior Wet/Dry Method (Preformed Tape and Sealant) Installation:
   1. Cut glazing tape to length and set against permanent stops, 3/16 inch below sight line. Seal corners by butting tape and dabbing with compatible butyl sealant.
   2. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete continuity of air and vapor seal.
   3. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
   4. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.
   5. Install removable stops, with spacer strips inserted between glazing and applied stops, 1/4 inch below sight line. [Place glazing tape on glazing pane or unit with tape flush with sight line.
   6. Fill gap between glazing and stop with elastomeric glazing sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch below sight line.
   7. Apply cap bead of elastomeric glazing sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

C. Interior Wet/Dry Method (Tape and Sealant) Installation:
   1. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.
   2. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
   3. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
   4. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
   5. Fill gaps between pane and applied stop with elastomeric glazing sealant to depth equal to bite on glazing, to uniform and level line.
   6. Trim protruding tape edge.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove glazing materials from finish surfaces.

C. Remove labels after Work is complete.

D. Clean glass and adjacent surfaces.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. After installation, mark pane with an 'X' by using removable plastic tape or paste.
END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section includes metal stud wall framing; metal channel ceiling framing; gypsum board and joint treatment; acoustic insulation; and smooth (non-textured) finish.

B. Related Sections:
   1. Section 05 40 00 – Cold Formed Metal Framing
   2. Section 06 11 00 - Wood Framing: Wood blocking.
   3. Section 07 21 00 - Thermal Insulation: Thermal insulation.
   4. Section 09 22 16 – Non-Structural Metal Framing

1.2 REFERENCES

A. American Society for Testing and Materials:

B. Gypsum Association:
   1. GA 214 - Recommended Levels of Gypsum Board Finish.
   2. GA 216 - Application and Finishing of Gypsum Board.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on metal framing, gypsum board, joint tape and acoustic accessories.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with GA-214, GA-216.

B. Fire Rated Wall Construction: Rating as indicated on Drawings
   1. Tested Rating: Determined in accordance with ASTM E119.
1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years’ experience.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Manufacturers:
   1. G-P Gypsum Corp.
   2. National Gypsum Co.
   3. United States Gypsum Co.
   4. Substitutions: Section 01 60 00 – Substitution Procedures.

2.2 COMPONENTS

A. Framing Materials:
   2. Furring, Framing, and Accessories: GA-216.
   3. Fasteners: ASTM C1002.
   4. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

B. Gypsum Board Materials:
   2. Moisture Resistant Gypsum Board: 5/8-inch-thick, maximum available length in place; ends square cut, tapered edges.
      a) Locations:
         (1) All restrooms up to 60” A.F.F.
         (2) At drinking foundation alcove up to soffit
         (3) Behind all sinks up to 60” A.F.F.

2.3 ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced, minimum 3 inch thick, R-11 min.

B. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.

C. Corner Beads: Metal.
D. Edge Trim: GA-216.

E. Joint Materials: GA-216; reinforcing tape, joint compound, adhesive, and water.

F. Fasteners: ASTM C1002, Type S12 and GA-216.

G. Control Joints: GA-216; provide fire rated control joints in fire rated wall assemblies.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 31 00 – Project Management and Coordination: Coordination and project conditions.

B. Verify site conditions are ready to receive work and opening dimensions are as instructed by manufacturer.

3.2 INSTALLATION

A. Metal Stud Installation:
   1. Install studs in accordance with GA-216.
   2. Metal Stud Spacing: 16 inches on center.
   3. Extend stud framing through ceiling to structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.
   4. Door Opening Framing: Install double studs at door frame jambs.
   5. Blocking: Screw wood blocking to studs. Install blocking for support of plumbing fixtures, wall cabinets, and toilet accessories. Coordinate with other trades to determine additional blocking requirements.

B. Acoustic Accessories Installation:
   1. Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.
   2. Install acoustic sealant within partitions.

C. Gypsum Board Installation:
   1. Install gypsum board in accordance with GA-216.
   2. Erect single layer standard gypsum board horizontal, with ends and edges occurring over firm bearing.
   3. Use screws when fastening gypsum board to metal furring or framing.
   4. Treat cut edges and holes in moisture resistant gypsum board with sealant.
   5. Place control joints consistent with lines of building spaces and as directed by architect. Install control joints in accordance with GA-216 at a minimum where uninterrupted runs in gypsum board exceed 30 feet.
6. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.
7. Apply gypsum board to curved walls in accordance with GA-216.

D. Joint Treatment:
1. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
2. Feather coats on to adjoining surfaces so that camber is maximum 1/32 inch.
3. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile.

E. Finish: Smooth finish.

3.3 ERECTION TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from Flat Surface: 1/8 inch in 10 feet.

END OF SECTION
SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes metal stud framing and accessories at interior locations.

B. Related Sections:
   1. Section 06 10 00 - Rough Carpentry: Rough wood blocking within stud framing.
   2. Section 07 21 16 - Blanket Insulation: Insulation between framing members.
   3. Section 09 21 16 - Gypsum Board Assemblies

1.2 REFERENCES

A. ASTM International:
   2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. National Association of Architectural Metal Manufacturers:

C. SSPC: The Society for Protective Coatings:
   1. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.3 SYSTEM DESCRIPTION

A. Interior Walls: Metal stud framing system with batt type acoustic insulation where indicated in construction drawings, interior gypsum board specified in Section 09 21 16.

B. Maximum Allowable Deflection: 1: 120 span.

C. Wall System:
   1. Design to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
   2. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
1.4 PERFORMANCE REQUIREMENTS

A. Select stud thickness to resist minimum 5psf uniform load and maximum 1/360 deflection.

1.5 SUBMITTALS

A. Shop Drawings:
   1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, type and location of fasteners, and accessories or items required of other related work.
   2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement to framing connections.
   3. Provide calculations for loadings and stresses of exterior walls, specially fabricated framing, and wood panel walls.

B. Product Data: Submit data describing standard framing member materials and finish, product criteria, load charts and limitations.

C. Manufacturer's Installation Instructions: Submit special procedures and perimeter conditions requiring special attention.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C754, NAAMM ML/SFA 540.

B. Form, fabricate, install, and connect components in accordance with NAAMM ML/SFA 540.

C. Furnish framing materials in accordance with SSMA - Product Technical Information.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
   1. Framing Manufacturer: Current member of Steel Stud Manufacturers Association.

B. Installer: Company specializing in performing Work of this section with minimum three years experience.

C. Design structural elements under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

PART 2 PRODUCTS

2.1 METAL FRAMING SYSTEM

A. Manufacturers:
   1. Clark Steel Framing Systems
   2. Dietrich Industries, Inc.
3. Harrison Manufacturing Co.
4. Marino/Ware
5. Unimast Incorporated
6. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

A. Framing System Components: ASTM C645.

B. Studs: ASTM A653/A653M, non-load bearing rolled steel, channel shaped, punched for utility access, as follows:
   1. Depth: 2-1/2, 3-5/8, 4, and 6 inches as indicated on drawings.
   2. Thickness: 0.03 inch.

C. Tracks and Headers: Same material and thickness as studs, bent leg retainer notched to receive studs. Ceiling Runners: With extended leg retainer.

D. Furring and Bracing Members: Of same material as studs; thickness to suit purpose.

E. Fasteners: ASTM C1002; Type S; length to suit application.

F. Acoustic Sealant: As specified in Section 09 21 16.

2.3 SHOP FINISHING

A. Studs, Tracks and Headers: Galvanize to G40 coating class.

B. Accessories: Same finish as framing members.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify rough-in utilities are in proper location.

3.2 INSTALLATION

A. Align and secure top and bottom runners at 24 inches oc

B. Achieve air tight seal between studs and adjacent vertical surfaces with acoustic sealant.

C. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

D. Install studs vertically at 16 inches oc.

E. Align stud web openings horizontally.

F. Secure studs to tracks using crimping method. Do not weld.
G. Stud splicing permissible. Splice studs with 8 inch nested lap, secure each stud flange with flush head screw.

H. Fabricate corners using minimum of three studs.

I. Double stud at wall openings, door and window jambs, not more than 2 inches from each side of openings.

J. Brace stud framing system rigid.

K. Coordinate erection of studs with requirements of door frames and window frames; install supports and attachments.

L. Coordinate installation of wood bucks, anchors, and wood blocking with electrical and mechanical work to be placed within or behind stud framing.

M. Blocking: Secure wood blocking to studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and opening frames.

N. Refer to Drawings for indication of partitions extending stud framing through ceiling to structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Install extended leg ceiling runners.

O. Coordinate placement of insulation in stud spaces after stud frame erection.

3.3 ERECTION TOLERANCES

A. Maximum Variation From Indicated Position: 1/8 inch in 10 feet.

B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION
SECTION 09 30 00
TILING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes ceramic and porcelain tile for floor and wall applications; and ceramic
accessories.

B. Related Sections:
   1. Section 03 35 00 - Concrete Finishing: Troweling of floor slab for tile application.
   2. Section 07 90 00 - Joint Protection.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A108.1 - Installation of Ceramic Tile, A collection.
   2. ANSI A108.10 - Specifications for Installation of Grout in Tilework.
   3. ANSI A118.4 - Latex-Portland Cement Mortar.
   4. ANSI A108.9 - Specifications for Ceramic Tile Installed with Modified Epoxy Emulsion
      Mortar/Grout.
   5. ANSI A118.6 - Ceramic Tile Grouts.
   6. ANSI A118.8 - Modified Epoxy Emulsion Mortar/Grout.
   8. ANSI A137.1 - Ceramic Tile.

B. Tile Council of America:

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit instructions for using grouts and adhesives.

C. Samples: Submit two tile and grout samples, in size illustrating pattern and color variations

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit recommended cleaning methods, cleaning materials,
stain removal methods, and polishes and waxes.
1.5 QUALITY ASSURANCE
A. Perform Work in accordance with TCA Handbook and ANSI A108 Series/A118 Series.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
B. Installer: Company specializing in performing Work of this section with minimum three years’ experience.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
B. Protect adhesives and grouts from freezing or overheating.

1.8 ENVIRONMENTAL REQUIREMENTS
A. Section 01 60 00 - Product Requirements.
B. Do not install adhesives and grouts in unventilated environment.
C. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

PART 2 PRODUCTS

2.1 TILE
A. Manufacturers:
   1. CommodiTile
   2. Daltile
   3. Marazzi
   4. Agrob Buchtal
   5. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS
A. Glazed Porcelain Floor Tile (CT 01):
   1. Manufacturer: CommodiTile
   2. Cantina, Glazed Polished
   3. Size: 12 x 24 inch.
   4. Thickness: 3/8”
   5. Grout Joint: 1/8”
   6. Shape: Rectangular
   7. Color: CTSILCAT12241L
B. Glazed Porcelain Floor Tile (CT 02):
   1. Manufacturer: CommodiTile
   2. Cantina, Honed Matte
   3. Size: 12 x 24 inch.
   4. Thickness: 3/8”
   5. Grout Joint: 1/8”
   6. Shape: Rectangular
   7. Color: CTSILCAT12241U

C. Mosaic Wall Tile (CT 03):
   1. Manufacturer: Daltile
   2. Regal Penant
   3. Size: 1.5 x 4 inch (11”x12” sheet)
   4. Thickness: 3/8”
   5. Grout Joint: 1/8”
   6. Shape: geometric
   7. Color: Contessa Charm RP11

D. Glazed Porcelain Floor Tile (CT 04):
   1. Manufacturer: Marazzi
   2. Merona
   3. Size: 8 x 42 inch.
   4. Thickness: 5/16”
   5. Grout Joint: 3/16”
   6. Shape: Rectangular
   7. Color: MR42 Brown

E. Exterior Ceramic Wall Tile (CT 05):
   1. Manufacturer: Agrob Buchtal
   2. Chroma Plural
   3. Size: 12 x 12 inch.
   4. Thickness: 8mm
   5. Grout Joint: 1/8”
   6. Shape: Square
   7. Color (reference drawings for locations):
      a. 2014/NCS S 0510-G (grun hell)
      b. 2015/NCS S 1515-G20Y (grun mittel)
      c. 2016/NCS S 3020-G10Y (grun dunkel)

2.3 ACCESSORIES

A. Adhesive Materials:

B. Mortar Materials:
   1. Mortar Bond Coat Materials:

C. Grout Materials:
1. Standard Grout: Epoxy Grout: ANSI A118.8, modified epoxy emulsion grout, color as selected by Architect from manufacturers full color range.

D. Cementitious Backer Board: ANSI A118.9; High density, cementitious, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners.

E. Thresholds: Where required, provide extruded aluminum with integral edge strip.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify surfaces are ready to receive work.

3.2 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler.

D. Install cementitious backer board. Tape joints and corners, cover with skim coat of dry-set mortar to feather edge.

E. Prepare substrate surfaces for adhesive installation.

3.3 INSTALLATION

A. Install tile, thresholds, and grout in accordance with applicable requirements of ANSI A108.1 through A108.10, and TCA Handbook recommendations.

B. Request tile pattern. Do not interrupt tile pattern through openings.

C. Place thresholds at exposed tile edges.

D. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor, base and wall joints.

E. Place tile with joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.

F. Form internal angles square and external angles square.

G. Install ceramic accessories rigidly in prepared openings.

H. Sound tile after setting. Replace hollow sounding units.
I. Keep expansion and control joints free of adhesive or grout.

J. Allow tile to set for a minimum of 48 hours prior to grouting.

K. Grout tile joints. Use standard grout unless otherwise indicated.

L. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

M. Installation - Floors - Thin-Set Methods:
   1. Over interior concrete substrates, install in accordance with TCA Handbook Method F113, dry-set or latex-portland cement bond coat.

N. Installation - Wall Tile:
   1. Over gypsum wallboard on metal studs install in accordance with TCA Handbook Method W223, thin set with organic adhesive

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean tile and grout surfaces.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION
SECTION 09 51 23
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes suspended metal grid ceiling system and perimeter trim, and acoustic ceiling tiles.

B. Related Sections:
   1. Section 07 90 00 - Joint Sealers.
   2. Section 08 31 13 – Access Doors and Frames
   3. Section 09 21 16 – Gypsum Board Assemblies
   4. Division 22 Sections as applicable.
   5. Division 23 Sections as applicable.
   6. Division 26 Sections as applicable.

1.2 REFERENCES

A. American Society for Testing and Materials:
   2. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

B. Ceilings and Interior Systems Construction Association:
   1. CISCA - Acoustical Ceilings: Use and Practice.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Samples: Submit two samples 6 x 6 inch in size illustrating material and finish of acoustic units.

C. Product Data: Submit data on metal grid system components and acoustic units.

1.4 QUALITY ASSURANCE

A. Conform to CISCA requirements.

B. Surface Burning Characteristics: Comply with the following when tested in accordance with NFPA 286.
   1. During 40 kW Exposure: No flame spread to ceiling.
   2. During 160 kW Exposure: No flame spread to perimeter of tested sample and no flashover.
   3. Total Smoke Release: Maximum 1,000 cu m.
1.5 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.6 ENVIRONMENTAL REQUIREMENTS
A. Section 01 60 00 - Product Requirements.
B. Maintain uniform temperature and humidity in accordance with manufacturer’s instructions. Maintain uniform temperature of minimum 60 degrees F and maximum humidity of 40 percent prior to, during, and after installation.

1.7 SEQUENCING
A. Section 01 31 00 – Project Management and Coordination: Work sequence.
B. Sequence Work to ensure acoustic 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.
C. Install acoustic units after interior wet work is dry.

1.8 EXTRA MATERIALS
A. Furnish two full boxes of extra panels to Owner.

PART 2 PRODUCTS

2.1 SUSPENDED ACOUSTICAL CEILINGS
A. Manufacturers:
   1. Armstrong World Industries
   2. 3 Form
   3. Substitutions: Section 01 60 00 – Substitution Procedures.

2.2 COMPONENTS
A. Beveled Tegular Lay-In Acoustic Panels: Conforming to the following (ACT 01):
   1. Armstrong Cirrus #589 Beveled Tegular
   2. Size: 24 x 24 inches
   3. Thickness: 7/8 inch
   4. Composition: Mineral Fiber
   5. Color: White
   6. Edge Profile: Beveled Tegular
7. NRC: 0.70
8. CAC: 35
10. Light Reflectance: 0.86
11. Humidity resistant.
12. Antimicrobial Protection.
13. Low VOC
14. 30-year warranty

B. Grid:
1. Non-fire Rated Grid: ASTM C635, heavy duty; exposed T; components die cut and interlocking.
2. Grid Materials: Commercial quality cold rolled steel with galvanized coating.
3. Exposed Grid Surface Width: 15/16 inch.
4. Grid Finish: White
5. Accessories: clips, splices, perimeter moldings, and hold down clips required for suspended grid system.
6. Support Channels and Hangers: Primed steel; size and type to suit application and ceiling system flatness requirement specified.

C. 3Form Clario Cloud Square (ACT02)
1. Size: 48” x 48” square
2. Composition: 3/8” soft felt
3. Color: Nickel & Hunter (or as selected by Architect from manufacturers standard colors)
4. NRC: 0.70

D. 3Form Clario Cloud Circle (ACT03)
1. Size: 48” & 72” diameter circle
2. Composition: 3/8” soft felt
3. Color: Nickel & Hunter (or as selected by Architect from manufacturers standard colors)
4. NRC: 0.70

2.3 ACCESSORIES
A. Waterproof, knife grade; type recommended by tile manufacturer.
B. Acoustic Sealant for Perimeter Mouldings: As specified in Section 07 90 00
C. Touch-up Paint: Type and color to match acoustic and grid units.

PART 3 EXECUTION

3.1 EXAMINATION
A. Section 01 31 00 – Administrative Requirements: Coordination and project conditions.
B. Verify layout of hangers will not interfere with other work.

3.2 INSTALLATION

A. Lay-In Grid Suspension System:
   1. Install suspension system in accordance with ASTM C636 and as supplemented in this section.
   2. Locate system on room axis according to reflected plan.
   3. Install after major above ceiling work is complete. Coordinate location of hangers with other work.
   4. Install hanger clips during steel deck erection. Install additional hangers and inserts as required.
   5. 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.
   6. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest affected hangers and related carrying channels to span extra distance.
   7. Do not support components on main runners or cross runners when weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner; or support components independently.
   8. Do not eccentrically load system, or produce rotation of runners.
   9. Perimeter Molding:
      a. Install edge molding at intersection of ceiling and vertical surfaces.
      b. Use longest practical lengths.
      c. Overlap and rivet corners.
   10. Install at junctions with other interruptions.

B. Acoustic Units:
   1. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.
   2. Install units after above ceiling work is complete.
   3. Install acoustic units level, in uniform plane, and free from twist, warp, and dents.
   4. Cutting Acoustic Units:
      a. Cut to fit irregular grid and perimeter edge trim.
      b. Double cut and field paint exposed edges of tegular units.
   5. Install hold-down clips to retain panels tight to grid system within 20 ft of exterior door.

3.3 ERECTION 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 65 00
RESILIENT FLOORING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes resilient plank flooring, resilient tile flooring, and resilient base.

1.2 REFERENCES

A. American Society for Testing and Materials:

B. Federal Specification Unit:
   1. FS L-F-475 - Floor Covering Vinyl, Surface (Tile and Roll), with Backing.
   2. FS RR-T-650 - Treads, Metallic and Nonmetallic, Skid Resistant.

C. National Fire Protection Association:

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Samples:
   1. Submit manufacturer's complete set of color samples for initial selection.
   2. Submit two samples, in size capable of illustrating color and pattern for each resilient flooring product specified.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 0 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect roll materials from damage by storing on end.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

C. Store materials for not less than 48 hours prior to installation in area of installation at temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.8 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Provide 50 square feet of flooring of each material and color specified under provisions of Section 01 70 00.

PART 2 PRODUCTS

2.1 LUXURY VINYL PLANK FLOORING

A. Manufacturers:
   1. Patcraft
   2. Shaw Contract
   3. Substitutions: Section 01 60 00 - Product Requirements.

B. Luxury Vinyl Plank (LVT 01):
   1. Manufacturer: Patcraft, Metal Collective
   2. Style Name: 1478V Molten
   3. Size: 24” x 24”
   4. Overall Thickness: 5mm
   5. Color: Shale 00540
C. Luxury Vinyl Plank (LVT 02):
   1. Manufacturer: Shaw Contract
   2. Collection: Rethink 0733V
   3. Size: 9” x 36”
   4. Overall Thickness: 3mm
   5. Color: Hybrid 33100

2.2 VинYL TILE FLOORING

A. Manufacturers:
   1. Azrock
   2. Substitutions: Section 01 60 00 - Product Requirements.

B. Vinyl Floor Tile (VCT 01):
   1. Manufacturer: Azrock
   2. Size: 12 x 12 inches
   3. Color: TBD

2.3 RUBBER WALL BASE

A. Manufacturers:
   1. Johnsonite
   2. Substitutions: Section 01 60 00 - Product Requirements.

B. 4” High standard toe base, continuous roll, pre-formed inside and outside corners.
   1. OC Standard Toe for outside corners
   2. IC Standard Toe for inside corners

C. Color: As selected by architect from manufacturers standard colors.

2.4 ACCESSORIES

A. Subfloor Filler: Premix latex; type recommended by adhesive material manufacturer.

B. Primers and Adhesives: Waterproof; types recommended by manufacturer.

C. Moldings and Edge Strips: Same material as flooring.

D. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify concrete floors are dry to maximum moisture content as recommended by manufacturer, and exhibit negative alkalinity, carbonization, and dusting.
3.2 PREPARATION

A. Prepare substrates in accordance with manufacturers written instructions to ensure adhesion of resilient flooring and base.

B. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

C. Prohibit traffic until filler is cured.

D. Clean substrate to be covered by resilient products immediately before installation.

E. Apply primer as required to prevent "bleed-thru" or interference with adhesion by substances that cannot be removed.

3.3 INSTALLATION – VINYL FLOORING

A. Mix tiles/planks from container to ensure shade variations are consistent when tile is placed.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical plank pattern.

C. Adhesives: Glue down adhesives as recommended by manufacturer.

D. Install tile to pattern selected by Architect. Allow minimum 8” plank size at room or area perimeter or as recommended by manufacturer.

E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

F. Where floor finishes 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.

3.4 INSTALLATION - BASE

A. Comply with manufacturers written instructions for installing base.

B. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

C. Preformed corners: Install preformed corners at all inside and outside corners before installing straight pieces.
D. Install base on solid backing. Bond tightly to wall and floor surfaces.
E. Scribe and fit to door frames and other interruptions.

3.5 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
B. Remove excess adhesive from floor, base, and wall surfaces without damage.
C. Damp-mop surfaces to remove marks and soil.
D. Clean, seal, and maintain resilient flooring products.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.
   1. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION
SECTION 09 68 13
TILE CARPETING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Carpet tile, fully adhered.
   2. Accessories.

1.2 REFERENCE STANDARDS

A. ASTM International:
   1. ASTM D2859 - Standard Specification for Ignition Characteristics of Finished Textile
      Floor Covering Materials.

B. Carpet and Rug Institute:
   2. CRI Green Label Plus Testing Program.
   3. CRI Model Specifications for Commercial Carpets.

C. Consumer Products Safety Commission:
   1. CPSC 16 CFR 1630 - Standard for the Surface Flammability of Carpets and Rugs.

D. National Fire Protection Association:
   1. NFPA 253 - Standard Method of Test for Critical Radiant Flux for Floor Covering Systems
      Using a Radiant Heat Energy Source.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on specified products, describing physical and performance
   characteristics; sizes, patterns, colors available, and method of installation.

C. Shop Drawings: Indicate layout of joints, direction of carpet pile and location of edge moldings.

D. Samples:
   1. Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
      Matching roll carpet samples.
   2. Submit two, 12-inch-long samples of edge strip and base cap.

E. Manufacturer's Instructions: Submit special procedures and perimeter conditions requiring special
   attention.
1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.5 QUALITY ASSURANCE

A. Surface Burning Characteristics:
   1. Floor Finishes: Comply with one of the following:
      a. Class I, minimum 0.45 watts/sq cm when tested in accordance with NFPA 253.
      b. CPSC 16 CFR 1630 and ASTM D 2859.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum five years documented experience.
   1. FCIB or IFCI certified carpet installers.

1.7 AMBIENT CONDITIONS

A. Section 01 50 00 - Temporary Facilities and Controls: Ambient conditions control facilities for product storage and installation.

B. Store materials in area of installation for 48 hours prior to installation.

PART 2 PRODUCTS

2.1 CARPET TILE

A. Manufacturer List:
   1. Patcraft
   2. Section 01 60 00 - Product Requirements: Requirements for substitutions for other manufacturers and products.

2.2 COMPONENTS

A. Carpet Tile (CPT 01):
   1. Style: Deconstructed Metal
   2. Tile Size: 12 x 48 inch, nominal.
   3. Color: Nickel Titanium 00510
   4. Pattern: Brick
2.3 ACCESSORIES

A. Sub-Floor Filler: Liquid Latex Type recommended by flooring material manufacturer.
B. Moldings and Edge Strips: Thin profile clear anodized aluminum.
C. Seam Adhesive: As recommended by manufacturer.
D. Contact Adhesive: Recommended by carpet manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
B. Verify floor surfaces are smooth and flat within tolerances specified and are ready to receive work.

3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
D. Clean substrate.

3.3 INSTALLATION

A. Install carpet tile in accordance with CRI Carpet Installation Standard.
B. Do not mix carpet from different cartons unless from same dye lot.
C. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
D. Install carpet tile in square pattern, with pile direction alternating to next unit, set parallel to building lines.
E. Locate change of color or pattern between rooms under door centerline.
F. Fully adhere carpet tile to substrate.
G. Trim carpet tile neatly at walls and around interruptions.
H. Complete installation of edge strips, concealing exposed edges.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Remove excess adhesive from floor, base, and wall surfaces without damage.

C. Clean and vacuum carpet surfaces.

END OF SECTION
SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes surface preparation and field application of paints, stains, and other coatings.

1.2 REFERENCES

A. ASTM International:

B. Painting and Decorating Contractors of America:

C. South Coast Air Quality Management District:

D. SSPC: The Society for Protective Coatings:
   1. SSPC - Steel Structures Painting Manual.

1.3 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on finishing products.

C. Samples:
   1. Submit two painted samples, illustrating selected colors for each color and system selected.

D. Manufacturer's Installation Instructions: Submit special surface preparation procedures, substrate and conditions requiring special attention.

1.5 CLOSEOUT SUBMITTALS

Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
A. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.6 QUALITY ASSURANCE

A. Surface Burning Characteristics:
   1. Fire Retardant Finishes: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing work of this section with minimum 3 years documented experience.

1.8 MOCKUP

A. Section 01 40 00 – Quality Requirements: Mock-up requirements.

B. Construct mockup as directed by architect.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

C. 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.

D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.

C. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by 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. Minimum Application Temperature for Stains/Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.

F. Provide lighting level of 80 ft candle measured mid-height at substrate surface.

1.11 SEQUENCING

A. Section 01 10 00 - Summary: Work sequence.

B. Sequence application to the following:
   1. Do not apply finish coats until paintable sealant is applied.
   2. Back prime wood trim before installation of trim.

1.12 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for paints and coatings.

1.13 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Supply 1 gallons of each color, type, and surface texture; store where directed.

C. Label each container with color, type, texture and room locations in addition to manufacturer's label.

PART 2 PRODUCTS

2.1 PAINTS AND COATINGS

A. Manufacturers: Paint, Primer Sealers.
   1. Sherwin Williams
   2. PPG Architectural Finishes
   3. Benjamin Moore
   4. Substitutions: Section 01 60 00 - Product Requirements

2.2 COMPONENTS

A. Coatings: Ready mixed, except field catalyzed coatings. Prepare coatings:
   1. To soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
   2. For good flow and brushing properties.
   3. Capable of drying or curing free of streaks or sags.

B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve finishes specified; commercial quality.
C. Patching Materials: Latex filler.

D. Fastener Head Cover Materials: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify surfaces are ready to receive Work as instructed by product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application.

D. Test shop applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Plaster and Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
   3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
   4. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

A. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

B. Hand Tool Cleaning: Hand Tool Cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife. Before hand tool cleaning, remove visible oil, grease, soluble residues, and salts by the methods outlined in SSPC-SP1. For complete instruction, refer to Steel Structures Paint Council Surface Preparation Specification No. 2 (SSPC-SP2)

C. Surfaces: Correct defects and clean surfaces capable of affecting work of this section.

D. Marks: Seal with shellac those which may bleed through surface finishes.

E. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Gypsum Board Surfaces: Must be clean and dry. All nail/screw heads must be set and spackled. Joints must be taped and covered with a joint compound. Spackled nail heads and tape joints must be sanded smooth and all dust removed prior to painting. Exterior surfaces must be spackled with exterior grade compounds.
G. Galvanized Surfaces: Allow to weather a minimum of 6 months prior to coating. Clean per SSPC-SP1 using detergent and water or a degreasing cleaner, then prime as required. When weathering is not possible or the surface has been treated with chromates or silicates, first Solvent Clean per SSPC-SP1 and apply a test area, priming as required. Allow the coating to dry at least one week before testing. If adhesion is poor, Brush Blast per SSPC-SP7 is necessary to remove these treatments.

H. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

I. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

J. Interior Wood Items Scheduled to Receive Paint Finish: Must be stored in dry, warm rooms to prevent absorption of moisture, shrinkage, and roughening of the wood. All surfaces must be sanded smooth, with the grain, never across it. Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.

K. Exterior Wood: Must be clean and dry. Prime and paint as soon as possible. Knots and pitch streaks must be scraped, sanded, and spot primed before a full priming coat is applied. Patch all nail holes and imperfections with a wood filler or putty and sand smooth.

3.3 APPLICATION

A. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

B. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.

C. Sand wood and metal surfaces lightly between coats to achieve required finish.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Where clear finishes are required, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.

F. Prime concealed surfaces of interior and exterior woodwork with primer paint.

G. Prime concealed surfaces of interior wood surfaces scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with thinner.

H. Finishing Mechanical And Electrical Equipment:
   1. Paint shop primed equipment.
2. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
3. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, and except where items are shop finished.
4. Paint interior surfaces of air ducts and convectors and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint to visible surfaces. Paint dampers exposed behind louvers and grilles to match face panels.
5. Paint exposed conduit and electrical equipment occurring in finished areas.
6. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
7. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
8. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.

3.5 SCHEDULE – EXTERIOR SURFACES

A. Wood – Transparent:

B. Pavement Markings:
   1. First and Second Coat: TM5632 or TM5633 – SetFast Acrylic Modified Alkyd Zone Paint – Yellow color to match existing campus.

C. Steel - Unprimed:
   1. Primer: B50WZ0001 – Kem Kromik Universal Metal Primer Off White
   2. First Coat: B54W00101 – Industrial Enamel Pure White

D. Steel - Shop Primed:
   1. Primer: B50WZ0001 – Kem Kromik Universal Metal Primer Off White
   2. First Coat: B54W00101 - Industrial Enamel Pure White
   3. Second Coat: B54W00101 - Industrial Enamel Pure White

E. Steel - Galvanized:
   1. Primer: B66W00310 – Pro Industrial Pro-Cryl Universal Primer Off White
   2. First Coat: B54W00101 - Industrial Enamel Pure White
   3. Second Coat: B54W00101 - Industrial Enamel Pure White
3.6 SCHEDULE - INTERIOR SURFACES

A. Wood - Painted:
1. Primer: PrepRite ProBlock Int/Ext Latex Primer/Sealer White
2. First Coat: Pro Industrial 0 VOC Acrylic Semi-Gloss
3. Second Coat: Pro Industrial 0 VOC Acrylic Semi-Gloss

B. Gypsum Board:
1. Primer: PVA INT PRMR WHITE
2. First Coat: Harmony Interior Acrylic Latex Paint, Zero VOC, Eggshell, color: reference interior finish schedule section 09 00 00
3. Second Coat: Harmony Interior Acrylic Latex Paint, Zero VOC, Eggshell, color: reference interior finish schedule section 09 00 00

C. Gypsum Board (at restrooms):
1. Primer: PVA INT PRMR WHITE
2. First Coat: Harmony Interior Acrylic Latex Paint, Zero VOC, Semi-Gloss, color: reference interior finish schedule section 09 00 00
3. Second Coat: Harmony Interior Acrylic Latex Paint, Zero VOC, Semi-Gloss, color: reference interior finish schedule section 09 00 00

D. Door Frames, Hollow Metal Doors:
1. Primer:
2. First Coat: ProClassic XP Alkyd Interior Enamel, Satin, color: reference interior finish schedule section 09 00 00
3. Second Coat: ProClassic XP Alkyd Interior Enamel, Satin, color: reference interior finish schedule section 09 00 00

E. Clean area, housekeeping, Kitchens, and Toilet Rooms:
2. First Coat: Pro Industrial Precatalyzed waterbased epoxy, Eggshell finish color: reference interior finish schedule section 09 00 00
3. Second Coat: Pro Industrial Precatalyzed waterbased epoxy, Eggshell finish, color: reference interior finish schedule section 09 00 00

F. Gypsum Board Ceilings:
1. Primer: PVA INT PRMR WHITE
2. First Coat: Harmony Interior Acrylic Latex Paint, Zero VOC, Eggshell, color: reference interior finish schedule section 09 00 00
3. Second Coat: Harmony Interior Acrylic Latex Paint, Zero VOC, Eggshell, color: reference interior finish schedule section 09 00 00

G. Wall Surfaces Under Wall Covering:
1. Primer: B28W08000 – PVA INT PRMR WHITE
SECTION 09 97 23

CONCRETE FLOOR SEALER

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Application of commercial grade membrane type curing and sealing compound on concrete surfaces to remain exposed excluding any spaces to be polished and/or burnished.

1.2 SUBMITTALS

A. Submit product data for all products proposed. Any product clearly not intended for commercial or institutional use shall be rejected as not being equal. Any reference to Residential use shall be rejected immediately.

PART 2 - PRODUCT

2.1 APPROVED MANUFACTURER

A. Manufacturers listed below whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications, comply with Division 1 requirements regarding substitutions to be considered and have Architect’s approval prior to its use on the Project.

1. Dayton-Superior Corp
2. Euclid Chemical Company
3. W.R. Meadows, Inc. (Basis of Specification)

2.2 MATERIALS

A. Typical, except as noted: Membrane type curing and sealing compound conforming to ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete, Type I, Class B and complying with Sealtight "Vocomp-20" as manufactured by W.R. Meadows, Inc., Fort Worth, TX; (817) 834-1969.

B. Non-slip Traffic Coating for Mechanical, Electrical and other interior rooms with sealed concrete floors: “Vocomp-20” as specified above, with “Sure-Step” slip-resistant additive as manufactured by W.R. Meadows, Inc., Fort Worth, TX; (817) 834-1969.

PART 3 - EXECUTION

3.1 APPLICATION

A. Concrete slabs shall be smooth, dry, and free of any foreign materials.

B. Apply two (2) coats of specified finish in accordance with manufacturer's instructions.

C. Allow approximately 24 hours drying time between installation of coats. Do not apply second coat until Architect has inspected first coat application.

D. Install coating after all painting operations are completed.

END OF SECTION
SECTION 10 14 16
ARCHITECTURAL SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

A. Furnish and install the following:
   1. Room identification signage
   2. Traffic signage, including, but not limited to accessibility (Handicapped) parking signs.
   3. Brackets, clips, posts, fasteners, and all accessories required for proper installation of signage.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings:
   1. Indicating materials, sizes, and finishes. Indicate letter style, edge, and corner treatment, details or fabrication and mounting installation, fasteners and hardware, attachments, related and adjacent work.
   2. Room signage: Provide code required restroom and exit signage.

C. Product Data:
   1. Manufacturer’s specification and other data needed to prove compliance with specified requirements
   2. Manufacturers installation instructions

D. Samples:
   1. One (1) actual sample of each type room identification sign with specified finish

E. Manufacturer's Installation Instructions: Submit special procedures, perimeter conditions requiring special attention.

1.3 QUALITY ASSURANCE

A. All signage and signage installation shall comply with latest edition of Americans with Disabilities Act (ADA) and Texas Accessibility Standards (TAS)

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Specifications are based on products and manufacturers listed as basis of specification or named. Products of manufacturers listed which meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience
manufacturing products meeting or exceeding the specification and comply with Division 1 requirements regarding substitutions to be considered.

1. Approved Manufacturers:
   a. CCSW Architectural Graphics & Sign Systems, Corpus Christi, Texas
   b. A.R.K. Ramos Architectural Signage Systems, Oklahoma City, OK
   c. Best Manufacturing Sign Systems, Montrose, CO
   d. Matthew Bronze Co.
   e. Gemini Incorporated, Cannon Falls, MN
   f. The Southwell Co., San Antonio, Texas
   g. South Texas Graphic Specialties, Inc., Houston, Texas
   h. In-Pro Corporation

2.2 ROOM AND EXIT IDENTIFICATION SIGNAGE

A. General:
   1. Provide min one (1) sign for every restroom; provide one (1) sign for each exit, one (1) sign for fire riser room and any other rooms as required by AHJ. Exact room numbering / wording on signs to be provided by architect (after conferring with the Owner) during construction. Room Signage column on Door Schedules indicate plaque type to be assigned to this door (see illustrations at the end of this section).
   2. Constructed of two (2) photopolymer colors bonded to an appropriate substrate, on both face-plate and back-plate; colors to be selected by Architect.
      a. Exterior room signs shall be constructed of exterior-grade alumni photopolymer; interior signs to be constructed of interior-grade photopolymer bonded to thermoplastic polymer resin.
      b. Raised tactile grade 2 Braille shall be integral with the sign face and be raised 1/32”.
         Glass of metallic rasters to have 0.059 surface diameters with body of sphere pressure secured below face laminate. Glued on dots will NOT be acceptable.
      c. Raised symbols shall be raised 1/32” for sign face and unitized with the acrylic sign core.
      d. All Raised lettering shall be 5/8” high (min._, raided 1/32” and be integral with their background and have an eggshell matte finish.
      e. All copy (lettering, numbering, & symbols) shall have a contrast with their background and have an eggshell matte finish.
      f. Refer to drawings to determine which signs shall be rated for exterior conditions (based on the premise that signs are to be located on the “public” side of the door); confirm with Architect via submittal prior to fabrications.
   3. Signage shall have radius corners with square-cut edges pre-finished in color as selected by Architect.
   4. Demarcation line, if any, shall be infilled to match copy color.
   5. Signs shall comply with all state and federal codes, including, but not limited to the ADA and TAS requirements.

B. Room Numbers, Symbols, and Restroom Copy:
   1. Shall be matte finished acrylic, raised 1/32 inch, of a color contrasting to the face laminate.
   2. Characters and pictograms shall be chemically welded to the acrylic backing, through the face laminate, to assure permanent adhesion.
   3. Room numbers and restroom copy shall be accompanied by Grade II Braille by means of “VisiTouch Duradot System”. Glass or metallic “Durodots” shall have 0.059 inch surface
diameter with body of sphere pressure secured below face laminate. Routed boxes or glued on dots are NOT acceptable.

C. Lower or Secondary Copy:
   1. Shall be a minimum of 5/8” inch high incised sans serif style, (Helvetica, Optima, Futura, or Arial as selected by Architect), all caps, paint-filled in a color as selected by Architect.

D. Restroom Pictograms:
   1. Shall appear on a minimum size (6) inch square, unobstructed field.

E. Fasteners and Accessories:
   1. 1/8-inch-thick, double-sided foam tape of type of the recommended to suit application and commercial grade silicone sealant.
   2. Back-up plates shall be supplied, where shown or required, for signage mounted on glass.

F. Provide all materials required for a complete installation.

G. Egress Signs:
   1. All doors serving as means of egress shall be identified in the interior side of the door with tactile signage indicated “EXIT. Provide one (1) sign at each door leading to the exterior, whether indicated on the drawings or not. Architect will confirm text.

2.3 Traffic Signs

A. Provide all TAS / ADA approved accessible parking signage and directions signage as indicated on the drawings

B. Signage Materials: 0.080-inch thick aluminum or galvanized steel sign with 1-1/2 inch silk screen upper case letters, copy and border. Signs shall have 1-1/2 inch radius at corners typically. Sizes shall be as shown on drawings or required by authorities having jurisdiction.

C. Post Materials: Provide by Section 05 50 00, Miscellaneous Metals

D. Graphics:
   1. Accessibility (“Handicapped Parking”) signs with lettering and graphics as detailed. All work shall comply with local codes, ADA, and TAS standards and requirements.
   2. “One Way”, “Stop”, and directional signage with lettering and graphics as detailed. All work shall comply with local codes, and standards and requirements of authorities having jurisdiction.
   3. Post Anchor Bold: Two (2) galvanized 1/2-inch by 6-inch Neilson anchor bolts welded to steel tube from and back.

E. Accessories:
   1. Sign Mounting Hardware: Provide sign mounting hardware of galvanized steel of type and size instructed by manufacturer to suit intended use.
   2. Provide concrete footings of 3,000 psi compressive strength at 28 days, unless noted or directed otherwise.

F. Provide all materials required for signage and proper installation.
PART 3 EXECUTION

3.1 INSTALLATION

A. Install signage level, plumb and at height required for disabled accessibility as required by Texas Accessibility Standards (TAS) and ADA. Locate signage as directed by Architect.

B. All architectural signage items shall be securely mounted with first quality anchors; mechanical mounting with sheet metal/wood or tap-in (for concrete block) screws, full threaded, one-way theft resistant. Mount level and square to surrounding surfaces. Location as directed by Architect.

C. At completion of work, clean signage in accordance with manufacturer’s instructions. Clean surrounding materials to remove dust, materials, etc.

D. Room Identification Signs:
   1. Install in accordance with manufacturer's instructions and in locations shown on drawings. If no locations are shown, room signage shall generally be located on the “public” side of the door indicated to receive the sign. Confirm all locations with Architect prior to installation.
   2. Installation shall be by means of double sided tape and silicone.
   3. Tactile characters on signs shall be located a min of 48 inches above finished floor or ground surface, measured from the baseline of the lowest tactile character and 60-inches maximum above finished floor or ground surface measured from the baseline of the highest tactile character on the wall adjacent to the latch side of the door.
   4. Signs containing tactile characters shall be located so that a clear floor space of 18 inches min. by 18 inches min., centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.
   5. Signs with tactile characters shall be permitted on the push side of doors with closers and without hold-open devices.
   6. Where there is no wall space, including double leaf doors, signs shall be placed on the nearest adjacent wall.
   7. Where shown or required, mount signs on glass using back-up plates.

E. Traffic Signs:
   1. Install sign posts in concrete footing as shown on drawings, with signs set to heights as shown on drawings. Install signs on posts in accordance with manufacturer’s instructions.

END OF SECTION
SECTION 10 21 14
PLASTIC-LAMINATE-CLAD TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes plastic laminate toilet compartments and urinal screens.

B. Related Sections:
   1. Section 05 50 00 - Metal Fabrications: Concealed steel support members.
   2. Section 06 10 00 - Rough Carpentry: Concealed wood framing and blocking for compartment support.
   3. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A208.1 - Mat-Formed Wood Particleboard.

B. APA-The Engineered Wood Association:

C. ASTM International:
   1. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

D. Forest Stewardship Council:
   1. FSC Guidelines - Forest Stewardship Council Guidelines.

E. National Electrical Manufacturers Association:
   1. NEMA LD 3 - High Pressure Decorative Laminates.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall, floor, and ceiling supports, door swings.

C. Product Data: Submit data on panel construction, hardware, and accessories.

D. Samples: Submit two 6x6 inch in size illustrating panel finish, color, and sheen.

E. Manufacturer's Installation Instructions: Submit special procedures and perimeter conditions requiring special attention.
1.4 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with placement of support framing and anchors in walls.

PART 2 PRODUCTS

2.1 PLASTIC LAMINATE TOILET COMPARTMENTS

A. Manufacturers:
   1. Accurate Partitions Corp.
   2. Bobrick Washroom Equipment, Inc.
   3. Flush Metal Partition Corp.
   4. Global Steel Products Corp.
   5. Substitutions: Section 01 60 00 - Product Requirements

B. Product Description: Floor mounted and wall mounted partitions.

2.2 COMPONENTS

A. Plywood for Core: Softwood, PS 1 Grade B-B, exterior waterproof glue.

B. Plastic Laminate: [NEMA LD 3] High pressure melamine laminate, General Purpose Type 0.050 inch thick.

C. Adhesive: Manufacturer's standard.

D. Toilet Compartments: Plastic laminate finished, floor-mounted and headrail braced system.

E. Doors, Panels, and Pilasters: Plastic laminate adhesive and pressure bonded to faces and edges of plywood core, with beveled corners and edges; edges of cut-outs sealed.

   1. Plastic Laminate Color: Formica – Color: Folkstone 927

F. Door and Panel Dimensions:
   1. Thickness: 1 inch
   2. Door Width: 28 inch
   3. Accessible Door Width: 32 inch minimum clear.
   4. Height: 84 inch above finished floor

2.3 ACCESSORIES

A. Pilaster Shoe: Formed chromed steel with satin finish, ASTM A666 Type 304 316 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
B. Brackets: Satin chrome-plated non-ferrous stainless steel, to color as selected.

C. Attachments, Screws, and Bolts: Stainless steel.
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts.

D. Steel Plate Reinforcement: Carbon steel, prepared for fasteners, 1/8 inch thick.

E. Hardware: Satin Stainless steel:
   1. Pivot hinges, gravity type, adjustable for door close positioning; two for each door.
   2. Nylon bearings.
   3. Thumb turn door latch with exterior emergency access feature.
   4. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
   5. Coat hook with rubber bumper; one for each compartment, mounted on door.
   6. Furnish accessible door pull for out swinging doors.
   7. Furnish continuous channel brackets at walls.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify field measurements are as indicated on shop drawings.

C. Verify correct spacing of plumbing fixtures.

D. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

A. Maintain 3/8 to ½ inch space between wall and panels and between wall and end pilasters.

B. Attach panel brackets securely to walls using anchor devices.

C. Attach panels and pilasters to brackets. Locate head rail joints at pilaster centerlines.

D. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.3 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Indicated Position: 1/4 inch.

C. Maximum Variation From Plumb: 1/8 inch.
3.4 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.

C. Adjust hinges to position doors in partially opened position when unlatched. Return out-swinging doors to closed position.

D. Adjust adjacent components for consistency of line or plane.

END OF SECTION
SECTION 10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes toilet accessories and utility room accessories.

B. Coordinate concealed blocking with Division 6 Sections.

1.2 REFERENCES

A. American Society for Testing and Materials:
   3. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   4. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

B. Federal Specification Unit:

1.3 DESIGN REQUIREMENTS

A. Design grab bars, and attachments to resist minimum 250 lb concentrated load applied at any point in any direction.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, attachment methods.

1.5 COORDINATION

A. Section 01 31 00 – Project Management and Coordination: Coordination and project conditions.

B. Coordinate the Work with placement of internal wall reinforcement to receive anchor attachments.
PART 2 PRODUCTS

2.1 TOILET AND BATH ACCESSORIES

A. Manufacturers:
   1. Bobrick
      a. Substitutions: Section 01 60 00 – Product Substitution Procedures.

2.2 COMPONENTS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.

B. Keys: Furnish 2 keys for each accessory to Owner; master key accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269, stainless steel.

E. Galvanized Sheet Steel: ASTM A653, G90 zinc coating.

F. Mirror: ¼” Thick acrylic plastic, lightweight and highly shock resistant. Image quality: Very good.

G. Adhesive: Type recommended by manufacturer, waterproof.

H. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof.

I. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.3 TOILET ROOM ACCESSORIES

A. **TA-1 & TA-2 TOILET GRAB BARS:** Stainless steel, 1-1/4 inches outside diameter, minimum 0.05 inch wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar. Provide and install one (1) pair of grab bars (side and rear of toilet) at each toilet indicated on plan (minimum one (1) pair per toilet room if not indicated otherwise).
   1. Length and configuration: As indicated on Drawings.
      a. **TA-1:** 36” length
      b. **TA-2:** 42” length
   2. Product: B-5806 manufactured by Bobrick.

B. **TA-3 TOILET TISSUE DISPENSERS:** Double roll, surface mounted bracket type, stainless steel, designed to prevent theft of tissue roll.
C. **TA-4 SANITARY NAPKIN DISPOSAL:** Surface mount or Recessed stainless steel sanitary napkin disposal at each female
   1. **Bobrick Model #B-270,** surface mounted, stainless steel, sanitary napkin disposal. Furnish and install one (1) at each female toilet partition location. Mount top of unit 25” to 30” above finished floor.
   2. **Bobrick Model #B-353,** recessed, stainless steel, sanitary napkin disposal. Furnish and install one (1) at each single user female toilet room and at end stall where toilet accessory mounting location is in adjacent wall and not a toilet partition. Mount top of unit 25” to 30” above finished floor.

D. **TA-5 PAPER TOWEL DISPENSER:** (at each sink location) Classic Surface Mounted, Bi-Fold, Paper Towel Dispenser.
   1. **Bobrick Model #B-262**

E. **TA-6 SOAP DISPENSER:** (at each sink location): Surface mounted soap dispenser,
   1. Stainless Steel Satin Finish
   2. Size: 7”W, 6-1/8”H

F. **TA-7 MIRRORS:** Stainless steel framed, ¼” (6 mm) thick acrylic plastic, lightweight, and highly shock resistant mirror.
   1. Size: reference drawings for sizes and quantities.
   2. Frame: 0.036 inch channel shapes, 20 gauge type 304 stainless steel with mitered corners; No.4 finish.
   3. Backing: Full-mirror sized, expanded polyethylene microcell foam sheet material, abrasion resistant and shock absorbing, water resistant, 1/8” total layer thickness.
   4. Product: 0620 manufactured by American Specialties, Inc.

G. **TA-8 CUSTOM SIZE MIRRORS:** Stainless steel framed, ¼” (6 mm) thick acrylic plastic, lightweight, and highly shock resistant mirror.
   1. Size: reference drawings for sizes and quantities.
   2. Frame: None
   3. Backing: Full-mirror sized, expanded polyethylene microcell foam sheet material, abrasion resistant and shock absorbing, water resistant, 1/8” total layer thickness.

H. **TA-9 RECESSED WASTE RECEPTACLE:** Recessed with projecting waste receptacle, stainless steel; seamless wall flanges, continuous piano hinges, tumbler locks on upper and lower doors.
   1. Waste receptacle liner: Reusable, heavy-duty vinyl.
   2. Waste receptacle capacity: 12 gallons.

I. **TA-13 ROBE HOOK:** Heavy-duty stainless steel, double-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish. Provide and install one robe hook at each restroom. Coordinate final location with Architect. Product: B-6727 manufactured by Bobrick.
J. **TA-14 MOP & BROOM HOLDER:** Mount holder on wall above mop sink so that mops will drip into sinks. Provide and install one (1) at each custodian sink location.
   1. 22 gauge, Type 304, stainless steel with 4 spring loaded rubber cams.
   2. Product: #B-223 x 36” by Bobrick

2.4 FACTORY FINISHING
   A. Stainless Steel: No. 8 mirror polished finish, unless otherwise noted.
   B. Galvanizing for Items other than Sheet: ASTM A123/A123M to 1.25 oz/sq yd. Galvanize ferrous metal and fastening devices.
   C. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
   D. Back paint components where contact is made with building finishes to prevent electrolysis.

PART 3 EXECUTION

3.1 EXAMINATION
   A. Section 01 31 00 – Project Management and Coordination: Coordination and project conditions.
   B. Verify exact location of accessories for installation.
   C. Verify field measurements are as instructed by manufacturer.
   D. See Division 6 Sections for installation of blocking in walls.

3.2 PREPARATION
   A. Deliver inserts and rough-in frames to site for timely installation.
   B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION
   A. Install plumb and level, securely and rigidly anchored to substrate.
   B. Mounting Heights and Locations: As indicated on Drawings and As Follows:
      1. Bottom of Mirrors: 40 inches to bottom of reflecting surface.
      2. Grab Bars at Barrier-Free Stalls: 33 inches minimum to 36 inches maximum to center line.
      3. Other Accessories: Maximum 48 inches to highest operating part.

**END OF SECTION**
SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes fire extinguishers; fire extinguisher cabinets; and brackets for wall mounting. Furnish and install fire extinguishers and cabinets at locations shown on the drawings and as specified herein. Coordinate with other trades where such cooperation is indicated by furnishing installation requirements and details along with the material in adequate time for progress of the work.

B. All items shall be installed with anchors appropriate to the wall construction.

C. Securely install, plumb, level, square with surrounding area to height and location as directed by architect.

D. Related Sections:
   1. Section 06 11 00 - Wood Framing: Wood blocking and shims.
   2. Section 09 90 00 - Painting and Coating: Field applied paint finish.

1.2 REFERENCES

A. National Fire Protection Association:
   1. NFPA 10 - Standard for Portable Fire Extinguishers.

B. Underwriters Laboratories Inc.:
   1. UL - Fire Protection Equipment Directory.

1.3 PERFORMANCE REQUIREMENTS

A. Conform to NFPA 10.

B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for purpose specified and indicated.

C. Provide fire extinguisher cabinets classified and labeled by Underwriters Laboratories Inc. for purpose specified and indicated.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets, wall bracket mounted measurements, location, and fire ratings.
C. Product Data: Submit extinguisher operational features, color and finish, anchorage details.

D. Manufacturer’s Installation Instruction: Submit special criteria and wall opening coordination requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 77 00 – Closeout Procedures: Closeout procedures.

B. Operation and Maintenance Data: Submit test, refill or recharge schedules and re-certification requirements.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not install extinguishers when ambient temperature are capable of freezing extinguisher ingredients.

PART 2 PRODUCTS

2.1 FIRE EXTINGUISHERS

A. Manufacturers:
   1. JL Industries
   2. Larsen’s Manufacturing Co.
   3. Nystrom Products Co.
   4. Potter Roemer
   5. Substitutions: Section 01 60 00 - Product Requirements

B. Dry Chemical Type: Drawn steel tank, with pressure gage; Class ABC, Size 10, and UL rated 4A-80B:C.

C. Extinguisher Finish: Steel, enamel to red color.

2.2 FIRE EXTINGUISHER CABINETS

1. JL Industries
2. Larsen’s Manufacturing Co.
3. Nystrom Products Co.
4. Potter Roemer

B. Metal: Formed stainless steel; 0.036-inch-thick base metal.

C. Configuration: Semi-recessed type, sized to accommodate portable fire extinguisher.

D. Trim Type: Returned to wall surface, with 4-inch maximum projection.
E. Door: 0.016-inch-thick, reinforced for flatness and rigidity; latch access.
F. Door Glazing: Plastic, clear, 1/8-inch-thick acrylic.
G. Cabinet Mounting Hardware: Appropriate to cabinet.
H. Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim and door stiles.
I. Pre-drill for anchors.
J. Hinge doors for 180 degree opening with continuous piano hinge. Furnish roller type catch.
K. Weld, fill, and grind components smooth.
L. Glaze doors with resilient channel gasket glazing.
M. Finishing Cabinet: Baked enamel, color as selected by architect.

2.3 ACCESSORIES
A. Extinguisher Brackets: Formed steel, red enamel finish.
B. Signage: As required by authority having jurisdiction to properly identify fire extinguishers.

PART 3 EXECUTION
3.1 EXAMINATION
A. Section 01 31 00 – Project Management and Coordination: Coordination and project conditions.
B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION
A. Install cabinets plumb and level in wall openings, maximum 48 inches from finished floor to top of extinguisher handle.
B. MOUNTING HEIGHTS
   1. Mount general use fire extinguisher cabinets at a height so that the fire extinguisher handle is at or below the following heights above finished floor:
      a. 48” max. (front approach)
   2. Mount kitchen and special use extinguishers so that the fire extinguisher handle is at or below 48” above finished floor.
C. Secure rigidly in place.

D. Place extinguishers in cabinets and on wall brackets.

E. Position cabinet signage as required by authorities having jurisdiction.

3.3 ADJUSTING, CLEANING AND PROTECTION

A. Adjust cabinet doors that do not swing or operate freely.

B. Refinish or replace cabinet doors damaged during installation.

C. Provide final protection and maintain conditions that ensure cabinets, doors, and extinguisher are without damage or deterioration at time of Substantial Completion.

END OF SECTION
SECTION 12 21 23
ROLL DOWN BLINDS

PART 1 GENERAL

1.1 SUMMARY
A. Section includes manual roller shades.

B. Related Sections:
   1. Section 06 10 53 - Miscellaneous Rough Carpentry: Blocking for attachment of headrail
   2. Section 09 21 16 – Gypsum Board Assemblies: Coordination with gypsum board assemblies
      for installation of shade pockets, closures and related accessories.
   3. Section 09 51 23 – Acoustical Ceiling: Coordination with acoustical ceiling systems for
      installation of shade pockets, closures and related accessories.

1.2 REFERENCES
A. ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to
   Fungi.
B. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS
A. Section 01 33 00 - Submittal Procedures: Submittal requirements.
B. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances,
   and operation.
C. Product Data: Submit data indicating physical and dimensional characteristics and operating
   features.
D. Samples: Submit two samples, 6-inch-long illustrating materials and finish, color.
E. Manufacturer's Installation Instructions: Submit special procedures and perimeter conditions
   requiring special attention.

1.4 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with
   minimum ten years documented experience.

B. Installer Qualification: Installer trained and certified by the manufacturer with a minimum of ten
   years' experience in installing products comparable to those specified in the section.
C. Electrical Components: NFPA Article 100 listed and labeled by either UL or ETL or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system.

1.5 FIELD MEASUREMENTS

A. Verify measurements in field prior to fabrication.

1.6 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate the Work with window installation and placement of concealed blocking to support blinds.

1.7 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.1 ROLL DOWN BLINDS

A. Manufacturers:
   1. MechoShade Systems, Inc.
   2. Substitutions: Section 01 60 00 - Product Requirements

B. Basis of Design:
   1. Mecho/5
      a. Manual roller shades with heavy duty hardware, LiftAssist, stainless steel chain & chain retainer, SnapLoc fascia, and end caps.
      b. Location: At all third and fourth floor exterior windows.

2.2 COMPONENTS

A. Shadecloth: ThermoVeil series 900
   1. Color: As selected by Architect

B. Accessory Hardware: Type recommended by blind manufacturer.

2.3 FABRICATION

A. Fabricate shades to fit within openings with uniform edge clearance of 1/2 inch.

B. At openings requiring multiple blind units, fabricate separate blind assemblies with space of ½ inch between assemblies, occurring at window mullion centers.
PART 3 EXECUTION

3.1 EXAMINATION
   A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
   B. Verify openings are ready to receive work.
   C. Verify structural blocking and supports are correctly placed.

3.2 INSTALLATION
   A. Install shades per manufacturer instructions.
   B. Secure in place with flush countersunk fasteners.
   C. Place intermediate head supports at 36-inch oc.

3.3 ERECTION TOLERANCES
   A. Section 01 40 00 - Quality Requirements: Tolerances.
   B. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch.
   C. Maximum Offset From Level: 1/8 inch.

3.4 ADJUSTING
   A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
   B. Adjust shades to ensure smooth operation.

3.5 CLEANING
   A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
   B. Clean shade surfaces just prior to occupancy.

END OF SECTION
SECTION 12 36 61
QUARTZ COUNTERTOPS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes quartz countertops.

B. Related Sections:
   1. Section 06 10 00 - Rough Carpentry: Grounds and support framing.
   2. Section 06 41 00 - Architectural Wood Casework: Wood casework.

1.2 REFERENCES

A. American National Standards Institute:
   2. C99 Modulus of Rupture of Dimension Stone
   4. C370 Moisture Expansion
   7. E662 Smoke Density.

B. American National Standards Institute (ASNI)
   1. ANSI Z124.6 Stain Resistance

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal requirements.

B. Shop Drawings: Indicate locations, large scale plans, elevations, rough-in and anchor placement dimensions and tolerances, and clearances required.

C. Product Data: Submit component dimensions, configurations, construction details, and joint details.

D. Samples:
   1. Submit manufacturers full color chart for initial selection. Allow for up to five colors to be selected for actual samples as noted below.
   2. Submit two samples, minimum size 3 x 6 inches of color/finish as selected by Architect.

1.4 QUALITY ASSURANCE

A. Delivery Storage and Handling: Observe manufacturer’s recommendations and handle in a manner to prevent breakage. Brace parts if necessary. Transport with finish face toward finish face. Do not allow finish surfaces to rub during shipping and handling.
B. Storage and Protection: Store in racks in near vertical position. Prevent warpage and breakage. Store inside away from direct exposure to sunlight. Store between 25 and 130 degrees F.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience and as approved by manufacturer.

B. Installer: By an installer certified by the manufacturer for installation.

1.6 WARRANTY

A. Warrant the work herein for 15 years against becoming unserviceable to causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

B. Defects shall include, but not be limited to the following:
   1. Shrinking, warping, cracking, chipping, splitting, or deteriorating excessively.
   2. Inadequate color depth.

PART 2 PRODUCTS

2.1 QUARTZ SURFACES

A. Manufacturers:
   1. Wilsonart
   2. Cambria
   3. Substitutions: Section 01 60 00 - Product Requirements.

2.2 MATERIALS

A. Homogeneous mixture containing 93% high quality quartz with additions of high performance resins.

B. Material Thickness: 3 cm

C. Color and Finish:
   1. CNT01: Cambria – Desert Collection, Templeton
   2. CNT02: Wilsonart – Vittorio Q3005

D. Exposed Edges and Corners: Countertop profiles, backsplash, and edges as detailed in drawings.

E. Performance:
   1. Flexural Strength: >6,000; ASTM D790
   2. Impact Resistance: 3.4 – 7.35; EN14617-9
   3. Stain Resistance: EN14617-10; No Effect
   4. High Temperature Heat Resistance: No Effect; NEMA LD3 3.6
   5. Chemical Resistance: C4; EN14617-10
   6. Abrasion Resistance: >100; ASTM C501
7. Compressive Strength: >20,000; ASTM C170

2.3 ACCESSORIES

A. Mounting Adhesive:
   1. Provide structural grade 50 year silicone or epoxy adhesive.
   2. Quartz Surface Adhesive: Provide epoxy or polyester adhesive of a type recommended by manufacturer for application and conditions of use.

2.4 FABRICATIONS

A. At locations as indicated in Drawings.
   1. Countertops include all horizontal surfaces of specific installation locations. For example, counters with high and low counters shall both receive quartz fabrications.
   2. 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.
   3. Form joints between components using manufacturer’s standard joint adhesive joints
      a. Reinforced as required.
   4. Rout and finish component edges with clean, sharp returns.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
B. Verify adequacy of support framing and surround millwork.
C. Verify dimensions by field measurements prior to installation.
D. Verify substrates supporting quartz surfacing are plumb, level and flat to within 1/8 inch in 10 feet and that all necessary supports and blocking are in place.

3.2 INSTALLATION

A. Install materials in accordance with manufacturer’s instruction and approved shop drawings.

3.3 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
B. Keep components and hands clean during installation. Remove adhesives, sealants, and other stains. Components shall be clean on date of Substantial Completion.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Do not permit finished countertops to be exposed to continued construction activity.

C. Protect surfaces from damage until Date of Substantial Completion. Replace damaged work that cannot be repaired to Architect’s satisfaction at contractors expense.

END OF SECTION
SECTION 14 21 23
ELECTRIC TRACTION PASSENGER ELEVATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electric traction passenger elevators.

1.2 RELATED SECTIONS

A. Section 05 50 00 – Metal Fabrications: Pit ladders, supports for entrances in drywall hoistways.

B. Section 06 10 53 – Miscellaneous Rough Carpentry: Temporary platform assembly.

C. Section 07 16 00 – Cementitious Waterproofing: Waterproofing of elevator pit.

D. Section 09 29 00 – Gypsum Board: Hoistway walls.

E. Section 09 90 00 – Paints and Coatings (Painting and Coating): Field painting of elevator entrances over primer.

F. Section 28 31 00 – Detection and Alarm (Fire Detection and Alarm): Heat, smoke, and products of combustion sensing devices, fire alarm signal lines to contacts in machine space.

G. Section 23 00 00 – Heating, Ventilating, and Air Conditioning Equipment (Heating, Ventilating, and Air-Conditioning (HVAC)): Heating, cooling, and ventilation of control and machinery space.

H. Section 26 05 00 – Wiring Methods (Common Work Results for Electrical): Light outlets, convenience outlets, light switches, and conduits.

I. Section 26 24 00 – Switchboards, Panelboards, and Control Centers (Switchboards and Panelboards): Disconnect switches.

J. Section 26 50 00 – Lighting: Light fixtures.

K. Section 22 14 29 – Sump Pumps: For sump pumps, sumps, and sump covers in elevator pits.

1.3 REFERENCES


B. ADAAG – Americans with Disabilities Act Accessibility Guidelines.


E. ANSI/UL 10B – Fire Tests of Door Assemblies.
F. CAN/CSA C22.1 – Canadian Electrical Code.


1.4 DESIGN REQUIREMENTS

A. Arrange elevator components in control closet or machinery space so equipment can be removed for repairs or replaced with minimal disturbance to other equipment and components.

B. Where permitted by code, provide all elevator equipment including controls, drives, transformers, and rescue features within the elevator hoistway.

1.5 SUBMITTALS

A. Comply with Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit manufacturer/installer’s product data, including,
   1. Descriptive brochures or detail drawings of car and hall fixtures, cab ceilings, and product features.
   2. Power Information: Horsepower, starting current, running current, machine and control heat release, and electrical requirements.

C. Shop Drawings: Submit manufacturer/installer’s shop drawings, including plans, elevations, sections, and details, indicating location of equipment, loads, dimensions, tolerances, materials, components, fabrication, fasteners, hardware, finish, options, accessories, and other information to render totally functional elevators.

D. Samples: Submit manufacturer/installer’s samples of standard colors and finishes of finish materials.

E. Operation and Maintenance Manual: Submit manufacturer/installer’s operation and maintenance manual; including operation, maintenance, adjustment, and cleaning instructions; trouble shooting guide; renewal parts catalogs; and electrical wiring diagrams.

F. Warranty: Submit manufacturer/installer’s standard warranty.

1.6 QUALITY ASSURANCE

A. Manufacturer/Installer’s Qualifications: Specialize in manufacturing and installing elevator equipment, with a minimum of 10 years successful experience.

B. Regulatory Requirements:
   1. Elevator design, clearances, construction, workmanship, materials, and installation, unless specified otherwise, shall be in accordance with ANSI/ASME A17.1, handicap accessibility, Americans with Disabilities Act, and other codes having legal jurisdiction.
   2. ANSI/ASME A17.1 shall govern, except where codes having legal jurisdiction include more rigid requirements or conflict with ANSI/ASME A17.1.
   3. Elevator shall follow design and manufacturing procedures certified in accordance with ISO 9001-2000 to meet product and service requirements for quality assurance for new products.
4. Where product is in variance to the published ANSI/ASME A17.1 model code, provide a 3rd party AECO certification demonstrating equivalent function, safety, and performance.

C. Pre-installation Meeting:
1. Convene pre-installation meeting before start of installation of elevators.
2. Require attendance of parties directly affecting work of this section, including Contractor, Architect, and elevator manufacturer/installer.
3. Review examination, installation, field quality control, adjusting, cleaning, protection, and coordination with other work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer/installer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer/installer.

B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer/installer’s instructions.

C. Handling: Protect materials during handling and installation to prevent damage.

1.8 PROJECT CONDITIONS

A. Temporary Electrical Power:
1. Owner will arrange for temporary 220 VAC, single-phase, 60 Hz., GFCI-protected electricity to be available for installation of elevator components.
2. Comply with Section 015100 – Temporary Utilities.

B. Installation of the Elevator:
1. General Contractor will provide permanent three-phase power prior to installation start.
2. General Contractor will provide clear, rollable access to a 20’ x 10’ secure and dry storage area prior to delivery.
3. General Contractor will provide a clean, dry, and complete hoistway along with temporary installation platform and all required OSHA-compliant barricades prior to delivery.

C. Temporary Use of Elevator:
1. Owner will negotiate with manufacturer/installer for temporary use of elevator, if required.
2. Temporary use of elevator shall be in accordance with terms and conditions of manufacturer/installer’s temporary acceptance form.

1.9 SCHEDULING

A. Coordinate elevator work with work of other trades, for proper time and sequence to avoid construction delays.

1.10 WARRANTY

A. Manufacturer/installer shall guarantee materials and workmanship of equipment installed under these specifications and make good, defects not due to ordinary wear or to improper use, which may develop within 1 year after completion of installation or acceptance thereof by beneficial use, whichever is earlier.
1.11 MAINTENANCE SERVICE

A. Elevator maintenance service shall be performed by elevator manufacturer/installer.

B. Elevators shall receive regular maintenance on each unit for period of 12 months after completion of work specified herein or acceptance thereof by beneficial use, whichever is earlier.

C. Trained employees shall make periodic examinations and perform work including necessary adjusting, greasing, oiling, and replacing parts to keep elevators in operation, except parts that require replacement because of accidents, vandalism, misuse, or negligence by parties other than manufacturer/installer.

D. Manufacturer/installer shall perform all Work, except emergency minor adjustment call-back service, during regular working hours. Manufacturer/installer shall provide emergency minor adjustment call-back service, during regular working hours.

E. Should Owner request that examinations, cleaning, lubrication, adjustments, repairs, replacements, or emergency minor adjustment call-back service, unless specified herein, be performed on other than manufacturer/installer’s regular working hours of regular working days, manufacturer/installer shall absorb straight-time labor charges and Owner will compensate manufacturer/installer for overtime premium, travel time, and expense at normal billing rates.

F. Elevator Control System:
   1. Include built-in remote diagnostic module to relay constant status of elevators and control system to a 24-hour, 7-days-a-week central-monitoring facility.
   2. Remote Monitoring Device: Transmit information on current status of elevators, including malfunctions, system errors, and shutdown.

PART 2 PRODUCTS

2.1 MANUFACTURER/INSTALLER


B. Elevator shall be installed by elevator manufacturer.

2.2 ELEVATOR SYSTEM AND COMPONENTS

A. Electric Traction Passenger Elevators: Basis of design is the Schindler 3300 Gearless Traction Elevator.

B. Elevator Equipment Summary:
   1. Application: Machine Room Less (MRL)
   2. Counterweight Location: Side
   3. Machine Location: Top of the hoistway mounted on car and counterweight guide rails
   4. Control Space Location: Top landing entrance frame or entrance frame at one floor below the top landing
   5. Service: General Purpose Passenger
   6. Quantity: 1 Unit
   7. Capacity: 2500 lbs
   8. Speed: 150 fpm
   9. Travel: 55' 9"
10. Landings: 5
11. Front Openings: 5
12. Rear Openings: 0
13. Door Hand: Center Opening
14. Rear Door Hand: N/A
15. Operation: Microprocessor Single Car Automatic Operation
17. Cab Height: 7' 9"
18. Guide Rails: Equivalent to 12 lb. per foot
19. Entrance Type and Width: Single Speed Center Opening 3' 6" Wide X 7' 0" High doors
20. Entrance Height: 7'-0"
21. Power Supply: 208 Volts 3 Phase 60 Hz

C. Performance:
1. Car Speed: -10% to +5% of contract speed under any loading condition or direction of travel.
2. Car Capacity: Safely lower, stop and hold up to 125% of rated load per code.

D. Ride Quality:
1. Vertical Vibration (maximum): 25 mg
2. Horizontal Vibration (maximum): 15 mg
3. Vertical Jerk (maximum): 2 ft/sec^3
4. Acceleration (maximum): 1.6 ft/sec^2
5. In Car Noise: 53-60 dB(A)
6. Stopping Accuracy: ±5mm
7. Starts per hour (maximum): 180

E. Elevator Operation:
1. Simplex Collective Operation: Using a microprocessor based controller, operation shall be automatic by means of the car and hall buttons. When all calls have been answered, the car shall park at the last landing served.
2. Group Automatic Operation with Demand-Based Dispatching: Provide reprogrammable group automatic system that assigns cars to hall calls based on a dispatching algorithm designed to minimize passenger waiting time.

F. Operating Features - Standard:
1. Door Light Curtain Protection
2. Static AC Drive
3. Phase Monitor Relay
4. Cab Overload with Indicator
5. Load-weighing
6. Central Alarm
7. Remote Monitoring
8. Firefighter’s Operation
9. Automatic Evacuation
   a. When the main line power is lost for longer than 5 seconds the emergency battery power supply provides power automatically to the elevator controller. If the car is at a floor when the power fails, it remains at that floor, opens its doors, and shuts down. If the car is between floors, it is raised or lowered to the first available landing, opens it doors, and shuts down.
10. Independent Service

G. Operating Features - Optional:
2.3 EQUIPMENT: CONTROL COMPONENTS AND CONTROL SPACE

A. Controller: Provide microprocessor based control system to perform all of the functions of safe elevator operation, as well as perform car and group operational control.
   1. All high voltage (110v or above) contact points inside the inspection and test panel shall be protected from accidental contact in a situation where the access panels are open.
   2. The controller shall be distributed throughout the elevator system located in the overhead, cab and inspection and test panel. The inverter will be mounted in the overhead adjacent to the hoist machine and an inspection and test panel will be located in the door jamb at the top floor or one floor below the top floor. No elevator equipment mechanical rooms or closets are required.
   3. Provide multi-bus control architecture to reduce cabling, material and waste.

B. Drive: Provide a Variable Voltage Variable Frequency AC Closed Loop drive system. Provide stable start without high peak current, quickly reaching a low energy consumption level.

C. Inspection and Test Panel: Integrated control equipment, main inspection and test panel in door frame at top level served or at one floor below the top level served.

2.4 EQUIPMENT: HOISTWAY COMPONENTS

A. Machine:
   1. Gearless asynchronous AC motor with integral drive sheave, service and emergency brakes.
   2. Design machine to enable direct power transfer, thereby avoiding loss of power.
   3. Design machine to be compact, lightweight and durable to optimize material usage and save space.
   4. Mount to structural support channels on top of guide rail system as applicable in hoistway overhead.

B. Governor:
   1. Tension type over-speed governor with remote manual reset.
   2. Mount to structural support channels as applicable in hoistway overhead.

C. Buffers, Car and Counterweight: Compression spring type buffers to meet code.

D. Hoistway Operating Devices:
   1. Emergency Stop switch in the pit.
   2. Terminal stopping switches.
   3. Emergency stop switch on the machine.

E. Positioning System: System consisting of proximity sensors and door zone vanes.

F. Guide Rails and Attachments: Provide Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.

G. Suspension System: Non circular Elastomeric coated suspension media with high tensile grade steel cords.

H. Governor rope: Steel wire rope with 6 mm diameter.
2.5 EQUIPMENT: HOISTWAY ENTRANCES

A. Hoistway Doors and Frames:
   1. UL rated with required fire rating.
   2. Doors: Rigid flush panel construction with reinforcement ribs.
   3. Frames: Securely fasten at corners to form unit frame. Frames shall be bolted.

B. Finish:
   1. Exposed Areas of Corridor Frames: Painted Primer - All Floors
   2. Doors: Painted Primer - All Floors
   3. Sills: Aluminum - All Floors

C. Entrance Markings and Jamb Plates: Provide standard entrance jamb tactile markings on both jambs, at all floors. Plate Mounting: Refer to manufacturer drawings.

2.6 EQUIPMENT: CAR COMPONENTS

A. Car Frame and Safety: Provide car frame with adequate bracing to support the platform and car enclosure. The safety shall be integral to the car frame and shall be flexible guide clamp type.

B. Platform: Provide platform of steel construction with plywood subfloor and aluminum threshold.

C. Car Guides: Provide sliding guide shoes mounted to top and bottom of both car and counterweight frame. Arrange each guide shoe assembly to maintain constant contact on the rail surfaces. Provide retainers in areas with Seismic design requirements.

D. Provide central guiding system to reduce mechanical friction and energy consumption.

E. Steel Cab:
   1. Fire rating: Provide Class B fire rating for cab, or Class A fire rating where required by local Code.
   2. Design cab to comply with LEED Indoor Environmental Quality requirements through use of Low-Emitting Materials on walls, ceiling and subflooring.
   3. Car wall finish: Laminate – New York Night, gloss finish (or as selected from manufacturers standard laminate colors)
   7. Ceiling: Canopy ceiling, finished in Brushed Silver With Compact Fluorescent Lighting. Provide lighting consisting of four compact fluorescent energy saving lights located in two semi-oval lateral cutouts located on the center-sides of the cab ceiling, Lexan lens cover.
   9. Flooring: By others. Not to exceed 3/8” finished depth. (CT01)
   11. Emergency Car Lighting: Provide an emergency power unit employing a 12 volt sealed rechargeable battery and static circuits to illuminate the elevator car and provide current to the alarm bell in the event of building power failure.
   12. Emergency Siren: Provide siren mounted on top of the car that is activated when the Alarm button in the car operating panel is engaged.
13. Emergency Exit Switch: Provide an electrical contact to open the safety circuit when the emergency car top exit is opened. When the exit door is opened, the top exit switch shall signal the control and the car will be unable to move.
14. Emergency Exit Lock: Provide an emergency exit lock where required by local code.
15. Emergency Exit Guard: Provide emergency exit guard on top of car when required for hoistway wall to platform clearance exceeds 12” or for multiple cars in hoistway.

2.7 DOOR OPERATOR AND REOPENING DEVICES

A. Door Operator: Provide a closed loop VVVF high performance door operator with frequency controlled drive for fast and reliable operation to open and close the car and hoistway doors simultaneously.

B. In case of interruption or failure of electric power, the doors can be readily opened by hand from within the car, in accordance with applicable code. Provide emergency devices and keys for opening doors from the landing as required by local code.

C. Doors shall open automatically when the car has arrived at or is leveling at the respective landings. Doors shall close after a predetermined time interval or immediately upon pressing of a car button. Provide door open button in the car operating panel. Momentary pressing of this button shall reopen the doors and reset the time interval.

D. Provide door hangers and tracks for each car and hoistway door. Contour tracks to match the hanger sheaves. Design hangers for power operation with provisions for vertical and lateral adjustment. Hanger sheaves shall have polyurethane tires and pre-lubricated sealed for life bearings.

E. Electronic Door Safety Device: Equip car doors with concealed transmitter and receiver infrared beam devices to detect presence of object in process of passing through hoistway entrance and car doorway (light curtain device).
   1. Use multi-beam scanning without moving parts to detect obstructions in door opening.
   2. Detector Device: Prevent doors from closing, or if they have already started closing, cause doors to reopen and remain open while object is within detection zone.
   3. Horizontal Beams: Minimum of 33 infra red beams to fill doorway from ground level to a height of 6 feet.

2.8 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

A. Car Operating Panel: Provide a car operating panel with all push buttons, key switches and message indicators for elevator operation.
   1. Full height car operating panel shall be surface-mounted on front return.
   2. Comply with handicap requirements.
   3. Push Buttons: Mechanical, illuminating using long-lasting LEDs for each floor served.
   4. Emergency Buttons: Provide in accordance with code. Emergency alarm button, door open and door close buttons.

B. Features of the Car Operating Panel Shall Include:
   1. Audible chime to signal that the car is either stopping at or passing a floor served by the elevator.
   2. Raised markings and Braille provided to the left hand side of each push button.
   3. Car Lantern: Provide LED illuminated car lantern with direction arrows to comply with local code when hall lanterns are not provided.
   4. Door open and close push buttons.
   5. Firefighter’s hat and Phase 2 Key-switch
6. Inspection key-switch.
7. Key-switch for optional Independent Service Operation
8. Illuminated alarm button with raised marking.
9. Elevator Data Plate marked with elevator capacity and car number.
10. Help Button: Activation of help button will initiate two-way communication between car and a location inside the building, switching over to alternate location if call is unanswered, where personnel are available to take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.

C. Hall Fixtures: Provide hall fixtures with necessary push buttons and key switches for elevator operation.
   1. Push buttons: Metallic tactile push buttons, up button and down button at intermediate floors, single button at each terminal floor.
   2. Height: Comply with handicap requirements.
   3. Illumination: Illuminating using long-lasting low power LEDs.

D. Hall Lanterns and Position Indicators.
   1. LED illuminated direction arrows with audible and visible call acknowledgement.

E. Hoistway access switches: Provide key-switch at top and/or bottom floor in entrance jamb as required by local code.

F. Firefighter’s Phase 1 Service: Key switch in brushed stainless steel cover plate.

G. Fixture Cover Plates: For push buttons, hall lanterns and position indicators, resistant white back-printed glass, no screws required for mounting. Provide stainless steel cover plates for Firefighter's Phase I switch and hoistway access switches, with tamper resistant screws in same finish.

H. Mounting: Mount hall fixtures in entrance frames.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine hoistways, hoistway openings, and pits before starting elevator installation.

B. Verify hoistway, pit, overhead, and openings are of correct size, within tolerances, and are ready for work of this section.

C. Verify walls are plumb where openings occur and ready for entrance sill installation. Traditional sill angle or concrete sill support shall not be required.

D. Verify hoistway is clear and plumb, with variations not to exceed -0 to +1 inch at any point. Verify projections greater than 4” must be beveled not less than 75 degrees from horizontal. No negative tolerance is permitted for minimum hoistway dimensions.

E. Verify minimum 2-hour fire-resistance rating of hatch walls.

F. Notify Architect in writing of dimensional discrepancies or other conditions detrimental to proper installation or performance of elevators.

G. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to manufacturer/installer.
3.2 INSTALLATION

A. Install elevators in accordance with manufacturer/installer’s instructions and ANSI/ASME A17.1.

B. Set entrances in vertical alignment with car openings, and aligned with plumb hoistway lines.

3.3 FIELD QUALITY CONTROL

A. Perform tests of elevator as required by ANSI/ASME A17.1 and governing codes.

3.4 ADJUSTING

A. Adjust elevators for proper operation in accordance with manufacturer/installer’s instructions.

B. Adjust elevators for smooth acceleration and deceleration of car so not to cause passenger discomfort.

C. Adjust doors to prevent opening of doors at landing on corridor side, unless car is at rest at that landing, or is in leveling zone and stopping at that landing.

D. Adjust automatic floor leveling feature at each floor to within 1/4 inch of landing.

E. Repair minor damages to finish in accordance with manufacturer/installer’s instructions and as approved by Architect.

F. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

3.5 CLEANING

A. Clean elevators promptly after installation in accordance with manufacturer/installer’s instructions.

B. Do not use harsh cleaning materials or methods that could damage finish.

3.6 PROTECTION

A. Protect installed elevators from damage during construction in accordance with the negotiated temporary use agreement between Owner and manufacturer’s installer.

END OF SECTION
SECTION 21 05 00
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes pipe, fittings, valves, and connections for sprinkler systems.

B. Related Sections:
1. Section 03 10 00 - Concrete Forming and Accessories: Execution requirements for inserts and sleeves specified by this section.
2. Section 09 90 00 - Painting and Coating: Execution requirements for piping painting specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
2. ASME B16.11 - Forged Steel Fittings - Socket-Welding and Threaded.
3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
4. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
5. ASME B16.25 - Buttwelding Ends.
7. ASME B16.4 - Gray Iron Threaded Fittings.
8. ASME B16.5 - Pipe Flanges and Flanged Fittings.
10. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.

B. ASTM International:

C. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
2. AWS D1.1 - Structural Welding Code - Steel.

D. American Water Works Association:

E. National Fire Protection Association:
2. NFPA 14 - Standard for the Installation of Standpipe, Private Hydrants and Hose Systems.
3. NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances.

F. Underwriter Laboratories, Inc.:
1. UL 1887 - Fire Tests of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics.

1.3 SUBMITTALS
A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
C. Product Data: Submit manufacturer’s catalogue information. Indicate valve data and ratings.
D. Manufacturer’s Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS
A. Section 01 77 00 - Execution and Closeout Requirements: Closeout procedures.
B. Project Record Documents: Record actual locations of components and tag numbering.
C. Operation and Maintenance Data: Submit spare parts lists.

1.5 QUALITY ASSURANCE
A. Provide fire sprinkler piping located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet when tested in accordance with UL 1887.
B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Deliver and store valves in shipping containers, with labeling in place.
B. Furnish cast iron and steel valves with temporary protective coating.
C. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.8 WARRANTY
A. Section 01 77 00 - Execution and Closeout Requirements: Product warranties and product bonds.
B. Furnish five-year manufacturer warranty for basic fire suppression materials and methods.

1.9 EXTRA MATERIALS
A. Section 01 77 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
B. Furnish two sets of valve stem packing for each size and type of valve installed.

PART 2 - PRODUCTS

2.1 VALVES
A. Manufacturers:
   1. Gem.
   2. Reliable.
   3. Tyco.
   4. Viking.
   5. Substitutions: None permitted.
B. Gate Valves:
   1. Up to and including 2 inches: Bronze body and trim, rising stem, hand wheel, solid wedge or disc, threaded ends.
   2. Over 2 inches: Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, hand wheel, OS&Y, solid rubber covered bronze or cast iron wedge ends.
   3. Over 4 inches: Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged ends, iron body indicator post assembly.
C. Globe or Angle Valves:
   1. Up to and including 2 inches: Bronze body, bronze trim, rising stem and hand wheel, inside screw, renewable rubber disc, threaded ends, with back seating capacity packable under pressure.
2. Over 2 inches: Iron body, bronze trim, rising stem, hand wheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

D. Ball Valves:
1. Up to and including 2 inches: Bronze two piece body, brass, stainless steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends with union.
2. Over 2 inches: Manufacturers: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

E. Butterfly Valves:
1. Bronze Body: Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, hand wheel and gear drive and integral indicating device, and built-in tamper proof switch rated 10 amp at 115 volt AC.
2. Cast or Ductile Iron Body: Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends. With extended neck, hand wheel and gear drive and integral indicating device and external tamper switch rated 10 amp at 115 volt AC.

F. Check Valves:
1. Up to and including 2 inches: Bronze body and swing disc, rubber seat, threaded ends.
2. Over 2 inches: Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends with automatic ball check.
3. 4 inches and Over: Iron body, bronze disc with stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

G. Drain Valves:
1. Compression Stop: Bronze with hose thread nipple and cap.
2. Ball Valve: Brass with cap and chain, 3/4 inch hose thread.

2.2 BURIED PIPING
A. Steel Pipe: ASTM A53/A53M, Grade B, or ASME B36.10, Schedule 40 black, with ASME C105 polyethylene jacket, or double layer, half-lapped 10 mil polyethylene tape.
4. Casing: Closed glass cell insulation.

B. Cast Iron Pipe: AWWA C151.
1. Fittings: AWWA C110, standard thickness.

2.3 ABOVE GROUND PIPING
A. Steel Pipe: ASTM A53/A53M, Grade B; ASTM A135 UL listed, threadable, light wall; ASTM A795; or ASME B36.10; Schedule 10 black.
4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

5. Mechanical Formed Fittings: Carbon-steel housing with integral pipe stop and O-ring pocked and O-ring uniformly compressed into permanent mechanical engagement onto pipe.

B. Cast Iron Pipe: AWWA C151.
   1. Fittings: AWWA C110, standard thickness.
   3. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped composition sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

2.4 PIPE HANGERS AND SUPPORTS
   A. Conform to NFPA 13.
   B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
   C. Hangers for Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
   D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   E. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
   F. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
   G. Vertical Support: Steel riser clamp.
   H. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
   I. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

PART 3 - EXECUTION

3.1 PREPARATION
   A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
   B. Remove scale and foreign material, from inside and outside, before assembly.
   C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION
   A. Install piping in accordance with NFPA 13 for sprinkler systems.
   B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
   C. Install piping to conserve building space, to not interfere with use of space and other work.
   D. Group piping whenever practical at common elevations.
   E. Install pipe sleeve at piping penetrations through footings partitions, and walls. Seal pipe and sleeve penetrations to maintain fire resistance equivalent to fire separation.
   F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
   G. Pipe Hangers and Supports:
1. Install in accordance with NFPA 13.
2. Install hangers to with minimum 1/2 inch space between finished covering and adjacent work.
3. Place hangers within 12 inches of each horizontal elbow.
4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Where installing several pipes in parallel and at same elevation, provide multiple or trapeze hangers.
7. Install sheet lead packing between hanger or support and piping.
8. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

H. Slope piping and arrange systems to drain at low points. Install eccentric reducers to maintain top of pipe level.
I. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 09 90 00.
J. Do not penetrate building structural members unless indicated.
K. Where more than one piping system material is specified, install compatible system components and joints. Install flanges, union, and couplings at locations requiring servicing.
L. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
M. Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.
N. Install gate valves for shut-off or isolating service.
O. Install drain valves at main shut-off valves, low points of piping and apparatus.

3.3 INTERFACE WITH OTHER PRODUCTS
A. Inserts:
   1. Install inserts for placement in concrete forms.
   2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Install hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.4 CLEANING
A. Section 01 77 00 - Execution and Closeout Requirements: Final cleaning.
B. Clean entire system after other construction is complete.

END OF SECTION
SECTION 21 05 53
IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Valve tags.
   5. Warning tags.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
C. Valve Schedules: Valve numbering scheme.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS
A. Plastic Labels for Equipment:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brady Corporation.
      b. Brimar Industries, Inc.
      c. Carlton Industries, LP.
      d. Champion America.
      e. Craftmark Pipe Markers.
      f. Kolbi Pipe Marker Co.
      g. LEM Products Inc.
      h. Marking Services, Inc.
      i. Seton Identification Products.
   2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
   4. Background Color: Red.
   5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately
larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.


B. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation.
   2. Brimar Industries, Inc.
   3. Carlton Industries, LP.
   5. Craftmark Pipe Markers.
   6. LEM Products Inc.
   7. Marking Services Inc.
   10. Stranco, Inc.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.


D. Background Color: Red.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.


I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation.
   2. Champion America.
   3. Craftmark Pipe Markers.
   4. Seton Identification Products.

B. General Requirements for Manufactured Pipe Labels:
   1. Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.

C. Pre-tensioned Pipe Labels:
1. Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-adhesive Pipe Labels:
   1. Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: Size letters according to ASME A13.1 for piping.

F. Pipe-Label Colors:
   1. Background Color: Safety Red.

2.4 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation.
   2. Champion America.
   3. Craftmark Pipe Markers.
   4. Seton Identification Products.

B. Description: ½ inch round, stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032 inch anodized aluminum, 0.032 inch thick, with predrilled holes for attachment hardware.
   2. Fasteners: Beaded chain.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation.
   2. Champion America.
   3. Craftmark Pipe Markers.
   4. Seton Identification Products.

B. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: 3 by 5-1/4 inches minimum.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping: Painting of piping is specified in Section 099123 "Interior Painting."

B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts and plenums; and exterior exposed locations as follows:

   1. Near each valve and control device.
   2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors and similar access points that permit a view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
   7. On piping above removable acoustical ceilings omit intermediately spaced labels.

C. Directional Flow Arrows:

   1. Arrows shall be used to indicate direction of flow in pipes.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION
SECTION 21 12 00
FIRE-SUPPRESSION STANDPIPES

PART 1 GENERAL

1.1 SUMMARY
A. Section includes entire standpipe system from fire department connection to fire hose connection.
B. Related Sections:
   1. Section 21 05 00 - Common Work Results for Fire Suppression: Product and execution requirements for pipe, fittings, valves, hangers, supports, identification and painting for placement by this section.

1.2 REFERENCES
A. FM Global:
B. National Fire Protection Association:

1.3 SUBMITTALS
A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
B. Shop Drawings: Indicate supports, components, accessories, and sizes.
C. Product Data: Submit manufacturer's catalog sheet for equipment indicating rough-in size, finish, and accessories.
D. Field Test Reports: Indicate compliance with specified performance.
E. Manufacturer's Installation Instructions: Submit with product data.
F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS
A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
B. Operation and Maintenance Data: Submit servicing requirements and test schedule.

1.5 QUALITY ASSURANCE
A. Perform Work in accordance with NFPA 14.
B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 PRE-INSTALLATION MEETINGS
A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
B. Deliver and store products in shipping packaging until installation.

1.9 WARRANTY
A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 VALVES
A. Manufacturers:
1. Crane.
2. Milwaukee.
4. Substitutions: Section 01 60 00 – Product Requirements.
B. Hose Connection Valve: Angle type; brass finish; 2-1/2 inch size, thread to match fire department hardware, 300 psi working pressure, with threaded cap and chain of brass finish.

2.2 FIRE DEPARTMENT CONNECTION
A. See Section 21 13 13 Wet Pipe Sprinkler Systems for fire department connection requirements.

2.3 PIPE HANGERS AND SUPPORTS
A. Conform to NFPA 13.
B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch:
1. Carbon steel, adjustable swivel, split ring.
C. Hangers for Pipe Sizes 2 inch and Over:
   1. Carbon steel, adjustable, clevis.

D. Multiple or Trapeze Hangers:
   1. Steel channels with welded spacers and hanger rods.

E. Wall Support for Pipe Sizes to 3 inches:
   1. Cast iron hook.

F. Wall Support for Pipe Sizes 4 inches and Over:
   1. Welded steel bracket and wrought steel clamp.

G. Vertical Support:
   1. Steel riser clamp.

H. Floor Support:
   1. Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify blocking in place for cabinet installation.

3.2 INSTALLATION

A. Install in accordance with NFPA 14.

B. Install hose station valve in cabinet at 60 inches above floor.

3.3 FIELD QUALITY CONTROL

A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Test entire system in accordance with NFPA 14.

C. Require test be witnessed by Authority having jurisdiction.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Flush entire system of foreign matter.

END OF SECTION 211200
SECTION 211313

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes wet-pipe sprinkler system, system design, installation, and certification.
B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 REFERENCES
A. National Fire Protection Association:

1.3 SYSTEM DESCRIPTION
A. System to provide coverage for areas identified on drawings.
B. Provide hydraulically designed system to NFPA 13 light hazard and ordinary hazard and as indicated on drawings.
C. Determine volume and pressure of incoming water supply from water flow test data.
D. Interface system with building fire and smoke alarm system.
E. Provide fire department connections accessible outside of the building.

1.4 SUBMITTALS
A. Shop Drawings:
   1. Indicate layout of finished ceiling areas indicating sprinkler locations coordinated with ceiling installation. Indicate detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
B. Product Data:
   1. Submit data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
C. Design Data:
   1. Submit design calculations; signed and sealed by registered Fire Protection Engineer or by a Responsible Managing Employee.
D. Manufacturer's Certificate:
   1. Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS
A. Project Record Documents:
   1. Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
B. Operation and Maintenance Data:
1. Submit components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

1.6 QUALITY ASSURANCE
A. Perform Work in accordance with NFPA 13, State of Texas and City of San Antonio Requirements.

1.7 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum three years experience.
B. Installer:
   1. Company specializing in performing Work of this section with minimum three years experience.
C. Design system under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of Texas.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Store products in shipping containers until installation.
B. Furnish piping with temporary inlet and outlet caps until installation.

1.9 EXTRA MATERIALS
A. Furnish extra sprinklers under provisions of NFPA 13.
B. Furnish suitable wrenches for each sprinkler type.
C. Furnish metal storage cabinet located adjacent to alarm valve.

PART 2 - PRODUCTS

2.1 SPRINKLERS
A. Manufacturers:
   1. Tyco.
   2. Automatic Sprinkler Corp.
   3. Grinnell Corp.
   4. Reliable Sprinkler Corp
   5. Viking Sprinkler Corp.
B. Suspended Ceiling Type:
   1. Type: Concealed pendant type with matching push on escutcheon plate.
   2. Finish: Chrome Plate or Brass.
   3. Escutcheon Plate Finish: Enamel, color as selected.
   4. Fusible Link: Glass bulb type temperature rated for specific area hazard.
C. Exposed Area Type:
   1. Type: Standard upright type.
   2. Finish: Chrome plated.
   3. Fusible Link: Glass bulb type temperature rated for specific area hazard.
D. Side Wall type:
1. Type: Semi-recessed horizontal side wall type with matching push on escutcheon plate.
2. Finish: Chrome plated.
3. Cover Plate Finish: Chrome plated.
4. Fusible Link: Glass bulb type temperature rated for specific area hazard.

E. Glass Protection:
   1. Type: Concealed type quick response heads.
   2. K-8.0 factor spaced at less than 200 square feet.
   3. Reference: Tyco Model WS.

2.2 PIPING SPECIALTIES

A. Wet Pipe Sprinkler Alarm Valve:
   1. Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm, with pressure retard chamber and variable pressure trim; with test and drain valve.

B. Water Motor Alarm:
   1. Hydraulically operated impeller type alarm with aluminum alloy chrome plated gong and motor housing, nylon bearings, and inlet strainer.

C. Water Flow Switch:
   1. Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.

D. Fire Department Connections:
   1. Type: wall type.
   2. Outlets: Two-way with fire department thread size. Threaded dust-cap and chain of matching material and finish.
   4. Label: "Sprinkler - Fire Department Connection"

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with NFPA 13 and manufacturer’s instructions.
B. Locate fire department connection with sufficient clearance from walls or obstructions to allow full swing of fire department wrench handle.
C. Locate outside alarm-gong on building wall as indicated on Drawings or where directed by Architect. Confirm final location prior to installation.
D. Place pipe runs to minimize obstruction to other work.
E. Install piping in concealed spaces above finished ceilings.
F. Center sprinklers in two directions in ceiling tile and install piping offsets.
G. Install guards on exposed sprinklers.
H. Hydrostatically test entire system.
I. Require test be witnessed by Authority having jurisdiction.
3.2 INTERFACE WITH OTHER PRODUCTS
   A. Verify signal devices are installed and connected to fire alarm system.

3.3 CLEANING
   A. Flush entire piping system of foreign matter.

3.4 PROTECTION OF INSTALLED CONSTRUCTION
   A. Apply masking tape or paper cover to protect concealed sprinklers, cover plates, and sprinkler escutcheons not receiving field paint finish. Remove after painting. Replace painted sprinklers with new.

END OF SECTION 211313
SECTION 21 32 13
ELECTRIC-DRIVE VERTICAL INLINE FIRE PUMPS

PART 1 GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Vertical-inline fire pumps.
   2. Fire-pump accessories and specialties.
   3. Flowmeter systems.

1.3 PERFORMANCE REQUIREMENTS
A. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig minimum unless higher pressure rating is indicated.

1.4 ACTION SUBMITTALS
A. Product Data:
   1. For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.
B. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS
A. Product Certificates: For each fire pump, from manufacturer.
B. Source quality-control reports.
C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data:
   1. For fire pumps to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. NFPA Compliance:
1.8 COORDINATION
A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VERTICAL INLINE FIRE PUMPS
A. Description:
1. Factory-assembled and -tested fire-pump and driver unit.
B. Finish:
1. Red paint applied to factory-assembled and tested unit before shipping.

2.2 VERTICAL INLINE FIRE PUMPS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong.
2. Aurora.
3. Patterson.
4. Peerless.
5. Pentair.
B. Pump Head: Cast iron, for surface discharge.
1. Discharge Outlet: With flange according to ASME B16.1 except connections may be threaded according to ASME B1.20.1, in sizes where flanges are not available.
2. Pump Head Seal: Stuffing box and packing.
3. Base: Cast iron or steel with hole for electrical cable.
C. Pump:
1. Standard: UL 448, for vertical-turbine pumps for fire service.
2. Line Shaft: Stainless steel or steel, with corrosion-resistant shaft sleeves.
3. Line Shaft Bearings: Rubber sleeve, water lubricated.
4. Line Shaft: Steel.
5. Line Shaft Bearings: Corrosion resistant, oil lubricated.
6. Impeller Shaft: Monel metal or stainless steel.
7. Bowl Section: Multiple cast-iron bowls with closed-type bronze or stainless-steel impellers.
8. Column Pipe: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded ends and cast-iron or steel fittings, in sections 10 feet or less.
9. Suction Strainer: Cast or fabricated, bronze or stainless steel, and sized to restrict passage of 0.5-inch spheres.
D. Driver:
1. Standard: UL 1004A.
2. Type: Electric motor; NEMA MG 1, polyphase Design B.
E. Capacities and Characteristics:
1. Refer to Plans.

2.3 FIRE-PUMP ACCESSORIES AND SPECIALTIES
A. Automatic Air-Release Valves:
1. Comply with NFPA 20 for installation in fire-pump discharge piping.
B. Relief Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. BERMAD Control Valves.
      b. CLA-VAL Automatic Control Valves.
      c. Kunkle Valve.
      d. OCV Control Valves.
      e. Watts; a Watts Water Technologies company.
      f. Zurn Industries, LLC.
   2. Description: UL 1478, bronze or cast iron, spring loaded; for installation in fire-suppression water-supply piping.

C. Outlet Fitting:
   1. Concentric tapered reducer at pump-head discharge outlet.

D. Discharge Cone: Open type.

2.4 FLOWMETER SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Fire Research Corp.
   4. Hydro Flow Products, Inc.
   5. Hyspan Precision Products, Inc.
   7. Preso Meters.

B. Description:
   1. UL-listed or FM-Approved, fire-pump flowmeter system with capability to indicate flow to not less than 175 percent of fire-pump rated capacity.

C. Pressure Rating: 175 psig.

D. Sensor:
   1. Annubar probe, orifice plate, or venturi unless otherwise indicated. Sensor size shall match pipe, tubing, flowmeter, and fittings.

E. Permanently Mounted Flowmeter: Compatible with flow sensor; with dial not less than 4-1/2 inches in diameter. Include bracket or device for wall mounting.
   1. Tubing Package: NPS 1/8 or NPS 1/4 soft copper tubing with copper or brass fittings and valves.

F. Portable Flowmeter:
   1. Compatible with flow sensor; with dial not less than 4-1/2 inches in diameter and with two 12-foot-long hoses in carrying case.

2.5 SOURCE QUALITY CONTROL

A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Protection Tests."
   1. Verification of Performance: Rate fire pumps according to UL 448.
B. Fire pumps will be considered defective if they do not pass tests and inspections.
C. Prepare test and inspection reports.

PART 3 EXECUTION

3.1 EXAMINATION
A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and conditions affecting performance of fire pumps.
B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
B. Equipment Mounting:
   1. Install fire pumps on cast-in-place concrete equipment pads.
C. Install fire-pump discharge piping equal to or larger than size required by NFPA 20.
D. Support piping and pumps separately so weight of piping does not rest on pumps.
E. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves.
F. Install pressure gage on pump head discharge flange pressure-gage tapping. Comply with requirements for pressure gages specified.
G. Install flowmeters and sensors. Install flowmeter-system components and make connections according to NFPA 20 and manufacturer's written instructions.
H. Electrical Wiring:
   1. Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
I. Wiring Method:
   1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

3.3 CONNECTIONS
A. Comply with requirements for piping and valves specified.
B. Install piping adjacent to pumps and equipment to allow service and maintenance.
C. Connect relief-valve discharge to drainage piping or point of discharge.
D. Connect flowmeter-system meters, sensors, and valves to tubing.
E. Connect fire pumps to their controllers.

3.4 IDENTIFICATION
A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.
3.5 FIELD QUALITY CONTROL

A. Test each fire pump with its controller as a unit. Comply with requirements for electric-motor-driver fire-pump controllers specified in Section 21 39 00 "Controllers for Fire Pump Drivers."

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:
   1. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
   2. Test according to NFPA 20 for acceptance and performance testing.
   3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

G. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

END OF SECTION
SECTION 21 39 00
CONTROLLERS FOR FIRE-PUMP DRIVERS

PART 1 GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Full-service, full voltage controllers rated 600 V and less.
   2. Controllers for pressure-maintenance pumps.
   4. Low-suction-shutdown panels.

1.3 DEFINITIONS
A. ECM: Electronic control module.
B. MCCB: Molded-case circuit breaker.
C. N.O.: Normally open.

1.4 ACTION SUBMITTALS
A. Product Data:
   1. For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
B. Shop Drawings: For each type of product indicated. Include dimensioned plans, elevations, sections, details, and attachments to other work, including required clearances and service spaces around controller enclosures.
   1. Show tabulations of the following:
      a. Each installed unit's type and details.
      b. Enclosure types and details for types other than NEMA 250, Type 2.
      c. Factory-installed devices.
      d. Nameplate legends.
      e. Short-circuit current (withstand) rating of integrated unit.
      f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices.
      g. Specified modifications.
   2. Detail equipment assemblies and indicate dimensions, weights, loads, method of field assembly, components, and location and size of each field connection.
   3. Schematic and Connection Diagrams: For power, signal, alarm, and control wiring and for pressure-sensing tubing.

1.5 INFORMATIONAL SUBMITTALS
A. Qualification Data: For qualified testing agency.
B. Product Certificates:
   1. For each type of product indicated, from manufacturer.
C. Manufacturer's factory test reports of fully assembled and tested equipment.
D. Source quality-control reports.
E. Field quality-control reports.
1.6 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For each type of product indicated to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 Operation and Maintenance Data, include the following:
   1. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
   2. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor-based logic controls.

1.7 MAINTENANCE MATERIAL SUBMITTALS
A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Indicating Lights: Two of each type and color of lens installed; two of each type and size of lamp installed.
   2. Auxiliary Contacts: One for each size and type of magnetic contactor installed.
   3. Power Contacts: Three for each size and type of magnetic contactor installed.
   4. Contactor Coils: One for each size and type of magnetic controller installed.
   5. Relay Boards: One for each size and type of relay board installed.
   6. Operator Interface: One microprocessor board(s), complete with display and membrane keypad.

1.8 QUALITY ASSURANCE
A. Testing Agency Qualifications: Member company of an NRTL.
B. Source Limitations:
   1. Obtain fire-pump controllers and all associated equipment from single source or producer.
C. Electrical Components, Devices, and Accessories:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
D. Comply with standards of authorities having jurisdiction pertaining to materials and installation.
E. Comply with NFPA 20 and NFPA 70.
F. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

1.9 DELIVERY, STORAGE, AND HANDLING
A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.10 PROJECT CONDITIONS
A. Environmental Limitations:
   1. Ambient Temperature Rating: Not less than 40 deg F and not exceeding 122 deg F unless otherwise indicated.
   2. Altitude Rating: Not exceeding 6600 feet unless otherwise indicated.
B. Interruption of Existing Electric Service:
   1. Notify Construction Manager and Owner no fewer than seven days in advance of proposed interruption of electric service, and comply with NFPA 70E.
1.11 COORDINATION

A. Coordinate layout and installation of controllers with other construction including conduit, piping, fire-pump equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels. Ensure that controllers are within sight of fire-pump drivers.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 PRODUCTS

2.1 FULL-SERVICE CONTROLLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Aquarius Fluid Products, Inc.
   2. ASCO Power Technologies, LP.
   7. Metron, Inc.
   8. Tornatech.

B. Method of Starting:
   1. Pressure-switch actuated.
      a. Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
      b. System pressure recorder, electric ac driven, with spring backup.
      c. Programmable minimum-run-time relay to prevent short cycling.
      d. Programmable timer for weekly tests.
   3. Solid-State Controller: Reduced-voltage type.
   4. Emergency Start: Mechanically operated start handle that closes and retains the motor RUN contactor independent of all electric or pressure actuators.

C. Method of Stopping: Automatic and non-automatic shutdown after automatic starting.

D. Capacity:
   1. Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at controller location.

E. Method of Isolation and Overcurrent Protection:
   1. Interlocked isolating switch and non-thermal MCCB; with a common, externally mounted operating handle, and providing locked-rotor protection.

F. Door-Mounted Operator Interface and Controls:
   1. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
   2. Method of Control and Indication:
      a. Microprocessor-based logic controller, with multiline digital readout.
      b. Membrane keypad.
      c. LED alarm and status indicating lights.
      d. Local Alarm and Status Indications:
      e. Controller power on.
f. Motor running condition.
g. Loss-of-line power.
h. Line-power phase reversal.
i. Line-power single-phase condition.
3. Audible alarm, with silence push button.
4. Non-automatic START and STOP push buttons or switches.

G. Optional Features:
1. Automatic Power Transfer Switch.
2. Extra Output Contacts:
   a. One N.O. contact(s) for motor running condition.
   b. One set(s) of contacts for loss-of-line power.
   c. One each, Form C contacts for high and low reservoir level.
3. Local alarm bell.
4. Door-mounted thermal or impact printer for alarm and status logs.

2.2 CONTROLLERS FOR PRESSURE-MAINTENANCE PUMPS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Aquarius Fluid Products, Inc.
   2. ASCO Power Technologies, LP.
   7. Metron, Inc.
   8. Tornatech.

B. General Requirements for Pressure-Maintenance-Pump Controllers:
   1. Type: UL 508 factory assembled, wired, and tested, across-the-line; for combined automatic and manual operation.
   2. Enclosure: UL 508 and NEMA 250, Type 2 for wall-mounting.
   3. Factory assembled, wired, and tested.
   4. Finish: Manufacturer's standard color paint.

C. Rate controller for scheduled horsepower and include the following:
   1. Fusible disconnect switch.
   2. Pressure switch.
   4. Pilot light.
   5. Running period timer.

2.3 REMOTE ALARM PANELS
A. General Requirements for Remote Alarm Panels: Comply with NFPA 20 and UL 218; listed by an NRTL for fire-pump service.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Aquarius Fluid Products, Inc.
   2. ASCO Power Technologies, LP.
7. Metron, Inc.
8. Tornatech.

C. Audible and Visual Alarm and Status Indications: Manufacturer's standard indicating lights; push-to-test.
   1. Controller main switch turned to the off or manual position.
   2. Supervised power on.
   3. Common Separated trouble on the controller.
   5. Controller connected to alternate power source.

D. Audible alarm, with silence push button.
E. Pump REMOTE START push button.

2.4 LOW-SUCTION-SHUTDOWN PANELS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Aquarius Fluid Products, Inc.
   2. ASCO Power Technologies, LP.
   3. Hubbell Incorporated.
   5. Master Control Systems, Inc.
   6. Metron, Inc.
   7. Tornatech.

B. Operation: Integral pressure switch.
C. Supervisory and Normal Control Voltage: 120-V; dual source.
D. Include audible and visual alarms and status indications, with silence push button, for the following conditions:
   1. Control power available.
   2. Low-suction pressure.
   3. Normal-suction pressure.

2.5 ENCLOSURES
A. Fire-Pump Controllers, Remote Alarm Panels, and Low-Suction-Shutdown Panels: NEMA 250, to comply with environmental conditions at installed locations and NFPA 20.
   1. Indoor, Dry and Clean Locations: Type 1 (IEC IP10).
   2. Indoor Locations Subject to Dripping Noncorrosive Liquids: Type 2 (IEC IP11).
   3. Other Wet or Damp, Indoor Locations: Type 4 (IEC IP56), Type 4X (IEC IP56).
   4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12 (IEC IP12).

B. Enclosure Color: Manufacturer's standard "fire-pump-controller red".
C. Nameplates:
   1. Comply with NFPA 20; complete with capacity, characteristics, approvals, listings, and other pertinent data.

2.6 SOURCE QUALITY CONTROL
A. Testing: Test and inspect fire-pump controllers according to requirements in NFPA 20 and UL 218.
1. Verification of Performance: Rate controllers according to operation of functions and features specified.

B. Fire-pump controllers will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive equipment, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine equipment before installation. Reject equipment that is wet or damaged by moisture or mold.

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

3.2 CONTROLLER INSTALLATION

A. Install controllers within sight of their respective drivers.

B. Connect controllers to their dedicated pressure-sensing lines.

C. Wall-Mounting Controllers: Install controllers on walls with disconnect operating handles not higher than 79 inches above finished floor, and bottom of enclosure not less than 12 inches above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 26 05 29.

D. Floor-Mounting Controllers: Install controllers on 4-inch nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than 12 inches above finished floor.
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to supported equipment.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

F. Comply with NEMA ICS 15.

3.3 REMOTE ALARM AND LOW-SUCTION-SHUTDOWN PANEL INSTALLATION

A. Install panels on walls with tops not higher than 72 inches above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For ATS not on walls, provide freestanding racks complying with Section 26 05 29.

3.4 POWER WIRING INSTALLATION

A. Install power wiring between controllers and their services or sources, and between controllers and their drivers. Comply with requirements in NFPA 20, NFPA 70, and Section 26 05 19.
3.5 CONTROL AND ALARM WIRING INSTALLATION

A. Install wiring between controllers and remote devices and facility’s central monitoring system. Comply with requirements in NFPA 20 and NFPA 70.

B. Install wiring between remote alarm and low-suction-shutdown panels and controllers. Comply with requirements in NFPA 20 and NFPA 70.

C. Install wiring between controllers and the building’s fire-alarm system. Comply with requirements specified in Section 28 31 00.

D. Bundle, train, and support wiring in enclosures.

E. Connect remote manual and automatic activation devices where applicable.

3.6 IDENTIFICATION

A. Comply with requirements in NFPA 20 for marking fire-pump controllers.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification in NFPA 20 and as specified in Section 26 05 53.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:
   1. Inspect and Test Each Component:
      a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
      b. Test insulation resistance for each element, component, connecting supply, feeder, and control circuits.
      c. Test continuity of each circuit.
   2. Verify and Test Each Electric-Driver Controller:
      a. Verify that voltages at controller locations are within plus 10 or minus 1 percent of motor nameplate rated voltages, with motors off. If outside this range for any motor, notify Construction Manager and Owner before starting the motor(s).
      b. Test each motor for proper phase rotation.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Field Acceptance Tests:
   1. Do not begin field acceptance testing until suction piping has been flushed and hydrostatically tested and the certificate for flushing and testing has been submitted to Construction Manager and Owner and authorities having jurisdiction.
   2. Prior to starting, notify authorities having jurisdiction of the time and place of the acceptance testing.
3. Engage manufacturer's factory-authorized service representative to be present during the testing.
4. Perform field acceptance tests as outlined in NFPA 20.

F. Controllers will be considered defective if they do not pass tests and inspections.
G. Prepare test and inspection reports.

3.8 STARTUP SERVICE
A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.

3.9 ADJUSTING
A. Adjust controllers to function smoothly and as recommended by manufacturer.
B. Set field-adjustable switches, auxiliary relays, time-delay relays, and timers.
C. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
D. Set field-adjustable pressure switches.

3.10 PROTECTION
A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.11 DEMONSTRATION
A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controllers, remote alarm panels, low-suction-shutdown panels, and to use and reprogram microprocessor-based controls within this equipment.

END OF SECTION
SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY
A. Applicable provisions of General Conditions, Special Conditions, and Special Instructions to Bidders govern work under this section and all of Division 22.
B. This section is in particular reference to and shall be considered a part of all Plumbing specifications sections following. It is intended that comments in this section be applicable to all parts of Division 22. Work described hereinafter shall be included as though written within each specific section of the specification.
C. The Contractor shall provide all items, articles, materials, operations, or methods listed, mentioned, or scheduled on the Drawings and/or herein, including all labor, materials, equipment, and incidentals necessary and required for their completion.
D. All work shall conform to requirements of all local construction codes, applicable sections of the National Fire Protection Association, Public Health Agencies and the Texas Accessibilities Standards, latest editions of all publications.

1.2 SECTION INCLUDES
A. Escutcheons.
B. Grout.

1.3 SCOPE
A. Requirements specified in this section shall govern applicable portions of all plumbing sections including paragraphs on related electrical work, whether so stated therein or not.
B. Where items specified in the specific plumbing sections conflict with requirements in this section, the former specific sections shall govern.
C. The Contractor shall furnish all labor, plant, equipment, and materials, complete in connection with the installation of the plumbing systems in strict accordance with this specification and accompanying plans. The Contractor shall submit his bid based on performing all work hereinafter specified or indicated on applicable plans. The Contractor shall furnish and install all connections and appurtenances necessary and usually furnished in connection with such work and systems even though not specifically mentioned or shown on the plans.
D. These requirements cover information, work, equipment and accessories listed under the following headings:
   1. References, Definitions, Procedures
   2. Permits and Fees
   3. Utility Connections and Inspections
   4. Workmanship
   5. Mechanical Provisions
E. Work of Other Sections:
1. Requirements given within this Section apply to the Work of all Sections of this Division.

F. Finish painting is specified in other Divisions. Prime and protective painting shall be provided under this Division.

G. Electrical interlock apparatus and other electrical apparatus, which is not an integral part of equipment specified under this Division, are specified under Division 26. Necessary conduit, wiring, boxes, and fittings are specified under Division 26.

1.4 REFERENCES

A. References to standards, codes, specifications and recommendations shall mean the latest edition of such publications adopted and published at date of invitation to submit Proposals.

B. References to technical societies, trade organizations and governmental agencies is made in plumbing work sections in accordance with the following abbreviations:

1. AGA American Gas Association
2. AIEE American Institute of Electrical Engineers
3. ANSI American National Standards Institute
4. ASME American Society of Mechanical Engineers
5. ASTM American Society for Testing and Materials
6. AWWA American Water Works Association
7. FM Factory Mutual
8. NFPA National Fire Protection Association
9. NBS National Bureau of Standards
10. NEC National Electrical Code (NFPA Pamphlet No. 70)
11. NEMA National Electrical Manufactures Association
12. UL Underwriters' Laboratories, Inc.

1.5 DEFINITIONS

A. Definitions of terms and expressions used in plumbing work are:

1. "Provide" shall mean "furnish and install" or "furnish labor and material required for installation of."

2. "Herein" shall mean the contents of a particular section where this term appears.

3. "Indicated" shall mean "indicated on contract drawings."

4. "Section" shall mean one of the portions of plumbing, mechanical or electrical work sections indexed in Division 22, 23 and 26.

5. "Concealed" where used in connection with insulation and painting of piping, and accessories, shall mean that they are hidden from sight as in chases, furred spaces, or hung ceilings.

6. "Exposed" where used in connection with insulation and painting of piping, and accessories shall mean that they are not "concealed" as defined herein above.

7. "Piping" includes in addition to pipe, also fittings, valves, hangers and other accessories, which comprise a system.

B. Drawings and Instructions
1. Contract drawings for plumbing work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement of equipment, fixtures, piping and approximate sizes and locations of equipment and outlets. Plumbing trade shall follow these drawings in laying out their work, consult other trades and general construction drawings to familiarize themselves with all conditions affecting their work, and shall verify and coordinate spaces in which their work will be installed. The contract drawings shall be considered as a part of these specifications. It is intended that any Contractor making proposal to execute any work should study the drawings for his own particular trade, as well as all drawings of all other trades in order to fully understand the work he is expected to perform. As a qualification for bidding, the contractor shall visit the site and be responsible for determining all existing conditions in as far as it affects his work prior to submitting a proposal.

1.6 DRAWINGS
A. General:
1. The Drawings are schematic in nature and indicate approximate locations of the plumbing equipment, fixtures and piping systems, except where specific locations are noted and dimensioned on the Drawings. All items are shown approximately to scale. The intent is to show how these items shall be integrated into the building. Locate all items by on-the-job measurements and in accordance with the Contract Documents. Cooperate with other trades to ensure project completion as indicated.

B. Unless otherwise expressly agreed to in writing, all rights to the specifications and drawings prepared by Alderson & Associates, Inc. shall belong to Alderson & Associates, Inc. The sole exception is that the specifications and drawings may be used for construction of the project for which the specifications and drawings were prepared if all other contractual obligations have been complied with, including the payment of fees. Each page of the drawings, if prepared in whole or in part by Alderson & Associates, Inc., and all pages of specifications of Division 22, Division 23 and Division 26 are covered by copyright and may not be reproduced, published or used in any way without the permission of Alderson & Associates, Inc.

C. Location:
1. Prior to locating plumbing fixtures and plumbing items, obtain the Architect/Engineer's approval as to exact location. Locations shall not be determined by scaling drawings. Plumbing fixtures, shall be mounted at the heights directed by the Architect/Engineer or as required by pertinent standards, codes or regulations. Contractor shall be responsible for costs of redoing work of trades necessitated by failure to comply with this requirement.

1.7 DISCREPANCIES
A. Clarification:
1. Clarification shall be obtained before submitting a proposal for the Work under this Division as to discrepancies or omissions from the Contract Documents or questions as to the intent thereof.

B. Contractor Agreement:
1. Consideration will not be granted for misunderstanding of the amount of work to be performed. Tender of a proposal conveys full Contractor agreement of the
items and conditions specified, shown, scheduled, or required by the nature of the project.

C. The drawings intend that all equipment and piping be arranged as shown with necessary minor rearrangements to suit the equipment approved and to comply with the requirements of the various equipment manufacturers' recommendations. Some minor rearrangements are expected to best fit the structural conditions. It shall be the responsibility of the Contractor to make known his desires in such change, by shop drawings as required, to obtain agreement of the Architect/Engineer before proceeding with any change or variation. Changes required by job conditions, equipment employed, or structural conditions of the building shall be at no cost to the Owner.

1.8 PRODUCT SUBSTITUTION PROCEDURES

A. Architect/Engineer will consider requests for Substitutions. Architect/Engineer shall receive such requests a minimum of 10 days prior to scheduled bid date.

B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that Bidder:
   1. Has investigated proposed product and has determined that it meets or exceeds quality level of specified product.
   2. Will provide same warranty for Substitution as for specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.
   5. Will reimburse Owner and Architect/Engineer for review or redesign services associated with re-approval by authorities having jurisdiction.

E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.

F. Substitution Submittal Procedure:
   1. Submit two copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
   2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
   3. Architect/Engineer will notify Contractor in writing of decision to accept or reject request.

1.9 SUBMITTALS

A. Submittal Procedures: Division 01 - Requirements in addition to the following:

   1. Submittal Preparation:
      a. Minimum of six copies are required, complete (all items submitted at one time), index to each Section of Specifications and include the following information and action taken.
         1) Project Name
         2) Date
         3) Name and Address of Architect
4) Name and Address of Engineer (See Division 01 of Specifications)
5) Name, Address and Telephone Number of Contractor or Sub-contractors.
6) Manufacturer's Name
7) Published ratings or capacity data
8) Detailed equipment drawing for fabricated items
9) Wiring diagrams
10) Installation instructions
11) Other pertinent data
12) All required submittals and data, bound together, submitted at one time.

b. Where literature is submitted covering a group or series of similar items, the applicable items must be clearly indicated on each copy with a highlighter pen, or other means of identification clearly legible.

c. Data and shop drawings shall be coordinated and included in a single submission. Multiple submissions are not acceptable except where prior approval has been obtained from the Architect/Engineer. In such cases, a list of data to be submitted later shall be included with the first submission. Failure to submit shop drawings that meet the requirements of the Drawings and Specifications in ample time for review shall not entitle the Contractor to an extension of contract time, and no claim for extension by reason of such Contractor default shall be allowed.

B. Submittal Organization:
1. Organize all required data in a 3-ring black (in color) binder of sufficient size (3 inch) with index tabs with number and appropriate title of specification section.

C. Provide a cover sheet and an index sheet listing all items submitted.

D. The second and third sheet shall be blank for stamping of submittals. All submittals are to be processed at same date; partial submittals will not and are not acceptable.

E. Show any revisions to equipment layout required by use of selected equipment. The Engineer shall receive submittals no later than thirty (30) working days from contract date with General Contractor and Owner.

F. The Engineer's review of submittals is only for confirmation of adherence to design of project and does not relieve the Contractor of final responsibility for furnishing all materials required for a complete working system and in complying with the Contract Documents in all respects.

1.10 SHOP DRAWINGS, DESCRIPTIVE DATA

A. As soon as practical and within thirty days after the official award of contract and before any materials and equipment are purchased, the Contractor shall submit to the Architect/Engineer, for review, five (5) copies of the complete list of all materials and equipment identified and referenced to specification paragraphs together with applicable shop drawings. In addition, the names and addresses of the manufacturers, their catalog data, numbers, and trade names shall be furnished. Published performance data indicating pressure drops, pump curves, balance points, etc., shall be furnished to indicate compliance with scheduled performance. For all fans and pumps, provide the “family” of
curves, not just the selected performance point (minimum size 8½” x 11”). This data will be marked "Reviewed" by the Engineer, dated and distributed to the several parties involved, with two (2) copies returned to the Contractor. The data shall include the following:

1. Equipment-room layouts drawn to ¼” scale, including equipment, piping, accessories, to show clearances for operating and servicing.
2. Equipment and materials as indicated in each Section.
3. Wiring diagrams, control panelboards, motor test data, motor starters and controls for electrically operated equipment furnished by plumbing trades.
4. Composite drawings of crowded locations where there is a possibility of conflict among trades.
5. Indicate exact locations and elevations of pipes, ducts, and conduits, obtained from field measurements, after consultation and agreement among trades involved.

B. Verification of Dimensions:

1. The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall verify all dimensions in the field and advise the Architect/Engineer of any discrepancy before performing the work. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner.

C. Equipment other than that shown should be used in bids only when approved by the Engineer prior to bidding. Those models and manufacturers identified in drawings and specifications were selected to provide minimum acceptable performance. These models are used in sake of brevity to establish a basis of quality, weights, performance, capacities, etc., required. Any such alternate proposals must include all necessary changes and additions to the work occasioned by such substitution including but not limited to foundations, supports, electrical work, connections, piping, etc. which shall be paid for by the Contractor. In the event that the Contractor submits for approval any material, equipment, etc., that are not in conformity with the specifications, the Architect/Engineer reserves the right to reject this equipment, and the Contractor shall submit data on other equipment which meets the requirements of the specifications for approval.

D. Installation Directions:

1. Obtain manufacturer's printed installation directions to aid in properly executing work on equipment requiring such directions.

E. Submit such directions to Architect/Engineer prior to time of installation for use in review of the work.

F. Operating Instructions, Charts:

1. Furnish manufacturer's printed operating and maintenance instruction for equipment and systems, which, in opinion of Architect/Engineer, require such instructions; obtain receipt for it.

G. When so specified or instructed, mount operating instructions in approved frame with glass over; locate where directed.

1.11 GENERAL INSTALLATION

A. Lines and Grades:
1. Construct work in conformity with lines and grades as indicated, using axis lines and bench marks provided under General Construction; verify such axis lines and bench marks.
2. Axis lines within building will be so spaced on each floor level that plumbing work may be laid out with tape measure having length of 50 feet maximum.
3. Bench marks outside building will be at accessible points on building walls, from which lines and grades required for installation of plumbing and electrical work may be set.

B. Existing Services:
   1. Active Services: When encountered in work, protect, brace and support existing active sewers, gas, piping and other services where required for proper execution of the work. If existing active services are encountered that require relocation, make request in writing for determination. Do not proceed with work until written directions are received. Do not prevent or disturb operation of active services that are to remain. Outages shall be kept to a minimum and allowed only as arranged with the Architect/Engineer.
   2. Inactive Services: When encountered in work, remove, cap, or plug inactive services.
   3. Interruption of Services: Where work makes temporary shut downs of services unavoidable, shut down at night or at such times as approved by Owner, which will cause the least interference with established operating routine. Arrange to work continuously, including overtime, if required, to assure that services will be shut down only during time actually required to make necessary connection to existing work.

C. Equipment Design and Installation:
   1. Uniformity: Unless otherwise specified, equipment or material of same type or classification, used for same purpose shall be the product of same manufacturer.
   2. Design: Equipment and accessories not specifically described or identified by manufacturer's catalog numbers shall be designed in conformity with ASME, AIEE or other applicable technical standards, be suitable for maximum working pressure and shall have neat and finished appearance.
   3. Installation: Erect equipment in neat and workmanlike manner; align, level and adjust for satisfactory operation; install so that connecting and disconnecting of piping and accessories can be made readily, and so that all parts are easily accessible for inspection, operation, maintenance and repair. Minor deviation from indicated arrangements may be made, as approved.

D. Protection of Equipment and Materials:
   1. Responsibility for care and protection of plumbing work rests with the Contractor until it has been tested and accepted.
   2. After delivery, before and after installation, protect equipment and materials against theft, injury or damage from all causes.
   3. Protect plumbing fixtures and other equipment with enamel or glaze surface, from damage, by covering and/or coating, as recommended in Bulletin, "Handling and Care of Enameled Cast Iron Plumbing Fixtures," issued by Plumbing Fixture Manufacturers Association, and as approved.

E. Adjustments:
   1. It shall be the responsibility of the Contractor to adjust properly any and all equipment and devices and to run reasonable operating tests together with more specific tests indicated in the separate sections of the specifications. If for some
reason any piece of equipment does not function satisfactorily after the first adjustments are made, the Contractor shall continue on the job until satisfactory corrections and adjustments have been made. The Contractor is responsible for the proper performance, functioning, integration, and balance of all equipment. Where tests are required by the Architect/Engineer to ascertain equipment capacities in the installed condition, it shall be the responsibility of the Contractor to run approved tests, to provide all required instruments and apparatus and to submit certified statements of test results. All such instruments shall be in proper calibration and shall meet approval of the Architect/Engineer.

F. Completeness:
   1. The Contractor shall be responsible for the absolute completeness of his work, including all adjustments and all final balancing to obtain proper operation in all respects. Balancing is in reference to proper water flow, control calibration or balancing to eliminate objectionable vibrations, noises, or surges.
   2. Each system is intended to be complete and functional in performance. All such items as piping trim, electrical work, controls, accessories, insulated condensate drains and appurtenances required shall be installed at no extra cost.

1.12 PERMITS AND FEES
   A. All building permits and their required fees, extension of utilities together with applicable meters, and all inspection fees for all plumbing work shall be arranged and paid for by the Plumbing trade involved in the particular work for which the permit is taken, and for the pertinent inspection fee for the work involved by the Contractor.

1.13 UTILITY CONNECTIONS AND INSPECTIONS
   A. Extensions:
      1. The Contractor shall provide or obtain and pay for all utility connections, utility extensions, and/or relocations and shall pay all costs and inspection fees for all work included therein.
   B. Compliance:
      1. The Contractor is required to comply in every respect with all requirements of local inspection departments, local ordinances and codes, and utility company requirements.
   C. Utilities:
      1. The Contractor shall check with the various utility companies whose services are required for this project and shall provide, complete in all respects, the required utility relocations, extensions, modifications, and/or changes.
   D. Certifications:
      1. Prior to final acceptance, the Contractor shall furnish without additional charge a certificate of acceptance from the inspection departments having jurisdiction over the work for any and all work installed under this Contract.
   E. Utility Locations and Elevations:
      1. Locations and elevations of the various utilities included within the scope of this work have been obtained from substantially reliable sources and are offered as a general guide only, without guarantee as to accuracy. The Contractor shall examine the site, shall verify to his own satisfaction the locations, elevations, and availability of all utilities and services required, and shall adequately inform
himself as to their relation to the work. The submission of bids shall be deemed evidence thereof.

F. Ordinances, Rules and Regulations:
1. All installations shall comply with applicable codes; ordinances and regulations except where drawings require a higher degree of work as indicated on the plans or specified hereinafter.

G. Installations and equipment shall comply with applicable requirements of the National Fire Protection Association, American Gas Association, Texas State Board of Insurance Underwriters, utility company, or other local, State or Federal agencies having jurisdiction. Compliance with these requirements shall be done at no additional cost to the Owner.

H. Any changes to the contract required by the aforementioned requirements shall be submitted to the Architect/Engineer in writing for approval prior to execution.

1.14 WORKMANSHIP
A. All materials and equipment shall be installed in accordance with the approved recommendation of the manufacturer, and by workmen skilled in the trade involved shall accomplish the installation.

1.15 FLAME SPREAD PROPERTIES OF MATERIALS
A. Materials and adhesives incorporated in this project shall conform to ASTM Standard E84, "Test Method of Surface Burning Characteristics of Building Materials" and NFPA 90. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc., specified for each system, and shall not exceed a smoke developed rating of 50.

1.16 ASBESTOS ABATEMENT
A. In the event the Contractor encounters at the site material reasonably believed to be asbestos which has not been abated, the Contractor shall immediately stop work in the area affected and report the condition to the Owner. If in fact the material is asbestos and the asbestos has not been abated, the Contractor shall not resume the non-asbestos-related work in the affected area until the asbestos has been abated. The abatement action may be done in two ways, as the Owner may decide. The Owner may perform the abatement by its own forces, or the Owner may contract with a third party to perform the abatement.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION
3.1 SPACE REQUIREMENTS
A. General:
1. Determine in advance of purchase that the equipment and materials proposed for installation will fit into the confines indicated, leaving adequate clearances for adjustment, repair or replacement.

B. Clearance:
1. Allow adequate space for clearance in accordance with the Code requirements and the requirements of the local inspection department.

C. Responsibility:
1. Since space requirements and equipment arrangement vary for each manufacturer, the responsibility for initial access and proper fit rests with the Contractor.

D. Review:
   1. Final arrangements of equipment to be installed shall be subject to the Architect/Engineer’s review.

E. Equipment, Spaces and Clearances:
   1. All equipment and accessories shall be new and standard models of a type that has been in satisfactory use for two (2) years. All major components of any given system shall be of the same manufacturer and shall have a manufacturer's nameplate stating address, catalog model number and capacity.

F. Materials and equipment shall be installed in accordance with manufacturers' recommendations and best standard practice for the type of work involved.

G. All equipment shall be continuously protected, using temporary shelters, etc., from dirt, dust, moisture, damage, etc., and will not be accepted otherwise. All necessary supports, frames and foundations shall be provided for all equipment.

H. The responsibility for the furnishing of the proper plumbing equipment rests entirely upon the Contractor who shall request advice and supervisory assistance from the representatives of specific manufacturers during the installation.

I. It shall be the responsibility of the Contractor that the combination of proposed equipment will fit into the allotted space shown on the plan with adequate clearances for maintenance and servicing.

J. Any apparatus, which is too large to permit access through stairways, doorways, shaft, etc., shall be delivered to the job and set in place prior to constructing the plumbing room enclosures.

K. Machinery Drive:
   1. For motor, and other power-driven equipment specified in plumbing work sections, the following shall apply:
      b. Belt Drive: Where V-belt drive is specified, design for overload as per manufacturer's recommendation for type of service intended but in any case not less than 125 percent of motor horsepower rating, of dimensions and number of belts to transmit required power with 95 percent minimum efficiency; use machined cast iron or steel sheaves designed for this type of drive; belts and sheaves shall be of same manufacture; "Gates Rubber Co., "Vulco Ropes & Sheaves," or approved equal.

L. Machinery Accessories:
   1. Lubricating Devices: Provide oil level gages, grease gun fittings for machinery bearings as recommended by machinery manufacturer; where these lubricating means are not easily accessible, extend to locations as directed. Furnish all grease gun fittings of uniform type.
   2. Sleeve Bearings: Where sleeve bearings are specified for equipment, use self-aligning type, Randall Graphite Bearings, Inc., or approved equal.
3. Belt Guards: Provide guards to enclose belt, pulleys and sheaves on belt-driven equipment. Construct of galvanized expanded or perforated sheet steel, or 1-inch mesh wire screen, in angle frame with steel angle or channel mounting supports; make guard easily removable for access to belt, pulley or sheave. Conform to codes or regulation of agencies having jurisdiction. Paint prime and finish coats as directed.

4. Guard Railing: Where guard railings are required for machinery hazard protection, provide galvanized pipe railing with special railing fittings, galvanized malleable iron, Grinnell Co., Inc., Fig. 1181, or approved equal; fasten, brace as directed. Where required provide suitable hinged and latched gate. Conform to codes or regulations of agencies having jurisdiction. Paint prime and finish coats as directed.

5. Equipment Supports, Foundations, Stands: Where supports, foundations, stands, suspended platforms for machinery, tanks or vessels, and other equipment are indicated or specified in plumbing work sections, perform as follows:
   a. Design, Construction, Location
      1) Design and construct supporting structures of strength to safely withstand stresses to which they may be subjected and to distribute properly the load and impact over the building areas.
      2) Conform to applicable technical societies' standards, also to codes and regulations of agencies having jurisdiction.
      3) Locate supports for vessels to avoid undue strain on shell and interference with pipe connections to vessel outlets.
      4) For vessels containing tubes, check support locations for clearance to pull tubes.
      5) Where saddles are indicated or specified for vessel supports, use cast iron or welded-steel saddles of curvature to fit vessel.
      6) Mount power-driven equipment on common base with driver unless otherwise indicated, specified or approved.
      7) Submit detailed shop drawings of all supports; obtain approval before fabricating or constructing.

M. Access Doors:
   1. Furnish and locate for installation under General Construction, access doors for concealed expansion joints, valves, traps, strainers, cleanouts, other parts requiring accessibility for operation and maintenance.
   2. In suspended tile ceilings, use tile in place of access door; provide in such tile a button or other means for identification and easy removal when necessary.
   3. Access door size shall be as indicated and where not indicated, make 12” x 12” minimum, or larger as directed. For acoustical ceilings, conform to Architect/Engineer panel pattern.
   4. Unless otherwise indicated, access doors shall be hinged flush type steel framed panel, 12 gage minimum for door, 14 gage minimum for frame, with anchor straps; only narrow border shall be exposed, preferably only thickness of frame. For tile walls, provide stainless steel access doors.
5. Hinges shall be concealed type; locking devices shall be flush cam type, screwdriver operated. Access doors and frames shall have prime coat of rust inhibiting paint.

3.2 RELATED ELECTRICAL PROVISIONS

A. Electrical Contractor To Provide:
   1. Line Voltage and hook-up to all Plumbing (Division 22) Equipment

B. Plumbing Contractor to Provide:
   1. All motor starters (with heaters as required).
   2. All Plumbing Equipment.
   3. All relays, contactors, and switches required to start/stop Plumbing Equipment other than switches shown on and required by Division 26.

C. The Electrical plans are based on the equipment and devices scheduled shown on the drawings or as called for in the specifications. Should any plumbing equipment or device associated devices be changed or accepted from those which are shown or noted, all electrical and/or plumbing changes shall be made at the expense of the trade or contractor initiating the change with no expense to the Owner, Engineer or their representatives.

D. All conduit and boxes for thermostats and/or sensors shall be provided by electrical contractor.

E. General:
   1. All electrical equipment, control components and circuits not specifically covered herein shall conform to the requirements in Division 26, Electrical.

F. Motor driven equipment and its installation shall be provided complete with motors, wiring, motor starters, interlocks, and operating and/or safety controls. Their electrical characteristics shall conform to that indicated. Motor starters shall be provided complete with properly sized thermal-overload protection in all phases and other appurtenances necessary for motor control. Motors shall be of adequate size to drive equipment at specified capacity without exceeding nameplate rating of the motor.

G. Such items as electric control, motors, relays, thermostats, terminal or limiting switches on equipment, etc., shall be furnished as part of the equipment involved. All of these electrical controls, interlocks, and devices shall be installed and wired into the system to conform to Division 26. They shall be complete with all required conduit, condulets, boxes, wire, grounds, power disconnect switches, etc. The electrical trades doing Division 26 work shall provide all power wiring of 115 volt or higher including interlocks. All control wiring shall be the responsibility of the plumbing trades, who shall furnish all wiring and diagrams.

H. Motors:
   1. Except where otherwise specified or indicated for motors in plumbing and electrical work sections, the following shall govern:
      a. Motors 1/2 - horsepower and smaller shall be single phase, 115 - volt; 3/4 - horsepower and larger shall be three phase; exceptions will be made, as approved, in case of fractional horsepower motor-driven equipment units furnished by manufacturer with integral motor to suit this standard design.
      b. Single-phase motors shall be capacitor-start, split-phase or shaded- pole type, as approved for individual application.
I. Polyphase motors shall be squirrel-cage induction, or wound-rotor induction type, of NEMA Design B, according to starting torque and current characteristics, as approved for individual application. Motors with variable frequency drives shall have insulation rated for that service.

J. Where motor type, horsepower, speed, or other essential data are not specified in detailed specification of individual equipment unit or indicated on schedules, obtain this information from manufacturer of equipment unit and have it approved before ordering motors.

K. Manufacture:
   1. Motors furnished under plumbing and electrical work shall not be the product of more than two manufacturers. Exceptions will be made as approved, in cases of fractional horsepower motor, or when motor is furnished integral with driven equipment unit as manufacturer's standard.

L. Design, Performance:
   1. NEMA standards shall be taken as minimum requirements for motor design and performance, except where otherwise specified.

M. Motors shall be suitable for load, duty, voltage, frequency and hazard, for service and location intended.

N. NEMA classification of motor enclosures shall apply when motor types are specified as open, drip proof, splash proof, totally enclosed and the like.

O. Motors shall have ball or roller type bearings with pressure grease lubrication; exceptions will be made, as approved, in special cases for sleeve type bearings with approved method of oil lubrication.

P. Motors shall be quiet operating.

Q. Motors shall be rated for continuous duty and under full load; maximum rise in temperature shall not exceed current standards.

R. Motors shall be capable of withstanding momentary overloads of 50 percent, without injurious overheating.

S. Motors for belt drive shall have adjustable bases with set screws to maintain belt tension; motors for direct drive with coupling shall be doweled to base plate at two points.

T. Motors shall have nameplates giving manufacturer's name, shop number, horsepower, rpm, and current characteristics.

U. Motor Tests:
   1. For motors 75 - horsepower or smaller, check tests against complete tests of similar motor will be accepted; for motors over 75 - horsepower, make complete test for each motor furnished and submit certified test data sheets for approval.

   2. Test for following:
      a. Determine motor load performance in accordance with ANSI Standard C-50, for insulation resistance, dielectric strength, efficiency, and power factor and temperature rise.
      b. Determine efficiency and power factor for 50 percent, 75 percent and 100 percent of rated horsepower; for motors 100 horsepower and larger, include also 125 percent rating.
      c. Perform temperature-rise test at rated horsepower for rated time interval or until temperature becomes constant.
V. Motor Starters:

1. System Description
   a. Single Phase Starter: Starters for 115VAC single phase motors less than 1 HP shall be capable of both manual and automatic operation. Refer to Section V.2 for single phase starter requirements.
   b. Combination Starters: Provide combination magnetic starters for all motors requiring branch circuit protection or a line-of-sight disconnect. Refer to Section W.3 for combination magnetic starter requirements.

2. Enclosed Full Voltage Non-Reversing (FVNR) Single Phase Starter
   a. Single Phase Motor Starter Control: The single phase motor starter shall consist of a manually operated quick-make toggle mechanism lockable in the “Off” position which shall also function as the motor disconnect. Additionally, the starter shall provide thermal overload protection, run status pilot light and fault pilot light. The starter must include the capability to operate in both manual and automatic control modes. In automatic mode, the starter shall have the capability to integrate with a building automation system by providing terminals for run input, run status output and fault output. All control terminals shall be integrated in the starter. At a minimum, each single phase starter shall include an interposing run relay and current sensing status output relay. Single phase motor starter shall be in a surface mount enclosure.
   b. Approved manufacturer: Franklin Control Systems.

3. Enclosed Full Voltage Non-Reversing (FVNR) Combination Starter.
   a. Magnetic Motor Starters with disconnects shall be enclosed in a general purpose electrical enclosure with the appropriate environmental rating. NEMA 1 for indoor installation and NEMA 3R for outdoor installation.
   b. Starters shall consist of a horsepower rated magnetic contactor with a minimum of 2NO and 2NC auxiliary contacts and solid state electronic overload relay.
   c. Overload relay shall protect all three phases with a wide range 1-40 amp current setting and trip class to allow field adjustment for specific motor FLA. Interchangeable heater elements are not acceptable.
   d. Overload relay shall incorporate SmartStart Technology, or the following protective functions:
      1) Out of calibration protection (if the FLA on the overload is set outside acceptable range, overload will trip to indicate fault event)
      2) Stall protection
      3) Max time to start
      4) Locked Rotor
      5) Phase Unbalance
      6) Phase loss
      7) Cycle Fault
e. Starter shall be field selectable for manual or auto reset to restore normal operation after a trip or fault condition. Manual pushbutton shall be accessible without removing or opening cover on starter.

f. In the event of a power failure, starter shall restart in last mode by default. Starter shall also be capable of restart with 10 second delay, or restart in “off” mode.

g. All starters must be provided with a universal power supply capable of a 208 to 600 volt input range. The power supply must accept the available line voltage and the control voltage shall not exceed 24V.

h. Installed accessories shall include Hand-Off-Auto operation pushbutton keypad. Include LED pilot light indicators for Hand, Off, Auto, Run and Overload conditions.

i. The starter shall include remote run terminals which accept both a voltage input signal and a contact closure. The voltage run input shall accept both AC and DC signals from 12-250V to allow direct connection of the transistorized automation signal to the starter.

j. Starter must contain an integral current sensor with NO contact which closes to indicate motor run status as well as a NO contact which closes when an overload trip condition occurs.

k. The starter must provide a voltage output to operate the actuator to open the damper or valve without closing the motor circuit. The starter will only close the motor circuit and start the motor after it has received a contact closure from a limit or end switch confirming the damper or valve position.

l. The starter shall include a dedicated voltage input for Fireman’s Override operation. When activated, the starter run the motor in any mode (Hand, Off or Auto) regardless of other inputs or lack of inputs either manual or auto. The purpose of the Fireman’s Override input is to act as a smoke purge function. Fireman’s Override has priority over the Emergency Shutdown input.

m. The starter shall include an Emergency Shutdown input which will disable the starter from operating in either Hand or Auto mode regardless of other inputs either manual or auto.

n. Manufacturer shall provide and install tags with engraved white lettering to designate equipment served

o. All disconnects shall include a lock-out mechanism when in the off position.

p. Motor circuit protectors (MCP) shall be provided as the acceptable form of disconnecting means. The MCP shall be a UL listed 508 current limiting manual motor starter with magnetic trip elements only. The MCP shall carry a UL 508F rating (up to 100A frame size) which provides for coordinated short circuit rating for use with the motor contactor and provides a minimum interrupting rating of 30,000 AIC for the combination starter.

q. Approved manufacturer: Franklin Control Systems.

W. Motor Control Enclosure for individual Motor:
1. Enclosure shall be furnished by manufacturer of control devices, of size and design to suit each application; with operating and resetting device operable from outside; hinged door with padlock; NEMA Type 1 for general purpose indoor application, other types for special applications, as approved.

X. Automatic Alternating Devices:
1. Where alternating devices are specified for duplex pumping units, furnish device, which will automatically alternate the cycle of operation.
2. Automatic alternator shall be Square D Co., Class 9039 in separate enclosure, or in common enclosure with specified starter and disconnect means, Class 8541, or approved equal.
3. Mechanical alternator for duplex unit with common tank shall be Square D Co., Class 9038 or approved equal.

Y. Alarm Audible Signal Device:
1. Where alarm bell or gong is specified, furnish 4 - inch, 6 - inch or 10 -inch heavy duty vibrating bell, for 24-volt or 115 - volt alternating current; Edwards Co., "Adaptable" No. 340, or approved equal.
2. Where size is not specified, furnish 10-inch sized for boiler room, 6-inch or 4-inch in other locations as approved.

Z. For outdoor installation, mount bell in weatherproof box Edwards Co., No. 348 or 349.

AA. Motor Control Enclosure for individual Motor:
1. Enclosure shall be furnished by manufacturer of control devices, of size and design to suit each application; with operating and resetting device operable from outside; hinged door with padlock; NEMA Type 1 for general purpose indoor application, other types for special applications, as approved.

BB. Cleaning Piping, and Equipment:
1. Piping and equipment shall be thoroughly cleaned of dirt, cuttings and other foreign substances. Should any pipe, or other part of the systems be stopped by any foreign matter, disconnect, clean and reconnect wherever necessary for purpose of locating and removing obstructions. Repair work damaged in the course of removing obstructions.

3.3 EXCAVATION, BACKFILLING, AND CUTTING
A. Boring, excavating, backfilling and cutting shall not be undertaken without receiving approval of the Architect/Engineer before starting same. Cutting through masonry on concrete shall be made with masonry saws or core drills. This approval is required where the work may interfere with the work of other trades or where it may weaken the structure in any way.

B. Excavation:
1. All excavation of every description and of whatever substances encountered, to the depth indicated on the drawings and/or required for the installation of piping, utility system, etc., shall be performed. All exterior lines shall be installed with a minimum cover of 24 inches unless otherwise indicated. Concrete encase all sewer lines under streets with less than 30 inches of cover. Generally, more cover shall be provided if grade will permit. All excavated materials not required for backfill or fill shall be removed and wasted as acceptable to the Architect/Engineer. All grading in the vicinity of excavations shall be controlled to prevent surface ground water from flowing into the excavation. During excavation, material suitable for backfilling shall be stacked in an orderly manner.
sufficient distance back from edges of trenches to avoid overloading and prevent slide or cave-ins. Any water accumulated in the excavations shall be removed by pumping or other approved method. All shoring and sheeting required to perform and protect the excavations and to safeguard employees shall be performed. Excavate as required under the building in order that all piping, ductwork, etc. shall clear the ground a minimum of 12 inches for a distance of 24 inches on either side. Edges of such excavation shall slope at an angle of not over 45 degrees with the horizontal unless otherwise approved by the Architect/Engineer. The bottom of such excavation shall be graded to drain in a manner acceptable to the Architect/Engineer.

C. Backfilling:
   1. The trenches shall not be backfilled until all required tests are performed and until the piping, conduits, utilities systems, etc., as installed, conform to the specified requirements. The trenches shall be carefully backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel, soft shale, or other approved materials free from larger clods of earth or stone, deposited in thoroughly and carefully rammed 6 inch layers, until the pipe has a cover of not less than 1 foot. The remainder of the material shall be backfilled after moistening and then tamped in place using 1-foot layers. Blasted rock, broken concrete or pavement, and large boulders shall not be used as backfill material. Any trenches improperly backfilled, or where settlement occurs, shall be reopened to the depth required for proper compaction, be refilled and mounded over and smoothed off. Unless otherwise indicated open trenches across roadways or other areas to be paved shall be backfilled as specified above, except that entire depth of trench shall be backfilled in 6 inch layers, each layer moistened and compacted to a density at least equal to that of the adjacent level in such manner as to permit the rolling and compaction of the filled trench together with the adjoining earth to provide the required bearing value, so that paving of the area can proceed immediately after backfilling is completed. Where an area has been prepared for pavement prior to excavation, backfill shall be of such materials and installed as to comply with the paving requirements for preparation of subgrade and stabilized base courses as specified in other sections of the specifications. Along all other portions of the trenches, the ground shall be graded to a reasonable uniformity and the mounding over the trenches left in a uniform and neat condition. Backfill under concrete slab on fill shall be as specified above, shall be select fill, or shall be such other materials more suitable for the application. Installation and compaction shall be as required for compatibility with adjacent materials.

D. Opening and Closing Pavement and Lawns:
   1. Where excavation requires the opening of existing walks, streets, drives, other existing pavement or lawns, such surfaces shall be cut as required to install new lines and to make new connections to existing lines. The sizes of the cut shall be held to minimum, consistent with the work to be accomplished. After the installation of the new work is completed and the excavation has been backfilled, paved areas shall be reinstalled to match existing paving and lawn areas shall be re-sodded.

3.4 CONCRETE WORK
A. Where concrete work is indicated or specified under plumbing work, as for foundations, piers, pedestals, tank encasement, cradles or saddles for tanks or pipes, manholes, pits, and catch basins, perform as follows:

1. Concrete Strength:
   a. Concrete shall have compressive strength after 28 days of 2,200 pounds per square inch minimum.
   b. Concrete mix shall consist of one part Portland cement to 4-1/2 parts by volume of fine and coarse aggregate in dry state, with 7-1/2 gallons water maximum per sack of cement.
   c. Portland cement shall be as per ASTM C 150, Type 1.
   d. Concrete aggregate shall be as per ASTM C 33.
   e. Water shall be clear, of quality suitable for domestic consumption.

3.5 TESTS

A. Following requirements are supplementary to tests specified for individual equipment or systems in plumbing work sections.

B. Notice of Tests:
   1. Give written notice in ample time to all concerned of date when tests will be conducted.

C. Prior Tests:
   1. Concealed or insulated work shall remain uncovered until required tests have been completed, but if construction schedule requires it, arrange for prior tests on parts of system as approved.

D. Preliminary Tests:
   1. As soon as conditions permit, conduct preliminary or "turn-over" test of certain equipment as directed, to ascertain compliance with specified requirements. Make needed changes, adjustments or replacements as preliminary tests may indicate, prior to acceptance test.

E. Acceptance Tests:
   1. Conduct pressure, performance and operating tests as specified for each system or equipment unit, in presence of Architect/Engineer or other accredited representative of Owner, as well as representatives of agencies having jurisdiction. The Contractor shall correct all deficiencies resulting from test data and from deficiencies identified at times of site observations.

F. Costs:
   1. Furnish labor, material, and instruments and bear other costs in connection with all tests.

G. Record Report Copies:
   1. Provide a copy of all test reports in Operations and Maintenance manual.

3.6 GUARANTEES

A. All work, including plumbing, equipment, and materials, shall be guaranteed by the Contractor for a period of one (1) year after final acceptance of the work. All defects in labor and materials occurring during the one year after final acceptance of the work shall be immediately repaired or replaced by the Contractor at no additional cost to the owner.
3.7 CERTIFICATION
A. Certification shall be furnished by the authorized manufacturer's representative stating equipment is installed in accordance with the manufacturer's recommendation and is eligible for specified warranties. Include in Operations and Maintenance manual.

3.8 OPERATING INSTRUCTIONS
A. The Contractor shall turn over the following to the Owner at completion of contract.
   1. Operating instructions together with wiring diagrams.
   2. Approved drawings, equipment submittals, as-built control diagrams, etc.
   3. All equipment guarantees and warranties together with instructions shipped with equipment.
   4. Parts list of all major items of equipment.
   5. Test reports.
   6. All above items shall be "punched" and bound in a loose-leaf notebook.

END OF SECTION
SECTION 22 05 17
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Sleeves.
      2. Sleeve-seal systems.

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

1.3 ACTION SUBMITTALS
   A. Product Data:
      1. For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES
   A. Galvanized-Steel-Pipe Sleeves:
      1. ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
   B. Galvanized-Steel-Sheet Sleeves:
      1. 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS
   A. Manufacturers:
      1. Subject to compliance with requirements, provide products by one of the following:
         a. Metraflex Company.
         b. Pipeline Seal and Insulator, Inc.
         c. Proco Products, Inc.
   B. Description:
      1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
      2. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
      3. Pressure Plates: Stainless steel.
      4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION
   A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and
walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
   2. Cut sleeves to length for mounting flush with both surfaces.
   3. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07.

E. Fire-Barrier Penetrations:
   1. Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Firestopping materials installation shall be performed under work of Division 07 and not as work of this Section. Coordinate requirements as required.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. All exterior wall, concrete slabs-on-grade, and concrete slabs above grade:
      a. Piping, all sizes: Galvanized-steel-pipe sleeves.
   2. Interior Partitions:
      a. Piping, all sizes: Galvanized-steel-sheet sleeves.

END OF SECTION
SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pipe hangers and supports.
   2. Hanger rods.
   3. Flashing.
   4. Formed steel channel.
   5. Firestopping relating to plumbing work.
   6. Firestopping accessories.
   7. Equipment bases and supports.

1.2 RELATED DOCUMENTS

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

1.3 REFERENCES

A. ASTM International:

B. American Welding Society:
   1. AWS D1.1 - Structural Welding Code - Steel.

C. FM Global:

D. Manufacturers Standardization Society of the Valve and Fittings Industry:
   1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
   2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
   3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

E. Underwriters Laboratories Inc.:
   3. UL 1479 - Fire Tests of Through-Penetration Firestops.
   5. UL - Fire Resistance Directory.
F. Intertek Testing Services (Warnock Hersey Listed):
   1. WH - Certification Listings.

1.4 DEFINITIONS

A. Firestopping (Through-Penetration Protection System):
   1. Sealing or stuffing material or assembly placed in spaces between and
      penetrations through building materials to arrest movement of fire, smoke, heat,
      and hot gases through fire rated construction.

1.5 SYSTEM DESCRIPTION

A. Firestopping Materials:
   1. ASTM E814 to achieve fire ratings as noted on Drawings for adjacent
      construction, but not less than 1 hour fire rating.
   2. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire
      rated assemblies unless otherwise required by applicable codes.
   3. ASTM E814 to achieve fire ratings of adjacent construction.

B. Firestop interruptions to fire rated assemblies, materials, and components.

1.6 PERFORMANCE REQUIREMENTS

A. Firestopping:
   1. Conform to applicable code for fire resistance ratings and surface burning
      characteristics.
   2. Provide certificate of compliance from authority having jurisdiction indicating
      approval of materials used.

1.7 SUBMITTALS

A. Shop Drawings:
   1. Indicate system layout with location including critical dimensions, sizes, and pipe
      hanger and support locations and detail of trapeze hangers.

B. Product Data:
   1. Hangers and Supports: Submit manufacturers catalog data including load
      capacity.
   2. Firestopping: Submit data on product characteristics, performance and limitation
      criteria.

C. Manufacturer's Installation Instructions:
   1. Hangers and Supports: Submit special procedures and assembly of components.
   2. Firestopping: Submit preparation and installation instructions.

1.8 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies:
   1. ASTM E814 with 0.10 inch water gage minimum positive pressure differential to
      achieve fire F-Ratings and temperature T-Ratings of not less than 1-hour.
   2. Wall Penetrations: Fire F-Ratings not less than 1-hour.
3. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings of not less than 1-hour.
4. Floor Penetrations within Wall Cavities: T-Rating is not required.

B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies:
   1. Materials to resist free passage of flame and products of combustion.
   3. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Surface Burning Characteristics:
   1. Maximum 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.

D. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

1.9 QUALIFICATIONS

A. Manufacturer:
   1. Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer:
   1. Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

1.12 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.13 WARRANTY

A. Furnish five year manufacturer warranty for pipe hangers and supports.
PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Plumbing Piping - DWV:
1. Conform to MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or Carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
8. Floor/Roof Support: Miro Model 3-RAH or approved equivalent.
9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.

B. Plumbing Piping – Water:
1. Conform to MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.

2.2 ACCESSORIES

A. Hanger Rods:
1. Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 FLASHING

A. Metal Flashing: 26 gage thick galvanized steel.
B. Metal Counterflashing: 22 gage thick galvanized steel.
C. Lead Flashing:
1. Waterproofing: 5 lb./sq. ft sheet lead.
D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
E. Caps:
1. Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.4 FORMED STEEL CHANNEL
A. Product Description:
   1. Galvanized, 12 gage thick steel. With holes 1-1/2 inches on center.

2.5 FIRESTOPPING

A. Product Description:
   1. Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
      a. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
      b. Foam Firestopping Compounds: Single component foam compound.
      c. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
      d. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
      e. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
      f. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
      g. Firestop Pillows: Formed mineral fiber pillows.

B. Color: Black

2.6 FIRESTOPPING ACCESSORIES

A. Primer:
   1. Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:
   1. Mineral fiberboard.
   3. Sheet metal.

C. Installation Accessories:
   1. Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:
   1. Furnish UL listed products.
   2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:
   1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
   2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.
B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
B. Remove incompatible materials affecting bond.
C. Install backing damming materials to arrest liquid material leakage.
D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
E. Do not drill or cut structural members.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install in accordance with MSS SP 58, MSS SP 69 and MSS SP 89.
B. Support horizontal piping as scheduled.
C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
D. Place hangers within 12 inches of each horizontal elbow.
E. Use hangers with 1-1/2 inch minimum vertical adjustment.
F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
I. Support riser piping independently of connected horizontal piping.
J. Provide copper plated hangers and supports for copper piping.
K. Design hangers for pipe movement without disengagement of supported pipe.
L. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
M. Provide clearance in hangers and from structure and other equipment for installation of insulation.

3.4 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 INSTALLATION - FLASHING

A. Provide flexible flashing and metal counterflushing where piping penetrates weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

D. Seal floor and mop sink drains watertight to adjacent materials.

E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

D. Compress fibere material to maximum 40 percent of its uncompressed size.

E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

F. Place intumescent coating in sufficient coats to achieve rating required.
G. Fire Rated Surface:
1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
   a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
   b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
   c. Pack void with backing material.
   d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
2. Where cable tray, bus, cable bus, conduit, wireway, trough penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

H. Non-Rated Surfaces:
1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
   a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
   b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
   c. Install type of firestopping material recommended by manufacturer.
2. Install escutcheons, floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
4. Interior partitions: Seal pipe penetrations at computer rooms, telecommunication rooms, data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.7 FIELD QUALITY CONTROL
   A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING
   A. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK
   A. Protect adjacent surfaces from damage by material installation.
### 3.10 SCHEDULES

<table>
<thead>
<tr>
<th>PIPE MATERIAL</th>
<th>MAXIMUM HANGER SPACING</th>
<th>HANGER ROD DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Feet</td>
<td>Inches</td>
</tr>
<tr>
<td>Cast Iron (All Sizes)</td>
<td>5</td>
<td>5/8</td>
</tr>
<tr>
<td>Cast Iron (All Sizes) with 10 foot length of pipe</td>
<td>10</td>
<td>5/8</td>
</tr>
<tr>
<td>Copper Tube, 1-1/4 inches and smaller</td>
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<td>1/2</td>
</tr>
<tr>
<td>Copper Tube, 1-1/2 inches and larger</td>
<td>10</td>
<td>1/2</td>
</tr>
<tr>
<td>PVC (All Sizes)</td>
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<td>3/8</td>
</tr>
<tr>
<td>Steel, 3 inches and smaller</td>
<td>12</td>
<td>1/2</td>
</tr>
<tr>
<td>Steel, 4 inches and larger</td>
<td>12</td>
<td>5/8</td>
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</table>

END OF SECTION
SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Nameplates.
   2. Pipe markers.
   3. Ceiling tacks.

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

1.3 REFERENCES
A. American Society of Mechanical Engineers:
B. National Fire Protection Association:
   1. NFPA 99.

1.4 SUBMITTALS
A. Product Data: Submit manufacturers catalog literature for each product required.
B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for plumbing identification.
C. Manufacturer’s Installation Instructions: Indicate installation instructions, special procedures, and installation.
D. Manufacturer’s Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS
A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE
A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
B. Maintain one copy of each document on site.

1.7 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS
A. Convene minimum one week prior to commencing work of this section.
1.9 FIELD MEASUREMENTS
A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 NAMEPLATES
A. Product Description:
   1. Laminated three-layer plastic with engraved white letters on black contrasting background color.

2.2 PIPE MARKERS
A. Color and Lettering:
B. Plastic Tape Pipe Markers:
   1. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Provide continuous banding tape with directional arrows around circumference at each end of markers.

2.3 CEILING TACKS
C. Description:
   1. Steel with 3/4 inch diameter color-coded head.
D. Color code as follows:
   1. HVAC equipment: Yellow.
   2. Fire dampers/smoke dampers: Red.
   3. Plumbing valves: Green.

PART 3 - EXECUTION

3.1 PREPARATION
A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION
A. Install identifying devices after completion of coverings and painting.
B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
C. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
D. Identify water heaters, pumps, tanks, and water treatment devices with plastic nameplates.
E. Identify control panels and major control components outside panels with plastic nameplates.
F. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
G. Stenciled identification is not acceptable for identifying any piping or equipment.
H. Provide ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION
SECTION 22 07 00

PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Plumbing piping insulation, jackets and accessories.

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

1.3 REFERENCES
   A. ASTM International:
      1. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel
         Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General
         Applications.
      2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet
         and Plate.
         Cement.
         Thermal Insulating and Finishing Cement.
      5. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting
         Covers for NPS Piping, and Vessel Lagging.
      6. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric
         Cellular Thermal Insulation in Sheet and Tubular Form.
         Insulation for Commercial and Industrial Applications.
      9. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal
         Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
     10. ASTM C612 - Standard Specification for Mineral Fiber Block and Board
         Thermal Insulation.
     11. ASTM C921 - Standard Practice for Determining the Properties of Jacketing
         Materials for Thermal Insulation.
     12. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor
         Retarders for Thermal Insulation.
         Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
     14. ASTM E84 - Standard Test Method for Surface Burning Characteristics of
         Building Materials.
1.4 SUBMITTALS
A. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
B. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE
A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.
B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
D. Maintain one copy of each document on site.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS
A. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.9 ENVIRONMENTAL REQUIREMENTS
A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
B. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.10 FIELD MEASUREMENTS
A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 PIPE INSULATION
A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation.
1. Thermal Conductivity: 0.23 at 75 degrees F.
2. Operating Temperature Range: 0 to 850 degrees F
3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied all service jacket (ASJ) with self-sealing adhesive joints.
4. Jacket Temperature Limit: minus 20 to 150 degrees F

2.2 PIPE INSULATION JACKETS
A. Vapor Retarder Jacket:
   1. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.
B. PVC Plastic Pipe Jacket:
   1. Product Description: ASTM D1785, One piece molded type fitting covers and sheet material, off-white color.
   2. Thickness: 10 mil
C. Aluminum Pipe Jacket:
   1. ASTM B209.
   2. Thickness: 0.020 inch thick sheet.
   5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
   6. Metal Jacket Bands: 1/2 inch wide; 0.015 inch thick aluminum. 0.020 inch thick stainless steel.

2.3 PIPE INSULATION ACCESSORIES
A. Vapor Retarder Lap Adhesive: Compatible with insulation.
B. Covering Adhesive Mastic: Compatible with insulation.
C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.
D. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.
E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
F. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.
G. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.
H. Adhesives: Compatible with insulation.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify piping has been tested before applying insulation materials.
B. Verify surfaces are clean and dry, with foreign material removed.
3.2 INSTALLATION - PIPING SYSTEMS

A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.

B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Division 07 for penetrations of assemblies with fire resistance rating greater than one hour.

C. Piping Systems Conveying Fluids Below Ambient Temperature:
   1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
   2. Furnish factory-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
   3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.

D. Hot Piping Systems less than 140 degrees F:
   1. Furnish factory-applied vapor retarder jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
   3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.

E. Inserts and Shields:
   1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
   2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
      a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
      b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
   3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.

F. Insulated Piping Exterior to Building:
   1. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o’clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.
3.3 SCHEDULES

A. Water Supply Services Piping Insulation Schedule:

<table>
<thead>
<tr>
<th>PIPING SYSTEM</th>
<th>INSULATION TYPE</th>
<th>PIPE SIZE</th>
<th>INSULATION THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Hot Water Supply and Recirculation</td>
<td>P-1</td>
<td>1-1/4 inches and smaller</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-1/2 inches and larger</td>
<td>1.5</td>
</tr>
<tr>
<td>Domestic Cold Water (where exposed to ambient conditions)</td>
<td>P-1</td>
<td>1-1/4 inches and smaller</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-1/2 inches and larger</td>
<td>1.0</td>
</tr>
</tbody>
</table>

B. Drainage Services Piping Insulation Schedule:

<table>
<thead>
<tr>
<th>PIPING SYSTEM</th>
<th>INSULATION TYPE</th>
<th>PIPE SIZE</th>
<th>INSULATION THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm/Overflow Drain Piping</td>
<td>P-1</td>
<td>All sizes</td>
<td>1.0</td>
</tr>
</tbody>
</table>

C. Drainage Services Piping within Plenum Insulation Schedule:

<table>
<thead>
<tr>
<th>PVC PIPING SYSTEMS</th>
<th>ENCLOSURE REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC piping serving any system located within return air plenums shall be encapsulated in a listed and labeled ASTM E 84, NFPA 262 and ASTM E 136 fire barrier plenum wrap designed and rated for such use. Wrap shall be equal to 3M Fire Barrier Plenum Wrap 5A+ or equal.</td>
<td></td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 22 08 00

COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1. SUMMARY

A. The purpose of this guideline is to describe the technical requirements for the application of the Commissioning Process that will verify the Plumbing System achieves the Owner’s Project Requirements and are compliant with the Basis of Design.

B. Section Includes:
   1. Plumbing commissioning description.
   2. Plumbing commissioning responsibilities.

C. Related Sections:
   1. Section 23 08 00: HVAC systems commissioning requirements.
   2. Section 26 08 00: Electrical systems commissioning requirements.

1.2. REFERENCES

A. International Plumbing Code

B. Other codes as specified.

1.3. COMMISSIONING DESCRIPTION

A. Plumbing commissioning process includes the following tasks:
   1. Testing and startup of Plumbing equipment and systems.
   2. Equipment and system readiness checklists.
   3. Provide qualified personnel to assist in commissioning tests, including seasonal testing.
   4. Complete and endorse functional performance test checklists provided by Commissioning Authority to assure equipment and systems are fully operational and ready for functional performance testing.
   5. Provide equipment, materials, and labor necessary to correct deficiencies found during commissioning process to fulfill contract and warranty requirements.
   6. Provide operation and maintenance information and record drawings to Commissioning Authority for review verification and organization, prior to distribution.
   7. Provide assistance to Commissioning Authority to develop, edit, and document system operation descriptions.
   8. Provide training for systems specified in this Section with coordination by Commissioning Authority.

B. Equipment and Systems to Be Commissioned:
   1. Domestic heating water systems.
   2. Domestic water booster pump systems.
1.4.  COMMISSIONING SUBMITTALS
A.  Test Reports: Indicate data on system verification form for each piece of equipment and system as specified.
B.  Field Reports: Indicate deficiencies preventing completion of equipment or system verification checks equipment or system to achieve specified performance.

1.5.  CLOSEOUT SUBMITTALS
A.  Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
B.  Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.
C.  Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when necessary revisions are discovered during commissioning.

1.6.  QUALITY ASSURANCE
A.  Perform Work in accordance with specified codes and BOD.
B.  Perform Work in accordance with all governing building codes as specified in the contract documents.

1.7.  COMMISSIONING RESPONSIBILITIES
A.  Equipment or System Installer Commissioning Responsibilities:
   1.  Attend commissioning meetings.
   2.  Provide instructions and demonstrations for Owner's personnel.
   3.  Ensure subcontractors perform assigned commissioning responsibilities.
   4.  Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
   5.  Develop startup and initial checkout plan using manufacturer’s startup procedures and functional performance checklists for equipment and systems to be commissioned.
   6.  Installation Contractor, under the direction of the Construction Manager (CM), with the Commissioning Authority (CxA) observing and documenting the results, will execute the Functional Performance Testing procedures for the various systems and pieces of equipment associated with the requirements for the plumbing system.
   7.  During verification check and startup process, execute plumbing related portions of checklists for equipment and systems to be commissioned.
   8.  Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Authority.
   9.  Provide manufacturer’s representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
  10.  Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
11. Provide personnel to assist Commissioning Authority during equipment or System Readiness Checks (SRC’s) and Functional Performance Tests (FPT’s).
12. Prior to FPT’s, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.
13. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.
14. Provide factory supervised startup services for equipment and systems. Coordinate work with manufacturer and Commissioning Authority.
15. Perform verification checks and startup on equipment and systems as specified.
16. Assist Commissioning Authority in performing FPT’s on equipment and systems as specified.
17. Perform operation and maintenance training sessions scheduled by Commissioning Authority.
18. Conduct plumbing system orientation and inspection.
19. Perform training sessions to instruct Owner's personnel in hardware operation, programming, and application in accordance with commissioning plan and specifications.
20. Demonstrate system performance and operation to Commissioning Authority during functional performance tests including each mode of operation.
21. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

1.8. COMMISSIONING MEETINGS

A. Attend initial commissioning meeting and progress commissioning meetings as required by Commissioning Authority.

1.9. SCHEDULING

A. Prepare schedule indicating anticipated start dates for the following:
   1. Domestic water system.
   2. Storm water system.
   3. Waste water system.
   4. Plumbing system orientation and inspections.
   5. Operation and maintenance manual submittals.
   6. Training sessions.

B. Schedule seasonal tests of equipment and systems during peak weather conditions to observe full-load performance.

C. Schedule occupancy sensitive tests of equipment and systems during conditions of both minimum and maximum occupancy or use.

1.10. COORDINATION

A. Notify Commissioning Authority minimum of 5 days in advance of the following:
   1. Scheduled equipment and system startups.
PART 2 - PRODUCTS
Not Used.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Place plumbing systems and equipment into full operation and continue operation during each working day of commissioning.

3.2 COMMISSIONING
A. Be responsible to participate in initial and alternate peak season test of systems required to demonstrate performance.

B. Occupancy Sensitive Functional Performance Tests:
1. Test equipment and systems affected by occupancy variations at minimum and peak loads to observe system performance.
2. Participate in testing delayed beyond final completion to test performance with actual occupancy conditions.

END OF SECTION
SECTION 22 1100

FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Domestic water piping, within 5 feet of building.
   2. Domestic water piping, above grade.
   3. Unions and flanges.
   4. Valves.
   5. Pressure gages.
   6. Pressure gage taps.
   7. Thermometers.
   8. Water pressure reducing valves.
   9. Relief valves.
  10. Strainers.
  11. Hose bibs.
  13. Recessed valve boxes.
  15. Water hammer arrestors.
  17. In-line circulator pumps.

1.2 RELATED DOCUMENTS

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

1.3 REFERENCES

A. American National Standards Institute:

B. American Society of Mechanical Engineers:
   1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
   2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
   3. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
   4. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

C. American Society of Sanitary Engineering:
   1. ASSE 1010 - Performance Requirements for Water Hammer Arresters.
   2. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers.
   3. ASSE 1013 – Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
4. ASSE 1019 - Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type.
5. ASSE 5013 – Performance Requirements for Reduced Pressure Principle Backflow Preventers (RP) and Reduced Pressure Fire Protection Principle Backflow Preventers (RFP).

D. ASTM International:

E. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

F. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 67 - Butterfly Valves.
3. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
4. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
5. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
6. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.4 SUBMITTALS

A. Product Data:
1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturer's catalog information.
2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
5. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

B. Manufacturer's Certificate:
1. Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS
A. Project Record Documents:
   1. Record actual locations of valves and equipment.
B. Operation and Maintenance Data:
   1. Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.6 QUALITY ASSURANCE
A. For drinking water service, provide valves complying with NSF 61, lead-free.
B. Lead Free: All wetted surface of pipe, fittings and fixtures in potable systems shall have a weighted average lead content equal to or less than 0.25% per Safe Drinking Water Act as amended January, 4, 2014.
   1. NSF Compliance: NSF/ANSI 61 and/or NSF/ANSI 372 for valve materials for potable water service. Values for domestic water must be third party certified.
C. All pipe fittings shall be domestically manufactured (Foreign pipe will not be acceptable).

1.7 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum ten years experience.
B. Installer:
   1. Company specializing in performing Work of this section with minimum five years experience.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.
B. Provide temporary protective coating on cast iron and steel valves.
C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS
A. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS
A. Verify field measurements prior to fabrication.

1.11 EXTRA MATERIALS
A. Furnish one packing kit for each size valve, and two loose keys for outside hose bibs.

PART 2 - PRODUCTS
2.1 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING
A. Copper Tubing: ASTM B88, Type K, annealed.
2. Joints: Compression connection or Brazed, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.

2.2 DOMESTIC WATER PIPING, ABOVE GRADE
A. Copper Tubing: ASTM B88, Type L, drawn.
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints:
      a. Option #1: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.
      b. Option #2: Copper or Bronze Press-Connect Fittings:
         1) Basis-of-Design Product: Subject to compliance with requirements, provide Viega ProPress fittings or Engineer approved equal.
         2) For Type L hard copper tubing 1/2 inch to 4 inch.
         3) Housing: Copper or bronze.
         4) Smart Connect Technology.
         5) Sealing Element: EPDM.
         6) Tools: Manufacturer's special tools.
         7) Maximum 200-psig working-pressure rating at 250 deg F.

2.3 UNIONS AND FLANGES
A. Unions for Pipe 2 inches and Smaller:
   1. Copper Piping: Class 150, bronze unions with soldered.
   2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
B. Flanges for Pipe 2-1/2 inches and Larger:
   1. Copper Piping: Class 150, slip-on bronze flanges.
   2. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.4 BALL VALVES
A. Manufacturers:
   1. NIBCO, Inc.
   2. Watts.
   3. Substitutions: None permitted.
B. 2 inches and Smaller: MSS SP 110, 400 psi WOG two piece silicon bronze body, chrome plated brass ball, full port, teflon seats, blow-out proof stem, solder or threaded ends with union, lever handle or extended lever handle for insulated pipe systems.

2.5 BUTTERFLY VALVES
A. Manufacturers:
   3. NIBCO, Inc.
   5. Substitutions: Section 01 60 00 - Product Requirements.
B. 2 inches and Larger: MSS SP 67, Class 150, Class 200, Class 250.
2.6 CHECK VALVES
A. Horizontal Swing Check Valves:
1. Manufacturers:
   a. NIBCO, Inc.
   b. Watts.
   c. Substitutions: Section 01 60 00 - Product Requirements.
2. 2 inches and Smaller: MSS SP 80, Class 150, silicon bronze body and cap, silicon bronze seat, Buna-N disc, solder or threaded ends.

2.7 PRESSURE GAUGES
A. Manufacturers:
1. Trerice.
2. Weksler.
3. Weiss.
4. Substitutions: None permitted.
B. Gage: ASME B40.1, UL 393 UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
   2. Bourdon Tube: Brass.
   3. Dial Size: 2 inch diameter.
   4. Mid-Scale Accuracy: Two percent.
   5. Scale: PSI.

2.8 PRESSURE GAGE TAPS
A. Ball Valve:
   1. Brass 1/4 inch NPT for 250 psi.
B. Pulsation Damper:
   1. Pressure snubber, brass with 1/4 inch NPT connections.

2.9 STEM TYPE THERMOMETERS
A. Manufacturers:
1. Trerice.
2. Weksler.
3. Weiss.
4. Substitutions: None permitted.
B. Thermometer: ASTM E1, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.
   1. Size: 9 inch scale.
2. Window: Clear Lexan.
4. Accuracy: 2 percent.
5. Calibration: Degrees F.

2.10 WATER PRESSURE REDUCING VALVES

A. Manufacturers:
   1. Armstrong.
   2. Taco.
   3. Watts.
   4. Substitutions: None permitted.

B. 2 inches and Larger: MSS SP 85, brass body, bronze fitted, elastomeric diaphragm and seat disc, flanged. 200 psi maximum inlet pressure and adjustable from 25 to 75 psi outlet pressure.

2.11 RELIEF VALVES

A. Manufacturers:
   1. Armstrong.
   2. Taco.
   3. Watts.
   4. Substitutions: None permitted.

   5. Pressure Relief:
      a. ANSI Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

B. Temperature and Pressure Relief:
   1. ANSI Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated temperature relief maximum 210 degrees F, capacity ASME certified and labeled.

2.12 STRAINERS

A. Manufacturers:
   1. NIBCO, Inc.
   2. Bell & Gossett.
   3. Taco.
   4. Substitutions: None permitted.

B. 2 inch and Smaller: Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

C. 1-1/2 inch to 4 inch: Class 125, flanged iron body, Y pattern with 1/16-inch stainless steel perforated screen.

2.13 HOSE BIBS

A. Manufacturers:
   1. Mifab.
   2. Watts.
   3. Zurn.
4. Substitutions: None permitted.

B. Interior:
1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with hand wheel, integral vacuum breaker in conformance with ASSE 1011.

2.14 HYDRANTS
A. Manufacturers:
1. Mifab.
2. Watts.
3. Zurn.
4. Substitutions: None permitted.

B. Wall Hydrant:
1. ASSE 1019; non-freeze, self-draining type with chrome plated lockable recessed box hose thread spout, hand wheel and integral vacuum breaker.

2.15 RECESSED VALVE BOXES
A. Refrigerator:
1. Plastic preformed rough-in box with brass valves, wheel handle, slip in style with finished cover.

2.16 BACKFLOW PREVENTERS
A. Reduced Pressure Backflow Preventers:
1. Comply with ASSE 1013.
2. Bronze body, with bronze internal parts and stainless steel springs.
3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.17 WATER HAMMER ARRESTORS
A. Manufacturers:
1. Mifab.
2. Watts.
3. Substitutions: None permitted.

B. ASSE 1010; stainless steel construction, bellows type sized in accordance with PDI WH-201.

C. Pre-charged suitable for operation in temperature range 34 to 250 degrees F and maximum 250 psi working pressure.

2.18 DIAPHRAGM-TYPE COMPRESSION TANKS
A. Manufacturers:
1. Armstrong.
2. Bell & Gossett.
3. Elbi.
4. Taco.
5. Substitutions: None permitted.

B. Construction:
1. Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

C. Accessories:
1. Pressure gage and air-charging fitting, tank drain; pre-charge to 12 psig.

2.19 IN-LINE CIRCULATOR PUMPS
A. Manufacturers:
1. Armstrong.
2. Bell & Gossett.
4. Taco.
5. Substitutions: None permitted.

B. Casing: Bronze rated for 125 psig working pressure with stainless steel rotor assembly.

C. Impeller: Bronze.

D. Shaft: Alloy steel with integral thrust collar and two, oil lubricated bronze sleeve bearings.

E. Seal: Carbon rotating against stationary ceramic seat.

F. Drive: Flexible coupling.

PART 3 - EXECUTION
3.1 PREPARATION
A. Ream pipe and tube ends. Remove burrs.
B. Remove scale and dirt, on inside and outside, before assembly.

3.2 INSTALLATION - THERMOMETERS AND GAGES
A. Install one pressure gage for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.
B. Install gage taps in piping.
C. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage.
D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
E. Provide instruments with scale ranges selected according to service with largest appropriate scale.
F. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
G. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.3 INSTALLATION - ABOVE GROUND PIPING
A. Install non-conducting dielectric connections wherever jointing dissimilar metals.
B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
C. Support piping in accordance with Section 22 05 29.
D. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
E. Group piping whenever practical at common elevations.
F. Slope piping and arrange systems to drain at low points.
G. Install press fittings in accordance with fitting manufacturer’s instructions.
H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
J. Provide access where valves and fittings are not accessible.
K. Install domestic water piping in accordance with ASME B31.9.
L. Sleeve pipes passing through partitions, walls and floors.
M. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.
N. Install unions downstream of valves and at equipment or apparatus connections.
O. Install valves with stems upright or horizontal, not inverted.
P. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
Q. Install ball valves for shut-off and to isolate equipment, parts of systems (any branch piping serving two or more fixtures), and vertical risers.
R. Install ball valves for throttling, bypass, or manual flow control services.
S. Provide spring loaded check valves on discharge of water pumps.
T. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.
U. Test backflow preventers in accordance with ASSE 5013.
V. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to toilets, urinals and showers and other fixtures as required by code.
W. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures. Fabricate same size as supply pipe or 3/4 inch minimum and minimum 18 inches long.
X. Install sleeve seals, sleeves, escutcheons and grout in accordance with Sections 22 05 00 and 22 05 17.

3.4 INSTALLATION - PUMPS
A. Install in-line circulator pumps in accordance with manufacturer’s requirements.

3.5 MAXIMUM PRESSURE
A. Provide pressure reducing valves on domestic water systems where pressures exceed 70 psi. Provide a minimum downstream pressure of 60 psi. Contractor shall obtain pressure readings at building cold water supply connection and forward pressure test findings to the Architect in written letter form prior to start of construction of interior water supply piping.
B. Pressure reducing valves shall be located exposed in mechanical rooms or (where space permits) above ceilings or in walls, with access doors of adequate size.
C. Equip all pressure reducing valves with two ball valves (for shut-off), a strainer, a pressure relief valve and two pressure gages. Relief valve discharge shall be routed to a safe point of discharge outside of building.

3.6 INSTALLATION - SERVICE CONNECTIONS
A. Provide new water service complete with pressure reducing valve, and strainer.

3.7 FIELD QUALITY CONTROL
A. Test domestic water piping system in accordance with Section 22 05 00.

3.8 CLEANING
A. Prior to starting work, verify system is complete, flushed and clean.
B. Verify pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
C. Inject disinfectant, free chlorine in liquid, powder and tablet or gas form, throughout system to obtain residual from 50 to 80 mg/L.
D. Bleed water from outlets to obtain distribution and test for disinfectant residual at minimum 15 percent of outlets.
E. Maintain disinfectant in system for 24 hours.
F. When final disinfectant residual tests less than 25 mg/L, repeat treatment.
G. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.
H. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C651.
I. The discharge chemical/water solution utilized in the sterilization process shall be discharged via the building sewer system.

END OF SECTION
SECTION 22 11 23.13
DOMESTIC-WATER PACKAGED BOOSTER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Domestic-Water packaged booster pumps.

1.3 DEFINITIONS

A. Low Voltage:
   1. As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

A. Product Data:
   1. For each product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves (including variable-speed pump curves and system curve), sequence of operation, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:
   1. For domestic water pumps to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.
C. The pumping system shall be factory tested to the job specific condition points prior to shipment.

D. The pumping package shall be certified by an approved independent testing and certification organization as being compliant with the requirements of NSF/ANSI 61 for potable drinking water and NSF-61 Annex G for low lead content.

E. Comply with pump manufacturer's written rigging instructions for handling.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with these specifications, the following manufacturers shall be acceptable:
   1. Armstrong.
   2. Bell and Gossett.
   4. Taco.
   5. Xylem/Goulds.

2.2 MANUFACTURED UNITS

A. Furnish and install as shown on the plans a Triplex Variable Speed System.

B. Manufacturer shall be listed by Underwriters Laboratories as a manufacturer of packaged pumping systems.

C. The entire pumping package shall be NSF/ANSI/NSF-61 certified for potable drinking water and NSF-61 Annex G for a wetted area, weighted average lead content =0.25%.

D. The control system shall include, as a minimum, the programmable logic station controller, variable frequency drives, a manifold mounted 4-20mA pressure transducer and any additional equipment as specified or as required to properly execute the sequence of operation.

E. System shall require only suction, discharge and drain connections and single point power connections from a service entrance disconnect.

F. All components shall be mounted and shipped as a single unit.

G. The discharge of each pump shall be fitted with a control valve appropriate for station operation. Each pump and discharge valve assembly shall also be equipped with isolation valves so that the pump can be serviced while system is still filled.
H. Pressure gauges shall be installed on the suction and discharge headers.

I. Piping shall be sized so that water velocity shall not exceed 10.0 ft/sec in either the branches or manifolds.

J. Pumps shall be protected from thermal accumulation via individual thermal relief mechanisms.

2.3 COMPONENTS

A. Variable Speed Pump Logic Controller
1. The pump controller shall be listed/recognized by and bear the label of Underwriter's Laboratory, Inc. (UL/cUL) and certified by the BACnet Testing Laboratory (BTL). The controller shall be specifically designed for packaged pressure booster applications.

2. The pump logic controller and operator interface shall be one integrated unit and shall be capable of controlling from 1-6 pumps

3. The pump logic controller shall be microcomputer based and hold its software in flash memory. On-line field modified data entries, such as stage point, alternation, serial communication, and sensor setup, as a minimum, shall be stored in non-volatile memory storage with capability to prevent accidental loss of data due to voltage surge or spike. In the event of a complete power outage, all factory preset or last saved data values remain stored and available for recall by the operator.

4. The variable speed pump controller shall function to a proven program that safeguards the pumps/system against damaging hydraulic conditions including:
   a. Motor Overload
   b. Pump Flow Surges
   c. Hunting
   d. Integral Curve Limiting Feature: The pump logic controller shall automatically protect the system from overload through frequency/current optimization.
   e. End of Curve Protection: The pump logic controller through a factory pre-programmed algorithm shall be capable of protecting the pumps from hydraulic damage due to operation beyond their published end-of-curve. This feature shall require a flow meter for activation.

5. The pump logic controller shall be capable of accepting individual analog inputs from up to 4 zone sensor/transmitters where indicated on the plans. Analog input resolution shall be 12-bit minimum, and the controller shall scan each analog input a minimum of once every 100 milliseconds. Use of a multiplexer for multiple sensor inputs is not acceptable. All sensor/transmitter inputs shall be individually wired to the pump logic controller for continuous scan and comparison function. All analog inputs shall be provided with current limit circuitry to provide short circuit protection and safeguard against incorrect wiring of sensors.

6. Hydraulic stabilization program shall utilize a proportional-integral-derivative control function. The proportional, integral and derivative values shall be user-adjustable over an infinite range. The scan and compare rate that selects the command set point and process variable signal shall be continuous and automatically set for optimum performance. Each sensor shall be scanned at least once every 100 milliseconds.
7. The pump logic controller shall be self-prompting. All messages shall be displayed in plain English. The following features shall be provided:
   a. Multi-fault memory and recall.
   b. On-screen help functions.
   c. LED pilot lights and switches.
   d. Soft-touch membrane keypad switches.
8. The variable speed pumping controller shall be provided with a user friendly operator interface complete with membrane switches and numeric keypad. Display shall be no less than four lines with each line capable of displaying up to twenty characters. The human interface panel shall display the following values:
   a. Pump On/Off Status
   b. Pump % Speed
   c. Individual Alarm Conditions
   d. Troubleshooting Diagnostics
   e. User-adjustable parameters such as alternation, PID, set points, etc.
9. An energy saving set point scheduling feature shall be provided allowing for an alternate set points for certain hours of the weekdays or weekend.
10. A data-logging feature shall be provided as a function of the pump logic controller.
   a. The Alarm log shall include the last 40 alarms with date/time stamp.
   b. The Pump data log shall display individual pump run timers and pump cycle counters.
   c. A Signal log shall be provided to display the maximum and minimum values with date/time stamps for each process variable.
11. The Logic controller shall incorporate a Flash Memory for saving and reloading customized settings. These field determined values shall be permanently retained in Flash memory for automatic reloading of the site specific setup values in the event of data corruption due to external disturbances. The Controller shall also employ a sensor setup copy feature.
12. The pump controller shall be capable of communicating with the Building Automation System (BAS) by both hard-wired and serial communications. The following communication features shall be provided to the BAS in 'hardwired' form via 4-20ma analog output signals and digital input/outputs:
   a. Remote system start/stop (dry contact supplied by BAS)
   b. General Alarm (qty. 1, relay output from pump controller)
   c. Process variable or VFD speed (qty. 1 4-20ma analog output supplied by pump controller)
   d. System on/off status (qty. 1 relay output supplied by pump controller)
13. The following communication features shall be provided to the Building Automation System via an onboard RS-485 port utilizing Johnson Controls Metasys N2, Modicon Modbus or BACnet MS/TP protocol:
   a. All sensor process variables
   b. Individual zone setpoints
   c. Individual pump failure
   d. Individual pump on/off status
   e. Individual VFD on/off status
   f. VFD speed
   g. Individual VFD Failure
   h. Individual sensor failure
14. The pump logic controller enclosure shall be NEMA 1 with NEMA 4 operator interface.
B. Variable Frequency Drive

1. The Drive shall be rated to operate from 3-phase power at 208VAC to 600VAC, +10% /-15%, 48Hz to 63Hz. The drive shall employ a full wave rectifier to prevent input line notching and operate at a fundamental (displacement) input power factor of 0.98 at all speeds and nominal load. The drive efficiency shall be 98% or better at full speed and load. An internally mounted AC line reactor or DC choke shall be provided to reduce input current harmonic content, provide protection from power line transients such as utility power factor correction capacitor switching transients and reduce RFI emissions. When a DC choke is utilized it shall be of swinging choke design to mitigate harmonics substantially more than conventional choke designs and shall provide equivalent to 5% impedance. Unit shall be the ABB ACS 550 Series manufactured by ABB Drives & Power Products.

2. The VFD, including all factory-installed options, shall have UL and cUL approval.

3. Enclosure shall be NEMA 1 ventilated for installation as a wall mounted or freestanding unit, depending on the amp rating. Drive shall be equipped with an integrated fusible disconnect switch, pad lockable in the open position for safety during maintenance, and fuses to protect against ground faults.

4. VFD shall utilize a full wave rectifier to convert three phase AC to a fixed DC voltage. Power factor shall remain above 0.98 regardless of speed or load. VFD's employing power factor correction capacitors shall not be acceptable.

5. An internal line reactor (5% impedance) shall be provided to lower harmonic distortion of the power line and to increase the fundamental power factor.

6. The VFD shall be suitable for elevations to 3300. ft above sea level without derating. Maximum operating ambient temperature rating shall not be greater than 104 deg F. VFD shall be suitable for operation in environments up to 95% non-condensing humidity.

7. The VFD shall be capable of displaying the following information in plain English via an alphanumeric display:
   a. Output Frequency
   b. Output Voltage
   c. Motor Current
   d. Kilowatts per hour
   e. Fault identification with text
   f. Percent torque
   g. Percent power
   h. RPM

8. The VFD shall have the ability to automatically restart after an over-current, overvoltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.

9. The VFD shall have three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.

10. Operator Control Panel (Keypad)
    a. Each VFD shall be equipped with a front mounted operator control panel (keypad) consisting of a backlit, alphanumeric, graphic display and a keypad with keys for Start/Stop, Local/Remote, Up/Down and Help. Two (2) Softkeys will be provided which change functionality depending upon the position within the parameter hierarchy or state of panel.
b. All parameter names, fault messages, warnings and other information shall be displayed in complete English words or Standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table.

c. The Display shall have contrast adjustment provisions to optimize viewing at any angle.

d. The control panel shall provide a real time clock for time stamping events and fault conditions.

e. The control panel shall include a feature for uploading parameter settings to control panel memory and downloading from the control panel to the same Drive or to another Drive.

f. All Drives throughout the entire power range shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating.

g. The keypad shall be able to be installed or removed from the drive while it is powered, capable of remote mounting, and shall have its own non-volatile memory.

11. Protective Functions

a. For each programmed warning and fault protection function, the Drive shall display a message in complete English words or Standard English abbreviations. The three (3) most recent fault messages along with time, current, speed, voltage, frequency and DI Status shall be stored in the Drive's fault history. The last ten (10) fault names shall be stored in Drive memory.

b. The Drive shall include internal MOV's for phase to phase and phase to ground line voltage transient protection.

c. Output short circuit withstand rating and ground fault protection rated for 100,000 AIC shall be provided per UL508C without relying on line fuses. Motor phase loss protection shall be provided.

d. The Drive shall provide electronic motor overload protection qualified per UL508C.

e. Protection shall be provided for AC line or DC bus overvoltage at 130% of maximum rated or under voltage at 65% of min. rated and input phase loss.

f. A power loss ride through feature will allow the Drive to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.

g. Output short circuit withstand rating and ground fault protection rated for 100,000 AIC shall be provided per UL508C without relying on line fuses. Motor phase loss protection shall be provided.

h. The Drive shall provide electronic motor overload protection qualified per UL508C.

i. Protection shall be provided for AC line or DC bus overvoltage at 130% of maximum rated or under-voltage at 65% of min. rated and input phase loss.

j. A power loss ride through feature will allow the Drive to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.

12. Electrical
a. Pump Logic Controller Enclosure. Main station disconnect shall have a through door operator and shall be sized as shown in the technical data sheet. Individual integrated fusible drive disconnects shall have exterior operators, and shall be sized as shown in the technical data sheet. Station disconnect panel shall be housed in a NEMA 1 enclosure with integral latches. The control enclosure shall be constructed of 14-gauge steel and the back plate assembly shall be constructed of 14-gauge steel.

b. Controls and Enclosure. The control panel with controls shall be built in accordance with NEC, and shall comply with UL standards. Pump station manufacturer shall be authorized under UL508A to manufacture its own control panels. All equipment and wiring shall be mounted within the enclosure and each device shall be labeled with proper identification. All adjustments and maintenance shall be accessible from the front of the control enclosure. A complete wiring circuit diagram and legend with terminals, components, and wiring completely identified shall be provided. Main disconnect shall be interlocked with door.

c. Station shall have a short circuit current rating (SCCR) OF 5000A

13. Sensor / Transmitters
a. Pressure transducer shall be utilized for providing all pressure signals for the pump control logic. Pressure transducer shall be a solid-state bonded strain gage type with an accuracy of < ±0.5% BFSL and constructed of 316 stainless steel. Transducer shall be rated for a pressure of 300 psi and shall provide gauge pressure output, rather than an absolute. Pressure transducer constructed of plastic is not acceptable. Pressure transducer shall be 4-20mA analog type with 10-28 VDC supply range shall utilize a packard type connector to prevent moisture intrusion and include surge protection against voltage spikes.

14. Flowmeter
a. Provide a Bell & Gossett ST-104 or equal field mounted flow sensor transmitter as indicated on the plans. Unit shall transmit an isolated 4-20 mA dc signal indicative of process variable to the pump logic controller via standard two wire 24 VDC system. Unit shall consist of an insertion probe and separately mounted transmitter. The unit shall be accurate to within 1% of flow rate from 1.0 ft/sec to 30.0 ft/sec and shall withstand a static pressure of 200.0 psi g with negligible change in output.

15. Variable Speed System Sequence of Operation
a. The system shall consist of a pump logic controller with multi-pump parallel operation control, duty-standby pump selection, automatic alternation and automatic transfer to the standby pump upon pump/VFD failure.
b. The pumping system shall start upon the closure of customer's contact when the pump logic controller Mode of Operation is in REMOTE.
c. When the pump logic controller mode in LOCAL, the pumping system shall operate automatically.
d. Each sensor/transmitter shall send a 4-20mA signal to the pump logic controller, indicative of process variable condition.
e. When the set point is satisfied by the process variable, the pump speed shall remain constant at the optimum energy consumption level.
f. The pump controller shall automatically start the lag pumps as necessary to satisfy system demand.

g. As demand is satisfied, the controller shall automatically stop lag pumps as necessary to conserve energy.

h. In the event of a pump failure or a VFD fault, the pump logic controller shall automatically initiate a timed sequence of operation to start the redundant pump/VFD set in the variable speed mode.

i. In the event of the failure of a zone sensor/transmitter, its process variable signal shall be removed from the scan/compare program. The redundant zone sensor/transmitters, if available, shall remain in the scan/compare program for control.

j. PUMP or VFD fault shall be continuously scrolled through the display on the operator interface of the pump logic controller until the fault has been corrected and the controller has been manually reset.

k. When the system is satisfied, the pump controller shall shut down the single running lead pump and enter energy saving/no flow shutdown mode.

C. Station Frame. The pump station frame shall be designed and fabricated to provide structural support for all attached equipment and provide anchor bolt support. The base shall supply sufficient rigidity to withstand the stresses of reasonable and competent transportation to site, off loading, installation, and operation.

D. All piping shall be constructed from 304 stainless steel, schedule 10 or heavier pipe as required to maintain a 3 to 1 pressure safety factor (including 0.062 in corrosion allowance).

E. Isolation ball valves.

   Isolation ball valves shall be certified to NSF-61 for use with potable drinking water.

   1. Isolation ball valves shall be certified as low lead having wetted surface area with a weighted average lead content <0.25%.

   2. Valves shall be rated for 600.0 psi g WOG / 150.0 psi g WSP for valves 0.25 in to 2.0 in and 400.0 psi g WOG / 125.0 psi g WSP for valves 2.5 in to 4.0 in.

   3. Seats and stem packing shall be virgin PTFE. Stem shall be bottom loaded blowout proof design with fluorocarbon elastomer O-ring to prevent stem leaks.

   4. Valves shall be 2-piece full port design.

F. Wafer check valves.

   1. The valve body shall be constructed of ASTM A126 Class B cast iron for Class 125/150 and Class 250/300 valves.

   2. The seat and disc shall be ASTM B584 Alloy C83600 cast bronze or ASTM B148 Alloy C95200 aluminum bronze.

   3. The compression spring shall be ASTM A313 Type 316 Stainless Steel with ground ends.

   4. Valve interiors and exteriors shall be coated with an NSF/ANSI-61 certified fusion bonded epoxy in accordance with AWWA C550.

   5. The exterior of the valve shall be coated with a universal alkyd primer.

   6. The valve design shall incorporate a center guided, spring loaded disc, guided at opposite ends and having a short linear stroke that generates a flow area equal to the nominal valve size.
7. The operation of the valve shall not be affected by the position of installation. The valve shall be capable of operating in the horizontal or vertical positions with the flow up or down.

8. All component parts shall be field replaceable without the need of special tools. A replaceable guide bushing shall be provided and held in position by the spring. The spring shall be designed to withstand 100,000 cycles without failure and provide a cracking pressure of 0.5 psi g.

9. The valve disc shall be concave to the flow direction providing for disc stabilization, maximum strength, and a minimum flow velocity to open the valve.

10. The valve disc and seat shall have a seating surface finish of 16 micro-inch or better to ensure positive seating at all pressures. The leakage rate shall not exceed the allowable rate for metal seated valves allowed by AWWA Standard C508 or 1 oz (30 ml) per hour per inch (mm) of valve diameter.

11. The valve flow way shall be contoured and unrestricted to provide full flow areas at all locations within the valve. Cv flow coefficients shall be equal to or greater than specified below and verified by an independent testing laboratory.

<table>
<thead>
<tr>
<th>VALVE SIZE (inches (mm))</th>
<th>Wafer Style Cv</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (50)</td>
<td>43</td>
</tr>
<tr>
<td>2.5 (65)</td>
<td>88</td>
</tr>
<tr>
<td>3 (80)</td>
<td>130</td>
</tr>
<tr>
<td>4 (100)</td>
<td>228</td>
</tr>
<tr>
<td>5 (125)</td>
<td>350</td>
</tr>
<tr>
<td>6 (150)</td>
<td>520</td>
</tr>
</tbody>
</table>

12. The valves shall be hydrostatically tested at 1.5 times their rated cold working pressure and seat tested at the valve CWP.

G. Pressure Gauges.
1. Gauges shall be provided for the suction and discharge manifold.
2. Accuracy shall be ±1.5%
3. Bourdon tube and connection shall be constructed of 316SS.
4. Case, bezel and internals shall be constructed of 316SS.
5. Gauge shall be filled with glycerin in order to dampen pulsation and vibration and to provide lubrication to the internal parts.
6. Gauge range shall be selected to cover the largest operating range for the specific conditions and pump selected.

H. Flange Bolts. Bolts shall be zinc plated and shall meet ASTM Grade A193 B7.

I. Paint. The finish coat shall be acrylic enamel to a thickness of no less than 3 mils.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

B. The contractor shall align the pump and motor shafts to within the manufacturer's recommended tolerances prior to system start-up.

C. Power wiring, as required, shall be the responsibility of the electrical contractor. All wiring shall be performed per manufacturer's instructions and applicable state, federal and local codes.

D. Control wiring for remote mounted switches and sensor / transmitters shall be the responsibility of the controls contractor. All wiring shall be performed per manufacturer's instructions and applicable state, federal and local codes.

E. Pump Mounting: Install pumps on concrete base using elastomeric pads. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.

A. Install piping adjacent to pumps to allow service and maintenance.

3.2 DEMONSTRATION/TRAINING

A. The system manufacturer's factory qualified representative shall be capable of providing optional start-up of the packaged pumping system. This start-up shall include verification of proper installation, system initiation, adjustment and fine tuning. Start-up shall not be considered complete until the sequence of operation, including all alarms, has been sufficiently demonstrated to the owner or owner's designated representative. This job site visit shall occur only after all hook-ups, tie-ins, and terminations have been completed and signed-off on the manufacturer's start-up request form.

B. The system manufacturer's factory qualified representative shall be capable of providing on-site training for owner's personnel. This training shall fully cover maintenance and operation of all system components.

3.3 WARRANTY

A. The manufacturer shall warrant the water pumping system to be free of defects in material and workmanship for one year (12 months) from date of authorized start-up, not to exceed
eighteen (18) months from date of manufacturer's invoice. Complete terms and conditions will be provided upon request.

3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

A. Owner start up assistance will be provided by a manufacturer qualified representative and will be limited to one 8-hour day, unless previously negotiated by the factory representative. When discharge piping, electrical connections, and electrical inspection have been completed, the pump station representative shall be contacted for start up. A minimum two-week notice shall be given to manufacturer representative prior to scheduled start up date. During start up, the complete pumping system shall be given a running test of normal start and stop, and fully loaded operating conditions. During this test, each pump shall demonstrate its ability to operate without undue vibration, or overheating, and shall demonstrate its general fitness for service. All defects shall be corrected and adjustments shall be made to the pumping station for satisfactory operation. System problems or concerns will be corrected by the general contractor or site station staff, in conjunction with the appropriate factory representative. Testing shall be repeated until satisfactory results are obtained, as determined by the engineer.

END OF SECTION
SECTION 22 1300

FACILITY SANITARY SEWERAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sanitary sewer and storm drainage piping buried within 5 feet of building.
   2. Sanitary sewer and storm drainage piping above grade.
   3. Floor drains and floor sinks.
   5. Roof drains.

1.2 RELATED DOCUMENTS

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

1.3 REFERENCES

A. ASTM International:

B. Manufacturers Standardization Society of the Valve and Fittings Industry:
   1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
   2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
   3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

Cast Iron Soil Pipe Institute:

1.4 SUBMITTALS

A. Product Data:
   1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturer’s catalog information.
   2. Sanitary and Storm Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
3. Hangers and Supports: Submit manufacturers catalog information including load capacity.

B. Manufacturer's Installation Instructions:
1. Submit installation instructions for material and equipment.

1.5 CLOSEOUT SUBMITTALS
1. Record actual locations of equipment and clean-outs.

1.6 QUALIFICATIONS
A. Manufacturer:
1. Company specializing in manufacturing products specified in this section with minimum three years’ experience.
2. Installer: Company specializing in performing Work of this section with minimum three years’ experience.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.8 FIELD MEASUREMENTS
A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 SANITARY SEWER, VENT PIPING, AND STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING AND BELOW GRADE
A. PVC Pipe:
1. ASTM D2665, polyvinyl chloride (PVC) material, bell and spigot solvent sealed ends.

2.2 SANITARY SEWER AND VENT PIPING, ABOVE GRADE
A. PVC Pipe:
1. ASTM D2665, polyvinyl chloride (PVC) material.
2. Fittings: ASTM D2665, PVC.

B. Cast Iron Pipe: CISPI 301, hub-less, service weight (Use of cast iron is allowed as a contractor option in lieu of fire wrapped pvc in return air plenums)
1. Fittings: Cast iron, CISPI 301.
2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp and shield assemblies.

2.3 STORM WATER PIPING, ABOVE GRADE
A. Cast Iron Pipe: CISPI 301, hub-less, service weight.
1. Fittings: Cast iron, CISPI 301.
2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp and shield assemblies.

2.4 FLOOR DRAINS AND FLOOR SINKS

A. Manufacturers:
   1. Mifab.
   2. Wade.
   3. Zurn.
   4. Substitutions: None permitted.

B. See schedules on drawings for further information.

2.5 CLEANOUTS

A. Manufacturers:
   1. Mifab.
   2. Wade.
   3. Zurn.
   4. Substitutions: None permitted.

B. See schedules on drawings for floor and wall cleanout requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.
B. Remove scale and dirt, on inside and outside, before assembly.
C. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION - ABOVE GROUND PIPING

A. Establish invert elevations, slopes for drainage to 1/4 inch per foot (2 percent) minimum. Maintain gradients.
B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
C. Support piping in accordance with Section 22 05 29.
D. Encase exterior cleanouts in concrete flush with grade.
E. Install floor cleanouts at elevation to accommodate finished floor.
F. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
G. Install piping to maintain headroom. Do not spread piping, conserve space.
H. Group piping whenever practical at common elevations.
I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
J. Provide clearance in hangers and from structure and other equipment for installation of insulation.
K. Install piping penetrating roofed areas to maintain integrity of roof assembly.
L. Install bell and spigot pipe with bell end upstream.
3.3 FIELD QUALITY CONTROL
A. Test sanitary waste and vent piping system in accordance with the International Plumbing code.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sump pumps.

1.2 DESIGN REQUIREMENTS

A. Design Criteria:
   1. Refer to schedule at end of this section.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:
   1. Submit installation details for pumps, piping, controls and accessories including wiring schematics.

C. Product Data: Submit data for specified Products.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.5 QUALIFICATIONS

A. Manufacturer: company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing and protecting products.

B. Prepare pumps and accessories for shipment to prevent entry of foreign matter into product body.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.
1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.8 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

PART 2 PRODUCTS

2.1 SUMP PUMPS

A. Manufacturers:
   1. Liberty.
   2. Weil.
   3. Zoeller.
   4. Substitutions: Section 01 60 00 - Product Requirements.

B. Impeller: Cast iron, semi-open, non-clog.

C. Casing: Cast iron.

D. Mechanical Seal: Silicon carbide.

E. Shaft: Stainless steel.

F. Designed for continuous operation.

G. Bearings: Upper and lower heavy duty ball bearings.

2.2 PUMP MOTORS

A. Fully submerged in high-grade turbine oil for lubrication and efficient heat transfer.

B. Power Cable: Severe duty rated, oil and water resistant, epoxy seal on motor end.

C. Built-in overload with automatic reset.

D. Class B insulation.

2.3 PUMP ACCESSORIES AND CONTROLS

A. As indicated on Drawings.
PART 3 EXECUTION

3.1 EXAMINATION
A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
B. Verify connections, size, and location are as indicated on Drawings.

3.2 INSTALLATION
A. Install sump pumps in accordance with Drawings and manufacturer’s instructions.
B. Provide necessary piping, fittings, and valves as indicated on Drawings.

3.3 FIELD QUALITY CONTROL
A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
B. Upon completion of installation, examine, adjust and test each pump for proper operation.
C. Test each pump with clean water through minimum of four complete cycles.

3.4 SCHEDULES
A. See schedule on Drawings.

END OF SECTION
SECTION 22 33 00

ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Commercial electric water heaters.

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

1.3 REFERENCES
A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
   1. ASHRAE 90.1 - Energy Standard for Buildings except Low-Rise Residential
      Buildings.
B. American Society of Mechanical Engineers:
   1. ASME PTC 25 - Pressure Relief Devices.
   2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

1.4 SUBMITTALS
A. Product Data:
   1. Submit dimensioned drawings of water heaters indicating components and
      connections to other equipment and piping. Submit electrical characteristics and
      connection locations.

1.5 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data:
   1. Submit replacement part numbers and availability.

1.6 QUALITY ASSURANCE
A. Conform to ASME Section VIII for construction of water heaters.
B. Water Heater Performance Requirements:
   1. Equipment efficiency not less than prescribed by ASHRAE 90.1.

1.7 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with
      minimum three years’ experience.
B. Installer:
   1. Company specializing in performing Work of this section with minimum three
      years’ experience.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Accept water heaters on site in original labeled cartons. Inspect for damage.
B. Protect tanks with temporary inlet and outlet caps. Maintain caps in place until
   installation.
1.9 FIELD MEASUREMENTS
   A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 COMMERCIAL ELECTRIC WATER HEATERS
   A. Manufacturers:
      1. A. O. Smith.
      2. Rheem.
      3. Rinnai.
      4. State.
      5. Substitutions: None permitted.
   B. Type:
      1. Factory-assembled and wired, electric, vertical storage.
   C. Tank:
      1. Glass lined welded steel; thermally insulated with minimum 2 inches glass fiber insulation encased in corrosion-resistant steel jacket; baked-on enamel finish.
   D. Controls:
      1. Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.
   E. Accessories:
      1. Brass water connections and dip tube drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Maintain manufacturer's recommended clearances around and over water heaters.
   B. Install water heaters as indicated on drawings.
   C. Connect piping to supply and return water heater connections.
   D. Install shut off valves on inlet and outlet of water heater.
   E. Install discharge piping from relief valves and drain valves to nearest floor drain.

END OF SECTION
SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL
1.1 SUMMARY
A. Section Includes:
   1. Protective devices.
   2. Water closets.
   3. Urinals.
   4. Lavatories.
   5. Sinks.
   6. Mop sinks.
   7. Electric drinking fountains.
   8. Fixture carriers.
   9. Lavatory insulation kits.

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

1.3 SUBMITTALS
A. Product Data:
   1. Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
B. Manufacturer's Certificate:
   1. Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data:
   1. Submit fixture, trim, exploded view and replacement parts lists.

1.5 QUALITY ASSURANCE
A. Provide products requiring electrical connections listed and classified by Underwriters Laboratories Inc., as suitable for purpose specified and indicated.
B. Provide plumbing fixture fittings in accordance with ASME A112.18.1 that prevent backflow from fixture into water distribution system.

1.6 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum three years’ experience.
B. Installer:
   1. Company specializing in performing Work of this section with minimum three years’ experience.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Accept fixtures on site in factory packaging. Inspect for damage.
B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.
PART 2 - PRODUCTS

2.1 GENERAL
A. Plumbing fixture types, manufacturer, style and other pertinent information is provided on the drawings. Alternate manufacturers from those identified on the drawings will be considered by the Engineer but must be submitted prior to bid for consideration and approval.

2.2 PROTECTIVE DEVICES
A. Approved backflow preventers shall be used to connect piping to plumbing fixtures or equipment that do not have an approved integral device for cross connection protection.
B. Reduced Pressure Principle Type:
   1. Furnish a Watts Number U-909-S-HW-QT Reduced Pressure Principle backflow preventer. Equip complete with bronze strainer, stainless steel check modules, quarter turn ball valves and integral body unions.
   2. For each backflow preventer valve, furnish a Watts 909-AG Fixed Air Gap fitting with inlet compatible with outlet of backflow preventer relief valve opening. Furnish a full size drain line from air gap fitting to floor drain or hub drain.

2.3 CHROME FINISH
A. All exposed fixture trim, including (but not limited to) p-trap, supplies, riser supports, flex tube risers, etc. shall have a polished chrome finish. Furnish all polished chrome finished nipples, extension pieces, escutcheons, etc. required to meet this requirement.

2.4 ACCEPTABLE MANUFACTURES
A. Plumbing Fixtures:
   1. Acorn
   2. American Standard
   3. Bradley
   4. Crane
   5. Guardian
   6. Kohler
   7. Sloan
   8. Zurn
B. Trim:
   1. American Standard
   2. Bradley
   3. Chicago Faucet
   4. Elkay
   5. Kohler
   6. McGuire
   7. Speakman
   8. Symmons
   9. T&S Brass
   10. Watersaver
   11. Sloan
C. Water Closet Seats:
   1. Bemis
   2. Beneke
3. Church
4. Zurn
5. Kohler
6. American Standard

D. Mop Sinks:
1. Stern-Williams
2. Zurn
3. Fiat
4. Acorn

E. Drinking Fountains:
1. Elkay
2. Halsey Taylor
3. Haws
4. Oasis
5. Sunroc.

F. Stainless Steel Sinks:
1. Elkay
2. Griffin
3. Just
4. Kohler
5. Zurn

G. Flush Valves:
1. Sloan
2. Zurn
3. Delany

H. Point-of-Use Thermostatic Mixing Valves:
1. Leonard
2. Powers
3. Symmons.

I. Carriers:
1. Zurn
2. Watts
3. Josam
4. Mifab
5. Wade
6. JR Smith

2.5 LAVATORY INSULATION KIT

A. Manufacturers:
1. McGuire Manufacturing, Inc.
2. Truebro.
3. Substitutions: As approved by Engineer prior to bid.

B. Product Description:
1. Where Lavatories are noted to be insulated for ADA compliance, furnish the following: Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick, white, for insulating tailpiece, P-trap, valves and supply piping. Furnish with weep hole and angle valve access covers.
PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify walls and floor finishes are prepared and ready for installation of fixtures.
   B. Verify electric power is available and of correct characteristics.
   C. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION
   A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION
   A. Install each fixture with trap, easily removable for servicing and cleaning.
   B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
   C. Install components level and plumb.
   D. Install thermostatic mixing valve on each fixture requiring tempered water whether indicated on the drawings or not.
   E. Install and secure fixtures in place with wall carriers and bolts.
   F. Seal fixtures to wall and floor surfaces with sealant.
   G. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.
   H. For ADA accessible water closets, install flush valve with handle to wide side of stall.

3.4 INTERFACE WITH OTHER PRODUCTS
   A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING
   A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING
   B. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION
   C. Do not permit use of fixtures before final acceptance.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Applicable provisions of General Conditions, Special Conditions, and Special Instructions to Bidders in addition to the requirements of Division One specifications govern work under this section and all of Division 23.

B. This section is in particular reference to and shall be considered a part of all Mechanical specifications sections following. It is intended that comments in this section be applicable to all parts of Division 23. Work described hereinafter shall be included as though written within each specific section of the specification.

C. The Contractor shall provide all items, articles, materials, operations, or methods listed, mentioned, or scheduled on the Drawings and/or herein, including all labor, materials, equipment, and incidentals necessary and required for their completion.

D. All work shall conform to requirements of all local construction codes, applicable sections of the National Fire Protection Association, and the Public Health Agency.

1.2 SCOPE
A. Requirements specified in this section shall govern applicable portions of all mechanical sections including paragraphs on related electrical work, whether so stated therein or not.

B. Where items specified in the specific mechanical sections conflict with requirements in this section, the specific sections shall govern.

C. The Contractor shall furnish all labor, plant, equipment, and materials, complete in connection with the installation of the heating, air conditioning, ventilating, controls, utilities and systems in strict accordance with this specification and accompanying plans. The Contractor shall submit his bid based on performing all work hereinafter specified or indicated on applicable plans. The Contractor shall furnish and install all connections and appurtenances necessary and usually furnished in connection with such work and systems even though not specifically mentioned or shown on the plans.

D. These requirements cover information, work, equipment and accessories listed under the following headings:
   1. References, Definitions, Procedures
   2. Permits and Fees
   3. Utility Connections and Inspections
   4. Workmanship

E. Work of Other Sections:
   1. Requirements given within this Section apply to the Work of all Sections of this Division.

F. Finish painting is specified in other Divisions. Prime and protective painting shall be
provided under this Division.

G. Electrical interlock apparatus and other electrical apparatus, which is not an integral part of equipment specified under this Division, are specified under Division 26. Necessary conduit, wiring, boxes, and fittings are specified under Division 26.

1.3 REFERENCES

A. References to standards, codes, specifications and recommendations shall mean the latest edition of such publications adopted and published at date of invitation to submit Proposals.

B. References to technical societies, trade organizations and governmental agencies is made in mechanical work sections in accordance with the following abbreviations:

1. AFI  Air Filter Institute
2. AGA  American Gas Association
3. AIEE  American Institute of Electrical Engineers
4. ANSI  American National Standards Institute
5. ASHRAE American Society of Heating, Refrigeration, and Air Conditioning Engineers
6. ASME  American Society of Mechanical Engineers
7. ASTM American Society for Testing and Materials
8. AWWA American Water Works Association
9. CMA  Convecter Manufactures Association
10. CSD  Commodity Standards Division U.S. Department of Commerce
11. HPACCNA Heating, Piping & Air Conditioning Contractors National Association
12. IBR Institute of Boiler & Radiator Manufacturers
13. IUHA  Industrial Unit Heater Association
14. NAFM National Association of Fan Manufacturers
15. NFPA National Fire Protection Association
16. NBS National Bureau of Standards
17. NEC National Electrical Code (NFPA Pamphlet No. 70)
18. NEMA National Electrical Manufactures Association
19. SBI Steel Boiler Institute
20. UL Underwriters' Laboratories, Inc.

1.4 DEFINITIONS

A. Definitions of terms and expressions used in mechanical work are:

1. "Provide" shall mean "furnish and install" or "furnish labor and material required for installation of."
2. "Herein" shall mean the contents of a particular section where this term appears.
3. "Indicated" shall mean "indicated on contract drawings."
4. "Section" shall mean one of the portions of mechanical work sections indexed in Division 23.
5. "Concealed" where used in connection with insulation and painting of piping,
ducts and accessories, shall mean that they are hidden from sight as in trenches, chases, furred spaces, pipe shafts or hung ceilings.

6. "Exposed" where used in connection with insulation and painting of piping, ducts, and accessories shall mean that they are not "concealed" as defined herein above.

7. "Piping" includes in addition to pipe, also fittings, valves, hangers and other accessories, which comprise a system.

B. Drawings and Instructions

1. Contract drawings for mechanical work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement of equipment, fixtures, ducts, interlocks, piping and approximate sizes and locations of equipment and outlets. Mechanical trades shall follow these drawings in laying out their work, consult other trades and general construction drawings to familiarize themselves with all conditions affecting their work, and shall verify and coordinate spaces in which their work will be installed. The contract drawings shall be considered as a part of these specifications. It is intended that any Contractor making proposal to execute any work should study the drawings for his own particular trade, as well as all drawings of all other trades in order to fully understand the work he is expected to perform. As a qualification for bidding, the contractor shall visit the site and be responsible for determining all existing conditions in as far as it affects his work prior to submitting a proposal.

1.5 DRAWINGS

A. General:

1. The Drawings are schematic in nature and indicate approximate locations of the heating, ventilating, air conditioning systems, and piping systems, except where specific locations are noted and dimensioned on the Drawings. All items are shown approximately to scale. The intent is to show how these items shall be integrated into the building. Locate all items by on-the-job measurements and in accordance with the Contract Documents. Cooperate with other trades to ensure project completion as indicated.

B. Unless otherwise expressly agreed to in writing, all rights to the specifications and drawings prepared by Alderson & Associates, Inc. shall belong to Alderson & Associates, Inc. The sole exception is that the specifications and drawings may be used for construction of the project for which the specifications and drawings were prepared if all other contractual obligations have been complied with, including the payment of fees. Each page of the drawings, if prepared in whole or in part by Alderson & Associates, Inc., and all pages of specifications of Division 23 are covered by copyright and may not be reproduced, published or used in any way without the permission of Alderson & Associates, Inc.

C. Location:

1. Prior to locating diffusers and grilles, obtain the Architect/Engineer's approval as to exact location. Locations shall not be determined by scaling drawings. Contractor shall be responsible for costs of redoing work of trades necessitated by failure to comply with this requirement.

1.6 DISCREPANCIES

A. Clarification:

1. Clarification shall be obtained before submitting a proposal for the Work under
this Division as to discrepancies or omissions from the Contract Documents or questions as to the intent thereof.

B. Contractor Agreement:

1. Consideration will not be granted for misunderstanding of the amount of work to be performed. Tender of a proposal conveys full Contractor agreement of the items and conditions specified, shown, scheduled, or required by the nature of the project.

C. The drawings intend that all equipment and piping be arranged as shown with necessary minor rearrangements to suit the equipment approved and to comply with the requirements of the various equipment manufacturers' recommendations. Some minor rearrangements are expected to best fit the structural conditions. It shall be the responsibility of the Contractor to make known his desires in such change, by shop drawings as required, to obtain agreement of the Architect/Engineer before proceeding with any change or variation. Changes required by job conditions, equipment employed, or structural conditions of the building shall be at no cost to the Owner or Architect/Engineer.

1.7 SUBMITTALS - GENERAL

A. Submittal Procedures: Division 01 - Requirements in addition to the following:

1. Submittal Preparation:
   a. Minimum of six (6) copies are required, complete (all items submitted at one time), index to each Section of Specifications and include the following information and action taken.
      1) Project Name
      2) Date
      3) Name and Address of Architect
      4) Name and Address of Engineer
      5) Name, Address and Telephone Number of Contractor and Subcontractors.
      6) Name, Address and Telephone number of major equipment manufacturer’s local representatives.
      7) Manufacturer's Name
      8) Published ratings or capacity data
      9) Detailed equipment drawing for fabricated items
      10) Wiring diagrams
      11) Installation instructions
      12) Other pertinent data
      13) All required submittals and data, bound together, submitted at one time.

   b. Where literature is submitted covering a group or series of similar items, the applicable items must be clearly indicated on each copy with a highlighter pen, or other means of identification clearly legible.

   c. Data and shop drawings shall be coordinated and included in a single submission. Multiple submissions are not acceptable except where prior approval has been obtained from the Architect/Engineer. In such cases, a
list of data to be submitted later shall be included with the first submission. Failure to submit shop drawings that meet the requirements of the Drawings and Specifications in ample time for review shall not entitle the Contractor to an extension of contract time, and no claim for extension by reason of such Contractor default shall be allowed.

B. Submittal Organization:
1. Organize all required data in a 3-ring black (in color) binder of sufficient size with index tabs with number and appropriate title of specification section.

C. Provide a cover sheet and an index sheet listing all items submitted.

D. The second and third sheet shall be blank for stamping of submittals. All submittals are to be processed at same date; partial submittals are not acceptable and will not be reviewed.

E. Show any revisions to equipment layout required by use of selected equipment. The Engineer shall receive submittals no later than thirty (30) working days from contract date with General Contractor and Owner. Allow two weeks (10 working days) for review process.

F. The Engineer's review of submittals is only for confirmation of adherence to design of project and does not relieve the Contractor of final responsibility for furnishing all materials required for a complete working system and in complying with the Contract Documents in all respects.

1.8 FABRICATION AND SHOP DRAWINGS, DESCRIPTIVE DATA

A. As soon as practical and within thirty days after the official award of contract and before any materials and equipment are purchased, the Contractor shall submit to the Architect/Engineer, for review, six (6) copies of the complete list of all materials and equipment identified and referenced to specification paragraphs together with applicable fabrication and shop drawings. In addition, the names and addresses of the manufacturers, their catalog data, numbers, and trade names shall be furnished. Published performance data indicating pressure drops, pump curves, balance points, etc., shall be furnished to indicate compliance with scheduled performance. For all fans and pumps, provide the “family” of curves, not just the selected performance point (minimum size 8 ½” x 11”). This data will be marked "Reviewed" by the Engineer, dated and distributed to the several parties involved, with three (3) copies returned to the Contractor. The data shall include the following:

1. Equipment-room layouts drawn to ¼” scale, including equipment, piping, accessories, to show clearances for operating and servicing.

2. Equipment and materials as indicated in each Section.

3. Automatic control system and sequence of control together with all data on components. In no case will wire-to-wire or terminal type of wiring diagrams for control system be included or checked as submittal; they shall be included as information only.

4. Wiring diagrams, control panelboards, motor test data, motor starters and controls for electrically operated equipment furnished by mechanical trades.

5. Composite coordination drawings of crowded locations where there is a possibility of conflict among trades. Indicate exact locations and elevations of pipes, ducts, and conduits, obtained from field measurements, after consultation and agreement among trades involved.

6. See also Section 23 31 00.
B. Verification of Dimensions:
   1. The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall verify all dimensions in the field and advise the Architect/Engineer of any discrepancy before performing the work. Adjustments to the work required in order to facilitate a coordinated installation shall be made at no additional cost to the Owner or Architect/Engineer.

C. Equipment other than that shown should be used in bids only when approved by the Engineer prior to bidding. Those models and manufacturers identified in drawings and specifications were selected to provide minimum acceptable performance. These models are used in sake of brevity to establish a basis of quality, weights, performance, capacities, etc., required. Any such alternate proposals must include all necessary changes and additions to the work occasioned by such substitution including but not limited to foundations, supports, electrical work, connections, piping, etc. which shall be paid for by the Contractor. In the event that the Contractor submits for approval any material, equipment, etc., that are not in conformity with the specifications, the Architect/Engineer reserves the right to reject this equipment, and the Contractor shall submit data on other equipment which meets the requirements of the specifications for approval.

D. Installation Directions:
   1. Obtain manufacturer's printed installation directions to aid in properly executing work on equipment requiring such directions. Submit such directions to Architect/Engineer prior to time of installation for use in review of the work.

E. Operating Instructions, Charts:
   1. Furnish manufacturer's printed operating and maintenance instruction for equipment and systems, which, in opinion of Architect/Engineer, require such instructions; see also requirements for owner's manuals at the end of this section.

F. When so specified or instructed, mount operating instructions laminated or in approved frame with glass over; locate where directed.

1.9 GENERAL INSTALLATION

A. Lines and Grades:
   1. Construct work in conformity with lines and grades as indicated, using axis lines and bench marks provided under General Construction; verify such axis lines and bench marks.

   2. Axis lines within building will be so spaced on each floor level that mechanical work may be laid out with tape measure having length of 50 feet maximum.

   3. Bench marks outside building will be at accessible points on building walls, from which lines and grades required for installation of mechanical and electrical work may be set.

B. Existing Services:
   1. Active Services: When encountered in work, protect, brace and support existing active sewers, gas, piping and other services where required for proper execution of the work. If existing active services are encountered that require relocation, make request in writing for determination. Do not proceed with work until written directions are received. Do not prevent or disturb operation of
active services that are to remain. Outages shall be kept to a minimum and allowed only as arranged with the Architect/Engineer.

2. Inactive Services: When encountered in work, remove, cap, or plug inactive services.

3. Interruption of Services: Where work makes temporary shutdowns of services unavoidable, shut down at night or at such times as approved by Owner, which will cause the least interference with established operating routine. Arrange to work continuously, including overtime, if required, to assure that services will be shut down only during time actually required to make necessary connection to existing work.

C. Objectionable Noise and Vibration:
   1. Mechanical equipment shall operate without objectionable noise or vibration.
   2. If such objectionable noise or vibration should be produced and transmitted to occupied portions of building apparatus, piping, ducts or other parts of mechanical work, make necessary changes and additions, as approved, without extra cost to Owner. The completed installation shall result in a noise level below the Noise Criteria Curves from ASHRAE Guide and Data books established for each type of space.

D. Equipment Design and Installation:
   1. Uniformity: Unless otherwise specified, equipment or material of same type or classification, used for same purpose shall be the product of same manufacturer.
   2. Design: Equipment and accessories not specifically described or identified by manufacturer's catalog numbers shall be designed in conformity with ASME, AIEE or other applicable technical standards, be suitable for maximum working pressure and shall have neat and finished appearance.
   3. Installation: Erect equipment in neat and workmanlike manner; align, level and adjust for satisfactory operation. Install duct and pipe straight and parallel to building lines, with any required slopes. Install so that connecting and disconnecting of duct, piping and accessories can be made readily, and so that all parts are easily accessible for inspection, operation, maintenance and repair. Minor deviation from indicated arrangements may be made, as approved.

E. Protection of Equipment and Materials:
   1. Responsibility for care and protection of mechanical and electrical work rests with the Contractor until it has been tested and accepted.
   2. After delivery, before and after installation, protect equipment and materials against theft, injury or damage from all causes.

F. Adjustments:
   1. It shall be the responsibility of the Contractor to adjust properly any and all equipment and devices and to run reasonable operating tests together with more specific tests indicated in the separate sections of the specifications. If for some reason any piece of equipment does not function satisfactorily after the first adjustments are made, the Contractor shall continue on the job until satisfactory corrections and adjustments have been made. The Contractor is responsible for the proper performance, functioning, integration, and balance of all equipment. Where tests are required by the Architect/Engineer to ascertain equipment capacities in the installed condition, it shall be the responsibility of the
Contractor to run approved tests, to provide all required instruments and apparatus and to submit certified statements of test results. All such instruments shall be in proper calibration and shall meet approval of the Architect/Engineer.

G. Completeness:
   1. The Contractor shall be responsible for the absolute completeness of his work, including all adjustments and all final balancing to obtain proper operation in all respects. Balancing is in reference to proper airflow and water flow, control calibration, refrigerant flow, or balancing to eliminate objectionable vibrations, noises, or surges.
   2. Each system is intended to be complete and functional in performance. All such items as piping trim, electrical work, controls, accessories, insulated condensate drains and appurtenances required shall be installed at no extra cost.

1.10 PERMITS AND FEES
   A. All building permits and their required fees, extension of utilities together with applicable meters, and all inspection fees for all mechanical work shall be arranged and paid for by the Mechanical trade involved in the particular work for which the permit is taken, and for the pertinent inspection fee for the work involved by the Contractor.
   B. The Mechanical Contractor shall assist the Owner and Engineer in the application process for any utility rebate that might apply, including scheduling of pre-inspection visits required by the utility, providing information and invoices, and any other requirements.

1.11 WORKMANKSHIP
   A. All materials and equipment shall be installed in accordance with the approved recommendation of the manufacturer, and workmen skilled in the trade involved shall accomplish the installation.

1.12 FLAME SPREAD PROPERTIES OF MATERIALS
   A. Materials and adhesives incorporated in this project shall conform to ASTM Standard E84, "Test Method of Surface Burning Characteristics of Building Materials" and NFPA 90. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc., specified for each system, and shall not exceed a smoke developed rating of 50.

1.13 ASBESTOS ABATEMENT
   A. In the event the Contractor encounters at the site material reasonably believed to be asbestos which has not been abated, the Contractor shall immediately stop work in the area affected and report the condition to the Owner. If in fact the material is asbestos and the asbestos has not been abated, the Contractor shall not resume the non-asbestos-related work in the affected area until the asbestos has been abated. The abatement action may be done in two ways, as the Owner may decide. The Owner may perform the abatement by its own forces, or the Owner may contract with a third party to perform the abatement.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 SPACE REQUIREMENTS
   A. General:
      1. Determine in advance of purchase that the equipment and materials proposed for installation will fit into the confines indicated, leaving adequate clearances for adjustment, repair or replacement.
B. Clearance:
   1. Allow adequate space for clearance in accordance with the Code requirements and the requirements of the local inspection department, and manufacturer's requirement.

C. Responsibility:
   1. Since space requirements and equipment arrangement vary for each manufacturer, the responsibility for initial access and proper fit rests with the Contractor.

D. Review:
   1. Final arrangements of equipment to be installed shall be subject to the Architect/Engineer’s review.

E. Equipment, Spaces and Clearances:
   1. All equipment and accessories shall be new and standard models of a type that has been in satisfactory use for a minimum of three (3) years. All major components of any given system shall be of the same manufacturer and shall have a manufacturer's nameplate stating address, catalog model number and capacity.

F. Materials and equipment shall be installed in accordance with manufacturers' recommendations and best standard practice for the type of work involved.

G. All equipment and materials shall be continuously protected, using temporary shelters, etc., from dirt, dust, moisture, damage, etc., and will not be accepted otherwise. All necessary supports, frames and foundations shall be provided for all equipment.

H. The responsibility for the furnishing of the proper mechanical and electrical equipment rests entirely upon the Contractor who shall request advice and supervisory assistance from the representatives of specific manufacturers during the installation.

I. It shall be the responsibility of the Contractor that the combination of proposed equipment will fit into the allotted space shown on the plan with adequate clearances for maintenance and servicing.

J. Any apparatus, which is too large to permit access through stairways, doorways, shaft, etc., shall be delivered to the job and set in place prior to constructing the mechanical room enclosures.

K. Machinery Drive:
   1. For motor and other power-driven equipment specified in mechanical work sections, the following shall apply:
      b. Belt Drive: Where V-belt drive is specified, design for overload as per manufacturer's recommendation for type of service intended but in any case not less than 125 percent of motor horsepower rating, of dimensions and number of belts to transmit required power with 95 percent minimum efficiency; use machined cast iron or steel sheaves designed for this type of drive. Belts and sheaves shall be of same manufacture; "Gates Rubber Co., "Vulco Ropes & Sheaves," or approved equal.

L. Machinery Accessories:
1. Lubricating Devices: Provide oil level gages, grease gun fittings for machinery bearings as recommended by machinery manufacturer; where these lubricating means are not easily accessible, extend to locations as directed. Furnish all grease gun fittings of uniform type.

2. Sleeve Bearings: Where sleeve bearings are specified for equipment, use self-aligning type, Randall Graphite Bearings, Inc., or approved equal.

3. Belt Guards: Provide guards to enclose belt, pulleys and sheaves on belt-driven equipment. Construct of galvanized expanded or perforated sheet steel, or 1-inch mesh wire screen, in angle frame with steel angle or channel mounting supports; make guard easily removable for access to belt, pulley or sheave and allow for tachometer. Conform to codes or regulation of agencies having jurisdiction. Paint prime and finish coats as directed.

4. Guard Railing: Where guard railings are required for machinery hazard or roof edge protection, provide galvanized pipe railing with special railing fittings, galvanized malleable iron, Grinnell Co., Inc., Fig. 1181, or approved equal; fasten, brace as directed. Where required provide suitable hinged and latched gate. Conform to codes or regulations of agencies having jurisdiction. Paint prime and finish coats as directed. (Note that roof mounted equipment has been located a minimum of 10’ from the roof edge to preclude requirement for roof edge safety railings. If this distance cannot be met, provide such railing at no additional cost).

5. Equipment Supports, Foundations, Stands: Where supports, foundations, stands, suspended platforms for machinery, tanks or vessels, and other equipment are indicated or specified in mechanical work sections, perform as follows: 
   a. Design, Construction, Location
      1) Design and construct supporting structures of strength to safely withstand stresses to which they may be subjected and to distribute properly the load and impact over the building areas.
      2) Conform to applicable technical societies' standards, also to codes and regulations of agencies having jurisdiction.
      3) Locate supports for vessels to avoid undue strain on shell and interference with pipe connections to vessel outlets.
      4) For vessels containing tubes, check support locations for clearance to pull tubes.
      5) Where saddles are indicated or specified for vessel supports, use cast iron or welded-steel saddles of curvature to fit vessel.
      6) Mount power-driven equipment on common base with driver unless otherwise indicated, specified or approved.
      7) Submit detailed shop drawings of all supports; obtain approval before fabricating or constructing.

M. Smoke Duct Detectors and Shut Down:

1. Fire Alarm Contractor shall furnish and install smoke duct detectors in all units providing 2,000 CFM or greater and/or in units serving corridors of egress and/or units having smoke/fire dampers. Interlock with air handler to turn unit off in the event of detection of smoke. Provide and install smoke duct detectors in units smaller than 2,000 CFM if these units supply a contiguous space served by
multiple units with a total airflow equal or greater than 2,000 CFM. In this case, provide a smoke duct detector in all units serving this space, regardless of CFM. Comply with the requirements of the authority having jurisdiction.

3.2 RELATED ELECTRICAL PROVISIONS

A. Electrical Contractor To Provide (coordinate with electrical contractor):
   1. Line Voltage and hook-up to all HVAC (Division 23) Equipment
   2. All Conduits into accessible attic space for thermostats and sensors.
   4. One TVSS power outlet or hard wired electrical connection at each building automation control panel located by project controls contractor. Controls contractor shall dictate quantity and location of panels. Electrical contractor shall provide necessary power to each panel.
   5. Controls contractor shall directly compensate electrical contractor for all 120V/1P power circuitry required to power DDC control panels.

B. Mechanical Contractor to Provide:
   1. All motor starters (with motor overload protection, including heaters or solid state devices sized for actual motor amperage as required).
   2. All thermostats.
   3. All HVAC Equipment.
   4. All relays, contactors, and switches required to start/stop Mechanical Equipment other than switches shown on electrical drawings and required by Division 26.

C. Controls Contractor to Provide, or Mechanical Contractor if no Controls Subcontractor:
   1. All required relays.
   2. All Sensors.
   3. All conduit required above ceiling.
   4. All control wiring.

D. The Electrical plans are based on the equipment and devices scheduled shown on the drawings or as called for in the specifications. Should any mechanical equipment or associated devices be changed from those which are shown or noted, all electrical and/or mechanical changes shall be made at the expense of the trade or contractor initiating the change with no expense to the Owner, Engineer or their representatives.

E. All Conduit and boxes for thermostats and/or sensors shall be provided by mechanical contractor. A thermostat or sensor junction box and 3/4" conduit to accessible attic and/or to corridor shall be provided for each room served with HVAC equipment. All control conduits required in attic, clear spaces, or on roof shall be by the Mechanical or Controls Contractor.

F. General Electrical Coordination:
   1. All electrical equipment, control components and circuits not specifically covered herein shall conform to the requirements in Division 26, Electrical.
   2. Mechanical contractor shall coordinate with Electrical trade to confirm that electrical service, including voltage, phase, overcurrent protection, conductors and terminations are compatible with equipment requirements. Any discrepancies shall be called to the attention of the Engineer during submittals.
3. Mechanical contractor shall also coordinate carefully to ensure all electrical starters, disconnects, and accessories are covered appropriately and are correct voltage. Review electrical drawings and equipment wiring schedules.

G. Motor driven equipment and its installation shall be provided complete with motors, wiring, motor starters, interlocks, and operating and/or safety controls. Their electrical characteristics shall conform to that indicated. Motor starters shall be provided complete with properly sized thermal-overload protection in all phases and other appurtenances necessary for motor control. Motors shall be of adequate size to drive equipment at specified capacity without exceeding nameplate rating of the motor.

H. Such items as electric control, motors, relays, thermostats, terminal or limiting switches on equipment, etc., shall be furnished as part of the equipment involved. All of these electrical controls, interlocks, and devices shall be installed and wired into the system to conform to Division 26. They shall be complete with all required conduit, condulets, boxes, wire, grounds, power disconnect switches, etc. The electrical trades doing Division 26 work shall provide all power wiring of 115 volt or higher including interlocks. All temperature control wiring shall be the responsibility of the mechanical trades, who shall furnish all wiring and diagrams.

I. Motors:

1. Except where otherwise specified or indicated for motors in mechanical and electrical work sections, the following shall govern:

   a. Motors 1/2 - horsepower and smaller shall be single phase, 115 - volt; 3/4 - horsepower and larger shall be three phase; exceptions will be made, as approved, in case of fractional horsepower motor-driven equipment units furnished by manufacturer with integral motor to suit their standard design.

   b. Single-phase motors shall be ECM, capacitor-start, split-phase or shaded-pole type, as approved for individual application.

J. Polyphase motors shall be squirrel-cage induction, or wound-rotor induction type, of NEMA Design B, according to starting torque and current characteristics, as approved for individual application. Motors with variable frequency drives shall have insulation rated for that service.

K. Where motor type, horsepower, speed, or other essential data are not specified in detailed specification of individual equipment unit or indicated on schedules, obtain this information from manufacturer of equipment unit and have it approved before ordering motors.

L. Manufacture: Motors furnished under mechanical work shall not be the product of more than two manufacturers. Exceptions will be made as approved, in cases of fractional horsepower motor, or when motor is furnished integral with driven equipment unit as manufacturer's standard.

M. Design, Performance:

1. NEMA standards shall be taken as minimum requirements for motor design and performance, except where otherwise specified.

N. Motors shall be suitable for load, duty, voltage, frequency and hazard, for service and location intended.

O. NEMA classification of motor enclosures shall apply when motor types are specified as open, drip proof, splash proof, totally enclosed and the like.
P. Motors shall have ball or roller type bearings with pressure grease lubrication; exceptions will be made, as approved, in special cases for sleeve type bearings with approved method of oil lubrication.

Q. Motors shall be quiet operating.

R. Motors shall be rated for continuous duty and under full load; maximum rise in temperature shall not exceed current standards.

S. Motors shall be capable of withstanding momentary overloads of 50 percent, without injurious overheating.

T. Motors for belt drive shall have adjustable bases with set screws to maintain belt tension; motors for direct drive with coupling shall be doweled to base plate at two points.

U. Motors shall have nameplates giving manufacturer's name, shop number, horsepower, rpm, and current characteristics.

V. Motor Tests:

1. For motors 75 - horsepower or smaller, check tests against complete tests of similar motor will be accepted.

2. Test for following:
   a. Determine motor load performance in accordance with ANSI Standard C-50, for insulation resistance, dielectric strength, efficiency, and power factor and temperature rise.
   b. Determine efficiency and power factor for 50 percent, 75 percent and 100 percent of rated horsepower; for motors 100 horsepower and larger, include also 125 percent rating.
   c. Perform temperature-rise test at rated horsepower for rated time interval or until temperature becomes constant.

W. Motor Starters:

1. System Description
   a. Single Phase Starter: Starters for 115VAC single phase motors less than 1 HP shall be capable of both manual and automatic operation. Refer to Section W.2 for single phase starter requirements.
   b. Combination Starters: Provide combination magnetic starters for all motors requiring branch circuit protection or a line-of-sight disconnect. Refer to Section W.3 for combination magnetic starter requirements.

2. Enclosed Full Voltage Non-Reversing (FVNR) Single Phase Starter
   a. Single Phase Motor Starter Control: The single phase motor starter shall consist of a manually operated quick-make toggle mechanism lockable in the “Off” position which shall also function as the motor disconnect. Additionally, the starter shall provide thermal overload protection, run status pilot light and fault pilot light. The starter must include the capability to operate in both manual and automatic control modes. In automatic mode, the starter shall have the capability to integrate with a building automation system by providing terminals for run input, run status output and fault output. All control terminals shall be integrated in the starter. At a minimum, each single phase starter shall include an interposing run relay and current sensing status output relay. Single phase motor starter shall be in a surface mount enclosure.
b. Approved manufacturer: Franklin Control Systems.

3. Enclosed Full Voltage Non-Reversing (FVNR) Combination Starter.
   a. Magnetic Motor Starters with disconnects shall be enclosed in a general purpose electrical enclosure with the appropriate environmental rating. NEMA 1 for indoor installation and NEMA 3R for outdoor installation.
   b. Starters shall consist of a horsepower rated magnetic contactor with a minimum of 2NO and 2NC auxiliary contacts and solid state electronic overload relay.
   c. Overload relay shall protect all three phases with a wide range 1-40 amp current setting and trip class to allow field adjustment for specific motor FLA. Interchangeable heater elements are not acceptable.
   d. Overload relay shall incorporate SmartStart Technology, or the following protective functions:
      1) Out of calibration protection (if the FLA on the overload is set outside acceptable range, overload will trip to indicate fault event)
      2) Stall protection
      3) Max time to start
      4) Locked Rotor
      5) Phase Unbalance
      6) Phase loss
      7) Cycle Fault
   e. Starter shall be field selectable for manual or auto reset to restore normal operation after a trip or fault condition. Manual pushbutton shall be accessible without removing or opening cover on starter.
   f. In the event of a power failure, starter shall restart in last mode by default. Starter shall also be capable of restart with 10 second delay, or restart in “off” mode.
   g. All starters must be provided with a universal power supply capable of a 208 to 600 volt input range. The power supply must accept the available line voltage and the control voltage shall not exceed 24V.
   h. Installed accessories shall include Hand-Off-Auto operation pushbutton keypad. Include LED pilot light indicators for Hand, Off, Auto, Run and Overload conditions.
   i. The starter shall include remote run terminals which accept both a voltage input signal and a contact closure. The voltage run input shall accept both AC and DC signals from 12-250V to allow direct connection of the transistorized automation signal to the starter.
   j. Starter must contain an integral current sensor with NO contact which closes to indicate motor run status as well as a NO contact which closes when an overload trip condition occurs.
   k. The starter must provide a voltage output to operate the actuator to open the damper or valve without closing the motor circuit. The starter will only close the motor circuit and start the motor after it has received a contact closure from a limit or end switch confirming the damper or
valve position.

1. The starter shall include a dedicated voltage input for Fireman’s Override operation. When activated, the starter run the motor in any mode (Hand, Off or Auto) regardless of other inputs or lack of inputs either manual or auto. The purpose of the Fireman’s Override input is to act as a smoke purge function. Fireman’s Override has priority over the Emergency Shutdown input.

m. The starter shall include an Emergency Shutdown input which will disable the starter from operating in either Hand or Auto mode regardless of other inputs either manual or auto.

n. Manufacturer shall provide and install tags with engraved white lettering to designate equipment served

o. All disconnects shall include a lock-out mechanism when in the off position.

p. Motor circuit protectors (MCP) shall be provided as the acceptable form of disconnecting means. The MCP shall be a UL listed 508 current limiting manual motor starter with magnetic trip elements only. The MCP shall carry a UL 508F rating (up to 100A frame size) which provides for coordinated short circuit rating for use with the motor contactor and provides a minimum interrupting rating of 30,000 AIC for the combination starter.

q. Approved manufacturer: Franklin Control Systems.

X. Motor Control Enclosure for individual Motor:

1. Enclosure shall be furnished by manufacturer of control devices, of size and design to suit each application; with operating and resetting device operable from outside; hinged door with padlock; NEMA Type 1 for general purpose indoor application, other types for special applications, as approved.

3.3 EXCAVATION, BACKFILLING, AND CUTTING

A. Boring, excavating, backfilling and cutting shall not be undertaken without receiving approval of the Architect/Engineer before starting same. Cutting through masonry on concrete shall be made with masonry saws or core drills. This approval is required where the work may interfere with the work of other trades or where it may weaken the structure in any way.

B. Excavation:

1. All excavation of every description and of whatever substances encountered, to the depth indicated on the drawings and/or required for the installation of piping, utility system, etc., shall be performed. All exterior lines shall be installed with a minimum cover of 24 inches unless otherwise indicated. Concrete encase all sewer lines under streets with less than 30 inches of cover. Generally, more cover shall be provided if grade will permit. All excavated materials not required for backfill or fill shall be removed and wasted as acceptable to the Architect/Engineer. All grading in the vicinity of excavations shall be controlled to prevent surface ground water from flowing into the excavation. During excavation, material suitable for backfilling shall be stacked in an orderly manner sufficient distance back from edges of trenches to avoid overloading and prevent slide or cave-ins. Any water accumulated in the excavations shall be removed by pumping or other approved method. All shoring and sheeting required to perform
and protect the excavations and to safeguard employees shall be performed. Excavate as required under the building in order that all piping, ductwork, etc. shall clear the ground a minimum of 12 inches for a distance of 24 inches on either side. Edges of such excavation shall slope at an angle of not over 45 degrees with the horizontal unless otherwise approved by the Architect/Engineer. The bottom of such excavation shall be graded to drain in a manner acceptable to the Architect/Engineer.

C. Backfilling:
1. The trenches shall not be backfilled until all required tests are performed and until the piping, conduits, utilities systems, etc., as installed, conform to the specified requirements. The trenches shall be carefully backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel, soft shale, or other approved materials free from larger clods of earth or stone, deposited in thoroughly and carefully rammed 6 inches layers, until the pipe has a cover of not less than 1 foot. The remainder of the material shall be backfilled after moistening and then tamped in place using 1-foot layers. Blasted rock, broken concrete or pavement, and large boulders shall not be used as backfill material. Any trenches improperly backfilled, or where settlement occurs, shall be reopened to the depth required for proper compaction, be refilled and mounded over and smoothed off. Unless otherwise indicated open trenches across roadways or other areas to be paved shall be backfilled as specified above, except that entire depth of trench shall be backfilled in 6 inch layers, each layer moistened and compacted to a density at least equal to that of the adjacent level in such manner as to permit the rolling and compaction of the filled trench together with the adjoining earth to provide the required bearing valve, so that paving of the area can proceed immediately after backfilling is completed. Where an area has been prepared for pavement prior to excavation, backfilled shall be of such materials and installed as to comply with the paving requirements for preparation of subgrade and stabilized courses as specified in other sections of the specifications. Along all other portions of the trenches, the ground shall be graded to a reasonable uniformity and the mounding over the trenches left in a uniform and neat condition. Backfill under concrete slab on fill shall be as specified above, shall be select fill, or shall be such other materials more suitable for the application. Installation and compaction shall be as required for compatibility with adjacent materials.

D. Opening and Closing Pavement and Lawns:
1. Where excavation requires the opening of existing walks, streets, drives, other existing pavement or lawns, such surfaces shall be cut as required to install new lines and to make new connections to existing lines. The sizes of the cut shall be held to minimum, consistent with the work to be accomplished. After the installation of the new work is completed and the excavation has been backfilled, paved areas shall be reinstalled to match existing paving and lawn areas shall be re-sodded.

3.4 CONCRETE WORK
A. Where concrete work is indicated or specified under mechanical work, as for foundations, piers, pedestals, tank encasement, cradles or saddles for tanks or pipes, manholes, pits, and catch basins, perform as follows:
1. Concrete Strength:
a. Concrete shall have compressive strength after 28 days of 2,200 pounds per square inch minimum.
b. Concrete mix shall consist of one part Portland cement to 4-1/2 parts by volume of fine and coarse aggregate in dry state, with 7-1/2 gallons water maximum per sack of cement.
c. Portland cement shall be as per ASTM C 150, Type 1.
d. Concrete aggregate shall be as per ASTM C 33.
e. Water shall be clear, of quality suitable for domestic consumption.

3.5 MISCELLANEOUS

A. Cleaning Piping, Ducts, Equipment:
   1. Piping, ducts, and equipment shall be thoroughly cleaned of dirt, cuttings and other foreign substances. Should any pipe, duct or other part of the systems be stopped by any foreign matter, disconnect, clean and reconnect wherever necessary for purpose of locating and removing obstructions. Repair work damaged in the course of removing obstructions.

B. Provide refrigerant circuit access ports located outdoors with locking-type tamper-resistant caps.

3.6 TESTS

A. Following requirements are supplementary to tests specified for individual equipment or systems in mechanical and electrical work sections.

B. Notice of Tests:
   1. Give written notice in ample time to all concerned of date when tests will be conducted.

C. Prior Tests:
   1. Concealed or insulated work shall remain uncovered until required tests have been completed, but if construction schedule requires it, arrange for prior tests on parts of system as approved.

D. Preliminary Tests:
   1. As soon as conditions permit, conduct preliminary or "turn-over" test of certain equipment as directed, to ascertain compliance with specified requirements. Make needed changes, adjustments or replacements as preliminary tests may indicate, prior to acceptance test.

E. Acceptance Tests:
   1. Conduct pressure, performance and operating tests as specified for each system or equipment unit, in presence of Architect/Engineer or other accredited representative of Owner, as well as representatives of agencies having jurisdiction. The Contractor shall correct all deficiencies resulting from test data and from deficiencies identified at times of site observations.

F. Costs:
   1. Furnish labor, material, and instruments and bear other costs in connection with all tests.

3.7 GUARANTEES

A. All work, including mechanical, equipment, and materials, shall be guaranteed by the Contractor for a period of one (1) year after final acceptance of the work. All defects in
labor and materials occurring during the one year after final acceptance of the work shall be immediately repaired or replaced by the Contractor at no additional cost to the Owner.

B. See also individual sections for further requirements.

3.8 CERTIFICATION

A. Certification shall be furnished by the authorized manufacturer's representative stating equipment is installed in accordance with the manufacturer's recommendation and is eligible for specified warranties.

3.9 OWNERS MANUALS

A. The Contractor shall turn over the following to the Owner at completion of contract.

1. Operating instructions together with wiring diagrams.
2. Approved drawings, equipment submittals, as-built control diagrams, etc.
3. All equipment guarantees and warranties together with instructions shipped with equipment.
4. Parts list of all major items of equipment.
5. List of all local suppliers with contact information
7. Certificates of acceptance by local inspection departments having jurisdiction.
8. Comply with the requirements of Division One in providing “As-built” Mechanical Drawings in a format acceptable to the Owner. Unless otherwise instructed, provide a clean, marked-up set of prints showing as-installed conditions to the Engineer for processing.
9. All above items shall be "punched" and bound in a loose-leaf notebook.

END OF SECTION
SECTION 23 05 14
VARIABLE-FREQUENCY DRIVES (VFD)

PART 1 GENERAL

1.1 SUMMARY

A. Section includes variable frequency drivers.

B. General:
   1. Furnish and install Variable Frequency Drive Packages using Pulse Width Modulation (PWM) variable voltage, variable frequency technology, as specified herein. All of the Variable Frequency Drive Packages shall be shop assembled and tested with all drives supplied by one manufacturer for this project.
   2. The Contractor shall furnish Variable Frequency Drive Packages to vary the motor speed of the supply air fans and pumps shown in the fan and pump schedules. Each Package shall have all components sized for the scheduled application.
   3. All components of each Package shall comply with the latest applicable provisions of the National Electric Code, NEMA, ETL, and UL.
   4. Each Package shall consist of a factory assembled pre-wired “Package Cabinet” containing a Line Side Inductor, a Variable Frequency Drive Section (VFD) integrated with a Proportional-Integral Process Controller, a Bypass-Contactor Section, a 120 Volt Control Section, and terminals for field connection to external circuits.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:
   1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NEMA FU 1 - Low Voltage Cartridge Fuses.
   3. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives.

C. International Electrical Testing Association:

1.3 SUBMITTALS

A. Section 23 05 00 – General Mechanical Requirements: Submittal procedures.

B. Shop Drawings:
   1. Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.

C. Product Data:
1. Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

D. Submittals:
1. Provide a submittal indicating all salient features listed above. Any deviation or deletion regarding itemized features shall be specifically identified. Also, noise level data, operation manuals, and warranty information should be included.
2. The manufacturer’s representative shall provide a priced list of recommended space parts, arranged by drive size and with indication as to which parts have application to more than one VFD size. These prices shall be good for 365 days from bid opening.
3. The manufacturer’s representative shall provide terminal block to terminal block wiring diagrams coordinated with the owner to provide a complete and functional operating system. Furnish detailed drawings showing construction, dimensions, wiring diagrams, and installation procedures for engineer’s approval.

E. Test Reports:
1. Indicate field test and inspection procedures and test results.

F. Manufacturer's Field Reports:
1. Indicate start-up inspection findings.

1.4 CLOSEOUT SUBMITTALS
A. Section 23 05 00 – General Mechanical Requirements: Closeout procedures.
B. Operation and Maintenance Data:
1. Submit instructions complying with NEMA ICS 7.1. Include procedures for starting and operating controllers, and describe operating limits possibly resulting in hazardous or unsafe conditions. Include routine preventive maintenance schedule.

1.5 QUALIFICATIONS
A. Manufacturer:
1. Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 25 miles of project.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Section 23 05 00 – General Mechanical Requirements: Product storage and handling requirements.
B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

1.7 ENVIRONMENTAL REQUIREMENTS
A. Conform to NEMA ICS 7 service conditions during and after installation of variable frequency controllers.
1.8 WARRANTY
A. Coordinate with General Contractor to provide product warranties and product bonds.
B. Furnish one year manufacturer warranty for variable frequency drivers.

PART 2 PRODUCTS
2.1 VARIABLE FREQUENCY DRIVE
A. Manufacturers:
   1. ABB.
   2. Yaskawa.
   3. Danfoss.
   4. Franklin Controls.
   5. Substitutions: As approved by Engineer prior to bid date.
B. Product Description:
   1. NEMA ICS 7, enclosed variable frequency drive/controller suitable for operating indicated loads. Select unspecified features and options in accordance with NEMA ICS 7.1.
C. Ratings:
   1. Rated Input Voltage: Scheduled.
   3. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
   4. Operating Ambient: 0 degrees C to 40 degrees C.
   5. Minimum Efficiency at Full Load: 98 percent.
D. Design Features:
   1. Employ microprocessor-based inverter logic isolated from power circuits.
   2. Employ pulse-width-modulated inverter system.
   3. Design for ability to operate controller with motor disconnected from output.
   4. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.
   5. Ride-through feature to allow continuous operation through up to a 3 cycle line loss.
E. Indicators and Manual Controls:
   1. Input Signal: 4 - 20 mA DC, 3 - 15 psi pneumatic or 0-10 mV DC.
   2. Display: Furnish integral digital display to indicate output voltage, output frequency, and output current.
   3. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, over temperature, and input power ON.
   4. Volts per Hertz Adjustment: Plus or minus 10 percent.
   6. Acceleration Rate Adjustment: 0.5 - 30 300 seconds.
7. Deceleration Rate Adjustment: 1 - 300 seconds.
8. HAND-OFF-AUTOMATIC selector switch and manual speed control.

F. Safeties and Interlocks:
1. Includes under voltage release.
2. Door Interlocks: Mechanical means to prevent opening of equipment with power connected, or to disconnect power when door is opened; include means for defeating interlock by qualified persons.
3. Safety Interlocks: Terminals for remote contact to inhibit starting under both manual and automatic mode.
4. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.
7. Disconnecting Means: Integral circuit breaker on line side of each controller.

G. Fabrication:
1. Wiring Terminations: Match conductor materials and sizes as indicated on Drawings.
2. Enclosure: NEMA 250, Type 1, suitable for equipment application in places restricted to persons employed on premises.
3. Finish: Manufacturer's standard enamel.

2.2 SOURCE QUALITY CONTROL
A. Shop, inspect and perform standard productions tests for each controller.
B. Make completed controllers available for inspection at manufacturer’s factory prior to packaging for shipment. Notify Architect/Engineer at least seven days before inspection is allowed.

PART 3 EXECUTION
3.1 EXAMINATION
A. Verify building environment is maintained within service conditions required by manufacturer.

3.2 INSTALLATION
A. Install in accordance with NEMA ICS 7.1.
B. Tighten accessible connections and mechanical fasteners after placing controller.
C. Select and install overload heater elements in motor controllers to match installed motor characteristics.
D. Install engraved plastic nameplates in accordance with Section 23 05 53.
E. Neatly type label inside controller door identifying motor served nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

F. Ground and bond controller in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL
A. Coordinate with General Contractor and Commissioning Agent to provide:
   1. Field inspecting, testing, adjusting, and balancing.
B. Inspect and test in accordance with NETA ATS, except Section 4.
C. Perform inspections and tests listed in NETA ATS, Section 7.16 and NEMA ICS 7.1.

3.4 MANUFACTURER'S FIELD SERVICES
A. Prepare and startup variable frequency controller under supervision of manufacturer’s approved technicians.

3.5 DEMONSTRATION AND TRAINING
A. Furnish 4 hours of instruction each for two persons, to be conducted at project site with manufacturer's representative.

END OF SECTION
SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pipe hangers and supports.
   2. Hanger rods.
   3. Flashing.
   4. Sleeves.
   5. Mechanical sleeve seals.
   6. Formed steel channel.
   7. Firestopping relating to HVAC work.
   8. Firestopping accessories.
   9. Equipment bases and supports.

B. Related Sections:
   1. Section 07 84 00 - Firestopping: Product requirements for firestopping for placement by this section.
   2. Section 07 90 00 - Joint Protection: Product requirements for sealant materials for placement by this section.
   3. Section 09 90 00 - Painting and Coating: Product and execution requirements for painting specified by this section.
   4. Section 23 05 03 - Pipes and Tubes for HVAC Piping and Equipment: Execution requirements for placement of hangers and supports specified by this section.
   5. Section 23 05 48 – Vibration Control of HVAC Piping and Equipment: Vibration Isolators.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
   1. ASME B31.1 - Power Piping.
   2. ASME B31.5 - Refrigeration Piping.
   3. ASME B31.9 - Building Services Piping.

B. ASTM International:
DEFINITIONS
A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

SYSTEM DESCRIPTION
A. Firestopping Materials: ASTM E814 to achieve fire ratings of adjacent construction in accordance with UL Design Numbers.

PERFORMANCE REQUIREMENTS
A. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.

SUBMITTALS
A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

Product Data:
1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.

F. Manufacturer's Installation Instructions:
   1. Hangers and Supports: Submit special procedures and assembly of components.
   2. Firestopping: Submit preparation and installation instructions.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

H. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.7 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
   1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
   2. Floor Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
      a. Floor Penetrations Within Wall Cavities: T-Rating is not required.

B. Through Penetration Firestopping of Non-Fire Rated Floor Assemblies: Materials to resist free passage of flame and products of combustion.
   2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

E. Surface Burning Characteristics: Maximum 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.

F. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing Work of this section with minimum 3 years experience.
1.9 DELIVERY, STORAGE, AND HANDLING
   A. Section 23 05 00 – General Mechanical Requirements: Requirements for transporting, handling, storing, and protecting products.
   B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
   C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS
   A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
   B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
   C. Provide ventilation in areas to receive solvent cured materials.

1.11 FIELD MEASUREMENTS
   A. Verify field measurements prior to fabrication.

1.12 WARRANTY
   A. Section 01 77 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS
2.1 PIPE HANGERS AND SUPPORTS
   A. Refrigerant and Condensate Piping:
      1. Conform to MSS SP58, MSS SP69, MSS SP89.
      2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
      3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
      4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
      5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
      8. Floor/Roof Support: Miro Model 3-RAH or approved equivalent.

2.2 ACCESSORIES
   A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 FLASHING
   A. Metal Flashing: 26 gage thick galvanized steel.
   B. Metal Counter-flashing: 22 gage thick galvanized steel.
   C. Lead Flashing:
      1. Waterproofing: 5 lb./sq. ft sheet lead.
2. Soundproofing: 1 lb./sq. ft sheet lead.

D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.4 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves for Round Ductwork: Galvanized steel.

D. Sleeves for Rectangular Ductwork: Galvanized steel.

E. Sealant: Acrylic.

2.5 MECHANICAL SLEEVE SEALS

A. Manufacturers:
   1. Thunderline Link-Seal, Inc.
   2. Substitutions: As approved by Engineer prior to bid date.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FORMED STEEL CHANNEL

A. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.7 FIRESTOPPING

A. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
   1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
   2. Foam Firestopping Compounds: Single component foam compound.
   3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
   4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
   5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
   6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
   7. Firestop Pillows: Formed mineral fiber pillows.

B. Color: Red.

2.8 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:
   1. Sheet metal.
C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:
   1. Furnish UL listed products.
   2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:
   1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
   2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.1 EXAMINATION
   A. Verify openings are ready to receive sleeves.
   B. Verify openings are ready to receive firestopping.

3.2 PREPARATION
   A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
   B. Remove incompatible materials affecting bond.
   C. Install damming materials to arrest liquid material leakage.
   D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
   E. Do not drill or cut structural members.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS
   A. Install in accordance with MSS SP 89.
   B. Support horizontal piping as scheduled.
   C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
   D. Place hangers within 12 inches of each horizontal elbow.
   E. Use hangers with 1-1/2 inch minimum vertical adjustment.
   F. Support vertical piping at every floor.
   G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
   H. Support riser piping independently of connected horizontal piping.
   I. Provide copper plated hangers and supports for copper piping.
   J. Design hangers for pipe movement without disengagement of supported pipe.
   K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
   L. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 23 07 00.
3.4 INSTALLATION - EQUIPMENT BASES AND SUPPORTS
   A. Manufacturer’s curb for roof mounted equipment. Coordinate installation with roofing contractor.
   B. Install roof mounted condensing units on equipment rail curbs equal to ThyCurb M#TEMS-1.
   C. All roof mounted curbs shall be secured to the roof structure and the associated equipment shall be secured to the curbs without the use of wood nailer strips. All roof mounted equipment shall be secured to be in compliance with Texas Windstorm requirements.

3.5 INSTALLATION - FLASHING
   A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
   B. Provide acoustical flashing around ducts and pipes penetrating equipment rooms for sound control.

3.6 INSTALLATION - SLEEVES
   A. Exterior watertight entries: Seal with mechanical sleeve seals.
   B. Set sleeves in position in forms. Provide reinforcing around sleeves.
   C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
   D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
   E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
   F. Install chrome plated steel escutcheons at finished surfaces.

3.7 INSTALLATION - FIRESTOPPING
   A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items requiring firestopping.
   B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
   C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.
   D. Place intumescent coating in sufficient coats to achieve rating required.
   E. Fire Rated Surface:
      1. Seal opening as follows:
         a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
         b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
         c. Pack void with backing material.
         d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
2. Where cable tray, bus, cable bus, conduit, wireway or trough, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

F. Non-Rated Surfaces:
1. Seal openings through non-fire rated building members as follows:
   a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
   b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
   c. Install type of firestopping material recommended by manufacturer.
2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
4. Interior partitions: Seal all pipe penetrations at all interior walls. Apply acoustical sealant to both sides of penetration to completely fill annular space between sleeve and wall. Additionally, apply acoustical sealant to both sides of penetration to completely fill annular space between piping and sleeve.

3.8 FIELD QUALITY CONTROL
A. Section 01 77 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.9 CLEANING
A. Section 01 77 00 - Execution and Closeout Requirements: Requirements for cleaning.
B. Clean adjacent surfaces of firestopping materials.

3.10 PROTECTION OF FINISHED WORK
A. Section 01 77 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
B. Protect adjacent surfaces from damage by material installation.

END OF SECTION
SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Inertia bases.
   2. Vibration isolators.

B. Related Sections:
   1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports.
   2. Section 23 33 00 - Air Duct Accessories: Product requirements for both solid and flexible duct connectors specified for placement by this section.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:
   1. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

B. American National Standards Institute:
   1. ANSI S1.4 - Sound Level Meters.
   2. ANSI S1.8 - Reference Quantities for Acoustical Levels.
   3. ANSI S1.13 - Methods for the Measurement of Sound Pressure Levels in Air.
   4. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.

C. Air-Conditioning, Heating and Refrigeration Institute:
   1. AHRI 575 - Method of Measuring Machinery Sound within Equipment Space.

D. American Society of Heating, Refrigerating and:

E. ASTM International:

F. Sheet Metal and Air Conditioning Contractors’:
   1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 SUBMITTALS

A. Section 23 05 00 – General Mechanical Requirements: Submittal procedures.
B. Shop Drawings:
   1. Indicate and locate vibration isolators, with static and dynamic load on each.

C. Product Data:
   1. Submit schedule of vibration isolator type with location and load on each.

D. Manufacturer's Installation Instructions:
   1. Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.

E. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.

1.4 QUALIFICATIONS

A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum three years experience.

B. Installer:
   1. Company specializing in performing Work of this section with minimum three years experience.

1.5 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 INERTIA BASES

A. Manufacturers:
   1. Mason Industries.
   2. Amber Booth.
   5. Vibro-Acoustics.
   6. Substitutions: As approved by Engineer prior to bid date.

B. Concrete Inertia Bases:
   1. Mass: Minimum of 1.5 times weight of isolated equipment.
   2. Construction: Structured steel channel perimeter frame, with gusset brackets and anchor bolts, adequately reinforced, concrete filled.
   3. Provide with integral open spring isolators.
   4. Concrete: Reinforced 3,000 psi concrete.

2.2 VIBRATION ISOLATORS

A. Manufacturers:
   1. Mason Industries.
2. Amber Booth.
5. Vibro-Acoustics.
6. Substitutions: As approved by Engineer prior to bid date.

B. Open Spring Isolators:
   1. Spring Isolators:
      a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
      b. Code: Color code springs for load carrying capacity.
   2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
   3. Spring Mounts: Furnish with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
   4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.

C. Neoprene Pad Isolators:
   1. Rubber or neoprene-waffle pads.
      a. 30 durometer.
      b. Minimum 1/2 inch thick.
      c. Maximum loading 40 psi.
      d. Height of ribs: not to exceed 0.7 times width.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Coordinate with General Contractor prior to installation.

B. Verify equipment, ductwork and piping is installed before work in this section is started.

3.2 INSTALLATION

A. Bases:
   1. Set inertia bases for 1 inch clearance between housekeeping pad and base.

B. Adjust equipment level.
3.3 SCHEDULES

A. Equipment Isolation Schedule:

<table>
<thead>
<tr>
<th>Isolated Equipment</th>
<th>Base</th>
<th>Isolator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type</td>
<td>Type</td>
</tr>
<tr>
<td>Pumps</td>
<td>Concrete</td>
<td>Open Spring</td>
</tr>
<tr>
<td>Inline Fans</td>
<td>None</td>
<td>Open Spring</td>
</tr>
<tr>
<td>Air Cooled Chiller</td>
<td>None</td>
<td>Neoprene Pad Isolators</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Size and place per chilled manufacturers recommendations)</td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Nameplates.
   2. Valve Tags.
   3. Pipe markers.

1.2 REFERENCES
A. American Society of Mechanical Engineers:

1.3 SUBMITTALS
A. Section 23 05 00 – General Mechanical Requirements: Submittal procedures.
B. Product Data:
   1. Submit manufacturers catalog literature for each product required.
C. Shop Drawings:
   1. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
D. Manufacturer's Installation Instructions:
   1. Indicate installation instructions, special procedures, and installation.
E. Manufacturer's Certificate:
   1. Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS
A. Section 23 05 00 – General Mechanical Requirements: Closeout procedures.

1.5 QUALITY ASSURANCE
A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

1.6 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Installer:
1. Company specializing in performing Work of this section with minimum three years documented experience.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Product Description:
   1. Laminated three-layer plastic with engraved white letters on black contrasting background color.

2.2 VALVE TAGS

A. Product Description:
   1. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.

2.3 PIPE MARKERS

A. Color and Lettering:
   2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Provide continuous banding tape with directional arrows around circumference at each end of markers.

2.4 CEILING TACKS

A. Description:
   1. Steel with 3/4 inch diameter color-coded head.

B. Color code as follows:
   1. HVAC equipment: Yellow.
   2. Fire dampers/smoke dampers: Red.
   3. Plumbing valves: Green.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install identifying devices after completion of coverings and painting.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

C. Identify valves in main and branch chilled water piping with valve tags.
D. Install valve tags using corrosion resistant chain. Number tags consecutively by location.

E. Identify control panels and major control components outside panels with plastic nameplates.

F. Identify all automatic controls, motor starters, instruments, and relays with plastic nameplates. Key to control schematic.

G. Identify chilled water supply and return, condensate and refrigerant pipes, concealed or exposed, with plastic tape pipe markers. Identify service, flow direction. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

H. Identify chillers, pumps, major hydronic components, fans, air handling units, VAV terminal units, condensing units, fan coils, and fans with nameplates.

I. Stenciled identification is not acceptable for identifying any piping or equipment.

J. Provide ceiling tacks to locate fan coil units, control panels and dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION
SECTION 23 05 93
TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Testing, adjusting and balancing (TAB) of air systems.
   2. Testing, adjusting and balancing of hydronic systems.
   3. Measurement of final operating condition of HVAC systems.
   4. Testing, adjusting and balancing domestic water recirculation systems.

B. Related Sections:
   1. Section 23 08 00 Commissioning of HVAC Commissioning Requirements.
   2. Section 23 09 23 - Direct-Digital Control System for HVAC: Requirements for coordination between DDC system and testing, adjusting, and balancing work.

1.2 REFERENCES

A. Associated Air Balance Council:

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

C. Natural Environmental Balancing Bureau:
   1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.3 SUBMITTALS

A. Section 23 05 00 – General Mechanical Requirements: Submittal procedures.

B. Within 60 days of notice to proceed submit firm’s name and proposed personnel to be used on the project; provide copies of current NEBB or AABC certificates. Also submit report forms or outlines indicating adjusting and balancing procedures to be used, and equipment data required. Include detailed procedures, agenda, sample report forms.

C. Test Reports: Indicate data on NEBB Report forms.

D. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
E. Submit draft copies of report for review prior to final acceptance of Project. Submit proof of latest calibration date of each instrument, no more than 1 year from date of test.

F. Furnish reports in soft cover, letter size, 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced (xerox, 11x17) drawings with air outlets and equipment identified to correspond with data sheets, and indicating actual thermostat locations. (Schematic sketch or diagram will not be acceptable.)

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report included in operating and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.6 QUALIFICATIONS

A. Acceptable Agencies:
   1. Engineered Air Balance Co., Inc.
   2. PHI Service Agency, Inc.
   3. Testing Specialties, Inc.

B. Perform Work under supervision of NEBB Certified Testing, Balancing and Adjusting Supervisor.

1.7 PRE-TEST MEETINGS

A. Convene minimum one week prior to commencing work of this section. Review procedures to be used, stage of construction required, list of personal and subcontractors required.

B. Coordinate with General Contractor, Commissioning Authority and Mechanical and Controls Contractors to ensure readiness for TAB.

1.8 SEQUENCING

A. Sequence balancing between completion of systems tested and Date of Substantial Completion.
PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify systems are complete and operable before commencing work. Verify the following:
   1. Systems are started and operating in safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   5. Duct systems are clean of debris.
   6. Fans are rotating correctly.
   7. Fire and volume dampers are in place and open.
   8. Air coil fins are cleaned and combed.
   9. Access doors are closed and duct end caps are in place.
  10. Air outlets are installed and connected.
  11. Hydronic systems are flushed, filled, and vented.
  12. Pumps are rotating correctly.
  13. Proper strainer baskets are clean and in place or in normal position.
  14. Service and balancing valves are open.

3.2 PREPARATION

A. Furnish instruments required for testing, adjusting, and balancing operations.
B. Make instruments available to Architect/Engineer to facilitate spot checks during review of testing.

3.3 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design.
B. Air Outlets and Inlets: Adjust total to within plus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

A. Comply with requirements of Division 1 for testing, adjusting, and balancing.
B. Verify recorded data represents actual measured or observed conditions.
C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

E. Report defects and deficiencies noted during performance of services, preventing system balance. (Present on summary page near front of report.)

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner/Engineer using same instruments as during TAB.

H. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.

F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.

G. Provide system HVAC floor plans (11x17 fold-out) with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers as a check on leakage.
K. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries and in labs.

3.6 WATER SYSTEM PROCEDURE

A. Adjust water systems, after air balancing, to obtain design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on pressure difference across various heat transfer elements in system.

C. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open or in normal position to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point. Mark all final settings in a permanent manner.

F. Where available pump capacity is less than total flow requirements or individual system parts, simulate full flow in one part by temporary restriction of flow to other parts.

3.7 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:
   1. Air Ducts.
   2. Plumbing Pumps.
   3. HVAC Pumps.
   4. Air Cooled Water Chillers.
   5. Air Cooled Condensing Units.
   6. Air Coils.
   7. Fan Coil Units. (including mini-split systems).
   8. Air Handling Units.
   10. Air Terminal Units.
   11. Air Inlets and Outlets.

B. Report Forms
1. Title Page:
   a. Name of Testing, Adjusting, and Balancing Agency
   b. Address of Testing, Adjusting, and Balancing Agency
   c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
   d. Project name
   e. Project location
   f. Project Architect
   g. Project Engineer
   h. Project Contractor
   i. Project altitude
   j. Report date

2. Summary Comments:
   a. Design versus final performance
   b. Notable characteristics of system
   c. Description of systems operation sequence
   d. Summary of outdoor and exhaust flows to indicate building pressurization
   e. Nomenclature used throughout report
   f. Test conditions

3. Instrument List:
   a. Instrument
   b. Manufacturer
   c. Model number
   d. Serial number
   e. Range
   f. Calibration date

4. Electric Motors:
   a. Manufacturer
   b. Model/Frame
   c. HP/BHP and kW
   d. Phase, voltage, amperage; nameplate, actual, no load
   e. RPM
   f. Service factor
   g. Starter size, rating, heater elements
   h. Sheave Make/Size/Bore

5. V-Belt Drive:
   a. Identification/location
b. Required driven RPM

c. Driven sheave, diameter and RPM

d. Belt, size and quantity

e. Motor sheave diameter and RPM

f. Center to center distance, maximum, minimum, and actual

6. Pump Data:

a. Identification/number

b. Manufacturer


c. Size/model

d. Impeller

e. Service

f. Design flow rate, pressure drop, BHP and kW

g. Actual flow rate, pressure drop, BHP and kW

h. Discharge pressure

i. Suction pressure

j. Total operating head pressure

k. Shut off, discharge and suction pressures

l. Shut off, total head pressure

7. Air Cooled Condensing Units:

a. Identification/number

b. Location

c. Manufacturer

d. Model number

e. Serial number

f. Entering DB air temperature, design and actual

g. Leaving DB air temperature, design and actual

h. Number of compressors

8. Chillers:

a. Identification/number

b. Manufacturer

c. Capacity

d. Model number

e. Serial number

f. Evaporator entering water temperature, design and actual

g. Evaporator leaving water temperature, design and actual

h. Evaporator pressure drop, design and actual

i. Evaporator water flow rate, design and actual
j. Condenser entering water temperature, design and actual
k. Condenser pressure drop, design and actual
l. Condenser water flow rate, design and actual

9. Cooling Coil Data:
   a. Identification/number
   b. Location
   c. Service
   d. Manufacturer
   e. Air flow, design and actual
   f. Entering air DB temperature, design and actual
   g. Entering air WB temperature, design and actual
   h. Leaving air DB temperature, design and actual
   i. Leaving air WB temperature, design and actual
   j. Water flow, design and actual
   k. Water pressure drop, design and actual
   l. Entering water temperature, design and actual
   m. Leaving water temperature, design and actual
   n. Saturated suction temperature, design and actual
   o. Air pressure drop, design and actual

10. Electric Heater:
   a. Manufacturer
   b. Identification/number
   c. Location
   d. Model number
   e. Design kW
   f. Number of stages
   g. Phase, voltage, amperage
   h. Test voltage (each phase)
   i. Test amperage (each phase)
   j. Air flow, specified and actual
   k. Temperature rise, specified and actual

11. Air Moving Equipment:
   a. Location
   b. Manufacturer
   c. Model number
   d. Serial number
   e. Arrangement/Class/Discharge
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>f.</td>
<td>Air flow, specified and actual</td>
</tr>
<tr>
<td>g.</td>
<td>Return air flow, specified and actual</td>
</tr>
<tr>
<td>h.</td>
<td>Outside air flow, specified and actual</td>
</tr>
<tr>
<td>i.</td>
<td>Total static pressure (total external), specified and actual</td>
</tr>
<tr>
<td>j.</td>
<td>Inlet pressure</td>
</tr>
<tr>
<td>k.</td>
<td>Discharge pressure</td>
</tr>
<tr>
<td>l.</td>
<td>Sheave Make/Size/Bore</td>
</tr>
<tr>
<td>m.</td>
<td>Number of Belts/Make/Size</td>
</tr>
<tr>
<td>n.</td>
<td>Fan RPM</td>
</tr>
</tbody>
</table>

12. Return Air/Outside Air Data:
   a. Identification/location
   b. Design air flow
   c. Actual air flow
   d. Design return air flow
   e. Actual return air flow
   f. Design outside air flow
   g. Actual outside air flow
   h. Return air temperature
   i. Outside air temperature
   j. Required mixed air temperature
   k. Actual mixed air temperature
   l. Design outside/return air ratio
   m. Actual outside/return air ratio

13. Exhaust Fan Data:
   a. Location
   b. Manufacturer
   c. Model number
   d. Serial number
   e. Air flow, specified and actual
   f. Total static pressure (total external), specified and actual
   g. Inlet pressure
   h. Discharge pressure
   i. Sheave Make/Size/Bore
   j. Number of Belts/Make/Size
   k. Fan RPM

14. Duct Traverse:
   a. System zone/branch
b. Duct size
c. Area
d. Design velocity
e. Design air flow
f. Test velocity
g. Test air flow
h. Duct static pressure
i. Air temperature
j. Air correction factor

15. Terminal Unit Data:
   a. Manufacturer
   b. Type
   c. Identification/number
   d. Location
   e. Model number
   f. Size
   g. Minimum static pressure
   h. Minimum design air flow
   i. Maximum design air flow
   j. Maximum actual air flow
   k. Inlet static pressure

16. Flow Measuring Station:
   a. Identification/number
   b. Location
   c. Size
   d. Manufacturer
   e. Model number
   f. Serial number
   g. Design Flow rate
   h. Design pressure drop
   i. Actual/final pressure drop
   j. Actual/final flow rate
   k. Station calibrated setting

17. Air Distribution Test Sheet:
   a. Air device number
   b. Room number/location
   c. Device type
   d. Device size
e. Area factor
f. Design velocity
g. Design air flow
h. Test (final) velocity
i. Test (final) air flow
j. Percent of design air flow

END OF SECTION
SECTION 23 07 00
HVAC INSULATION

PART I GENERAL

1.1 SUMMARY

A. Section Includes:
   1. HVAC piping insulation, jackets and accessories.
   2. HVAC equipment insulation, jackets and accessories.
   3. HVAC ductwork insulation, jackets, and accessories.

B. Related Sections:
   1. Section 07 84 00 - Firestopping: Product requirements for firestopping for placement by this section.
   2. Section 09 90 00 - Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.
   3. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment: Product requirements for placement by this section.
   4. Section 23 08 00 – Commissioning of HVAC: Commissioning Requirements.

1.2 REFERENCES

A. ASTM International:
   2. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
B.  Sheet Metal and Air Conditioning Contractors’:
   1.  SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 SUBMITTALS

A.  Section 01 33 00 - Submittal Procedures: Submittal procedures.

B.  Product Data:
   1.  Submit product description, thermal characteristics and list of materials and thickness for each service, and location.

C.  Manufacturer’s Installation Instructions:
   1.  Submit manufacturers published literature indicating proper installation procedures.

D.  Manufacturer’s Certificate:
   1.  Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A.  Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.

B.  Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.

C.  Factory fabricated fitting covers manufactured in accordance with ASTM C450.

D.  Duct insulation, Coverings, and Linings:
   1.  Maximum 25/50 flame spread/smoke developed index, when tested in accordance with ASTM E84, using specimen procedures and mounting procedures of ASTM E 2231.

1.5 QUALIFICATIONS

A.  Manufacturer:
   1.  Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B.  Applicator:
   1.  Company specializing in performing Work of this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A.  Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Manufacturers for Glass Fiber Insulation Products:
   1. CertainTeed.
   2. Knauf.
   4. Owens-Corning.
   5. Substitutions: None Permitted.

B. Manufacturers for Closed Cell Elastomeric Insulation Products:
   1. Aeroflex.
   2. Aerocell.
   3. Armacell, LLC.
   4. Armaflex.
   5. Nomaco.
   7. Substitutions: None Permitted.

2.2 PIPE INSULATION

A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation.
   1. Thermal Conductivity: 0.23 at 75 degrees F.
   2. Operating Temperature Range: 0 to 850 degrees F.
   4. Jacket Temperature Limit: minus 20 to 150 degrees F.

2.3 PIPE INSULATION JACKETS

A. Aluminum Pipe Jacket:
   1. ASTM B209.
   2. Thickness: 0.016 inch thick sheet.
3. Finish: Embossed.
5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
6. Metal Jacket Bands: 0.010 inch thick stainless steel.

2.4 PIPE INSULATION ACCESSORIES

A. Covering Adhesive Mastic:
   1. Compatible with insulation.

B. Piping 1-1/2 inches diameter and smaller:
   1. Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.

C. Piping 2 inches and larger:
   1. Galvanized steel protection shield (saddle) and insulation insert. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation. High density phenolic or foamglass insert with all service jacket single piece construction with self-adhesive closure. Thickness to match pipe insulation.

D. Adhesives:
   1. Compatible with insulation.

2.5 EQUIPMENT INSULATION

A. TYPE E-1: ASTM C534, Type II, flexible, nonhalogen, closed-cell elastomeric insulation, sheet.
   1. Thermal Conductivity: 0.27 at 75 degrees F.
   2. Maximum Service Temperature: 250 degrees F.
   3. Operating Temperature Range: Range: Minus 290 to 250 degrees F.
   4. Water Vapor Permeability: 0.08 perm.

2.6 EQUIPMENT INSULATION JACKETS

A. Aluminum Equipment Jacket:
   1. ASTM B209.
   2. Thickness: 0.016 inch thick sheet.
   3. Finish: Embossed.
   5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
   6. Metal Jacket Bands: 0.010 inch thick stainless steel.
2.7 EQUIPMENT INSULATION ACCESSORIES
A. Covering Adhesive Mastic:
   1. Compatible with insulation.
B. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
C. Adhesives:
   1. Compatible with insulation.

2.8 DUCTWORK INSULATION
A. TYPE D-1: ASTM C1290, Type III, flexible glass fiber, commercial grade with factory applied reinforced aluminum foil jacket meeting ASTM C1136, Type II.
   1. Maximum Thermal Conductivity: 0.29 at 75 degrees F.
   2. Maximum Operating Temperature: 250 degrees F.
   3. Density: 0.75 pound per cubic foot.
B. TYPE D-2: ASTM C1071, Type I, flexible, glass fiber duct liner with coated air side.
   1. Maximum Thermal Conductivity: 0.13 at 75 degrees F.
   2. Maximum Operating Temperature: 250 degrees F.
   3. Maximum Air Velocity: 6,000 feet per minute.

2.9 DUCTWORK INSULATION JACKETS
A. Vapor Retarder Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Water Vapor Permeance: ASTM E96/E96M; 0.02 perms.

2.10 DUCTWORK INSULATION ACCESSORIES
A. Vapor Retarder Lap Adhesive:
   1. Compatible with insulation, equal to Fosters 30 series, with 0.02 perm rating or better, low VOC.
B. Adhesive:
   1. Waterproof, ASTM E162 fire-retardant type.
C. Liner Fasteners:
   1. Galvanized steel, welded with integral head.
D. Tie Wire:
   1. 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
E. Impale Anchors:

F. Adhesives:
   1. Compatible with insulation.

G. Membrane Adhesives:
   1. As recommended by membrane manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Coordinate applications of insulation and adhesives, mastics, etc. with General Contractor and Commissioning Authority prior to installation.

B. Verify piping, equipment and ductwork has been tested before applying insulation materials.

C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

A. Piping Exposed to View in Finished Spaces:
   1. Locate insulation and cover seams in least visible locations.

B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 84 00 for penetrations of assemblies with fire resistance rating greater than one hour.

C. Piping Systems Conveying Fluids Below Ambient Temperature:
   1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections and expansion joints.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with vapor retarder adhesive.

D. Inserts and Shields:
   1. Piping 1-1/2 inches diameter and smaller: Install galvanized steel shield between pipe hanger and insulation.
   2. Piping 2 inches Diameter and Larger: Install insert between galvanized support shield and piping and under finish jacket.
      a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
      b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service. (No metal or wood inserts.)
   3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.
E. Insulation Terminating Points:
   1. Chilled Water Coil Branch Piping: Insulate chilled water piping and associated components up to coil connection.
   2. Condensate Piping: Insulate entire piping system and components within building envelope to prevent condensation.

F. Closed Cell Elastomeric Insulation:
   1. Push insulation on to piping.
   2. Miter joints at elbows.
   3. Seal seams and butt joints with manufacturer’s recommended adhesive.
   4. When application requires multiple layers, apply with joints staggered.
   5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.

G. Insulated Piping Exterior to Building:
   1. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with vapor retarder adhesive. Cover with aluminum jacket with seams located at 3 or 9 o’clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.

3.3 INSTALLATION – EQUIPMENT

A. Factory Insulated Equipment: Do not insulate.

B. Exposed Equipment: Locate insulation and cover seams in least visible locations.

C. Equipment Containing Fluids Below Ambient Temperature:
   1. Insulate entire equipment surfaces.
   2. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
   3. Finish insulation at supports, protrusions, and interruptions.

D. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with aluminum jacket.

E. Equipment Located Exterior to Building: Finish with vapor retarder adhesive and cover with aluminum jacket with seams located on bottom side of horizontal equipment.

F. Nameplates and ASME Stamps: Bevel and seal insulation around; do not cover with insulation or permanently afix nameplate/stamp to exterior jacket of insulation in the case of cold equipment.

G. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.
3.4 INSTALLATION - DUCTWORK SYSTEMS

A. Duct dimensions indicated on Drawings are finished inside dimensions.

B. Insulated ductwork conveying air below ambient temperature:
   1. Provide insulation with vapor retarder jackets.
   2. Finish with vapor retarder jacket.
   3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
   4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Insulated ductwork conveying air above ambient temperature:
   1. Provide with standard vapor retarder jacket.
   2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

D. External Glass Fiber Duct Insulation:
   1. Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder adhesive to match jacket. The use of pressure sensitive foil tape is unacceptable.
   2. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
   3. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive. The use of pressure sensitive foil tape is unacceptable.
   4. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

E. Duct Liner:
   1. Adhere insulation with adhesive for 100 percent coverage.
   4. Seal liner surface penetrations with adhesive.
   5. Cut insulation for tight overlapped corner joints. Support top pieces of liner at edges with side pieces.
### 3.5 SCHEDULES

#### A. Cooling Services Piping Insulation Schedule:

<table>
<thead>
<tr>
<th>PIPING SYSTEM</th>
<th>INSULATION TYPE</th>
<th>PIPE DIAMETER in.</th>
<th>INSULATION THICKNESS in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condensate Piping from Cooling Coils located within building envelope</td>
<td>P-1</td>
<td>Less than 1-1/2&quot;</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-1/2” - 4”</td>
<td>1.0</td>
</tr>
<tr>
<td>Refrigerant Liquid and Suction</td>
<td>P-1</td>
<td>Less than 1-1/2&quot;</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-1/2” - 4”</td>
<td>1.0</td>
</tr>
<tr>
<td>Chilled Water Supply and Return located above grade</td>
<td>P-1</td>
<td>Less than 2-1/2&quot;</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-1/2” - 8”</td>
<td>1.5</td>
</tr>
<tr>
<td>Chilled Water Supply and Return located below grade</td>
<td>See Specification 23 31 13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### B. Equipment Insulation Schedule:

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>INSULATION TYPE</th>
<th>INSULATION THICKNESS in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled Water Pump Bodies</td>
<td>E-1</td>
<td>1.0</td>
</tr>
<tr>
<td>Chilled Water Air Separators</td>
<td>E-1</td>
<td>1.0</td>
</tr>
<tr>
<td>Chilled Water Buffer Tanks, Expansion Tanks and Chemical/Filter Feeders</td>
<td>E-1</td>
<td>1.0</td>
</tr>
<tr>
<td>Chiller Cold Surfaces (Not Factory Insulated)</td>
<td>E-1</td>
<td>1.0</td>
</tr>
</tbody>
</table>

#### C. Ductwork Insulation Schedule:

<table>
<thead>
<tr>
<th>DUCTWORK SYSTEM</th>
<th>INSULATION TYPE</th>
<th>INSTALLED R-VALUE (THICKNESS, IN.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return ducts (first 10 feet from unit connection)</td>
<td>D-2</td>
<td>(2.0)</td>
</tr>
<tr>
<td>Return ducts other than listed above</td>
<td>D-1</td>
<td>R-6.0</td>
</tr>
<tr>
<td>Supply &amp; outside air ducts concealed from view</td>
<td>D-1</td>
<td>R-6.0</td>
</tr>
<tr>
<td>Supply &amp; outside air duct exposed to view (double wall construction)</td>
<td>See 23 31 00</td>
<td>R-6.0</td>
</tr>
<tr>
<td>Exhaust ducts within 10 feet of exterior</td>
<td>D-1</td>
<td>R-6.0</td>
</tr>
</tbody>
</table>

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. HVAC commissioning description.
   2. HVAC commissioning responsibilities.

B. Related Sections:
   1. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC: For requirements and procedures concerning testing, adjusting, and balancing of mechanical systems.
   2. Section 23 09 23 - Direct-Digital Control System for HVAC: Submittal, training, and programming requirements.

1.2 REFERENCES

A. Associated Air Balance Council:
   1. AABC - AABC Commissioning Guideline.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
   1. ASHRAE Guideline 1 - The HVAC Commissioning Process.

C. National Environmental Balancing Bureau:
   1. NEBB - Procedural Standards for Building Systems Commissioning.

D. Others as specified.

1.3 COMMISSIONING DESCRIPTION

A. HVAC commissioning process includes the following tasks:
   1. Testing and startup of HVAC equipment and systems.
   2. Equipment and system readiness checklists.
   3. Assistance in functional performance testing to verify testing and balancing, and equipment and system performance.
   4. Provide qualified personnel to assist in commissioning tests, including seasonal testing.
   5. Complete and endorse functional performance test checklists provided by Commissioning Authority to assure equipment and systems are fully operational and ready for functional performance testing.
   6. Provide equipment, materials, and labor necessary to correct deficiencies found during commissioning process to fulfill contract and warranty requirements.
   7. Provide operation and maintenance information and record drawings to Commissioning Authority for review verification and organization, prior to distribution.
   8. Provide assistance to Commissioning Authority to develop, edit, and document system operation descriptions.
9. Provide training for systems specified in this Section with coordination by Commissioning Authority.

B. Equipment and Systems to Be Commissioned:
   1. All HVAC systems specified on the mechanical drawings.
   2. Building automation system.

C. Perform seasonal function performance tests for the following equipment and systems:
   1. All new HVAC systems.
   2. Building automation system.

1.4 COMMISSIONING SUBMITTALS
   A. Section 01 33 00 - Submittal Procedures: Submittal Procedures.
   B. Test Reports: Indicate data on system verification form for each piece of equipment and system as specified.
   C. Field Reports: Indicate deficiencies preventing completion of equipment or system verification checks equipment or system to achieve specified performance.

1.5 CLOSEOUT SUBMITTALS
   A. Section 01 77 00 - Execution and Closeout Requirements: Requirements for submittals.
   B. Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.
   C. Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when necessary revisions are discovered during commissioning.

1.6 QUALITY ASSURANCE
   A. Perform Work in accordance with AABC.
   B. Perform Work in accordance with all governing building codes as specified in the contract documents.

1.7 COMMISSIONING RESPONSIBILITIES
   A. Equipment or System Installer Commissioning Responsibilities:
      1. Attend commissioning meetings.
      2. Ensure temperature controls installer performs assigned commissioning responsibilities as specified below.
      3. Ensure testing, adjusting, and balancing agency performs assigned commissioning responsibilities as specified.
      4. Provide instructions and demonstrations for Owner's personnel.
      5. Ensure subcontractors perform assigned commissioning responsibilities.
      6. Installation Contractor, under the direction of the Construction Manager (CM), with the Commissioning Authority (CxA) observing and documenting the results, will execute the Functional Performance Testing procedures for the various systems and pieces of equipment associated with the requirements for the electrical system.
      7. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
8. Develop startup and initial checkout plan using manufacturer’s startup procedures and functional performance checklists for equipment and systems to be commissioned.

9. During verification check and startup process, execute HVAC related portions of checklists for equipment and systems to be commissioned.

10. Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Authority.

11. Provide manufacturer’s representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.

12. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.

13. Provide personnel to assist Commissioning Authority during equipment or System Readiness Checks (SRC’s) and Functional Performance Tests (FPT’s).

14. Prior to FPT’s, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.

15. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.

16. Provide factory supervised startup services for equipment and systems. Coordinate work with manufacturer and Commissioning Authority.

17. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.

18. Assist Commissioning Authority in performing FPT’s on equipment and systems as specified.

19. Perform operation and maintenance training sessions scheduled by Commissioning Authority.

20. Conduct HVAC system orientation and inspection.

B. Temperature Controls Installer Commissioning Responsibilities:

1. Attend commissioning meetings.

2. Review design for ability of systems to be controlled including the following:
   a. Confirm proper hardware requirements exists to perform functional performance testing.
   b. Confirm proper safeties and interlocks are included in design.
   c. Confirm proper sizing of system control valves and actuators and control valve operation will result capacity control identified in Contract Documents.
   d. Confirm proper sizing of system control dampers and actuators and damper operation will result in proper damper positioning.
   e. Confirm sensors selected are within device ranges.
   f. Review sequences of operation and obtain clarification from Architect/Engineer.
   g. Indicate delineation of control between packaged controls and building automation system, listing BAS monitor points and BAS adjustable control points.

3. Inspect, check, and confirm proper operation and performance of control hardware and software provided in other HVAC sections.

4. Submit proposed procedures for performing automatic temperature control system point-to-point checks to Commissioning Authority and Architect/Engineer.
5. Inspect check and confirm correct installation and operation of automatic temperature control system input and output device operation through point-to-point checks.

6. Perform training sessions to instruct Owner's personnel in hardware operation, software operation, programming, and application in accordance with commissioning plan and specifications.

7. Demonstrate system performance and operation to Commissioning Authority during functional performance tests including each mode of operation.

8. Provide control system technician to assist during Commissioning Authority verification check and functional performance testing.

9. Provide control system technician to assist testing, adjusting, and balancing agency during performance of testing, adjusting, and balancing work.

10. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

C. Testing, Adjusting, and Balancing Agency Commissioning Responsibilities:

1. Attend commissioning meetings.

2. Participate in verification of testing, adjusting, and balancing report for verification or diagnostic purposes. Repeat sample of 25 percent of measurements contained in testing, adjusting, and balancing report as selected by Commissioning Authority.

3. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

1.8 COMMISSIONING MEETINGS

A. Attend initial commissioning meeting and progress commissioning meetings as required by Commissioning Authority.

1.9 SCHEDULING

A. Prepare schedule indicating anticipated start dates for the following:

1. Piping system pressure testing.

2. Piping system flushing and cleaning.

3. Ductwork cleaning.

4. Ductwork pressure testing.

5. Equipment and system startups.

6. Automatic temperature control system checkout.


8. HVAC system orientation and inspections.


10. Training sessions.

B. Schedule seasonal tests of equipment and systems during peak weather conditions to observe full-load performance.

C. Schedule occupancy sensitive tests of equipment and systems during conditions of both minimum and maximum occupancy.
1.10 COORDINATION

A. Notify Commissioning Authority minimum of 5 days in advance of the following:
   1. Scheduled equipment and system startups.
   2. Scheduled automatic temperature control system checkout.
   3. Scheduled start of testing, adjusting, and balancing work.

B. Coordinate programming of automatic temperature control system with construction and commissioning schedules.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 INSTALLATION

A. Install additional balancing dampers, balancing valves, access doors, test ports, and pressure and temperature taps required by Commissioning Authority.

B. Place HVAC systems and equipment into full operation and continue operation during each working day of commissioning.

C. Install replacement sheaves and belts to obtain system performance, as requested by Commissioning Authority.

D. Install test holes in ductwork and plenums as requested by Commissioning Authority for taking air measurements.

E. Prior to start of functional performance test, install replacement filters in equipment.

3.2 COMMISSIONING

A. Occupancy Sensitive Functional Performance Tests:
   1. Test equipment and systems affected by occupancy variations at minimum and peak loads to observe system performance.
   2. Participate in testing delayed beyond final completion to test performance with actual occupancy conditions.

END OF SECTION
SECTION 23 09 23
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 REFERENCES

A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
   1. ANSI MC85.1 - Terminology for Automatic Control.
   2. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
   4. International Building Code (IBC), including local amendments, IECC and IMC.
   5. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
   7. FCC Part 15, Subpart J, Class A
   8. EMC Directive 89/336/EEC (European CE Mark)

B. City, county, state, and federal regulations and codes in effect as of contract date.

C. Except as otherwise indicated the system supplier shall secure and pay for all permits, inspections, and certifications required for his work and arrange for necessary approvals by the governing authorities.

D. All BAS system components (electronic DDC hardware and all software) shall be of one manufacturer as indicated in manufacturer’s trade catalog. Hybrid systems assembled from various manufacturers shall not be acceptable. This requirement does not apply to field devices.

E. All BAS networks and field devices shall be wired in lieu of wireless. Use of wireless networks and/or field devices shall only be used when expressly approved by the Engineer and only in those locations designated by the Engineer.

1.2 SYSTEM DESCRIPTION

A. The system shall be a web based Building Automation System (BAS) accessible with standard browsers such as Internet Explorer and Google Chrome. Systems requiring workstation software licenses shall not be acceptable.

B. Systems based on Lonworks shall not be acceptable.

C. General Description:
   1. Install the Building Global Controller in the MDF Room.
   2. The direct digital control (DDC) system shall control equipment as indicated on the drawings.
   3. Provide a building engineer laptop computer. The computer shall have sufficient computing power, memory and networking capabilities that is required to allow for seamless operation of the building automation software. In addition to the computer, provide the following accessories:
      a. Keyboard.
b. Mouse.
c. (2) 22” Video monitors with 1920x1080 resolution capabilities.

1.3 WORK INCLUDED

A. Provide a complete Facility Management and Control System.
B. Provide all necessary BACnet-compliant hardware and software to meet the system’s functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers.
C. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
D. Implement the detailed design for all analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.
E. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
F. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.
G. Provide and install all interconnecting cables between all operator’s terminals and peripheral devices (such as printers, etc.) supplied under this section.
H. Provide complete manufacturer’s specifications for all items that are supplied. Include vendor name of every item supplied.
I. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning.
J. Provide a comprehensive operator and technician training program as described herein.
K. Provide as-built documentation, operator’s terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
L. Provide computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories to operate mechanical systems, and to perform functions specified and detailed.

1.4 SYSTEM REQUIREMENTS

A. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be based on ANSI/ASHRAE Standard 135-2010, BACnet. This system is to control all mechanical equipment, including all unitary equipment, all air handlers and any other listed equipment using BACnet-compliant components. Non-BACnet-compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited.
B. It shall be the responsibility of the Controls Contractor to coordinate all interface requirements with the respective equipment vendors to provide a complete and working system in all respects.
C. The Web Server should be designed to harness the power of the Internet and provide efficient integration of standard open protocols (i.e. BACnet). The Network Server creates a powerful network environment with comprehensive database management and
messaging services. In addition, the Web Server shall provide an engineering environment and graphical user interface.

D. The web server shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the web server. It shall be capable of executing application control programs to provide:
1. Calendar functions
2. Scheduling
3. Trending
4. Alarm monitoring and routing
5. Time synchronization
6. Integration of controller data for each applicable protocol
7. Network Management function for all network devices

E. All application controllers for every terminal unit (VAV, etc.), and any other piece of controlled equipment shall be fully programmable. Application controllers shall be mounted next to controlled equipment and communicate with building controller via BACnet LAN.

F. Provide installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

1.5 SUBMITTALS

A. Section 23 05 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings:
1. Indicate the following:
   a. Trunk cable schematic showing programmable control-unit locations and trunk data conductors.
   b. Connected data points, including connected control unit and input device.
   c. System graphics showing monitored systems, data (connected and calculated) point addresses, and operator notations. System configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
   d. Description and sequence of operation for operating, user, and application software.
   e. Electrical drawing showing all system internal and external connection points, terminal block layouts and terminal identification.
   f. Complete bill of materials, valve schedule and damper schedule.
   g. For all system elements (building controllers) provide BACnet protocol implementation conformance statements (PICS) as per ANSI/ASHRAE Standard 135-2010.
   h. Provide complete description and documentation of all services and/or objects used in the system
   i. Manufacturer's Installation Instructions: Submit installation, maintenance, operation instructions for each control system component.
Use terminology in submittals conforming to ASME MC85.1.

Coordinate submittals with information requested in Section 23 09 93 in tabbed format.

C. Product Data:
1. Submit data for each system component and software module.

D. Manufacturer's Installation Instructions:
1. Submit installation instruction for each control system component.

E. Manufacturer's Certificate:
1. Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents:
1. Record actual locations of control components, including control units, thermostats, and sensors.
2. Revise shop drawings to reflect actual installation and operating sequences.

B. Operation and Maintenance Data:
1. Submit interconnection wiring diagrams complete field installed systems with identified and numbered system components and devices.
3. Submit inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

1.7 QUALIFICATIONS

A. Manufacturer:
1. Company specializing in manufacturing products specified in this section with minimum five years experience, and with service facilities within 50 miles of Project.

B. Installer:
1. Company specializing in performing Work of this section with minimum three years experience.

1.8 PRE-INSTALLATION MEETINGS

A. Pre-installation meeting:
1. Contractor shall attend a pre-installation meeting at the job site with all related contractors and trades on the job. At a minimum the following shall be addressed and coordinated:
   a. BAS wiring diagrams, work assignments and trade responsibilities.
   b. 120VAC power requirements for any and all locations.
2. Convene prior to commencing work of this section.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.
1.10 WARRANTY
A. Warrant work against faulty material or workmanship in accordance with Division 01. If the project is occupied or the systems placed in operation in several phases at the request of the Owner’s Representative, then the warranty of each system or piece of equipment used shall begin on the date each system or piece of equipment was placed in satisfactory operation and accepted as such, in writing, by the Owner’s Representative. The use of building equipment for temporary service and testing does not constitute the beginning of warranty.
B. Equipment and material provided under this section shall be periodically inspected and serviced by competent technicians. This function becomes the responsibility of the Owner’s Representative when the system is accepted by the Owner’s Representative. The one year material and workmanship warranty is not intended to supplant normal inspection or service and shall not be construed to mean the Contractor shall provide free service for normal maintenance items such as periodic lubrication and adjustment due to normal use, nor to correct without charge, breakage, maladjustment and other trouble shooting caused by improper maintenance.

1.11 MAINTENANCE SERVICE
A. Furnish service and maintenance of control systems for one year from Date of Substantial Completion.
B. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.
C. Perform work without removing units from service during building normal occupied hours.
D. Provide emergency call back service during normal operating hours for this maintenance period.
E. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
F. Perform maintenance work using competent and qualified personnel under supervision of manufacturer or original installer.
G. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

1.12 RELATED WORK IN OTHER SECTIONS
A. Refer to Division 0 and Division 1 for related contractual requirements.
B. Refer to Section 23 05 00 for General Mechanical Provisions
C. Refer to Section 22 08 00 and 23 08 00 for Commissioning Provisions
D. Refer to Section 26 05 00 for General Electrical Provisions

1.13 BAS GENERAL REQUIREMENTS
A. All electrical control wiring shall be furnished and installed under this section, unless shown on the electrical drawings. Low voltage wiring shall be run in EMT conduit in exposed areas and in vertical risers between floors. Low voltage plenum rated wire may be used without conduit in concealed but assessable areas. All conduit on roofs or exteriors shall be rigid with rain tight fittings. Line voltage wiring control wiring shall be
run EMT conduit or rigid if outdoors or on roofs.

B. Space Sensor Installation:
1. Provide conduit stub-ups with junction box in new walls. Wire mold may be used on existing block walls. Provide nylon bushing at the end of all conduit whips for space sensors to prevent chafing of wire.

C. All 120 volt and higher power wiring associated with the control system shall be provided by Division 26-Electrical. Electrical contractor under the direction of the controls contractor shall provide 120VAC and higher power to all control panels as required. All transformers with secondary voltages of 24 volts or less shall be provided by controls contractor with the exception of the transformers for factory mounted controls such as VAV boxes. In the case of factory mounted controls the manufacturer doing the mounting shall provide control transformers and coordinate the voltages.

D. All automatic dampers furnished under this section shall be installed by the Mechanical Contractor. It shall be the responsibility of the Mechanical Contractor to provide and install blank off plates when the control application requires dampers smaller than duct size.

E. All finished painting required for Control piping and equipment shall be done by the General Contractor.

F. All cutting and patching necessary for the installation of the Control System shall be done by the General Contractor.

G. Enclosures:
1. Equipment room controllers or relay packs shall not be installed in the room’s ceiling. If the equipment is in a mechanical room, electrical room, MDF/IDF room or other dedicated room the associated controller and relays shall be mounted in a NEMA-1 fabricated and hinged metal enclosure with lock within sight of the equipment it controls. Fabricated panel means built in a shop environment with templates and not constructed on site. Extensions to controllers for additional controlled or monitored items for a given area shall be mounted adjacent to the equipment controls.

H. Space Local Indication:
1. Each IDS (Indicating Digital Space) sensor, where specified, shall display digital readouts of temperature and temperature setpoint. The Operator shall be able delete these readouts from the Central Workstation on an individual IDS basis as desired.

I. Local Override Buttons:
1. Shall be integral to the sensor and installed in all areas except common areas such as lobbies, bathrooms, hallways, cafeteria's and auditoriums. Equipment room sensors shall not be equipped with override buttons.

J. Space Temperature Sensor Local Adjustment:
1. Areas specified to have adjustment shall have a temperature setpoint adjustment that can be limited in software to plus or minus 2 Deg F adjustment range from setpoint.

K. Air Balance:
1. The test and balance contractor shall set the OA damper positions on all units to
the scheduled and OA amounts by coordination with the controls contractor.

L. Actuators:
1. All damper actuators shall be electronic type (Belimo or equal). OA dampers actuators shall be spring return as indicated.

M. DDC Outputs:
1. Separate DDC outputs will be provided for each valve and damper actuator.

N. DDC Control:
1. All sensors and actuators shall be controlled/monitored by the direct digital control system. Thermostats and humidistats wired to actuators will not be allowed.

O. Wide Area Network:
1. Connect all networks of points specified above to the owner’s network to allow for real time communication. Auto dial up modems are not allowed.

PART 2 PRODUCTS

2.1 DIRECT DIGITAL CONTROLS

A. Browser based, open protocol, with all components listed by BTL as BACnet compliant Acceptable alternate manufactures are:

1. Alerton.
2. Automated Logic.
3. Carrier i-Vu.
4. Distech.
5. Johnson Controls.
7. Trane.

2.2 OPERATING SYSTEM SOFTWARE

A. Input/output Capability From Operator Station:
1. Request display of current values or status.
2. Command selected equipment to specified state.
3. Initiate logs and reports.
5. Add, delete, or change points within each control unit or application routine.
6. Change point input/output descriptors, status, alarm descriptors, and unit descriptors.
7. Add new control units to system.
8. Modify and set up maintenance scheduling parameters.
9. Develop, modify, delete or display full range of color graphic displays.
10. Automatically archive select data even when running third party software.
11. Capability to sort and extract data from archived files and to generate custom reports.
12. Support printer operations.
13. Accommodate daylight savings time adjustments.

B. Operator System Access:
   1. Via software password with multiple access levels at work stations and at each control unit.

C. Data Base Creation and Support:
   1. Control unit automatically checks workstation data base files upon connection and verify data base match. Include the following minimum capabilities:
      a. Add and delete points.
      b. Modify point parameters.
      c. Change, add, or delete English language descriptors.
      d. Add, modify, or delete alarm limits.
      e. Add, modify, or delete points in start/stop programs, trend logs, and other items.
      f. Create custom relationship between points.
      g. Create or modify DDC loops and parameters.
      h. Create or modify override parameters.
      i. Add, modify, and delete applications programs.
      j. Add, delete, develop, or modify dynamic color graphic displays.

D. Dynamic Color Graphic Displays:
   1. Utilizes custom symbols or system supported library of symbols.
   2. Sixteen (16) colors.
   3. Real-time live dynamic data for each graphic.
   4. Dynamic graphic data.

E. Operator Station:
   1. Accept data from LAN as needed without scanning entire network for updated point data.
   2. Interrogate LAN for updated point data when requested.
   3. Allow operator command of devices.
   4. Allow operator to place specific control units in or out of service.
   5. Allow parameter editing of control units.
   6. Store duplicate data base for every control unit and allow down loading while system is on line.
   7. Control or modify specific programs.
   8. Develop, store and modify dynamic color graphics.
   9. Data archiving of assigned points and support overlay graphing of this data.

F. Alarm Processing:
   1. Off normal condition: Cause alarm and appropriate message, including time, system, point descriptor, and alarm condition. Select alarm state or value and alarms causing automatic dial-out.
2. Critical alarm or change-of-state: Display message, stored on disk for review and sort, or print.
3. Print on line changeable message, up to 60 characters in length, for each alarm point specified.
4. Display alarm reports on video. Display multiple alarms in order of occurrence.
5. Define time delay for equipment start-up or shut down.
6. Allow unique routing of specific alarms.
7. Operator specifies when alarm requires acknowledgment.
8. Continue to indicate unacknowledged alarms after return to normal.
9. Alarm notification:
10. Print automatically.
11. Display indicating alarm condition.

G. Event Processing:
1. Automatically initiate commands, user defined messages, take specific control actions or change control strategy and application programs resulting from event condition. Event condition may be value crossing operator defined limit, change of state, specified state, or alarm occurrence or return to normal.

H. Automatic Restart:
1. Automatically start field equipment on restoration of power. Furnish time delay between individual equipment restart and time of day start/stop.

I. Messages:
1. Automatically display or print user-defined message subsequent to occurrence of selected events.
2. Compose, change, or delete message.
3. Display or log message at any time.
4. Assign any message to event.

J. Reports:
1. Manually requested with time and date.
2. Long term data archiving to hard disk.
3. Automatic directives to download to transportable media for storage.
4. Data selection methods to include data base search and manipulation.
5. Data extraction with mathematical manipulation.
6. Data reports to allow development of XY curve plotting, tabular reports (both statistical and summary), and multi-point timed based plots with not less than four (4) variables displayed.
7. Generating reports either normally at operator direction, or automatically under workstation direction.
8. Either manually display or print reports. Automatically print reports on daily, weekly, monthly, yearly or scheduled basis.
9. Include capability for statistical data manipulation and extraction.
10. Capability to generate four types of reports: Statistical detail reports, summary reports, trend graphic plots, x-y graphic plots.

K. Parameter Save/Restore:
   1. Store most current operating system, parameter changes, and modifications on disk or diskette.

L. Data Collection:
   1. Automatically collect and store.
   2. Archiving of stored data for use with system supplied custom reports.

M. Graphic Display:
   1. Support graphic development on work station with software features:
      a. Page linking.
      b. Generate, store, and retrieve library symbols.
      c. Single or double height characters.
      d. Sixty (60) dynamic points of data for each graphic page.
      e. Pixel level resolution.
      f. Animated graphics for discrete points.
      g. Analog bar graphs.
      h. Display real time value of each input or output line diagram fashion.

N. Maintenance Management:
   1. Run time monitoring, for each point.
   2. Maintenance scheduling targets with automatic annunciation, scheduling and shutdown.
   3. Equipment safety targets.
   4. Display of maintenance material and estimated labor.
   5. Target point reset, for each point.

2.3 LOAD CONTROL PROGRAMS

A. Systems shall be capable of all programs listed; however not all are required by the current sequences of operations.

B. Demand Limiting:
   1. Monitor total power consumption for each power meter and shed associated loads automatically to reduce power consumption to an operator set maximum demand level.

C. Duty Cycling:
   1. Periodically stop and start loads, based on space temperature, and according to various On/Off patterns.

D. Automatic Time Scheduling:
   1. Self-contained programs for automatic start/stop/scheduling of building loads. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two (2) temporary schedules.

E. Start/Stop Time Optimization:
1. Perform optimized start/stop as function of outside conditions, inside conditions, or both.
2. Adaptive and self-tuning, adjusting to changing conditions.
3. For each point under control, establish and modify:
   a. Occupancy period.
   b. Desired temperature at beginning of occupancy period.
   c. Desired temperature at end of occupancy period.

F. Night Setback/Setup Program:
1. Reduce heating space temperature set point or raise cooling space temperature set-point during unoccupied hours; in conjunction with scheduled start/stop and optimum start/stop programs.

G. Calculated Points:
1. Define calculations and totals computed from monitored points (analog/digital points), constants, or other calculated points.

H. Event Initiated Programming:
1. Any data point capable of initiating event, causing series of controls in a sequence.

I. Direct Digital Control:
1. Furnish software so operator is capable of customizing control strategies and sequences of operation by defining appropriate control loop algorithms and choosing optimum loop parameters.

J. Trend logging:
1. Each control unit capable of storing samples of control unit's data points.
2. Update file continuously at operator assigned intervals.
3. Automatically initiate upload requests and then stores data on hard disk.
4. Time synchronize sampling at operator specified times and intervals with sample resolution of one minute.
5. Co-ordinate sampling with specified on/off point-state.
6. Display trend samples on workstation in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time versus data.

2.4 HVAC CONTROL PROGRAMS
A. Optimal Run Time:
1. Control start-up and shutdown times of HVAC equipment for both heating and cooling. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room temperature. Employ adaptive model prediction for how long building takes to warm up or cool down under different conditions.

2.5 PROGRAMMING APPLICATION FEATURES
A. Trend Point:
1. Sample points, real or computed, with each point capable of collecting samples at intervals specified in minutes, hours, days, or month. Output trend logs as line-graphs or bar graphs.
B. Alarm Messages:
1. Allow definition of messages, each having sufficient characters for each individual message.
2. Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totaled point's warning limit, hardware elements advisories.
3. Output assigned alarm with "message requiring acknowledgment".
4. Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.

C. Weekly Scheduling:
1. Automatically initiate equipment or system commands, based on selected time schedule for points specified.
2. Program times for each day of week, for each point, with one minute resolution.
3. Automatically generate alarm output for points not responding to command.
4. Allow for holidays

D. Interlocking:
1. Permit events to occur, based on changing condition of one or more associated master points.

2.6 BUILDING COMMUNICATIONS CONTROLLER
A. General Requirements
1. BACnet Conformance
   a. Building Controller shall be approved by the BTL as meeting the BACnet Building Controller requirements.
   b. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

2. Building controller shall be of modular construction such that various modules may be selected to fit the specific requirements of a given project. At a minimum, modules shall consist of a power supply module, a BACnet Ethernet-MS/TP (master slave token passing) module, a BACnet MS/TP-only module, and a modem module for telephone communication. Those projects that require special interfaces may use Modbus modules as needed. However, all Ethernet communications and all controllers—including central plant controllers, advanced application controllers and unitary controllers—supplied by BAS manufacturer shall utilize the BACnet protocol standard.

3. Modules shall be selected to fit the particular project application. Up to seven modules shall be powered by a single power supply module. All modules shall be panel-mounted on DIN rail for ease of addition and shall be interconnected using a simple plug-in cable. A module in the middle shall be replaceable without removing any other modules.

4. All modules shall be capable of providing global control strategies for the system based on information from any objects in the system, regardless if the object is
5. Programming shall be object-oriented using control function blocks, and support DDC functions, 1000 Analog Values and 1000 Binary Values. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on workstation. The same tool shall be used for all controllers.

6. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed using the operator’s workstation or field computer.

7. Controller shall have sufficient memory to ensure high performance and data reliability. Battery shall provide power for orderly shutdown of controller and storage of data in nonvolatile flash memory. Battery backup shall maintain real-time clock functions for a minimum of 20 days.

8. Global control algorithms and automated control functions shall execute using 32-bit processor.

9. Schedules
   a. Each building controller module shall support a minimum of 80 BACnet Schedule Objects and 80 BACnet Calendar Objects.
   b. Building controller modules shall provide normal seven-day scheduling, holiday scheduling and event scheduling.

10. Logging Capabilities
    a. Each building controller shall log as minimum 320 values. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator’s workstation.
    b. Logs may be viewed both on-site and off-site using WAN or remote communication.
    c. Building controller shall periodically upload trended data to networked operator’s workstation for long-term archiving if desired.
    d. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.

11. Alarm Generation
    a. Alarms may be generated within the system for any object change of value or state (either real or calculated). This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
    b. Each alarm may be dialed out as noted elsewhere.
    c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator’s terminal or off-site using remote communications.
Controller must be able to handle up to 320 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.

12. Demand Limiting
   a. Demand limiting of energy shall be a built-in, user-configurable function. Each controller module shall support shedding of up to 200 loads using a minimum of two types of shed programs.

2.7 APPLICATION CONTROLLERS
   A. Provide one or more native BACnet application controllers as needed for all equipment. All controllers shall interface to building controller via BACnet/IP or BACnet MS/TP. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable using graphical programming blocks. Programming tool shall be system resident. No auxiliary or non-BACnet controllers shall be used.
   B. BACnet Conformance
      1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as native BACnet devices. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
         a. Files Functional Group
         b. Reinitialize Functional Group
         c. Device Communications Functional Group
      2. Refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
      3. Standard BACnet object types supported shall include as a minimum—Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
   C. Application controllers shall include universal inputs with 10-bit resolution that accept 3K and 10K thermostats, 0–10VDC, 0–5 VDC, 4–20 mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of 3 inputs that accept pulses. Controller shall also include support and modifiable programming for interface to Intelligent Room Sensor with digital display. Controller shall include binary and analog outputs on board. Analog outputs shall be switch selectable as either 0–10VDC or 0–20mA. Software shall include scaling features for analog outputs. Application controller shall include 24VDC voltage supply for use as power supply to external sensors.
   D. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and...
system shall support display of all information in floating-point nomenclature at operator’s terminal. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using programming tools as described in operator’s terminal section.

E. Application controller shall include support for Intelligent Room Sensor (see Sensors and Miscellaneous Devices section). Display on Intelligent Room Sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor.

2.8 SENSORS AND MISCELLANEOUS DEVICES

A. Temperature Sensors

1. All temperature sensors to be solid state electronic, factory-calibrated to within 0.5°F, totally interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount 44 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.

B. Wall Sensor (Adjustable & Non-Adjustable)

1. Standard wall sensor shall use solid-state sensor and shall be packaged in aesthetically pleasing enclosure. Adjustable sensor shall provide override function, warmer/cooler lever for set point adjustment and port for plug-in of Field Service Tool for field adjustments. Override time shall be stored in controller and be adjustable on a zone-by-zone basis. Adjustment range for warmer/cooler lever shall also be stored in EEPROM on controller. All programmable variables shall be available to Field Service Tool through wall sensor port. Sensors shall fit neatly over the rough-in box without the need for additional dress plates.

C. Outside air relative humidity sensor

1. Provide outside air relative humidity sensors as indicated per the control diagrams. Humidity sensors shall meet, at minimum, the following requirements:
   a. Non-corroding outdoor shield to minimize wind effects and solar heating. Wall mount weather proof enclosure with conduit fitting.
   b. Two wire, 4-20 mA output proportional to relative humidity range of 0% to 100%.
   c. ± 2% accuracy (5 - 95% RH).
   d. Humidity sensor shall be replaceable.

D. Wall mounted relative humidity sensor

1. Provide wall mounted relative humidity sensors as indicated per the control diagrams. Humidity sensors shall meet, at minimum, the following requirements:
   a. Wall mount enclosure with white cover.
b. Two wire, 4-20 mA output or digitally communicating proportional to relative humidity range of 0% to 100%.
c. Humidity sensor shall be replaceable.
d. ± 2% accuracy (5 - 95% RH).
e. Mounted 44 inches above floor.

E. Duct mounted relative humidity sensor
   1. Provide duct mounted relative humidity sensors as indicated per the control diagrams. Humidity sensors shall meet, at minimum, the following requirements:
      a. Duct mounted moisture resistant enclosure with conduit fitting.
      b. Two wire, 4-20 mA output proportional to relative humidity range of 0% to 100%.
      c. Humidity sensor shall be replaceable.
      d. ± 2% accuracy (5 - 95% RH).
      e. 8 inch probe length.

F. Carbon Dioxide Sensors – Duct and WallMount
   2. Accuracy: +/- 30 ppm.
   5. Response time: 2 minutes or less.
   6. Display: 4 digit LCD.
   7. Operating Humidity: 0% to 95% non-condensing.
   8. Operating temperature: 32F to 122F.

G. Outside air flow measuring stations (or Engineer approved equal):
   1. Ebtron Model GTA116-PC
   2. The equipment vendor shall include in its price the cost to attend a pre-installation meeting and shall include the costs to commission its devices certifying proper operation.

H. Photohelic Differential Pressure Switch and Gauge – Auto Reset – Filter Monitoring
   1. Contact Type: Two DPDT
   2. Indication: Visible magnetehelic pressure indication.
   3. Range: Select appropriate range.
   4. Accuracy: 2% full scale.
   5. Setpoints: Visible.
   6. Dial: 4”

I. Rosemont/Emerson 2051 Differential Pressure Transmitter – Chiller Evaporator Differential Pressure Measurement for Flow Control (or Engineer approved equal):
   1. Measurement Type: Differential pressure.
2. Accuracy +/- 0.075% of span.
4. Long Term Stability: 0.1% of URL for 2 years.
5. Rangedown: 100:1

J. Static Pressure Switches – Manual Reset
1. Range: Select appropriate range for anticipated pressures.
2. Duct Static Pressure Tip: Provide tips as required.
3. Contact Type: One DPDT
4. Operating Temperature: -30F to 180F.
5. Reset Type: Manual

K. Differential Pressure Transmitters - Duct
2. Overpressure: 10 psig.
3. Accuracy: 1% full scale.
5. Non-Repeatability: 0.1% full scale.
6. Hysteresis: 0.2% full scale.
7. Compensated Temperature Range: 0F to 155F.

L. Flow Meter for Water Measurement– Insertion Type
2. Model: Onicon F-1200 (or Engineer approved equal).
3. Accuracy: NIST traceable factory calibration +/- 0.5%. 
4. Turn Down: 175:1
5. Operating Range: 0.17 to 30 ft/second.

2.9 ENCLOSURES
A. All controllers, power supplies and relays shall be mounted in enclosures.
B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment.
C. Outdoor enclosures shall be NEMA 3R.
D. Enclosures shall have hinged, locking doors.
E. Provide laminated plastic nameplates for all enclosures. Include location and unit served on nameplate. Laminated plastic shall be 1/8” thick sized appropriately to make label easy to read.

2.10 ELECTRONIC ACTUATORS

2.11 ELECTRONIC ACTUATORS AND VALVES
A. Execution Details for Actuators and Valves
   1. Install “Hard Wire” interlock to disconnect the mechanical spring return actuator power circuit for fail-safe operation. Use of the control signal to drive the actuators closed is not acceptable.
2. Each DDC analog output point shall have an actuator feedback signal, independent of control signal, wired and terminated in the control panel for true position information and troubleshooting.

3. VAV box damper actuation shall be Floating type or Analog (2-10vdc, 4-20ma).

4. Primary valve control shall be Analog (2-10vdc, 4-20ma).

B. Actuators for Damper and Control Valves ½" to 6" shall be Electric unless otherwise specified, provide actuators as follows:

1. UL Listed Standard 873 shall certify Actuators.
2. 5 year Manufacturers Warranty. Two-year unconditional + Three year product defect from date of installation.
3. Mechanical spring shall be provided when specified. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
4. Position indicator device shall be installed and made visible to the exposed side of the Actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the Actuator.
5. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for Butterfly Valve actuators.
6. A push button gearbox release shall be provided for all non-spring actuators.
7. Modulating actuators shall be 24Vac and consume 10VA power or less.
8. Conduit connectors are required when specified and when code requires it.

C. Damper Actuators:

1. Outside Air and Exhaust Air Damper Actuators shall be Mechanical Spring Return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
2. Economizer Actuators shall utilize Analog control 2-10 VDC, Floating control is not acceptable.
3. Electric damper actuators (including VAV box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.
4. One electronic actuator shall be direct shaft mounted per damper section. No connecting rods or jacks shafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
5. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section. (See below execution section for more installation details.)

D. Valve Actuators ½" to 6"

1. Mechanical spring shall be provided on all actuators for AHU heating or cooling coil when units are mounted outside. See plans for fail save flow function: Normal Open or Normal Closed. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
2. All zone service actuators shall be non-spring return unless otherwise specified.
3. The valve actuator shall be capable of providing the minimum torque required for proper valve close off for the required application.
4. All control valves actuators shall have an attached 3-foot cable for easy installation to a junction box.
5. Override handle and gearbox release shall be provided for all non-spring return valve actuators.

E. Control Dampers. The control contractor shall furnish and size all automatic control dampers unless provided with packaged equipment. The sheet metal contractor shall install all dampers unless provided with packaged equipment.

1. All dampers used for modulating service shall be opposed blade type arrange for normally open or normally closed operation as required. The damper is to be sized so that when wide open the pressure drop is a sufficient amount of its close-off pressure drop for effective throttling.
2. All dampers used for two-position or open-close control shall be parallel blade type arranged for normally open or closed operation as required.
3. Damper linkage hardware shall be constructed of corrosion resistant zinc & nickel-plated steel.
4. Frame shall utilize a heavy duty 5in. by 1 in. 13 gauge galvanized steel hat channel frame designed for installation inside the ductwork. Frame shall have reinforced corners and low profile head and sill on dampers less than 17 in high.
5. Blades shall be 3-V, single thickness of 16 gauge galvanized steel
6. Shafts shall be ½ in. diameter square plated steel axles positively locked to the blades to eliminate slippage between blades and axles. Actuator shaft shall be removable.
7. Provide molded synthetic (acetal) bearings in a polished extruded frame raceway.
8. Blade-to-blade linkage shall be concealed within the frame
9. Provide dampers with flexible metal compression-type jamb seals and extruded vinyl blade seals for low leakage performance. Seals shall be silicone.
10. Dampers shall be Model D642 manufactured by Honeywell or equal.

F. Characterized Control Valves

1. NPS 2.0 and Smaller: Nickel-plated forged brass body rated at no less than 400 psi, stainless steel ball and blowout proof stem, female NPT end fittings, with a dual EPDM O-ring packing design, fiberglass reinforced Teflon seats, and a TEFZEL flow characterizing disc. NPS ¾” and Smaller for Terminal Units: Nickel plated forged brass body rated at no less than 600 psi, chrome plated brass ball and blowout proof stem, female NPT end fittings, with a dual EPDM O-Ring packing design, fiberglass reinforced Teflon seats, and a TEFZEL flow characterizing disc.
2. NPS 2-1/2 and 3: GG25 cast iron body according to ANSI Class 125, standard class B, stainless steel ball and blowout proof stem, flange to match ANSI 125 with a dual EPDM O-ring packing design, PTFE seats, and a stainless steel flow characterizing disc.
3. Close off pressure rating: 200 psi.
4. The actuator shall be the same manufacturer as the valve, integrally mounted to the valve at the factory with a single screw on a four-way DIN mounting-base.
5. NPS 2” and smaller characterized control valves for individual coil control shall be provided as part of a pipe package supplied by the valve manufacturer. The supply side of the coil shall contain a strainer/shut-off ball valve/drain with a P/T port. The return side of the coil shall contain a union fitting with a P/T port, characterized control valve, an integrated pressure independent automatic balancing valve/union/isolation ball valve/manual air vent with P/T port. Shut-off valves as an integrated part of the characterized control valve are prohibited.
For 3-way installations, supply an integrated 100% port isolation valve/manual air vent with a P/T port for field installation in the bypass of the circuit.

G. Butterfly Valves – High Performance
   1. Valve body shall be full lugged carbon steel ANSI Class 150 body with a 316 stainless steel disc without a nylon coating, RTFE seat, and be ANSI Class 150300 flange standards. Blowout-proof shaft shall be 17-4ph stainless steel and shall be supported at four locations by glass-backed TFE bushings. Valve packing shall be Chevron TFE and shall include fully adjustable packing flange and separable packing gland. Valve body shall have long stem design to allow for 2” insulation (minimum). Valve face-to-face dimensions shall comply with API 609 and MSS-SP-68. Valve assembly shall be completely assembled and tested, ready for installation.
   2. Disk: Full rated disk @ 200 psi.
   3. Sizing:
      a. Two-Position: Line size or size using a pressure differential of 1 psi.
      b. Modulating: 5 psig or twice the load pressure drop, whichever is more. Size for the design flow with the disc in a 60-degree-open-position with the design velocity less than 32 feet per second.
   4. Flow Characteristics: Modified equal percentage, unidirectional
   6. Media Temperature Range: ANSI Class 150 limitations
   7. Differential Pressure: 285 psi @ 100 deg F for ANSI 150 (725 psi @ 100 deg F for ANSI 300).

PART 3 EXECUTION

3.1 EXAMINATION
   A. Verify conditioned power supply is available to control units.
   B. Verify field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.2 INSTALLATION
   A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
   B. Install software in control units. Implement features of programs to specified requirements and appropriate to sequence of operation.
   C. Install with 120 volts alternating current, 15 amp circuit to each programmable control unit. Controls for life safety equipment shall be on emergency power circuit.
   D. Install conduit and electrical wiring in accordance with requirements of Division 26.
   E. Install electrical material and installation in accordance with appropriate requirements of Division 26.

3.3 MANUFACTURER'S REPRESENTATIVE FIELD SERVICES
   A. Start and commission systems. Allow adequate time for start-up and commissioning prior to placing control systems in permanent operation.
   B. Furnish service technician employed by system installer to instruct Owner's representative in operation of systems plant and equipment.

3.4 DEMONSTRATION AND TRAINING
   A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
B. Furnish basic operator training for multiple persons on data display, alarm and status descriptors, requesting data, execution commands and log requests. Include a minimum of 12 hours instructor time for onsite training and 12 hours of hands on class environment training.

C. Demonstrate complete and operating system to Owner, Engineer and Commissioning Authority.

3.5 SEQUENCES OF OPERATION
A. See drawings for sequences.

3.6 SYSTEM GRAPHICS - BROWSER BASED DISPLAYS
A. General – on all graphics
   1. Display time, outside air temperature and outside air humidity on each graphic.
   2. Provide navigation links to scheduling, trends, alarms.
   3. Provide navigation link to the campus level graphic and building level graphic.
   4. Ensure standard operation of backward and forward button on browser.
   5. Provide color animation to indicate run status.

B. Campus Level Graphic
   1. Display each building on a geographical map
   2. Display time, outside air temperature and outside air humidity.

C. Building Level Graphic
   1. Display equipment on floorplans.
   2. Outline each HVAC zone with bold lines.
   3. Display thermograph on floorplan (i.e. color shading to represent temperate deviation from setpoint).
   4. Display if system is following occupied/unoccupied schedule.

D. Equipment Graphics
   1. Display equipment graphic that depicts the actual configuration of the equipment.
   2. Display each point value in the appropriate place on the equipment.
   3. Provide override capability for output points from equipment graphic.
   4. Provide animation to indicate operational points.
   5. Provide indication of program outputs such as, but not limited to cooling mode, dehumidification, occupied/unoccupied, etc.

E. Summary Page Graphics
   1. Provide summary list of AHU’s, schedule status, discharge air temperature and discharge air temperature setpoint.
   2. Provide summary list of terminal units, schedule status, zone air temperature and zone air temperature setpoint.
   3. Provide summary list of all equipment with out of service flags.
   4. Provide summary list of all exhaust fans and status.

3.7 Trend Points List
A. Control contractor to start trends on all points during commissioning.

END OF SECTION
SECTION 23 21 13

HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. HVAC chilled water piping, below grade.
      2. HVAC chilled water piping, above grade.
      3. Condensate and equipment drain and overflow piping.
      4. Valves.
      5. Unions and flanges.
   B. Related Sections:
      1. Section 23 05 00 – General Mechanical Requirements: Execution requirements for trenching and backfill required by this section.
      2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers, supports and firestopping for placement by this section.
      3. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for valve and pipe identification for placement by this section.
      4. Section 23 25 00 – HVAC Water Treatment: Cleaning requirements for closed hydronic systems.

1.2 REFERENCES
   A. American Society of Mechanical Engineers:
      1. ASME B16.3 - Malleable Iron Threaded Fittings.
      2. ASME B16.4 - Gray Iron Threaded Fittings.
      3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
      4. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
      5. ASME B31.9 - Building Services Piping.
      6. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
   B. ASTM International:

C. American Welding Society:
   1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
   2. AWS D1.1 - Structural Welding Code - Steel.

D. American Water Works Association:

E. Manufacturers Standardization Society of the Valve and Fittings Industry:
   1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
   2. MSS SP 67 - Butterfly Valves.
   3. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
   4. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
   5. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
   6. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 SYSTEM DESCRIPTION
A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

B. Provide flanges, union, and couplings at locations requiring servicing. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

C. Use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

D. Use ball, plug or butterfly valves for throttling, bypass, or manual flow control services.

E. Use lug end butterfly valves to isolate equipment.

F. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

1.4 SUBMITTALS
A. Section 23 05 00 – General Mechanical Requirements: Submittal procedures.

B. Shop Drawings:
   1. Indicate schematic layout of piping system, including equipment, critical dimensions, and sizes.

C. Product Data:
   1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.

D. Test Reports:
   1. Indicate results of chilled and hot water piping system pressure test.

E. Manufacturer's Certificate:
   1. Certify products meet or exceed specified requirements.

F. Welders’ Certificate:
   1. Include welders’ certification of compliance with AWS D1.1.

G. Detailed plan of flushing and cleaning procedures.

1.5 CLOSEOUT SUBMITTALS
A. Section 23 05 00 – General Mechanical Requirements: Closeout procedures.
B. Project Record Documents:
   1. Record actual locations of valves, equipment and accessories.
C. Operation and Maintenance Data:
   1. Submit instructions for installation and changing components, spare parts lists, exploded assembly views, supplier contact information.

1.6 QUALITY ASSURANCE
A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

1.7 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum ten years experience.

B. Fabricator or Installer:
   1. Company specializing in performing Work of this section with minimum five years experience.

1.8 PRE-INSTALLATION MEETINGS
A. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING
A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.10 ENVIRONMENTAL REQUIREMENTS
A. Do not install underground piping when bedding is wet or frozen.

1.11 FIELD MEASUREMENTS
A. Verify field measurements prior to fabrication.

1.12 WARRANTY
A. Section 23 05 00 – General Mechanical Requirements: Guarantees
PART 2 - PRODUCTS

2.1 HVAC CHILLED WATER PIPING, BELOW GRADE

A. Buried piping shall be pre-insulated and jacketed, manufactured by Insul-Pipe Systems or Engineer approved equal.

B. Carrier Pipe: Copper Tubing: ASTM B88, Type K, drawn.
   1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
   2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.

C. Insulation and Casing: 1.0 inch thick, 2.5 pcf density, closed cell polyurethane insulation with PVC jacket rated for H-20 highway loading.

2.2 HVAC CHILLED WATER PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black.
   2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.

B. Copper Tubing: ASTM B88, Type L, drawn.
   1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
   2. Joints:
      a. Option #1: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.
      b. Option #2: Copper or Bronze Press-Connect Fittings:
         1) Basis-of-Design Product: Subject to compliance with requirements, provide Viega LLC or Engineer approved equal.
         2) For Type L hard copper tubing 1/2 inch to 4 inch.
         3) Housing: Copper or bronze.
         4) Smart Connect Technology.
         5) Sealing Element: EPDM.
         6) Tools: Manufacturer's special tools.

2.3 CONDENSATE AND EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tubing: ASTM B88, Type L, drawn.
   1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
   2. Joints:
      a. Option #1: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.
      b. Option #2: Copper or Bronze Press-Connect Fittings:
         1) Basis-of-Design Product: Subject to compliance with requirements, provide Viega LLC or Engineer approved equal.
         2) For Type L hard copper tubing 1/2 inch to 4 inch.
         3) Housing: Copper or bronze.
         4) Smart Connect Technology.
         5) Sealing Element: EPDM.
         6) Tools: Manufacturer's special tools.
         7) Maximum 200-psig working-pressure rating at 250 deg F
2.4 VALVES

A. Manufacturers:
   1. NIBCO Models indicated below or equivalent by the following manufactures:
      a. Crane Valve, North America.
      b. Hammond Valve.
      c. Milwaukee Valve Company.
      d. Stockham Valves & Fittings.
      e. Substitutions: As approved by Engineer prior to bid date.

B. Chilled Water:
   1. Line Control Valves 2 ½” and Smaller
      a. Ball Valves: Valves shall be rated 150 psi SWP and 600 psi non-shock WOG and will have 2-pc cast bronze bodies. TFE seats, standard port, separate packnut with adjustable stem packing, anti-blowout stems and chrome-plated brass/bronze ball. Valve ends shall have full depth ANSI threads or extended solder connections and manufactured to comply with MSS SP110.
      b. Note: Where piping is insulated, ball valves shall be equipped with 2” extended handles of non-thermal conductive material. Also, provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which are fully adjustable after insulation is applied, shall be included.
   2. Line Control Valves 2 ½” and Larger:
      a. Butterfly Valves: Valves shall be lug or I.P.S grooved body style manufactured in accordance with MSS-SP67 rated at least 200 psi non-shock cold water working pressure. Body to have 2” extended neck for insulating and to be cast iron or ductile iron. Valve to have aluminum bronze alloy disc with EPDM rubber seat and seals; or EPDM rubber encapsulated disc with polymer coated body. Stem shall be 400 series stainless steel and shall not have exposed stem to disc fasteners. Sizes 2 ½” – 6” shall be lever operated with 10-position throttling plate sizes 8” and larger shall have weatherproof gear operators. Lug style shall be capable for use as isolation valves and recommended by manufacturer for dean-end service at full pressure without the need for downstream flanges.

2.5 PLUG VALVES

A. Manufacturers:
   1. DeZURIK, Unit of SPX Corp.
   2. Flow Control Equipment, Inc.
   3. Homestead Valve.
   4. Substitutions: As approved by Engineer prior to bid date.

B. 2 inches and Smaller: MSS SP 78, Class 150, semi-steel construction, square or rectangular port, full pipe area, pressure lubricated, teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.
C. 2-1/2 inches and Larger: MSS SP 78, Class 150, semi-steel construction, square or rectangular port, full pipe area, pressure lubricated, teflon packing, flanged ends. Furnish wrench-operated.

2.6 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:
   1. Ferrous Piping: Class 150, malleable iron, threaded.
   2. Copper Piping: Class 150, bronze unions with brazed joints.
   3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches and Larger:
   1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
   2. Copper Piping: Class 150, slip-on bronze flanges.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
B. Remove scale and dirt on inside and outside before assembly.
C. Prepare piping connections to equipment with flanges or unions.
D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
E. After completion, fill, clean, and treat systems.

3.2 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Route piping parallel to building structure and maintain gradient.
B. Install piping to conserve building space, and not interfere with use of space.
C. Group piping whenever practical at common elevations.
D. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.
E. Firestopping of piping penetrating any fire rated construction shall be installed under Section 07 84 00.
F. Install pipe identification in accordance with Section 23 05 53.
G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
H. Slope hydronic piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe aligned.
I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
J. Install valves with stems upright or horizontal, not inverted.
K. Insulate piping and equipment; refer to Section 23 07 00.

3.3 TESTING

A. All systems shall be hydrostatically tested at 125 psig or a pressure equal to 150% of the total system operating pressure, whichever is greater, for a period of time sufficient to inspect every joint in the system, and, in no case, less than two hours. No loss of pressure will be
allowed. Leaks found during tests shall be repaired by replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping shall be tested in place before covering or concealing.

B. Operational Tests:

1. After the above testing and cleaning have been completed and before the system is accepted, capacity and general operating tests of the air conditioning and heating system shall be conducted as specified under Section 23 05 93: Testing and Balancing. Contractor shall make all adjustments and/or modifications to the piping systems as required, in order for the Balancing and Performance Test results to indicate that the facility meets the requirements of the Contract Documents.

3.4 CLEANING AND FLUSHING WATER SYSTEMS:

A. Refer to Section 23 25 00 - HVAC Water Treatment Systems for cleaning and flushing of piping systems.

END OF SECTION
SECTION 23 21 16
HYDRONIC PIPING SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY
A. Section Includes:
   2. Pressure gages.
   3. Pressure gage taps.
   4. Thermometers.
   5. Thermometer supports.
   6. Test plugs.
   7. Flexible connectors.
   8. Air vents.
  10. Automatic flow controls.
  11. Flow meters.
  12. Relief valves.

1.2 REFERENCES
A. American Society of Mechanical Engineers:
   1. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
B. ASTM International:

1.3 PERFORMANCE REQUIREMENTS
A. Flexible Connectors:
   1. Provide at or near pumps and chillers where piping configuration does not absorb vibration.

1.4 SUBMITTALS
A. Section 23 05 00 – General Mechanical Requirements:
   1. Submittal procedures.
B. Product Data:
   1. Submit for manufactured products and assemblies used in this Project.
   2. Manufacturer’s data indicating use, operating range, total range, accuracy, and location for manufactured components.
   3. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
4. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
5. Submit electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions:
   1. Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.

1.5 CLOSEOUT SUBMITTALS
A. Section 23 05 00 – General Mechanical Requirements:
   1. Closeout procedures.
B. Project Record Documents:
   1. Record actual locations of actual locations of components and instrumentation, flow controls and flow meters.
C. Operation and Maintenance Data:
   1. Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.6 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
B. Installer:
   1. Company specializing in performing Work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE AND HANDLING
A. Section 23 05 00 – General Mechanical Requirements:
   1. Product storage and handling requirements.
B. Accept piping specialties on site in shipping containers with labeling in place. Inspect for damage.
C. Provide temporary protective coating on cast iron and steel items.
D. Protect systems (new and existing) from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.8 ENVIRONMENTAL REQUIREMENTS
A. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.9 FIELD MEASUREMENTS
A. Verify field measurements before fabrication.
1.10 WARRANTY
A. Furnish one year manufacturer warranty for piping specialties.

PART 2 PRODUCTS

2.1 MANUAL LIQUID FLOW MEASURING & SETTING DEVICES
A. Manufacturers:
   1. Flow Design Inc.
   2. Nexus.
   3. Hays.
   4. Substitutions: As approved by Engineer prior to bid date.

B. Measuring:
   1. ½”-2”: Provide calibrated, venturi type balance valve (to be used in full gpm position for measuring only, on outlet side), equal to Nexus Ultra XB Ortu, Model XB, with venturi section constructed so as not to require upstream/downstream straight pipe diameters. Rated for 600 WOG, 325°F; accuracy ± 3%. Provide with extended housing/handle for 2” insulation and extend pressure test ports.
   2. 2 ½”-4”: Provide Nexus Nextrol, Model NXFB calibrated balance valve (for measuring only full gpm on outlet side), or approved equal. Provide extended neck on pressure test port and valve for 2 ½” insulation.

C. Setting:
   1. ½”-2”: Provide memory stop valves for setting flow (on inlet side), complete with strainer and test port. Nexus Ultra Y, Model UY or approved equal. Provide with extended housing/handle for 2” insulation and extend pressure test ports.
   2. 2 ½”-4”: Provide butterfly valve with memory stop and strainer with pressure test port. Provide with extended ports and valve handles for 2 ½” insulation; provide extended neck pressure test ports.

2.2 PRESSURE GAGES
A. Manufacturers:
   1. Trerice.
   3. Weiss.
   4. Substitutions: As approved by Engineer prior to bid date.

B. Gage: ASME B40.1 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
   2. Bourdon Tube: Phosphor bronze.
   3. Dial Size: 3-1/2 inch diameter.
   4. Mid-Scale Accuracy: Two percent.
   5. Scale: Psi.
2.3 PRESSURE GAGE TAPS
A. Manufacturers:
   1. Peterson Engineering
   2. Substitutions: None Permitted.
B. Needle Valve:
   1. Brass, 1/4 inch NPT for minimum 300 psi.
C. Ball Valve:
   1. Brass, 1/8 inch NPT for minimum 300 psi.
D. Pulsation Damper:
   1. Pressure snubber, brass with 1/4 inch NPT connections.
E. Siphon:
   1. Brass, 1/4 inch NPT angle or straight pattern.

2.4 STEM TYPE THERMOMETERS
A. Manufacturers:
   1. Trerice.
   3. Weiss.
   4. Substitutions: As approved by Engineer prior to bid date.
B. Thermometer: ASTM E1, adjustable angle, red appearing liquid, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.
   1. Size: 9 inch scale.
   2. Window: Clear glass Lexan.
   4. Accuracy: ASTM E77 2 percent.
   5. Calibration: Degrees F.

2.5 THERMOMETER SUPPORTS
A. Socket:
   1. Brass separable sockets for thermometer stems with extensions, and with cap and chain.
B. Flange:
   1. 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.6 TEST PLUGS
A. Manufacturers:
   1. Peterson Engineering.
   2. Substitutions: None Permitted.
B. 1/4 inch NPT or 1/2 inch NPT brass stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
   1. Neoprene core for temperatures up to 200 degrees F.
   2. Extended type for insulation thickness.

C. Test Kit:
   1. Carrying case, internally padded and fitted containing:
      a. Two 2 inch diameter pressure gages.
         1) Scale range: 0 to 100 psi.
      b. One gage adapter with 1/8 inch probes.
      c. Two 1-1/2 inch dial thermometers.
         1) Scale range: 0 to 100 degrees F.

2.7 FLEXIBLE CONNECTORS
A. Manufacturers:
   1. Mason.
   2. Substitutions: As approved by Engineer prior to bid date.

B. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 300 psig.

2.8 AIR VENTS
A. Manual Type:
   1. Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle or ball valve at top of chamber.

B. Float Type:
   1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2.9 STRainers
A. Size 2 inch and Smaller:
   1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

B. Size 2-1/2 inch to 4 inch:
   1. Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

C. Size 5 inch and Larger:
   1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.10 AUTOMATIC FLOW CONTROLS
A. Manufacturers:
   1. Danfoss.
   2. Flow Design.
3. Substitutions: As approved by Engineer prior to bid date.

B. Construction:
   1. Brass or bronze body with union on inlet, temperature and pressure test plug on inlet and outlet.

C. Calibration:
   1. Control within 5 percent of design flow over entire operating pressure.

D. Control Mechanism:
   1. Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.

E. Accessories:
   1. In-line strainer on inlet and ball valve on outlet.

2.11 FLOW METERS
A. Orifice type by-pass circuit with direct reading gage, soldered or flanged piping connections for 125 psig working pressure, with shut off valves, and drain and vent connections.
B. Direct reading with insert pitot tube, threaded coupling, for 150 psig working pressure, maximum 240 degrees F, 5 percent accuracy.
C. Cast iron, wafer type, orifice insert flow meter for 250 psig working pressure, with read-out valves equipped with integral check-valves and caps with gaskets.
D. Calibrated, plug type balancing valve with precision-machined orifice, readout valves equipped with integral check valves and caps with gaskets, calibrated nameplate and indicating pointer.
E. Cast iron or bronze, globe style, balancing valve with hand wheel with vernier type ring setting and memory stop, drain connection, readout valves equipped with integral check valves and caps with gaskets.

2.12 RELIEF VALVES
A. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

PART 3 EXECUTION
3.1 INSTALLATION - METERS
A. Install liquid flow meters with shutoff valves on inlet and outlet.

3.2 INSTALLATION - THERMOMETERS AND GAGES
A. Install one pressure gage for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.
B. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.
C. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
D. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.
E. Coil and conceal excess capillary on remote element instruments.
F. Provide instruments with scale ranges selected according to service with largest appropriate scale.
G. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
H. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.3 INSTALLATION - HYDRONIC PIPING SPECIALTIES
A. Locate test plugs as indicated on Drawings.
B. Install manual air vents at system high points.
C. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain (or cooling coil drain pan).
D. Provide drain and hose connection with valve on strainer blow down connection at control valves and other remote devices. For those strainers near a floor drain, pipe discharge to floor drain.
E. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
F. Select system relief valve capacity greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
G. Pipe relief valve outlet to nearest floor drain.
H. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

3.4 FIELD QUALITY CONTROL
A. Coordinate with CxA for field inspecting, testing, adjusting, balancing and Cx work.

3.5 PROTECTION OF INSTALLED CONSTRUCTION
A. Do not install hydronic pressure gauges until after systems are pressure tested.

END OF SECTION
SECTION 23 21 23

HYDRONIC PUMPING SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Section includes a packaged chilled water pumping system including the following components:
   1. Enclosure
   2. Pumps and motors
   3. Piping, valves, and fittings
   4. Control valves
   5. Variable frequency drives
   6. Air/dirt separator
   7. Expansion Tank
   8. Buffer Tank
   9. Chemical Feeder.
   10. Sequencing controls
   11. Flow transmitters
   12. BACnet interface

1.2 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. Underwriters Laboratories Inc.:
   1. UL 778 - Motor Operated Water Pumps.

1.3 PERFORMANCE REQUIREMENTS

A. Provide pumps to operate at system fluid temperatures indicated on Drawings without vapor binding and cavitations, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve. The packaged system shall include all components, pumps, electrical wiring and controls as required to provide a fully functional variable primary pumping system.

1.4 SUBMITTALS

A. Section 23 05 00 – General Mechanical Requirements:
   1. Submittal procedures.

B. Product Data:
   1. System design information sheet.
   2. Description of system operation including sequence of operation and BAS interface points list.
   3. Packaged system dimension and general arrangement drawing.
4. Electrical power and control-wiring diagram.
5. Pump material and construction drawing.
6. Pump curve showing design point.
7. Catalog information on valves, strainers and control components.
8. Piping schematic of packaged system components, showing all pipe sizes, location of reducers, components, specialties and instrumentation.
9. Structural base drawings showing number and size of members accompanied by deflection calculations.
10. Enclosure drawings depicting construction materials and dimensional data.
11. Complete Variable Frequency Drive submittal.

C. Manufacturer's Installation Instructions:
   1. Submit manufacturer’s installation instructions for packaged system.

1.5 CLOSEOUT SUBMITTALS
A. Section 23 05 00 – General Mechanical Requirements:
   1. Closeout procedures.
B. Operation and Maintenance Data:
   1. System design information sheet.
   2. Description of system operation.
   3. Packaged system dimension and general arrangement drawing.
   4. Piping schematic of packaged system components and specialties.
   5. Control panel drawing with list of operator interfaces.
   6. Electrical power and control-wiring diagram.
   7. Bill of material.
   8. Pump operation and maintenance instructions.
   9. Special electrical component operation instructions.

1.6 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Installer:
   1. Company specializing in performing Work of this section with minimum three years documented experience.

1.7 QUALITY ASSURANCE
A. After factory assembly, the packaged pump system shall be hydrostatically tested to 150 PSIG for ANSI Class 150 and 250 PSIG for ANSI Class 300 for a minimum of thirty minutes. The control system shall be tested and all sequences and alarms shall be simulated.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Section 23 05 00 – General Mechanical Requirements:
   1. Product storage and handling requirements.
B. Protect systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
1.9 FIELD MEASUREMENTS  
A. Verify field measurements prior to fabrication.

1.10 WARRANTY  
A. Furnish one year manufacturer warranty for pumps and motors.

PART 2 PRODUCTS

2.1 MANUFACTURERS  
A. Canariis.  
B. EnviroSep.  
C. Grundfos.  
D. Substitutions: As approved by Engineer prior to bid date.

2.2 MANUFACTURED UNITS  
A. Furnish and install a factory assembled variable speed packaged pump system. The system shall require only suction and discharge pipe connections and one electrical power connection and necessary terminal contacts to the various field mounted devices and the building automation system.  
B. The packaged system shall consist of system base, enclosure, pumps, electric motors, controls, valves and all necessary piping and components as listed in this specification for a complete system. The system shall be designed as scheduled. The package will have an N+1 pumping arrangement.  
C. Basic Construction  
   1. General Construction  
      a. The skid shall be factory assembled and shipped in one piece.  
D. Structural steel base, wall and roof frame  
   1. Shall be manufactured of structural carbon steel and shall be of a fully welded construction.  
   2. All critical load bearing points shall be engineered and certified for structural integrity to meet both stationary and shipping conditions.  
   3. Strut may only be used in the mounting of wiring and electrical connections.  
   4. The use of strut as structural reinforcement is prohibited or to mount equipment shall not be accepted.  
E. Support Structure  
   1. The entire skid shall be designed to meet and or exceed loading (wind, snow/sand, live and dead loading, and lifting) to which it might be exposed.  
F. The skid shall include removable lifting lugs placed in specific locations as required for rigging, lifting, and shipping of entire (in sections or complete) module  
G. The wall frame shall be constructed of structural carbon steel using 3” square tube members. 4” square tubing may be used if the structural load demands it.  
   1. Square tubing less that 3”x3” shall not be accepted.  
   2. The wall frame shall be a structural “post and beam” design that is of a completely welded construction.  
   3. Bolting of the post(s) and beam(s) shall not be unacceptable.
H. Roof Assembly
1. Roof assembly shall be constructed of 3” square structural carbon steel. A 2% or ¼” per foot of slope of the roof shall be provided.
2. Any slope that is less than 2% is unacceptable.
3. The roof structure shall be of a fully welded construction.

I. Accessories
1. The skid shall be provided with all access doors, support structures and removable panels to access all equipment supplied.
2. Interior and exterior lighting, safety devices and 120/1/60 convenience outlets shall be provided.

J. Piping
1. Piping systems shall be of a quantity and size as required for proper operation of the skid.
2. All piping shall be hydrostatically pressure tested in the factory before shipping.
3. Pressure testing using compressed air is not acceptable.
4. Vendor must record the pressure test and include test documentation as part of the Commissioning / Operational and Maintenance manuals to be located in a fixed location within the skid enclosure.
5. All piping systems shall be complete and installed in the factory.
6. All chilled water piping shall use Schedule 40 black steel piping.
7. All interior piping shall have welded connections.
8. All makeup, pressure relief and drain piping shall be type L copper.
9. All water pipe welds shall be performed by ASME Certified facility and according to ASME procedures.

K. Pipe Supports
1. Piping shall utilize heavy duty pipe supports to assure proper support of pipe and equipment under all operating conditions and to prevent excessive vibration from being introduced into pipework or equipment.
2. All headers to have adjustable screw type leveling system installed to raise and lower piping for alignment.
3. U-clamp pipe supports shall not be accepted.

L. Interior Piping
1. Interior chilled water piping, vessels and chilled water pumps shall be factory insulated with insulation as specified in section 23 07 00.
2. Prior to the application of insulation, pipe surfaces shall be painted.
3. To assure proper insulation adhesion, glue shall be applied in full coverage to both the piping and insulation.
4. Hydrostatic system testing and repair of any leaks shall be performed prior to the application of insulation.

M. Exterior Piping
1. All CHW piping external to the skid enclosure shall be field insulated by the Div 23 contractor as specified in 23 07 00.
2. All domestic makeup water piping external to the skid enclosure shall be field insulation by the Div 22 contractor as specified in 22 07 00.

N. Wall and Roof Panels
1. All equipment is installed within a fabricated industrial grade double-wall enclosure.
2. The wall panels shall be 2” thick, 42” wide as detailed on the design drawings. The
side joint shall be of tongue-and-groove and shiplap design with factory supplied weather sealing, permitting exterior side installation and fasteners completely concealed within the side joint. The concealed fasteners shall positively lock the face sheet of the panel to the structural supports and provide positive resistance to negative load pull-off.

3. Panel Exterior shall have a minor rib profile with ribs at 3-1/2" centers and shall be stucco embossed. The exterior element shall be formed of 26 gauge galvanized steel, conforming to ASTM A 446, hot dipped, commercial quality galvanized steel (designated G-90) using the following finish specification:
   a) Valspar® modified polyester finish with a total minimum dry film thickness of 1.0 mil including primer.
   b) A primer on the non-show side having a minimum dry film thickness of 0.2 mil.
   c) Exterior color shall be as specified by the Architect, with the interior being Imperial White.
   d) Panel Interior shall have a minor rib profile with ribs at 3-1/2" centers and be of 26 gauge, stucco embossed hot dipped galvanized steel (designation G-90) using the following finish specifications:
   e) Valspar® modified polyester finish, USDA accepted, warranted for 20 years in areas requiring heavy wash down.
   f) Primer on the non-show side, with a minimum dry film thickness of 0.2 mil.
   g) Interior color shall be Imperial White.

4. Fasteners – self tapping fasteners shall be cadmium plated steel, designed to resist maximum negative pull-off loads and hold the face sheet mechanically to the structural building support steel. Heads of concealed fasteners shall be insulated from the exterior environment to prevent condensation and “ice-balling” from occurring on the fastener shaft.

5. Perimeter Trim and Penetration Treatments - Furnish all required extruded trim and gauge metal flashing with same coating and color as the exterior face of the insulated panel.

O. Self-contained Cooling/Heating Unit with:
   1. Aluminum Finned Copper Coils:
      a) Grooved tubing and enhanced louvered fin
   2. Twin Blowers:
      a) multispeed blower motors providing airflow adjustment for high and low static operation.
   3. Heat Pump Compressor:
      a) Scroll Compressors 3 ton models.
      b) Phase Rotation Monitor:
      c) R-410A Refrigerant:
      d) R-410A (HFC) non-ozone depleting refrigerant in compliance with the Montreal protocol and 2010 EPA requirements.
   4. Liquid Line Filter Drier:
   5. Galvanized 20 Gauge Zinc Coated Steel
   6. Cabinet:
      a) Cleaned, rinsed, sealed and dried before the polyurethane primer is applied. The cabinet is handsomely finished with a baked on, beige textured enamel, which allows it to withstand 1000 hours of salt spray tests per ASTM B117-
7. Foil Faced Insulation:
8. Electric Heat Strips:
   a) Features an automatic limit and thermal cut-off safety control. Features easy slide-in field assembly with various BTUH outputs.
9. Condenser Fan and Motor
10. One Inch, Disposable Air Filters:
11. Solid State Electronic Heat Pump Control:
    a) Provides efficient 30, 60 or 90 minute defrost cycle. A thermistor sensor, speed up terminal for service and 10 minute defrost override are standard on the electronic heat pump control.
12. Barometric Fresh Air Damper:
    a) Allows up to 25% outside fresh air.
14. Slope Top:
    a) Standard feature for water run-off.
15. Full Length Mounting Brackets.
16. Unit shall be sized by skid manufacturer to ensure the enclosure is adequately conditioned to protect the electronic equipment and water filled components housed within the enclosure.

P. Performance – Structural Test
1. Thermal Properties - The panel shall provide an R-17 value when corrected to a 15 MPH wind condition and when tested by a recognized facility in accordance with ASTM C 1363 or ASTM C 518.
2. Fatigue Test - There shall be no evidence of metal/insulation interface delamination when the panel is tested by simulated wind loads of 20 psf (positive and negative loads), when applied for two million alternate cycles. This should be verified by an independent testing facility.
3. Bond Strength - No metal primer interface corrosion and/or delamination shall occur after 1000 hours at 140°F and 100% relative humidity. No delamination shall occur after 2-1/2 hours in a 2 psi 212°F autoclave.
4. Water Penetration - There shall be no uncontrolled water leakage at 6.24 psf air pressure differential when tested in accordance with ASTM E 331 and with the wall assembly containing at least principal horizontal joint.
5. Air Infiltration - Air infiltration through the wall shall not exceed 0.01 cfm/s.f. at 20 psf air pressure differential when tested in accordance with ASTM E 283 and with the wall assembly shall contain at least one principal horizontal joint.
6. The interior metal substrate shall include a 20-year polyester coating to a total dry thickness of 1.0 mil including primer. The exterior metal substrate shall include a 30-year ceramic polyester finish to a total dry thickness of 1.0 mil including primer. The exterior will coated with a 3 part epoxy with sea salt spray rating of 1000 hours continuous and overall life of 20 years in sea salt environment;
7. Units shall be rated and carry Factory Mutual’s Class 1 rating for wall and ceiling construction - FM 4880 Unlimited Height.

Q. Factory Testing
1. The skid shall be provided as a completed unit ready to install at the job site and shall be tested including a complete system hydrostatic and simulated operational testing.
2. Hydrostatic test shall be an ASME certified and approved testing procedure.
3. Complete system hydrostatic and simulated operational testing and any repairs made shall be documented and retained by manufacturer.
4. Testing shall include filling all closed water circuits with water and testing for any leaks under pressure. Any leaks found shall be repaired and the equipment retested.
5. Simulated operational testing shall include run testing of pumps and testing control operations.

2.3 COMPONENTS

A. Pumps and Motors – End Suction Pumps (Vertical Inline Pumps will also be acceptable)
   1. Furnish and install end suction split coupled pumps as per plans and pump schedule.
      The pumps shall be split coupled, base mounted, single stage, end suction top discharge design, cast iron bronze fitted construction. The pumps shall have the following features:
      2. Volute: Cast iron ASTM A48 - Class 30
      3. Case Wear ring: Vesconite
      4. Impeller: Stainless Steel AISI 304
      5. Shaft: Stainless Steel AISI 303
      7. Motor Bracket: Cast Iron ASTM A48- Class 30
      8. Bushing (shaft bearing): Vesconite
     10. Mechanical Seals: Carbon – Ceramic with Buna Elastomers and Stainless Steel hardware
     11. Recirculation Line: Nylon Tubing with Brass Fittings
     12. Pump shall be connected to the drive motor by a rigid, aluminum, axially split coupling capable of withstanding all torsional, radial and axial loads. The coupling design shall facilitate alignment of the motor and pump shaft.
     13. The pump manufacturer shall provide an OSHA approved coupling guard, which shall be mounted between the pump and motor.
     14. The base shall be of bolted construction. The motor deck shall be cast iron with ductile iron pump support. The side rail shall be structural steel. The minimum stiffness of the base shall conform to ANSI/HI 1.3-2000, section 1.3.5.3 for Horizontal Base Plate Design standards. The entire unit shall not require grouting for operation within Hydraulic Institute Standards for Vibration.
     15. Each pump shall be painted with one coat of high quality factory approved paint and name-plated before shipment from the factory.
     16. Motors
        a. Pump and motors shall be factory aligned, and shall be realigned after installation by the manufacturer’s representative.
        b. Motor shall be of a C-face design with a lockable split collar on motor side to facilitate precise positioning of rotating assembly with reference to
Hydraulic geometry.

c. Motors shall be suitably sized per ISO5199 and shall meet NEMA specifications and conform to the standards outlined in EISA 2007.
d. Acceptable Manufacturers shall include Armstrong, Bell & Gossett, Grundfos, Paco, and Taco.

B. Piping, valves, and fittings

1. The package piping shall consist of fabricated welded steel headers using manufactured fittings conforming to ASME Code B.31.1. All piping for the system shall be sized for a maximum velocity of 10 feet per second with no greater head loss per 100 feet of pipe than 8.5 feet. Branch piping to the pumps shall be sized for the design capacity of the pump. Base mounted supports shall be provided for the suction header, the suction and discharge piping on each pump and the discharge header. Piping shall be supported independently of pump connections. Pipe supports welded directly to the pipe shall be unacceptable. Pipe supports shall be arranged to permit field installation by the contractor of 1.5" thick pipe insulation.

2. Pete's plugs are to be provided on the suction and discharge of the package connections.

3. Drain plugs are to be provided in the pipe above the check valve or in any low piping that may collect water.

4. Butterfly valves shall be furnished on the suction and discharge of each pump. Valves shall be constructed with a ductile iron lug body, EPDM seat, aluminum bronze disc, 416 stainless steel shaft and bronze bushings. Valves 6" and smaller shall be provided with lever operators and valves 8" and larger shall be provided with hand-wheel and gear operator.

5. A spring-loaded check valve shall be installed on the discharge of each pump. Valve shall be iron body with a pressure rating equal to pump shut-off head plus maximum suction pressure. Valve trim shall be bronze with stainless steel spring. Above each check valve provide spool piece with a drain plug.

6. A suction strainer shall be installed on the suction of each pump. The strainer shall be of the suction diffuser type. The strainer shall be constructed with a cast iron body and stainless steel or brass screen. The strainer shall be full sized; a reducing strainer is not acceptable. Provide an eccentric reducer connected directly to the suction of the pump and a concentric expander connected directly to the discharge of the pump. The strainer shall include mounted blow-down valve. Blow-down valve shall be piped to drain by contractor.

C. Expansion tank

1. An expansion tank shall be provided. The expansion tank shall be a 23 gallon pre-charged steel hydro pneumatic tank with replaceable heavy-duty rubber bladder. The unit shall be constructed in accordance with Section VIII of the ASME boiler and pressure vessel code and stamped 125 PSIG design pressure.

D. Buffer tank

1. A 200 gallon buffer tank shall be provided. The tank shall include internal baffles and flanged connections. The unit shall be constructed in accordance with Section
VIII of the ASME boiler and pressure vessel code and stamped 125 PSIG design pressure.

**E. Chemical shot feeder**

1. A 5 gallon chemical shot feeder shall be provided. The shot feeder shall be piped across the system and shall include shut-off valves, fill funnel with valve, manual air release valve, and drain connection with valve.

**F. Make up water (as needed)**

2. A 3/4” make-up water system shall be provided. This system shall include pressure-reducing valve, RPZ type backflow preventer, shut-off valves, Y-strainer, pressure gauge, and manual bypass.

**G. Air/Dirt Separator**

1. Furnish and install a full flow coalescing type combination air eliminator and dirt separator for the chilled water systems. In no case shall entering velocity exceed 10 feet per second. Separator shall be fabricated steel, rated for 150 psig working pressure, stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels, and include two equal chambers above and below the inlet / outlet nozzles. Unit shall include internal elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% free air, 100% entrained air, and 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes. The elements must consist of a copper core tube with continuous wound copper wire medium permanently attached and followed by a separate continuous wound copper wire permanently affixed. Each unit shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism. Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill. Basis of design for the air eliminator / dirt separator shall be the 4900 Series Air/Dirt Separator as manufactured by Taco or Engineer approved equal. Air/dirt separator shall include removable top head for internal inspection.

**H. Variable frequency drives**

a. A variable frequency drive with NEMA 3R enclosure shall be furnished for each chilled water pump. See specification 23 05 14 for additional requirements.

**I. Sequencing Controls**

1. The electric control system for the pumps shall be designed to start and stop the pumps and modulate their speed as required by system demands. The system shall operate as indicated in the sequences on the drawings.

2. **Graphical Controller and Enclosure**

a. All control components shall be mounted in a single enclosure. The enclosure will be of metal construction for rejection of EMI and RFI signals. The enclosure material shall be as a minimum 12 gauge steel and shall conform to NEMA standards for type 4. The enclosure shall include mounting legs for freestanding floor mount installation. The control panel shall be UL listed as an assembly. The controls shall include all
components and wiring to perform the necessary operations. The panel shall include terminal block connections for the external sensors and remote telemetry contacts.

b. The control panel will include an incoming service three phase monitor to protect against phase loss, under voltage and phase reversal conditions. The phase monitor will include an LED that will illuminate when all line conditions are normal. The phase monitor will further include an adjustable operating voltage range of 430-480 VAC. A panel mounted indicating light shall be provided to annunciate “Power Normal” status.

c. A secondary Surge Arrester suitable for service entrance locations conforming to NEC article 280 shall be included in the control panel. The surge arrester shall meet ANSI/IEEE C62.11-1993 requirements. The surge arrester shall include LED indication for operating status of each phase.

d. The control panel will include one thermal-magnetic molded case circuit breaker per motor. The combination of the motor circuit protector and the VFD overload feature shall protect the motor from short circuit and thermal overload conditions. The circuit breaker shall be of the permanent trip type, UL listed with a minimum of 600 Vac, 18kA interruption rating. The AC magnetic trip setting shall be sized for the appropriate motor load. Each motor circuit breaker will include a thru the door disconnect operator. Disconnect operator will include “locked in off” position feature. Motor nameplate amps, FLA, shall be used for setting of both the overload and short circuit limits allowing ample capacity on the motor circuit protector for normal starting current draw.

e. The system logic shall be by a microprocessor-based controller and shall include an operator interface unit for display of system variables and adjustment of designated set points. Field programming shall be password accessible.

f. The operator interface unit shall offer the following features:

1) Touch screen interface
2) Graphical object capabilities
3) Text display
4) Alarm capabilities with history, count and detail
5) Built in clock
6) Screen and object password protection, up to eight user defined levels
7) Minimum of 256K internal memory
8) NEMA and UL type 4 enclosure
9) UL listed

g. All system messages will be displayed in plain English with standard engineering units.
h. System logic shall be preprogrammed by the panel vendor. The microprocessor controller shall include the following minimum configuration:
   1) 20 discrete inputs
   2) 16 discrete outputs
   3) 4 analog inputs
   4) 2 analog outputs
   5) 2 communication ports
   6) 4-I/O expansion slots
   7) Nonvolatile memory
   8) PID programming capability and floating point math
   9) Real time clock

i. The control panel shall include individual pump hand-off-auto selectors. The selectors shall be mounted external through the panel door and shall be NEMA 4X rated.

j. The control panel shall include a common audible alarm horn to annunciate a fault condition. Specific cause of fault will be displayed on the HMI. The control panel shall be supplied with a horn silence pushbutton.

k. The system will include a 120 Vac step down transformer for systems were the primary line voltage exceeds 120 Vac. Transformer primary and secondary will be fuse protected.

l. A door handle shall be provided for each panel disconnect switch so that power circuits are turned off before the door is opened. Electric wiring shall be completed between cubicle, electric motors, and system mounted controls.

m. Each control enclosure controller shall be equipped with communications module(s) and cabling such as to allow transfer of data needed during periods of emergency operation, and for transmission of data to the building automation system. Communications module(s) and cabling shall be BACNet compatible.

n. Electrical wiring shall be run in conduit. Conduit shall be Electrical metallic conduit (EMT) and shall be constructed of galvanized steel with a minimum trade size of 1/2". UL listed aluminum or galvanized steel split type fittings shall be used. EMT shall be used to enclose conductors exterior to all enclosures, panels, and motor terminator boxes.

o. Exception: UL listed liquid tight flexible metallic conduit may be used for motor connections and all control devices with a maximum length of three feet without a grounding conductor and unlimited length with a grounding conductor. Application and installation shall meet all requirements of NEC articles 300, 348, and 351.

J. Transmitters
   1. Differential Pressure Transmitters
a. Provided by Controls Contractor. See Section 23 09 23.

2. Flow Meters
   a. The packaged pump system manufacturer shall provide zero dual turbine, insertion type flow meter(s) equal to an Onicon SF1210. Wiring installed by the contractor between the control system and the meters shall be Belden 9320, two wire, shielded twisted cable, and shall not be included in conduit containing AC circuit wiring.
   b. The sensor shall have integral analog outputs of 0-10 VDC and 4-20 mA linear to within +0.1% of calibrated span for connection to the control system. The sensor shall also include three internal frequency outputs, (top turbine, bottom turbine, average frequency) for commissioning and diagnostic purposes. All outputs shall be linear with flow rate.

K. Building automation system

1. The pump package system manufacturer shall provide a direct communication interface as an integral part of the package. The communication interface shall be BACnet and be connected to the BAS as indicated on the drawings. In addition to the following points, the manufacturer shall make provisions required to accommodate the sequence of operations indicated on the drawings.

2. Transmit:
   a. System Request to Start (Digital)

3. Receive:
   a. Equipment on/off status (Each pump) (Digital)
   b. Equipment failure alarms (Each pump) (Digital)
   c. Pump suction pressure (Each pump) (Analog)
   d. Pump Discharge pressure (Each pump) (Analog)
   e. Suction pressure (Each connection) (Analog)
   f. Discharge pressure (Each connection) (Analog)
   g. Chilled water flow (Analog)
   h. Chilled water zone differential pressure (Analog)
   i. Chiller differential pressures (Analog)
   j. Pump speed (Each Pump) (Analog)
   k. System supply temperature (Analog)
   l. System return temperature (Analog)

N. Electrical

1. All electrical enclosures, VFD(s) and devices shall be mounted onto welded tubular steel uprights and cross members to form a rigid welded frame. The use of a bolted construction frame, or formed steel members shall not be acceptable.
   a. The use of strut to directly support any mounted electrical device shall not be acceptable.
2. The module shall have a single-point electrical connection for all line voltage power (208/3/60) at the enclosure with a NEMA-4 enclosure.
   a. Electrical service and final connection to the electrical enclosure shall be the responsibility of the installing electrical contractor.
   b. This main distribution panel shall contain a main circuit breaker type disconnect switch. Disconnect shall be sized to accommodate all module components.

3. The skid shall include one (1) 208V/120V single phase load center. This will allow for interior lighting, GFI convenience outlets, exterior lighting at doors, controls and ventilation circuits.
   a. The skid manufacturer shall provide load center with all necessary lockable breakers as required for all circuits listed above. All conduit and wire on the load side of this panel shall be factory supplied and wired.

4. All wiring in the skid enclosure shall be run in UL Listed conduit, raceways, gutters or liquid tight (final connections only) with NEC compliant fittings.
   a. The above applicable items shall be completely installed and wired in accordance to NEC code and UL Listed requirements.
   b. All electrical components used in the assembly of the skid shall be constructed in accordance with UL guidelines.
   c. Entire skid shall be UL Listed.

2.4 FINISHING
   A. All steel components shall be cleaned, degreased and painted with a rust preventive primer.
   B. The complete packaged pump system shall be factory painted with machine enamel prior to shipment.

PART 3 EXECUTION

3.1 INSTALLATION
   A. Install the packaged pump system in accordance with manufacturer's instructions.
   B. The contractor shall align the pump and motor shafts to within the manufacturer's recommended tolerances prior to system start-up.

3.2 CLEANING
   A. Clean and flush chilled water piping systems before adding chemicals. See Section 23 25 00.

3.03 DEMONSTRATION
   A. The system manufacturer or his representative shall provide an on-site job visit for commissioning of the pump system. The packaged pump system manufacturer’s commissioning shall include final checkout, adjustment, and start-up. Prior to commissioning, the installing contractor shall perform a preliminary check for proper installation. Commissioning shall occur only after all hook-ups, tie-ins, and terminations have been completed and signed-off on the system manufacturer’s start-up request form by the installer. At that time, all ancillary equipment (i.e. chillers, boilers, cooling towers, BAS systems, air handlers, etc.) shall be ready for automatic start-up.
B. The system manufacturer shall include provisions to coordinate and make adjustments to system programming/operation as may be deemed necessary by the Owner's Commissioning Authority to achieve a fully functional system and be in compliance with the sequence of operations indicated on the drawings.

C. The final visit shall include the system manufacturer or his representative to provide a minimum of four (4) hours of on-site training for the owner's personnel on the operation and maintenance of the packaged pump systems.

END OF SECTION
SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SCOPE

A. This section contains specifications for all Refrigerant piping for this project. Included are
the following topics:

1. Part 1 - General
   a. Scope
   b. Related Work
   c. Reference
   d. Reference Standards
   e. Shop Drawings
   f. Quality Assurance
   g. Delivery, Storage, and Handling
   h. Design Criteria

2. Part 2 - Products
   a. Refrigerant Piping

3. Part 3 - Execution
   a. Preparation
   b. Erection
   c. Refrigerant Piping
   d. Construction Verification Items

1.2 RELATED SECTIONS

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

B. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

C. Section 23 07 00 - HVAC Insulation

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings

B. ASTM B88 Seamless Copper Water Tube

C. ASTM B280 Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

D. ASHRAE 15 Safety Code for Mechanical Refrigeration

E. ASME B31.5 Refrigeration Piping and Heat Transfer Components

F. UL 207 Refrigerant-Containing Components and Accessories, Nonelectrical
1.5 SHOP DRAWINGS
   A. Refer to division 1, General Conditions, Submittals.
   B. Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

1.6 QUALITY ASSURANCE
   A. Order all copper refrigeration tube with each shipping unit marked with the metal or alloy designation, temper, size, and name of supplier; with soft straight lengths or coils identified with a tag indicating that the product was manufactured in accordance with ASTM B280; and with each hard temper straight length identified throughout its length by a blue colored marking not less than 3/16 inch in height and a legend at intervals of not greater than three feet that includes the designation "ACR" and pipe outside diameter.
   B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.7 DELIVERY, STORAGE, AND HANDLING
   A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.
   B. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. If end caps are not present on tube bearing the "ACR" designation, clean and re-cap in accordance with ASTM B280. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
   C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
   D. Storage and protection methods must allow inspection to verify products.

1.8 DESIGN CRITERIA
   A. Use only new material, free of defects and scale, and meeting the latest revision of ASTM specifications as listed in this specification.
   B. Where ASTM B88, type L hard temper copper tubing is specified, ASTM B88, Type K hard temper copper tubing may be substituted at Contractor's option.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPING
   A. ASTM B88 type L hard drawn copper tube, cleaned and capped in accordance with ASTM B280, and marked "ACR", with ANSI B16.22 wrought copper or forged brass solder-type fittings.

PART 3 - EXECUTION

3.1 PREPARATION
   A. Remove all foreign material from interior and exterior of pipe and fittings.

3.2 ERECTION
A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

B. Do not route piping through transformer vaults, elevator equipment rooms, or above transformers, panel boards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment. Coordinate with condensate drain piping, and electrical and mechanical trades. Prepare coordination drawings for field use.

3.3 REFRIGERANT PIPING

A. Refrigeration piping to be installed by firms who are experienced in installation of such piping.

B. All joints to be brazed and have a melting point greater than 1,125 degrees F. Filler impurities shall not exceed 0.15%. Tubing to be new and delivered to the job site with the original mill end caps in place. Purge all lines with nitrogen during brazing. Provide manual shut-off and check valves as required.

C. No refrigerant is to be vented directly to the atmosphere except that which may escape through leaks in the system during leak testing. During evacuation procedures, use equipment designed to recover and allow recycling of the refrigerant.

D. Leak test the system by charging the system to a pressure of 10 psig with an HFC refrigerant, with the compressor suction and discharge valves closed and with all other system valves open. Increase pressure to 300 psig with dry nitrogen. Rap all joints with a mallet and check for leaks with an electric leak detector having a certified sensitivity of at least one ounce per year. Seal any leaks that may be found and retest.

E. After completion of the leak test, evacuate the system with a vacuum pump to an absolute pressure not exceeding 1500 microns while the system ambient temperature is above 60°F. Break the vacuum to 2 psig with the refrigerant to be used in the system. Repeat the evacuation process, again breaking the vacuum with refrigerant. Install a drier of the required size in the liquid line, open the compressor suction and discharge valves, and evacuate to an absolute pressure not exceeding 500 microns. Leave the vacuum pump running for not less than two hours without interruption. Raise the system pressure to 2 psig with refrigerant and remove the vacuum pump.

F. Charge refrigerant directly from original drums through a combination filter-drier. Each drier may be used for a maximum of three cylinders of refrigerant and then must be replaced with a fresh drier. Charge the system by means of a charging fitting in the liquid line. Weigh the refrigerant drum before charging so that an accurate record can be kept of the weight of refrigerant put in the system. If refrigerant is added to the system through the suction side of the compressor, charge in vapor form only.

END OF SECTION
SECTION 23 25 00
HVAC WATER TREATMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. System cleaner.
   2. Closed system treatment (water).

1.2 SUBMITTALS

A. Section 23 05 00 – General Mechanical Requirements:
   1. Submittal procedures.

B. Shop Drawings:
   1. Indicate system schematic, equipment locations, and controls schematics and
   connection requirements.

C. Product Data:
   1. Submit chemical treatment materials and chemicals.

D. Manufacturers Field Reports:
   1. Indicate start-up of treatment systems when completed and operating properly.
   Indicate analysis of system water after cleaning and after treatment.

1.3 CLOSEOUT SUBMITTALS

A. Section 23 05 00 – General Mechanical Requirements:
   1. Closeout products.

B. Project Record Documents:
   1. Record actual locations of equipment and piping.

C. Operation and Maintenance Data:
   1. Submit data on equipment including spare parts lists, procedures, and treatment
   programs. Include step by step instructions on test procedures including target
   concentrations.

1.4 QUALIFICATIONS

A. Installer:
1. Company specializing in performing Work of this section with minimum three years experience.

PART 2 PRODUCTS

2.1 SYSTEM CLEANER

A. Product Description:

1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.

2.2 CLOSED SYSTEM TREATMENT (WATER)

A. Sequestering agent to reduce deposits and adjust pH.

B. Corrosion inhibitors boron-nitrite, sodium nitrite and borax, sodium tolyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulfites.

PART 3 EXECUTION

3.1 PREPARATION

A. Operate, fill, start and vent systems prior to cleaning. Place all control valves in open position during cleaning.

3.2 CLEANING

A. Concentration:

1. As recommended by manufacturer.

B. Chilled Water Systems (Closed):

1. Circulate for 48 hours then drain systems as quickly as possible.

2. Refill with clean water, circulate for 24 hours, then drain.

3. Refill with clean water and repeat until system cleaner is removed.

C. Use neutralizer agents on recommendation of system cleaner supplier and acceptance of Engineer.

D. Flush systems with clean water for one hour minimum. Drain completely and refill.

E. Remove, clean, and replace strainer screens.

F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.
3.3 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system. Install isolating and drain valves and interconnecting piping.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

3.4 DEMONSTRATION

A. Furnish two-hour training course for operating personnel, instruction to include installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start up of systems.

END OF SECTION
SECTION 23 31 00
HVAC DUCTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Duct Materials.
   2. Insulated flexible ducts.
   4. Double wall spiral insulated round ducts.
   5. Double wall spiral insulated flat oval ducts.
   6. Transverse duct connection system.
   7. Ductwork fabrication.
   8. Duct cleaning.
   9. Duct leakage testing.

B. Related Sections:
   1. Section 09 90 00 - Painting and Coating: Execution requirements for Weld priming, weather resistant, paint or coating specified by this section.
   2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers, supports and sleeves for placement by this section.
   3. Section 23 07 00 – HVAC Insulation: Product requirements for duct insulation for placement by this section.
   4. Section 23 08 00 – Commissioning of HVAC – Commissioning requirements.
   5. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.2 REFERENCES

A. ASTM International:
   2. ASTM A90/A90M - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
   4. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   6. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
7. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.


B. National Fire Protection Association:
   2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

C. Sheet Metal and Air Conditioning Contractors:
   1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

D. Underwriters Laboratories Inc.:
   1. UL 181 - Factory-Made Air Ducts and Connectors.

1.3 PERFORMANCE REQUIREMENTS

A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings:
   1. Submit duct fabrication drawings, drawn to scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:
      a. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
      b. Duct layout, indicating pressure classifications and sizes in plan view.
      c. Fittings.
      d. Reinforcing details and spacing.
      e. Seam and joint construction details.
      f. Penetrations through fire rated and other walls.
      g. Terminal unit installations.
      h. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 77 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents:
1. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE
A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.
B. Construct ductwork to NFPA 90A and NFPA 90B standards.

1.7 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Installer:
   1. Company specializing in performing Work of this section with minimum three years documented experience.

1.8 ENVIRONMENTAL REQUIREMENTS
A. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.
B. Maintain temperatures during and after installation of duct sealant.

1.9 FIELD MEASUREMENTS
A. Verify field measurements prior to fabrication.

1.10 WARRANTY
A. Section 01 77 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 DUCT MATERIALS
A. Mastic/Sealants:
   1. Manufacturers:
      b. Fosters/Childers.
   2. Non-hardening, water resistant, fire resistive, compatible with lining materials, liquid (fully sprayed into joints) or liquid and tape; or heavy mastic.
   3. Substitutions: As approved by Engineer prior to bid date.
B. Galvanized Steel Ducts:
   1. ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G60 zinc coating of in conformance with ASTM A90/A90M.
C. Fasteners:
   1. Rivets, bolts, or sheet metal screws.
D. Hanger Rod:
   1. ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
2.2 INSULATED FLEXIBLE DUCTS

A. Manufacturers:
   1. FlexMaster, Series 1M.
   2. Thermaflex, Series M-KE.
   3. Substitutions: None permitted.

B. Product Description: UL 181, Class 1 air duct with PE inner film, mechanically locked without adhesives to a galvanized spring steel helix, fiber glass insulation; aluminized vapor barrier film.
   1. Pressure Rating: 10 inches wg positive and 1.0 inches wg negative.
   3. Temperature Range: -10 degrees F to 160 degrees F.

2.3 SINGLE WALL SPIRAL ROUND DUCTS

A. Manufacturers:
   1. Duct Direct.
   4. Spiral Pipe of Texas.
   5. Substitutions: As approved by Engineer prior to bid date.

B. Product Description:
   1. UL 181, Class 1, round spiral lockseam duct constructed of galvanized steel. Provide ducts and fittings with paint grip finish.
   2. Insulate ducts per specification 23 07 00.

C. Construct duct with the following minimum gages:

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 inches to 14 inches</td>
<td>26</td>
</tr>
<tr>
<td>15 inches to 26 inches</td>
<td>24</td>
</tr>
<tr>
<td>28 inches to 36 inches</td>
<td>22</td>
</tr>
<tr>
<td>38 inches to 50 inches</td>
<td>20</td>
</tr>
<tr>
<td>52 inches to 84 inches</td>
<td>18</td>
</tr>
</tbody>
</table>

D. Construct fittings with the following minimum gages:

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 inches to 14 inches</td>
<td>24</td>
</tr>
<tr>
<td>15 inches to 26 inches</td>
<td>22</td>
</tr>
<tr>
<td>28 inches to 36 inches</td>
<td>20</td>
</tr>
<tr>
<td>38 inches to 50 inches</td>
<td>20</td>
</tr>
<tr>
<td>52 inches to 60 inches</td>
<td>18</td>
</tr>
<tr>
<td>62 inches to 84 inches</td>
<td>16</td>
</tr>
</tbody>
</table>
2.4 DOUBLE WALL SPIRAL INSULATED ROUND DUCTS

A. Manufacturers:
   1. Duct Direct.
   4. Spiral Pipe of Texas.
   5. Substitutions: As approved by Engineer prior to bid date.

B. Product Description:
   1. Machine made from round spiral lockseam duct with light reinforcing corrugations, galvanized steel outer wall, 2 inch thick glass fiber insulation, perforated galvanized steel inner wall; fittings manufactured with perforated inner wall.

C. Construct oval duct with the following minimum gages:

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Gage</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 inches to 14 inches</td>
<td>20</td>
</tr>
<tr>
<td>15 inches to 26 inches</td>
<td>20</td>
</tr>
<tr>
<td>28 inches to 36 inches</td>
<td>20</td>
</tr>
<tr>
<td>38 inches to 50 inches</td>
<td>20</td>
</tr>
<tr>
<td>52 inches to 84 inches</td>
<td>18</td>
</tr>
</tbody>
</table>

D. Construct round fittings with the following minimum gages:

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Gage</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 inches to 14 inches</td>
<td>20</td>
</tr>
<tr>
<td>15 inches to 26 inches</td>
<td>20</td>
</tr>
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<td>20</td>
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<td>20</td>
</tr>
<tr>
<td>52 inches to 60 inches</td>
<td>18</td>
</tr>
<tr>
<td>62 inches to 84 inches</td>
<td>16</td>
</tr>
</tbody>
</table>

2.5 DOUBLE WALL SPIRAL INSULATED FLAT OVAL DUCTS

A. Manufacturers:
   1. Duct Direct.
   4. Spiral Pipe of Texas.
   5. Substitutions: As approved by Engineer prior to bid date.

B. Product Description:
1. Machine made from round spiral lockseam duct with light reinforcing corrugations, galvanized steel outer wall, 2 inch thick glass fiber insulation, perforated galvanized steel inner wall; fittings manufactured with perforated inner wall.

C. Construct flat oval duct with the following minimum gages:

<table>
<thead>
<tr>
<th>Major Axis Dimension</th>
<th>Gage</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 inches to 24 inches</td>
<td>20</td>
</tr>
<tr>
<td>26 inches to 48 inches</td>
<td>20</td>
</tr>
<tr>
<td>50 inches to 70 inches</td>
<td>20</td>
</tr>
<tr>
<td>72 inches to 82 inches</td>
<td>18</td>
</tr>
</tbody>
</table>

D. Construct flat oval fittings with the following minimum gages:

<table>
<thead>
<tr>
<th>Major Axis Fitting Dimension</th>
<th>Gage</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 inches to 36 inches</td>
<td>20</td>
</tr>
<tr>
<td>38 inches to 60 inches</td>
<td>18</td>
</tr>
<tr>
<td>62 inches to 84 inches</td>
<td>16</td>
</tr>
</tbody>
</table>

2.6

2.7 TRANSVERSE DUCT CONNECTION SYSTEM

A. Manufacturers:
   1. Ductmate or equivalent.

B. Product Description:
   1. SMACNA "E" rated rigidity class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.

2.8 DUCTWORK FABRICATION

A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible (Round Duct Construction Standards), and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.
F. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, or mastic plus embedded fabric systems. Tape of any kind is unacceptable for duct sealing.

G. Sealants and Mastics:
   1. Conform to UL 181A. Provide products bearing appropriate UL 181A markings.
   2. Do not provide sealing products not bearing UL approval markings.

2.9 EXAMINATION
A. Verify sizes of equipment connections before fabricating transitions.

2.10 INSTALLATION
A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
B. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
C. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 8 inch and smaller.
D. Ductwork exposed to view shall be of either double wall round or double wall flat oval construction unless noted otherwise.
E. Ducts exposed to view shall be painted per architectural specifications.
F. Install duct hangers and supports in accordance with SMACNA & ASHRAE standards and as indicated on the drawings.
G. Use double nuts and lock washers on threaded rod supports.
H. Connect flexible ducts to metal ducts with stainless steel draw bands.
I. Exhaust Outlet Locations:
   1. Minimum Distance from Property Lines: 3 feet.
   2. Minimum Distance from Building Openings: 3 feet.
   3. Minimum Distance from Outside Air Intakes: 10 feet.

2.11 INTERFACE WITH OTHER PRODUCTS
A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.
B. Connect diffusers to low pressure ducts as indicated on drawings (see details).
C. Connect air terminal units to supply ducts as indicated on drawings (see details).

2.12 DUCT LEAKAGE TESTING
A. For ductwork designed for 3 inches w.c. above ambient, pressure test minimum 25 percent of ductwork after duct cleaning, but before duct insulation is applied or ductwork is concealed.
   1. Test in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Test shall be conducted by Test, Adjust and Balance Contractor. Coordinate and support their efforts.
## SCHEDULES

### A. Ductwork Material Schedule:

<table>
<thead>
<tr>
<th>AIR SYSTEM</th>
<th>MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply/Outside Air</td>
<td>Galvanized Steel</td>
</tr>
<tr>
<td>Return</td>
<td>Galvanized Steel</td>
</tr>
<tr>
<td>General Exhaust</td>
<td>Galvanized Steel</td>
</tr>
</tbody>
</table>

### B. Ductwork Pressure Class Schedule:

<table>
<thead>
<tr>
<th>AIR SYSTEM</th>
<th>PRESSURE CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable Air Volume Supply (downstream of VAV boxes)</td>
<td>1.0 inch w.g. regardless of velocity</td>
</tr>
<tr>
<td>Variable Air Volume Supply (upstream of VAV boxes)</td>
<td>4.0 inch w.g. regardless of velocity</td>
</tr>
<tr>
<td>Return, Relief and General Exhaust</td>
<td>2.0 inch w.g. regardless of velocity</td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Combination fire and smoke dampers.
   2. Duct access doors.
   3. Volume control dampers.
   4. Flexible duct connections.
   5. Duct test holes.
B. Related Sections:
   1. Section 23 31 00 - HVAC Ducts: Requirements for duct construction and pressure classifications.

1.2 REFERENCES
A. Air Movement and Control Association International, Inc.:
   1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
B. National Fire Protection Association:
   2. NFPA 92A – Recommended Practice for Smoke-control Systems.
C. Sheet Metal and Air Conditioning Contractors:
   1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
D. Underwriters Laboratories Inc.:
   1. UL 555 - Standard for Safety for Fire Dampers.

1.3 SUBMITTALS
A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers and duct access doors.
C. Product Data: Submit data for shop fabricated assemblies and hardware used.
D. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.
   1. Combination fire/smoke dampers including locations and ratings.
   2. Flexible duct connections.
   3. Volume control dampers.
   4. Duct access doors.
E. Product Data: For combination fire/smoke dampers submit the following:
1. Include UL ratings, dynamic ratings, leakage, pressure drop and maximum pressure data.
2. Indicate materials, construction, dimensions, and installation details.
3. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

F. Manufacturer's Installation Instructions: Submit for combination fire/smoke dampers.
G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS
A. Section 01 77 00 - Execution and Closeout Requirements: Closeout procedures.
B. Project Record Documents: Record actual locations of all dampers.
C. Operation and Maintenance Data: Submit for combination fire/smoke dampers.

1.5 QUALITY ASSURANCE
A. Dampers tested, rated and labeled in accordance with the latest UL requirements.
B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Section 23 05 00 – General Mechanical Requirements: Product storage and handling requirements.
B. Protect dampers from damage to operating linkages and blades.
C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
D. Storage: Store materials in a dry area indoor, protected from damage.
E. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.8 FIELD MEASUREMENTS
A. Verify field measurements prior to fabrication.

1.9 COORDINATION
A. Coordinate Work where appropriate with building control Work.

1.10 WARRANTY
A. Comply with requirements of Division 1 and coordinate with General Contractor for product warranties and product bonds.

1.11 EXTRA MATERIALS
A. Furnish two of each size and type of fusible link; turn over to Owner’s representative.

PART 2 PRODUCTS
2.1 COMBINATION FIRE/SMOKE DAMPERS
A. Manufacturers:
   1. Greenheck.
   2. Ruskin.

4. Substitutions: As approved by Engineer prior to bid date.

B. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S.

C. Fire Resistance: as required by barrier.

D. Leakage Rating: Class I, maximum of 8 cfm at 4 inches wg differential pressure.

E. Damper Temperature Rating: 350 degrees F.

F. Frame: 16 gage, galvanized steel.

G. Blades:
   3. Orientation: Horizontal.
   5. Width: Maximum 6 inches.

H. Bearings: Stainless steel pressed into frame.

I. Seals: Silicone blade edge seals and flexible stainless steel jamb seals.

J. Linkage: Concealed in frame.

K. Release Device: Close in controlled manner and allow damper to be automatically reset.

L. Actuator:
   1. Type: Electric 120 volt, 60 hertz, two-position, fail close. Mounting: External.

M. Fusible Link Release Temperature: 165 degrees F.

N. Finish: Mill galvanized.

O. Factory installed sleeve and mounting angles. Furnish silicone caulk factory applied to sleeve at damper frame to comply with leakage rating requirements.

2.2 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.

B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1.0 inch thick insulation with sheet metal cover.
   1. Less than 12 inches round, spin-in type, secure with cam locks.
   2. Up to 18 inches Square: Furnish two hinges and two sash locks.
   3. Up to 24 x 48 inches: Three hinges and two compression latches.
   4. Larger Sizes: Furnish additional hinge.
   5. Access panels with sheet metal screw fasteners are not acceptable.

2.3 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized frame channel with suitable hardware.
C. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or sintered bronze bearings. Furnish closed end bearings on ducts having pressure classification over 2 inches wg.

D. Quadrants:
   1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers. For inaccessable ceilings, remote operated quadrants shall be Rototwist M# RT-150 operable from face of the air device.
   2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters. Minimum height to be equal to insulation thickness.
   3. Where rod lengths exceed 30 inches furnish regulator at both ends.

E. Spin-in Type Duct Tap Fittings:
   1. 24 gage G-90 galvanized construction, without scoop, with 2” damper shaft extender and locking quadrant handle.
   2. Provide conical taps on branches to air terminal units; straight tap branches to air devices.

2.4 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Connector: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
   3. Metal: 3 inch wide, 24 gage galvanized steel.

2.5 DUCT TEST HOLES

A. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 23 05 00 – General Mechanical Requirements: Coordination and project conditions.

B. Verify rated walls and floors are ready for combination fire/smoke damper installation.

C. Verify ducts and equipment installation are ready for accessories.

D. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 INSTALLATION

A. Install in accordance with NFPA 90A and NFPA 92A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.

B. Access Doors: Install access doors at the following locations and as indicated on Drawings:
   1. Spaced every 50 feet of straight duct.
   2. Before each automatic control damper.
3. Before and after each combination fire/smoke damper.
4. Downstream of each VAV box.

C. Access Door Sizes: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated on Drawings. Install 8 inch for balancing dampers only. Review locations prior to fabrication.
   1. Mark access doors for combination fire/smoke dampers on outside surface, with minimum 1/2 inch high letters reading: FIRE/SMOKE DAMPER

D. Install flexible duct connectors on inlets and outlets of all equipment with moving parts to minimize vibration transmission.

E. Install permanent duct test holes required for testing and balancing purposes.

F. Install combination fire/smoke dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
   1. Install combination fire/smoke dampers in accordance with NFPA 92A and the manufacturer’s requirements for listing.
   2. Install dampers square and free from racking with blades running horizontally.
   3. Do not compress or stretch damper frame into duct or opening.
   4. Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jack shaft.
   5. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

END OF SECTION
SECTION 23 34 00

HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A.  Section Includes:
   1.  Ceiling fans.
   2.  Centrifugal square inline fans.

B.  Related Sections:
   1.  Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for resilient mountings and snubbers for fans for placement by this section.
   2.  Section 23 07 00 - HVAC Insulation: Product requirements for power ventilators for placement by this section.
   3.  Section 23 09 23 - Direct-Digital Control System for HVAC: Controls remote from unit.
   4.  Section 23 31 00 - HVAC Ducts and Casings: Product requirements for hangers for placement by this section.
   5.  Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.2 REFERENCES

A.  American Bearing Manufacturers Association:
   1.  ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2.  ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B.  Air Movement and Control Association International, Inc.:
   2.  AMCA 204 - Balance Quality and Vibration Levels for Fans.
   5.  AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

C.  National Electrical Manufacturers Association:
   1.  NEMA MG 1 - Motors and Generators.
   2.  NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D.  Underwriters Laboratories Inc.:
   1.  UL 705 - Power Ventilators.

1.3 SUBMITTALS

A.  Section 01 33 00 - Submittal Procedures: Submittal procedures.
B. Shop Drawings:
   1. Indicate size and configuration of fan assembly, mountings, weights, ductwork
      and accessory connections.

C. Product Data:
   1. Submit data on each type of fan and include accessories, fan curves with
      specified operating point plotted, power, RPM, sound power levels for both fan
      inlet and outlet at rated capacity, electrical characteristics and connection
      requirements.

D. Manufacturer's Installation Instructions:
   1. Submit fan manufacturer’s instructions.

E. Manufacturer's Certificate:
   1. Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data:
   1. Submit instructions for lubrication, motor and drive replacement, spare parts list,
      and wiring diagrams.

1.5 QUALITY ASSURANCE

A. Performance Ratings:
   1. Conform to AMCA 210 and bear AMCA Certified Rating Seal.

B. Sound Ratings:
   1. AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

C. UL Compliance:
   1. UL listed and labeled, designed, manufactured, and tested in accordance with UL
      705.

D. Balance Quality:
   1. Conform to AMCA 204.

1.6 QUALIFICATIONS

A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with
      minimum five years documented experience.

B. Installer:
   1. Company specializing in performing Work of this section with minimum three
      years documented experience.

1.7 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
1.8 DELIVERY, STORAGE, AND HANDLING
   A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
   B. Protect motors, shafts, and bearings from weather and construction dust.

1.9 FIELD MEASUREMENTS
   A. Verify field measurements prior to fabrication.

1.10 WARRANTY
   A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
   B. Furnish one year manufacturer’s warranty for fans.

1.11 MAINTENANCE SERVICE
   A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.
   B. Furnish service and maintenance of fans for one years from Date of Substantial Completion.
   C. Perform work without removing fans from service during building normal occupied hours.
   D. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
   E. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.

PART 2 - PRODUCTS

2.1 CEILING FANS
   A. Manufacturers:
      1. Greenheck Corp
      2. Loren Cook Company
      3. Substitutions: None Permitted.
   B. Centrifugal Fan Unit:
      1. Direct driven with injection molded resin housing lined with 1/2 inch acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge opening, integral outlet duct collar.
   C. Disconnect Switch:
      1. Cord and plug in housing for thermal overload protected motor.
D. Grille:
1. Aluminum w/baked white enamel finish.

E. Wheel:
1. Centrifugal forward curved type constructed of injection molded or polypropylene resin.

F. Motor:
1. Open drip proof type with permanently lubricated sealed bearings and thermal overload protection.

G. Accessories:
1. Wall cap with damper, round duct inlet.
3. Fan speed controller.
4. Time delay relay.

H. Electrical Characteristics and Components:
1. See Schedule on Drawings.

2.2 CENTRIFUGAL SQUARE INLINE FANS

A. Manufacturers:
1. Greenheck Corp
2. Loren Cook Company
3. Substitutions: None Permitted.

B. Product Description:
1. Direct drive with galvanized steel housing lined with 1 inch acoustic glass fiber insulation, integral inlet cone, removable access doors on 3 sides, inlet and outlet duct collar, and horizontal hanging brackets.

C. Fan Wheel:
1. Backward inclined centrifugal type, aluminum construction.

D. Motor and Drive Mounting:
1. Out of air stream.

E. Motor:
1. TEFC, EC Type with on board controls.

F. Bearings:
1. ABMA 9 life at 200,000 hours.

G. Accessories:
1. Disconnect Switch: NEMA 250 Type 1 enclosure.
2. Motor control cover.
3. Motorized backdraft damper, same voltage as fan.

H. Electrical Characteristics and Components:
1. See Schedule on Drawings.
PART 3 - EXECUTION

3.1 EXAMINATION
   A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

3.2 INSTALLATION
   A. Suspended Fans:
      1. Install flexible connections specified in Section 23 33 00 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum two inches flex between ductwork and fan while running.
   B. Provide backdraft dampers on fans and as indicated on Drawings.

3.3 MANUFACTURER'S FIELD SERVICES
   A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer’s field services.

3.4 CLEANING
   A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

3.5 DEMONSTRATION
   A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
   B. Demonstrate fan operation and maintenance procedures.

3.6 PROTECTION OF FINISHED WORK
   A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
   B. Do not operate fans until ductwork is clean, bearings lubricated, and fan has been test run under observation.

3.7 SCHEDULES
   A. See Schedules on Drawings.

END OF SECTION
SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Single Duct or Variable volume terminal units.
   2. Variable volume controls.
B. Related Sections:
   1. Section 23 08 00 – Commissioning of HVAC: Commissioning requirements.
   2. Section 23 09 23 - Direct-Digital Control System for HVAC: Controls remote from unit.

1.2 REFERENCES
A. Air Condition, Heating and Refrigeration Institute:
   1. AHRI 260 - Sound Rating of Ducted Air Moving and Conditioning Equipment.
   2. AHRI 410 - Forced-Circulation Air Cooling & Air Heating Coils.
   3. AHRI 880 - Air Terminals.
   4. AHRI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.
B. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
C. National Fire Protection Association:
D. Underwriters Laboratories Inc.:
   1. UL 181 - Factory-Made Air Ducts and Connectors.

1.3 SUBMITTALS
A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
B. Product Data: Submit data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings indicating airflow, static pressure, heating coil capacity and NC designation. Include electrical characteristics and connection requirements. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of 1 inch wg.
C. Manufacturer's Installation Instructions: Submit support and hanging details, and service clearances required.
D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS
A. Section 01 77 00 - Execution and Closeout Requirements: Closeout requirements.
B. Project Record Documents: Record actual locations of units and controls components.
C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting volume regulators.

1.5 QUALITY ASSURANCE
A. Test and rate air terminal unit performance for air pressure drop, flow performance, and acoustical performance in accordance with AHRI 880 and AHRI 885. Attach AHRI seal to each terminal unit.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION REQUIREMENTS
A. Coordinate with General Contractor prior to commencing work of this section.

1.8 FIELD MEASUREMENTS
A. Verify field measurements prior to fabrication.
B. Ensure services access is maintained; coordinate with other trades and General Contractor.

1.9 COORDINATION
A. Coordinate with General Contractor to provide for coordination and readiness of project conditions.
B. Coordinate Work with 23 09 23 – Direct Digital Control System for HVAC and electrical, plumbing and ceiling trades.

1.10 WARRANTY
A. Section 01 77 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS
2.1 SINGLE DUCT VARIABLE VOLUME AIR TERMINAL UNITS
A. Manufacturers:
   1. Metal-Aire.
   2. Environmental Technologies, Inc./Johnson Controls.
   4. Titus.
   5. Trane.
   7. Substitutions: As approved by the Engineer prior to bid date.
B. Product Description: Variable air volume pressure-independent terminal units for connection to central air systems, with direct digital controls.
C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.
D. Basic Assembly:
2. Lining: Minimum 1.0 inch thick dual density matte faced glass fiber insulation, minimum 1.5 lb./cu ft density, meeting NFPA 90A requirements and UL 181 and NFPA 90A erosion requirements.
3. Plenum Air Inlets: Round stub connections for duct attachment.

E. Basic Unit:
2. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating (nylon is unacceptable) bearings; maximum damper leakage: 2 percent of design air flow at 1.5 inches rated inlet static pressure. Damper shaft shall be scored to indicate damper position. Incorporate mechanical stop to prevent overstroking.
3. Unit shall not exceed 0.15 in. wg pressure drop at 2000 fpm inlet velocity (for basic terminal).
4. Sound rating for the terminal shall not exceed scheduled NC levels. Rating shall be per AHRI std. 260.

F. Electric Heating Coil:
1. Construction: UL or ETL listed, slip-in type, open coil design, 80/20 nickel/chrome elements, integral NEMA 1 control box factory wired and installed, with:
   a. Primary (auto reset) and secondary (manual reset) over-temperature protection.
   b. Minimum airflow switch.
   c. Integral door interlock disconnect switch.
   d. Magnetic contactor for each step of control or SCR controller where indicated in the schedules on drawings.
   e. Terminal block for connections.
2. Electrical Characteristics: As scheduled on drawings. (Fuse per NEC.)
3. Position coil a minimum of 5” back from unit outlet to protect coil.

G. Controls: Electronic Controls: Contain in NEMA Type 1 enclosure with access panel sealed from airflow and mounted on side of unit. Coordinate with controls subcontractor.
1. The terminals shall be equipped with pressure independent direct digital controls supplied by the control contractor and mounted by the terminal unit manufacturer. Control contractor shall provide data sheets on all components to be mounted, indicating component dimensions, mounting hardware, and methods, as well as wiring and piping diagrams for each application identified by unit tag per the schedule in the drawings, to the terminal manufacturer.
2. Controls shall be compatible with pneumatic inlet velocity sensors supplied by the terminal manufacturer. This sensor shall be multi-point center averaging type, with a minimum of four measuring ports parallel to the take-off point from the sensor. Sensors with measuring ports in series are not acceptable. The sensor must provide a minimum differential pressure signal of 0.03 inch wg. at an inlet velocity of 500 fpm.
3. Controls shall be field set by control contractor for the scheduled minimum and maximum flow rates. Flow measuring taps and flow curves will be supplied with each terminal for field balancing airflow. All pneumatic tubing shall be UL listed fire retardant (FR) type. Each terminal shall be equipped with labeling showing unit location, size, and scheduled cfm.

4. The terminal manufacturer shall provide a Class II 24 VAC transformer and disconnect switch (Coordinate primary voltage with electrical contractor). Actuator shall be direct connection shaft mount type without linkage. All controls shall be installed in approved NEMA type sheet metal enclosure by terminal manufacturer.

5. Actuator shall have a minimum of 35 in-lbs of torque and shall be mounted external to the unit but in the controls enclosure.

H. Sequence of Operation: Refer to drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify ductwork is ready for air terminal installation.

B. Coordinate voltage and maximum over-current protection with electrical trade. Coordinate power for controls transformers on any terminals without electric heat.

C. Coordinate with General Contractor and all involved trades to ensure installation allows required service and maintenance access, including access doors removed/opening.

3.2 INSTALLATION

A. Connect to ductwork in accordance with Section 23 31 00.

B. Install ceiling access doors or locate units above easily removable ceiling components.

C. Support air terminal units that are connected at inlet by flexible duct independently of that flexible duct. See detail on drawings.

D. Install reducer to transition from flexible duct size to inlet or outlet of variable air volume terminal. See detail on drawings for inlet conditions required.

3.3 ADJUSTING

A. Coordinate with General Contractor and Commissioning Authority for requirements for starting, adjusting and operational testing.

B. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to scheduled minimum values. Coordinate with Test, Adjust and Balance Contractor.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Diffusers.
   2. Registers
   4. Louvers.

B. Related Sections:
   1. Section 09 90 00 - Painting and Coating: Execution and product requirements for
     Painting of ductwork visible behind outlets and inlets specified by this section.
   2. Section 23 33 00 - Air Duct Accessories: Volume dampers for inlets and outlets.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:
   1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
   1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and
     Inlets.

C. Sheet Metal and Air Conditioning Contractors:
   1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data:
   1. Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets
      showing type, size, location, application, and noise level.

C. Test Reports:
   1. Rating of air outlet and inlet performance.

D. Manufacturer's Certificate:
   1. Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents:
   1. Record actual locations of air outlets and inlets.
1.5 QUALITY ASSURANCE
   A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.
   B. Test and rate louver performance in accordance with AMCA 500.

1.6 QUALIFICATIONS
   A. Manufacturer:
      1. Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 PRE-INSTALLATION MEETINGS
   A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

1.8 WARRANTY
   A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

1.9 EXTRA MATERIALS
   A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 - PRODUCTS

2.1 DIFFUSERS, REGISTERS AND GRILLES
   A. Manufacturers:
      1. Krueger.
      2. Metal-Aire.
      5. Titus.
   B. See schedule on drawings for further information.

2.2 LOUVERS
   A. Manufacturers:
      1. Greenheck.
      2. Ruskin.
      3. United Enertech.
   B. Product Description:
      1. Stationary, double drainable, high wind and impact resistant, wind driven louver.
   C. Miami-Dade County Test Protocols Tested and Passed:
1. PA201-94 Large Missile Impact test.
2. PA 202-94 Uniform Pressure Test (for +/-140 psf windload).
3. PA 203-94 Cyclic Wind Pressure Test.

D. Type: 5 inch deep with blades on 2 inch centers on 45 degree slope and heavy channel frame.

E. Fabrication: 0.081 inch thick extruded aluminum, with factory baked enamel finish. Color to be selected by Architect.

F. Mounting:
   1. Compatible with wall construction.

G. Insect Screen:
   1. Aluminum construction.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
   B. Verify inlet and outlet locations.
   C. Verify ceiling and wall systems are ready for installation.

3.2 INSTALLATION
   A. Install diffusers to ductwork with airtight connection.
   B. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Section 09 90 00.

3.3 INTERFACE WITH OTHER PRODUCTS
   A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.4 SCHEDULES
   A. See schedule on drawings.

END OF SECTION
SECTION 23 64 11

AIR COOLED PACKAGE WATER CHILLERS – SCROLL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes chiller package, charge of refrigerant and oil, controls and control connections, chilled water connections, starters.

B. Related Sections:
   1. Section 23 05 00 – General Mechanical Requirements: Execution requirements for concrete housekeeping pads specified by this section.
   2. Section 23 05 48 – Vibration Control of HVAC Piping and Equipment: Vibration Isolators.
   3. See Drawings for Sequences of operation for chillers specified in this section.
   4. Section 23 21 13 - Hydronic Piping: Product requirements for chilled water piping for placement by this section.
   5. Section 23 25 00 – HVAC Water Treatment: Cleaning requirements for closed hydronic systems.

1.2 REFERENCES

A. Air-Conditioning, Heating and Refrigeration Institute:
   1. AHRI 550/590 - Water Chilling Packages Using the Vapor Compression Cycle.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

C. American Society of Mechanical Engineers:
   1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

D. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 DEFINITIONS

A. Coefficient of Performance (COP) - cooling: The ratio of the rate of heat removal to the rate of energy input, in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.

B. Integrated Part-Load Value (IPLV): A single-number figure of merit based on part-load EER, COP, or kW/ton expressing part-load efficiency for air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment.
1.4 SUBMITTALS

A. Section 23 05 00 General Mechanical Requirements: Submittal procedures.

B. Shop Drawings: Indicate components, assembly, dimensions, weights and loads, required clearances, and location and size of field connections. Indicate valves, strainers, flow sensors and valves required for complete system.

C. Product Data: Submit rated capacities, weights, specialties and accessories, electrical requirements, wiring diagrams, and control diagrams.

D. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include startup instructions.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements including those furnished but not produced by manufacturer.

F. Manufacturer's Field Reports: Submit start-up report for each unit. Indicate results of leak test and refrigerant pressure test.

1.5 CLOSEOUT SUBMITTALS

A. Section 23 05 00 General Mechanical Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.

1.6 QUALITY ASSURANCE

A. Conform to AHRI 550/590 code for testing and rating of scroll water chillers.

B. Performance Ratings: Energy Efficiency Rating (EER) and Integrated Part-Load Value (IPLV) not less than prescribed by ASHRAE 90.1, and as scheduled.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience and with service facilities within 100 miles of Project.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

A. Coordinate with General Contractor prior to unit placement.
1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 23 05 00 General Mechanical Requirements: Product storage and handling requirements.

B. Accept chillers on site in factory packaging. Inspect for damage.

C. Protect chillers from weather by providing temporary protection/caps; provide secure location prior to installation.

1.10 WARRANTY

A. Coordinate with General contractor to provide product warranties and product bonds.

B. Furnish five year manufacturer warranty to include coverage for compressor, evaporator and condenser (complete assembly) including materials and labor.

PART 2 - PRODUCTS

2.1 PACKAGED WATER CHILLERS

A. Manufacturers:
   1. Carrier.
   2. Daikin Applied.
   3. Trane.
   5. Substitutions: As approved by Engineer prior to bid date.

B. Product Description: Factory assembled and tested, packaged, air cooled, liquid chillers consisting of hermetic scroll compressors, compressor motors, condensers, evaporator, refrigeration accessories, refrigerant and oil, instrument and control panel including gages and indicating lights, auxiliary components and accessories, and motor starters.

2.2 COMPRESSORS

A. Scroll Compressors:
   1. Unit: Direct drive, hermetic, 3600 RPM, fixed compression, scroll motor-compressors with control panel.
   2. Features: Centrifugal oil pump, sump oil heater, oil level sight glass, oil charging valve, two point lubrication for each motor bearing, flooded lubrication for journal and thrust bearings, check valve on scroll discharge port.
   5. Provide rubber isolators for each compressor, and ½” neoprene pads for entire unit.
2.3 CASING
A. Provide galvanized steel, heavy gage, powder coat painted casing, capable of passing 1000 hr ASTM B117 salt spray test.

2.4 EVAPORATOR
A. Scroll units: Brazed plate heat exchanger, seamless or welded stainless steel construction. Furnish multiple refrigerant circuits on units over 35 tons.
B. Design, test, and stamp refrigerant side for 225 psig working pressure and water side for 150 psig working pressure, in accordance with ASME Section VIII.
C. Insulate with 0.75 inch minimum thick flexible expanded polyvinyl chloride (Armaflex or equal) insulation with maximum K factor of 0.28.
D. Furnish water drain connection and thermometer wells for temperature controller and low temperature cutout.
E. Provide grooved pipe connections at inlet/outlet water side. (Field insulated.)
F. Temperature-actuated, off-cycle evaporator heater for freeze protection down to 0°F.

2.5 CONDENSER COILS, FANS AND MOTORS
A. Coils: Aluminum fins mechanically bonded to seamless copper tubing or aluminum microchannel type. Furnish sub-cooling circuits as applicable. Air test under water to minimum 425 psi, and vacuum dehydrate.
B. Condenser coils shall be furnished with corrosion resistant coating capable of withstanding salt spray test of 1,000 hours in accordance with ASTM B117, equal to E-Coat, applied by factory.
C. Coil Guard: Expanded metal Louvered.
D. Configuration: Two refrigeration circuits on units over 35 tons, each with receiver.
E. Vertical direct driven propeller type condenser fans with fan guard on discharge.
F. Weatherproof top mounted, TEAO motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with permanent lubricated ball bearings and built-in current and thermal overload protection.

2.6 REFRIGERANT CIRCUIT
A. Factory furnished and piped.
B. Furnish for each refrigerant circuit:
   1. Liquid line solenoid valve.
   2. Filter dryer (replaceable core type).
3. Liquid line sight glass and moisture indicator.
4. Thermal expansion for maximum operating pressure.
5. Charging valve, locking type.
6. Insulated suction lines 3/4” Armaflex or equal
7. Thermostatic or Electronic expansion valve on each circuit.
8. Discharge line check valve.
9. Compressor discharge and suction service valves.
10. Pressure relief device.

C. Provide dual circuit (minimum) on units over 35 tons.

2.7 CONTROLS

1. A centrally located weatherproof control panel shall contain the field power connection points, control interlock terminals, and control system. Box shall be designed in accordance with NEMA 3R rating. Power and starting components shall include factory circuit breaker for fan motors and control circuit, individual contactors for each fan motor, solid-state compressor three-phase motor overload protection, inherent fan motor overload protection and two power blocks (one per circuit) for connection to remote, contractor supplied disconnect switches. Hinged access doors shall be lockable. Barrier panels or separate enclosures are required to protect against accidental contact with line voltage when accessing the control system.

2. Shall include optional single-point connection to a non-fused disconnect switch with through-the-door handle and compressor circuit breakers.

A. Unit Controller

1. An advanced DDC microprocessor unit controller with a 5-line by 22-character liquid crystal display provides the operating and protection functions. The controller shall take preemptive limiting action in case of high discharge pressure or low evaporator pressure. The controller shall contain the following features as a minimum:

2. The unit shall be protected in two ways: (1) by alarms that shut the unit down and require manual reset to restore unit operation and (2) by limit alarms that reduce unit operation in response to some out-of-limit condition. Shut down alarms shall activate an alarm signal.

3. Shutdown Alarms
   a. No evaporator water flow (auto-restart)
   b. Sensor failures
   c. Low evaporator pressure
   d. Evaporator freeze protection
   e. High condenser pressure
   f. Outside ambient temperature (auto-restart)
   g. Motor protection system
   h. Phase voltage protection (Optional)

4. Limit Alarms
   a. Condenser pressure stage down, unloads unit at high discharge pressures.
   b. Low ambient lockout, shuts off unit at low ambient temperatures.
   c. Low evaporator pressure hold, holds stage #1 until pressure rises.
   d. Low evaporator pressure unload, shuts off one compressor.
5. Unit Enable Section
   a. Enables unit operation from either local keypad, digital input, or BAS

6. Unit Mode Selection
   a. Selects standard cooling, ice, glycol, or test operation mode

7. Analog Inputs:
   a. Reset of leaving water temperature, 4-20 mA
   b. Current Limit

8. Digital Inputs
   a. Unit off switch
   b. Remote start/stop
   c. Flow switch
   d. Motor protection

9. Digital Outputs
   a. Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared
   b. Evaporator pump; field wired, starts pump when unit is set to start

10. Condenser fan control - The unit controller shall provide control of condenser fans based on compressor discharge pressure.

11. Building Automation System (BAS) Interface
   a. Factory mounted DDC controller(s) shall support operation on a BACnet network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier.
   b. BACnet MS/TP master (Clause 9)
   c. BACnet IP, (Annex J)
   d. BACnet ISO 8802-3, (Ethernet)
   e. The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.
   f. All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2016). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.

2.8 CHILLER PERFORMANCE – See Schedules on Drawings.

2.9 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics: In accordance with Division 26 specifications and the Drawings.
   1. Coordinate power connection with electrical trade.

B. Disconnect Switch: Factory mount in control panel on equipment.

2.10 SOURCE QUALITY CONTROL (AND TESTS)

A. Furnish testing and analysis of package chillers; ship with chiller.
B. Furnish shop inspection and testing for package chillers; ship with chiller.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install packaged outdoor chiller on the existing concrete foundation. Extend the existing foundation as required to accommodate the unit footprint. Refer to Section 23 05 00 for concrete requirements.

B. Install units on neoprene waffle pads per Section 23 05 48.

C. Install the following piping accessories on evaporator chilled water piping connections. Refer to Section 23 21 16 and Section 23 21 13.

1. On inlet:
   a. Thermometer well for temperature controller.
   b. Thermometer.
   c. Strainer.
   d. Flow switch.
   e. Flexible pipe connection.
   f. Pressure gage.
   g. Shut-off valve.

2. On outlet:
   a. Thermometer.
   b. Flexible pipe connection.
   c. Pressure gage.
   d. Shut-off Balancing valve with memory stop.

D. Arrange piping for easy dismantling to permit tube cleaning.

E. Install emergency ports (valved tees with blind flanges) for plug-in (rental) chiller; see plans.

F. Install chiller accessories furnished loose for field mounting.

G. Install electrical devices furnished loose for field mounting.

H. Install control wiring between chiller control panel and field mounted control devices.

3.2 FIELD QUALITY CONTROL

A. Coordinate with General Contractor and Test, Adjust and Balance Contractor for field inspecting, testing, adjusting, and balancing.

B. Furnish cooling season start-up, winter season shutdown service, for first year of operation. When initial start-up and testing takes place in winter and machines are to remain inoperative, repeat start-up and testing operation at beginning of first cooling season.
3.3 MANUFACTURER'S FIELD SERVICES

A. Furnish services of factory trained representative for minimum of one day to leak test, refrigerant pressure test, evacuate, dehydrate, charge (as required), start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.4 DEMONSTRATION AND TRAINING

A. Demonstrate system operations and verify specified performance. Demonstrate low ambient operation during winter testing for air-cooled condensers. Provide training for up to 4 designated Owner’s representatives. Training shall cover all aspects of operation, controls and maintenance, and shall be held at the Owner’s site. Minimum duration of 4 hours.

3.5 SCHEDULES – See Drawings for schedule.

END OF SECTION
SECTION 23 73 00

INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes modular factory fabricated air-handling units and accessories.

B. Related Sections:

1. Section 23 05 00 - General Mechanical Requirements for overall requirements relating to installation.
2. Section 23 05 14 - Variable-Frequency Motor Controllers: Product requirements for VFD controllers for placement by this section.
3. Section 23 07 00 - HVAC Insulation: Product requirements for insulation for placement by this section.
4. Section 23 08 00 – Commissioning of HVAC: Commissioning requirements.
5. Section 23 09 23 - Direct-Digital Control System for HVAC: Controls remote from unit.
6. Section 23 21 13 - Hydronic Piping: Product requirements for chilled water and hot water piping connections to air handling units.
7. Section 23 21 16 - Hydronic Piping Specialties: Product requirements for hydronic piping specialties for placement by this section.
8. Section 23 33 00 - Air Duct Accessories: Product requirements for flexible duct connections for placement by this section.

1.2 REFERENCES

A. American Bearing Manufacturers Association:
1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. Air Movement and Control Association International, Inc.:
2. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
4. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
5. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

C. Air-Conditioning, Heating and Refrigeration Institute:
2. AHRI 430 - Central-Station Air-Handling Units.
3. AHRI Guideline D - Application and Installation of Central Station Air-Handling Units.

D. ASTM International:
E. National Electrical Manufacturers Association:
   1. NEMA MG 1 - Motors and Generators.

F. Sheet Metal and Air Conditioning Contractors:
   1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

G. Underwriters Laboratories Inc.:
   1. UL 900 - Air Filter Units.
   2. UL - Fire Resistance Directory.

1.3 SUBMITTALS
A. Section 23 05 00 - General Mechanical Requirements: Submittal procedures.
B. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements. Calculations for required baserail heights to satisfy condensate trapping requirements of cooling coil shall be included.
C. Product Data, Submit the following:
   1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
   2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
   3. Fans: Performance and fan curves with specified operating point plotted, power, RPM. Provide curves showing entire range of fan capacity, not just at selected point.
   4. Sound Power Level Data: Unit discharge, return and casing radiation at rated capacity.
   6. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
D. Manufacturer's Installation Instructions: Submit.
E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS
A. Section 23 05 00 - General Mechanical Requirements: Closeout procedures.
B. Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.5 QUALITY ASSURANCE
A. Outside Air Damper Leakage: Test in accordance with AMCA 500.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.
1.7 PRE-INSTALLATION COORDINATION
A. Coordinate with General Contractor, commissioning authority and other involved trades prior to setting unit.
B. Coordinate layout, accessories and utility connections with other trades.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Section 23 05 00 - General Mechanical Requirements: Product storage and handling requirements.
B. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
C. Protect units from weather and construction traffic by storing in dry, secure location. Close/seal all openings in casing.

1.9 WARRANTY
A. Coordinate with General contractor for provision of product warranties and product bonds.

1.10 EXTRA MATERIALS
A. Furnish one set of filters for each unit. Deliver to Owner’s representative.

PART 2 - PRODUCTS
2.1 AIR HANDLING UNITS
A. Manufacturers:
   1. Carrier.
   2. Climacraft.
   4. York/JCI.
   5. Temtrol.
   6. Trane.
   7. Substitutions: As approved by Engineer prior to bid date.
B. Configuration: See AHU schedules on drawings for configurations.
C. Performance Base: Sea level pressure or altitude.
D. Fabrication: Conform to AMCA 99, AHRI 410 and AHRI 430.

2.2 UNIT CONSTRUCTION
A. Fabricate unit with heavy gauge channel posts and panels secured with mechanical fasteners. All panels, access doors, and ship sections shall be sealed with permanently applied bulb-type gasket. Shipped loose gasketing is not allowed.
B. Panels and access doors shall be constructed as a 2-inch nominal thick; thermal broke double wall assembly, injected with foam insulation with an R-value of not less than R-13.
   1. The outer panel shall be constructed of G60 painted galvanized steel.
   2. The inner liner shall be constructed of 304 stainless steel.
   3. The floor plate shall be constructed as specified for the inner liner.
   4. Unit will be furnished with solid inner liners.
C. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, maximum 5 inches of positive or 6 inches of negative static pressure. Deflection shall be measured at the panel midpoint.
D. The casing leakage rate shall not exceed .5 cfm per square foot of cabinet area at 5 inches of positive static pressure or 6 inches of negative static pressure.

E. Module to module field assembly shall be accomplished with an overlapping, full perimeter internal splice joint that is sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.

F. Access doors shall be flush mounted to cabinetry, with minimum of two six inch long stainless steel piano-type hinges, latch and full size handle assembly. Access doors shall swing outward for unit sections under negative pressure. Access doors on positive pressure sections, shall have a secondary latch to relieve pressure and prevent injury upon access.

G. Air handler chilled water coil piping shall extend through the unit casing for field connection.

H. The unit shall have a 6-inch base rail for structural rigidity and condensate trapping. The base shall be designed with sloped drip pans located under all unit sections except duct openings and shall be supported by frame member.

I. Construct drain pans from stainless steel with cross break and double sloping pitch to drain connection. Provide drain pans under cooling coil section. Drain connection centerline shall be a minimum of 3” above the base rail to aid in proper condensate trapping. Drain connections that protrude from the base rail are not acceptable. There must be a full 2” thickness of insulation under drain pan.

2.3 FAN SECTION

A. Acceptable fan assembly shall be a single width, single inlet, class II, direct-drive type plenum fan dynamically balanced as an assembly, as shown in schedule. Maximum fan RPM shall be below first critical fan speed. Fan assemblies shall be dynamically balanced by the manufacturer on all three planes. Provide access to motor and fan assembly through hinged access door. For small pre-packaged units, forward curved centrifugal fans will be acceptable.

B. Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of the unit if removal is required. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on 2” deflection spring vibration type isolators inside cabinetry.

C. Bearings: Basic load rating computed in accordance with AFBMA - ANSI Standards. The bearings shall be provided on the motor with the fan wheel mounted directly on the motor shaft, AMCA arrangement 4.

D. Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.

E. The fan wheel shall be direct coupled to the motor shaft. The wheel width shall be determined by motor speed and fan performance characteristics.

F. Fan motors shall be manufacturer provided and installed, Open Drip Proof or TEFC, premium efficiency (meets or exceeds EPAct requirements), 1750 RPM or 3,500 RPM as indicated on the drawings, and be inverter duty rated.

G. Provide field mounted VFD’s for fan modulation. VFD’s shall comply with Section 23 05 14. For small pre-packaged units, EC motors will be acceptable.

H. Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclosed terminal lugs in terminal box sized to NFPA 70.
I. All electrical connection components shall be field provided and mounted as shown on project schedule.

2.4 COOLING COILS

A. Certification: Acceptable water cooling coils shall be certified in accordance with AHRI Standard 410 and bear the AHRI label. Coils exceeding the scope of the manufacturer’s certification and/or the range of AHRI’s standard rating conditions will be considered provided the manufacturer is a current member of the AHRI Forced Circulation Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with AHRI Standard 410.

B. Provide access to coil for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 5” beyond unit casing for ease of installation. Drain and vent connections shall be provided exterior to unit casing. Coil connections must be factory sealed with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly. If not factory packaged, Contractor must supply all coil connection grommets and sleeves. Coils shall be removable through side panels of unit without the need to remove and disassemble the entire section from the unit.

1. Headers shall consist of seamless copper tubing to assure compatibility with primary surface. Headers to have intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility. Header diameter should vary with fluid flow requirements.

2. Fins shall have a minimum thickness of 0.0075 inch thick aluminum plate construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.

3. Coil tubes shall be OD seamless copper, 0.020 inch nominal tube wall thickness, expanded into fins, brazed at joints.

4. Coil connections shall be carbon steel, NPT threaded connection. Connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent and drain fittings shall be furnished on the connections, exterior to the air handler. Vent connections provided at the highest point to assure proper venting. Drain connections shall be provided at the lowest point to ensure complete drainage and prevent freeze-up.

5. Coil casing shall be a formed channel frame of galvanized steel.

2.5 FILTER SECTION

A. Furnish combination filter section with 2-inch pleated MERV 8 flat pre-filter with microbial resistant coating. Provide side loading and removal of filters.

B. Filter Magnehelic gauge(s) shall be furnished and mounted by equipment manufacturer.

2.6 OUTSIDE AIRFLOW MEASURING DEVICE

A. See Specification 23 09 23 and controls drawings for outside airflow measuring device requirements.
2.7 ADDITIONAL SECTIONS
   A. Access sections shall be provided for access between components. Access door minimum size shall be 16 inches wide. Access doors/sections shall be larger where necessary for proper maintenance. Floor options shall include 0.125-inch aluminum treadplate or drain pan as shown on project schedule.
   B. Mixing box section shall be provided with outside air and return air openings with parallel low leak airfoil damper blades. Connection locations shall be as indicated on the drawings. Dampers shall be hollow core galvanized steel airfoil blades, fully gasketed and have continuous vinyl seals between damper blades in a galvanized steel frame. Dampers shall have stainless steel jamb seals along end of dampers. Connecting linkage and ABS plastic end caps shall be provided when return and outside air dampers are each sized for full airflow. Damper Leakage: Leakage rate shall be less than two tenths of one percent leakage at 2.0 inches static pressure differential. Leakage rate tested in accordance with AMCA Standard 500. Controls contractor shall install actuators on dampers for operation as indicated in sequences on drawings.

2.8 CONTROLS
   A. Controls: Refer to Section 23 09 23 and drawings for sequence of operation.

2.9 CAPACITY – See Schedule on Drawings.

2.10 ELECTRICAL CHARACTERISTICS AND COMPONENTS
   A. Electrical Characteristics: See Schedules on Drawings:

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Coordinate with General Contractor to verify existing conditions before starting work.

3.2 INSTALLATION
   A. Install in accordance with AHRI 430 and manufacturer’s recommendations.
   B. Install isolated fans with resilient mountings and flexible electrical leads. Install restraining snubbers as required. Adjust snubbers to prevent tension in flexible connectors when fan is operating.
   C. Install condensate piping with trap and route from drain pan to condensate drainage system, as indicated on Drawings. Refer to Section 23 21 13.
   D. Insulate coil headers if located outside airflow as specified for piping. Refer to Section 23 07 00.
   E. Install auxiliary drain pan constructed of galvanized steel w/welded seams under entirety of air handling unit. Provide moisture sensing kill switch in drain pan. See plans for additional information.

3.3 INSTALLATION HYDRONIC COILS
   A. Make connections to coils with unions or flanges.
   B. Connect water supply to leaving airside of coil (counter flow arrangement).
   C. Install water coils to allow draining and install drain connection at low points.
   D. Install valves and piping specialties in accordance with details as indicated on Drawings.
   E. Install air vents at high points complete with shutoff valve. Refer to Section 23 21 13 and details on drawings.
3.4 MANUFACTURER'S FIELD SERVICES
   A. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

3.5 CLEANING
   A. Vacuum clean coils and inside of unit cabinet.
   B. Comb out coil fins.
   C. Install temporary filters during construction period. Replace with a new set of filters at Substantial Completion.

3.6 DEMONSTRATION
   A. Coordinate with General Contractor and Commissioning Authority to provide for demonstration and training.
   B. Demonstrate unit operation and maintenance.

3.7 PROTECTION OF FINISHED WORK
   A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

3.8 SCHEDULES – See Drawings.

END OF SECTION
SECTION 23 81 23

SPLIT-SYSTEM AIR CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Air handling unit.
   2. Condensing unit.
B. Related Sections:
   1. Section 23 05 00 - General Mechanical Requirements.

1.2 REFERENCES
A. Air-Conditioning, Heating and Refrigeration Institute:
   2. AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
   4. AHRI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.
B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
C. ASTM International:
D. National Electrical Manufacturers Association:
   1. NEMA MG 1 - Motors and Generators.
E. National Fire Protection Association:

1.3 SUBMITTALS
A. Section 23 05 00 - General Mechanical Requirements.
B. Product Data: Submit data indicating:
   1. Cooling and heating capacities.
   2. Dimensions.
   3. Weights.
   4. Rough-in connections and connection requirements.
   5. Duct connections.
   6. Electrical requirements with electrical characteristics and connection requirements.
   7. Provide family of fan curves or tables showing entire range of fan/motor capacities, not just the selected point.
   8. Controls.
C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
1.4 CLOSEOUT SUBMITTALS
A. Section 23 05 00 - General Mechanical Requirements: Closeout procedures.
B. Project Record Documents: Record actual locations of controls installed remotely from units.
C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.5 QUALITY ASSURANCE
A. Performance Requirements: Energy Efficiency Rating SEER or EER not less than as indicated on drawings when used in combination with compressors and evaporator coils when tested in accordance with AHRI 210/240 or AHRI 340/360.
B. Cooling Capacity: Rate in accordance with AHRI 210/240, AHRI 340/360 or AHRI 365.
C. Sound Rating: Measure in accordance with AHRI 270.
D. Insulation and adhesives: Meet requirements of NFPA 90A.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION COORDINATION
A. Coordinate with General Contractor prior to equipment installation.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Section 23 05 00 - General Mechanical Requirements: Requirements for transporting, handling, storing, and protecting products.
B. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
C. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.
D. Protect units from weather and construction traffic by storing in dry, roofed location.

1.9 COORDINATION
A. Coordinate with General Contractor and other related trades for layout and utility connections.
B. Coordinate installation of condensing units with concrete pads and disconnect switches.
C. Coordinate installation of air handling units with building structure and housekeeping pads.

1.10 WARRANTY
A. Coordinate with General Contractor to provide for warranties.
B. Furnish five year manufacturers warranty for compressors.

1.11 MAINTENANCE MATERIALS
A. Furnish one set of filters for each unit. Deliver to Owner’s representative.

PART 2 - PRODUCTS

2.1 SPLIT SYSTEM AIR CONDITIONING UNITS
A. Manufacturers:
   1. Carrier.
   2. Daikin/Goodman.
3. Lennox.
4. Trane.
5. York.
6. Substitutions: As approved by Engineer prior to bid date.

B. Product Description: Split system consisting of air handling unit and condensing unit including cabinet, evaporator fan, refrigerant cooling coil, compressor, refrigeration circuit, condenser, electric heating coil, air filters, controls, air handling unit accessories, condensing unit accessories, and refrigeration specialties.

2.2 AIR HANDLING UNIT
A. Configuration: As indicated on Drawings.
B. Cabinet:
   1. Panels: Constructed of galvanized steel with baked enamel finish.
   2. Access Panels: Located on both sides of unit. Furnish with duct collars on inlets and outlets.
   3. Insulation: Factory applied foil face insulation.
D. Evaporator Coil: Constructed of copper tubes expanded onto aluminum fins. Factory leak tested under water. Removable, PVC construction, double-sloped drain pan with piping connections on both sides.
E. Refrigeration System: Refrigeration circuits as indicated and controlled by factory installed thermal expansion valve.
F. Electric Heating Coil: Helical nickel-chrome resistance wire coil heating elements with refractory ceramic support bushings easily accessible with automatic reset thermal cut-out, built-in contactors, galvanized steel frame, control circuit transformer and fuse, air flow proving device, load fuses. Number of stages as indicated on Drawings.
G. Air Filters: 1” inch thick glass fiber disposable media in metal frames. 25 to 30 percent efficiency based on ASHRAE 52.1.

2.3 CONDENSING UNIT
A. General: Factory assembled and tested air cooled condensing units, consisting of casing, compressors, condensers, coils, condenser fans and motors, and unit controls.
B. Unit Casings: Exposed casing surfaces constructed of galvanized steel with manufacturer's standard baked enamel finish. Designed for outdoor installation and complete with weather protection for components and controls, and complete with removable panels for required access to compressors, controls, condenser fans, motors, and drives.
C. Compressor: Single refrigeration circuit with scroll type compressor, resiliently mounted, with positive lubrication, and internal motor overload protection.
D. Condenser Coil: Constructed of copper tubing mechanically bonded to aluminum fins, factory leak and pressure tested. Condenser coils shall be furnished with corrosion resistant coating capable of withstanding salt spray test of 1,000 hours in accordance with ASTM B117, equal to E-Coat, applied by factory.
E. Controls: Furnish operating and safety controls including high and low pressure cutouts, control transformer. Furnish magnetic contactors for compressor and condenser fan motors.
F. Condenser Fan and Drive: Direct drive propeller fan statically and dynamically balanced. Wired to operate with compressor. Permanently lubricated ball bearing type motors with
built-in thermal overload protection. Provide “motor-on-top” arrangement with totally encased motor.

G. Condensing Unit Accessories: Furnish the following accessories:
1. Time delay relay.
2. Anti-short cycle timer.
3. Disconnect switch.
4. Condenser Coil Hail Guard: Condenser and fan openings furnished with painted steel wire safety guards.
5. Suction and discharge pressure ports.

H. Refrigeration specialties: Furnish the following for each circuit:
1. Charge of compressor oil.
2. Holding charge of refrigerant.
3. Replaceable core type filter drier.
4. Liquid line sight glass and moisture indicator.
5. Shut-off valves on suction and liquid piping.
6. Charging valve, locking type.
7. Oil level sight glass.
8. Crankcase heater.

I. Refrigerant: Furnish charge of refrigerant R-410A.

2.4 CONTROLS
A. Terminal strip for control by BAS. See specification 23 09 23.

2.5 CAPACITY – See Schedule on Drawings.

2.6 ELECTRICAL CHARACTERISTICS AND COMPONENTS
A. Electrical Characteristics: See schedules on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Coordinate with General Contractor for verification of existing conditions before starting work.
B. Verify concrete pads for condensing units and air handlers are ready for unit installation.

3.2 INSTALLATION - AIR HANDLING UNIT
A. Connect air handling units to supply and return ductwork with flexible connections. Insulate over flexible connections with flexible uni-cellular insulation Arma-flex or equal.
B. Install condensate piping with trap and route to floor drain as indicated on drawings.
C. Install components furnished loose for field mounting.

3.3 INSTALLATION - CONDENSING UNIT
A. Install units on concrete pad.
B. Install refrigerant piping from unit to condensing unit. Install refrigerant specialties per equipment manufacturer’s instructions. Provide suction line insulation and weather protection as specified in Section 23 07 00.
C. Evacuate refrigerant piping and install initial charge of refrigerant.
D. Install electrical devices furnished loose for field mounting.
E. Install control wiring between air handling unit, condensing unit, and field installed accessories.
3.4 CLEANING
   A. Install temporary filters during construction period. Replace with new set of filters at Substantial Completion.

3.5 DEMONSTRATION
   A. Coordinate with General Contractor for demonstration and training.
   B. Demonstrate air handling unit operation and maintenance.
   C. Demonstrate starting, maintenance, and operation of condensing unit.
   D. Furnish services of manufacturer's technical representative for 2 hours to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days notice to Engineer of training date.

3.6 PROTECTION OF FINISHED WORK
   A. Do not operate air handling units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION
SECTION 23 81 27
MINI-SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wall-mounted fan coil unit.
   2. Condensing unit.

1.2 REFERENCES

A. Air-Conditioning, Heating and Refrigeration Institute:
   2. AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
   4. AHRI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

C. ASTM International:

D. National Electrical Manufacturers Association:
   1. NEMA MG 1 - Motors and Generators.

E. National Fire Protection Association:

1.3 SUBMITTALS

A. Section 23 05 00 Mechanical General Requirements: Submittal procedures.

B. Product Data:
   1. Submit data indicating:
      a. Cooling capacities.
      b. Dimensions.
      c. Weights.
      d. Rough-in connections and connection requirements.
e. Electrical requirements with electrical characteristics and connection requirements.
f. Controls.
g. Accessories.

C. Manufacturer’s Installation Instructions:
   1. Submit assembly, support details, connection requirements, and include start-up instructions.

D. Manufacturer’s Certificate:
   1. Certify Products meet or exceed specified requirements.

E. Manufacturer’s Field Reports:
   1. Submit start-up report for each unit.

1.4 CLOSEOUT SUBMITTALS

A. Section 23 05 00 – General Mechanical Requirements: Closeout procedures.

B. Project Record Documents:
   1. Record actual locations of controls installed remotely from units.

C. Operation and Maintenance Data:
   1. Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.5 QUALITY ASSURANCE

A. Performance Requirements:
   1. Season Energy Efficiency Rating (SEER) not less than prescribed by ASHRAE 90.1 when used in combination with compressors and evaporator coils when tested in accordance with ARI 210/240.

B. Cooling Capacity:
   1. Rate in accordance with ARI 210/240.

C. Sound Rating:
   1. Measure in accordance with ARI 270.

D. Insulation and adhesives:
   1. Meet requirements of NFPA 90A.

1.6 QUALIFICATIONS

A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum five years documented experience and local representation.
B. Installer:
   1. Company specializing in performing Work of this section with minimum three years experience.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Section 23 05 00 - General Mechanical Requirements: Requirements for transporting, handling, storing, and protecting products.
B. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
C. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.
D. Protect units from weather and construction traffic by storing in dry, roofed location.

1.8 COORDINATION
A. Coordinate with General Contractor prior to installation of equipment.
B. Coordinate installation of condensing units with roofing contractor.
C. Coordinate installation of fan coil units with building structure.

1.9 WARRANTY
A. Coordinate with General Contractor for requirements for warranties.
B. Furnish five year manufacturers warranty for compressors.

1.10 MAINTENANCE MATERIALS
A. Furnish one set of extra filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:
A. Acceptable manufactures:
   1. Daikin.
   2. LG
   3. Mitsubishi
   4. Substitutions: None Permitted.

2.2 INDOOR UNIT (WALL MOUNTED)
A. General:
1. Indoor unit, where indicated, shall be a wall mounted fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation onto a wall within the conditioned space. The unit shall be equipped with a programmed drying mechanism that dehumidifies while inhibiting changes in room temperature when used with a local controller. A mildew-proof, polystyrene air filter and condensate drain pan shall be included as standard equipment.

B. Fan:
   1. The fan shall be direct-drive type, statically and dynamically balanced impeller with high and low fan speeds available.

C. Coil:
   1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

D. Provide little giant condensate pump, model VCMA-20, 115V/1PH, 1.5A, 60GPH@7 ft. with ½ gallon tank, UL listing, power cord, check valve. Install below fan coil on wall and pipe condensate up to overhead drain.

E. Electrical:
   1. The unit electrical power shall be 115 volts (or 208), 1 phase, 60 hertz. Unless otherwise noted, coordinate power with outdoor unit; indoor unit shall derive its power from the outdoor unit. Coordinate with electrician if 208 volts for indoor unit. (Note that other voltages for the indoor unit are not acceptable.)
   2. The system shall be capable of satisfactory operation within 10% of nominal voltage.
   3. The indoor unit shall not have any supplemental electrical heat elements.

F. Control:
   1. This unit shall perform input functions necessary to operate the system, using the unit-mounted control panel. The control panel shall consist of a Power On-Off switch, Cool/Dry-Fan selector, Thermostat setting, Timer Mode, fan speed selector, Auto Vane selector, Test Run switching and Check Mode switching.
   2. Temperature changes shall be by 2°F increments with a range of 65 - 87°F.
   3. The microprocessor located in the indoor unit shall have the capability of sensing at the remote sensor (sensor only, wired, not wireless), receiving and processing commands, providing emergency operation and controlling the outdoor unit. Provide locking plexiglass cover for the wall-mounted sensor; secure the indoor-unit-mounted controller either with means to prevent unauthorized personnel from changing setpoints, etc. (Wireless remote or physical securing of controller).
   4. The control wiring from the outdoor unit to the indoor unit shall be in separate conduit from the power, or it shall be shielded.
   5. The system shall be capable of automatic restart when power is restored after power interruption. System shall operate 24x7, 365 days per year, with a setpoint adjustable at the secured controller only.
   6. Control system shall control the continuous operation of the air sweep louvers.

2.3 OUTDOOR UNIT

A. General:
   1. The units shall be equipped with a circuit board that interfaces to the indoor unit and
perform all functions necessary for operation. The unit must have a powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit must be run tested at the factory.

B. Unit Cabinet:
   1. The casing shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.

C. Fan:
   1. The unit shall be furnished with a direct drive propeller type fan.
   2. The motor shall have inherent protection, be permanently lubricated bearings.
   3. The fan motor shall be mounted for quiet operation.
   4. The fan shall be provided with a raised guard to prevent contact with moving parts.

D. Coil:
   1. The condenser coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
   2. Condenser coils shall be furnished with corrosion resistant coating capable of withstanding salt spray test of 1,000 hours in accordance with ASTM B117, equal to E-Coat, applied by factory.
   3. The coil shall be protected with an integral metal guard.
   4. Refrigerant flow from the condenser shall be controlled by means of a thermal expansion valve.

E. Compressor:
   1. The compressor shall be a high performance scroll, R410a.
   2. A crankcase heater shall be factory mounted on the outside of the compressor.
   3. The outdoor unit shall have an accumulator.
   4. The compressor will be equipped with an internal thermal overload.
   5. The outdoor unit shall have a high-pressure safety switch.
   6. The outdoor unit must have the ability to operate with a maximum height difference of 100 feet and have refrigerant tubing length of 100 feet between indoor and outdoor units without the need for line size changes, traps or additional oil.
   7. The compressor shall be mounted to avoid the transmission of vibration.
   8. The outdoor unit shall be capable of operating at 0°F ambient temperature.

F. Electrical:
   1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
   2. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts.
   3. The outdoor unit shall be controlled by the microprocessor located in the indoor unit.
   4. The control wiring between the indoor unit and the outdoor unit shall be shielded or in a separate conduit.
   5. Power for indoor unit shall be from the outdoor unit; provide conduit with a motor-rated disconnect switch at indoor unit. Coordinate with electrical contractor if voltage is different.
PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify of existing conditions before starting work.
   B. Verify roof is ready for rail curb installation; coordinate with roofing contractor.

3.2 INSTALLATION – FAN COIL UNIT
   A. Install fan coil per manufacturer’s instructions.
   B. Install condensate piping without trap and route from unit to condensate drainage system.
   C. Install components furnished loose for field mounting.
   D. Install with time delay relay on door switch such that system will shut down if room door stays open more than 60 seconds.

3.3 INSTALLATION - CONDENSING UNIT
   A. Install condensing units on concrete housekeeping pads or equipment rail curbs as applicable as specified in 23 05 29.
   B. Install refrigerant piping from fan coil unit to condensing unit. Install refrigerant specialties furnished with unit. Insulate suction and liquid piping: Install with aluminum jacket on exterior piping and piping exposed to view. Jacket may be over the two lines together.
   C. Install electrical devices furnished loose for field mounting.
   D. Install control wiring between fan coil unit, condensing unit, and field installed accessories.

3.4 MANUFACTURER'S FIELD SERVICES
   A. Coordinate with General Contractor to provide manufacturer’s field services.
   B. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

3.5 CLEANING
   A. Vacuum clean coils and inside of unit cabinet.
   B. Install new filters in units at Substantial Completion. (Deliver extra set of filters to Owners.)

3.6 DEMONSTRATION
   A. Demonstrate air handling unit operation and maintenance to owner.
B. Demonstrate starting, maintenance, and operation of condensing unit including low ambient
temperature operation.

3.7 PROTECTION OF FINISHED WORK

A. Do not operate fan coil units until unit is clean, filters are in place and fan has been test run
under observation.

3.8 SCHEDULES

A. See schedule on drawings.

END OF SECTION
SECTION 23 81 28
SPLIT-SYSTEM AIR CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Air handling unit.
   2. Condensing unit.
B. Related Sections:
   1. Section 23 05 00 - General Mechanical Requirements.

1.2 REFERENCES
A. Air-Conditioning, Heating and Refrigeration Institute:
   2. AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
   4. AHRI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.
B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
C. ASTM International:
D. National Electrical Manufacturers Association:
   1. NEMA MG 1 - Motors and Generators.
E. National Fire Protection Association:

1.3 SUBMITTALS
A. Section 23 05 00 - General Mechanical Requirements.
B. Product Data: Submit data indicating:
   1. Cooling and heating capacities.
   2. Dimensions.
   3. Weights.
   4. Rough-in connections and connection requirements.
   5. Duct connections.
   6. Electrical requirements with electrical characteristics and connection requirements.
   7. Provide family of fan curves or tables showing entire range of fan/motor capacities, not just the selected point.
   8. Controls.
C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
1.4 CLOSEOUT SUBMITTALS
A. Section 23 05 00 - General Mechanical Requirements: Closeout procedures.
B. Project Record Documents: Record actual locations of controls installed remotely from units.
C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.5 QUALITY ASSURANCE
A. Performance Requirements: Energy Efficiency Rating SEER or EER not less than as indicated on drawings when used in combination with compressors and evaporator coils when tested in accordance with AHRI 210/240 or AHRI 340/360.
B. Cooling Capacity: Rate in accordance with AHRI 210/240, AHRI 340/360 or AHRI 365.
C. Sound Rating: Measure in accordance with AHRI 270.
D. Insulation and adhesives: Meet requirements of NFPA 90A.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION COORDINATION
A. Coordinate with General Contractor prior to equipment installation.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Section 23 05 00 - General Mechanical Requirements: Requirements for transporting, handling, storing, and protecting products.
B. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
C. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.
D. Protect units from weather and construction traffic by storing in dry, roofed location.

1.9 COORDINATION
A. Coordinate with General Contractor and other related trades for layout and utility connections.
B. Coordinate installation of condensing units with concrete pads and disconnect switches.
C. Coordinate installation of air handling units with building structure and housekeeping pads.

1.10 WARRANTY
A. Coordinate with General Contractor to provide for warranties.
B. Furnish five year manufacturers warranty for compressors.

1.11 MAINTENANCE MATERIALS
A. Furnish one set of filters for each unit. Deliver to Owner’s representative.

PART 2 - PRODUCTS
2.1 SPLIT SYSTEM AIR CONDITIONING UNITS
A. Manufacturers:
   1. Carrier.
   2. Daikin/Goodman.
3. Lennox.
4. Trane.
5. York.
6. Substitutions: As approved by Engineer prior to bid date.

B. Product Description: Split system consisting of air handling unit and condensing unit including cabinet, evaporator fan, refrigerant cooling coil, compressor, refrigeration circuit, condenser, electric heating coil, air filters, controls, air handling unit accessories, condensing unit accessories, and refrigeration specialties.

2.2 AIR HANDLING UNIT
A. Configuration: As indicated on Drawings.
B. Cabinet:
   1. Panels: Constructed of galvanized steel with baked enamel finish.
   2. Access Panels: Located on both sides of unit. Furnish with duct collars on inlets and outlets.
   3. Insulation: Factory applied foil face insulation.
C. Evaporator Fan: Forward curved centrifugal type resiliently mounted with direct drive, Motor permanently lubricated with built-in thermal overload protection. Motor shall be EC type.
D. Evaporator Coil: Constructed of copper tubes expanded onto aluminum fins. Factory leak tested under water. Removable, PVC construction, double-sloped drain pan with piping connections on both sides.
E. Refrigeration System: Refrigeration circuits as indicated and controlled by factory installed thermal expansion valve.
F. Electric Heating Coil: Helical nickel-chrome resistance wire coil heating elements with refractory ceramic support bushings easily accessible with automatic reset thermal cut-out, built-in contactors, galvanized steel frame, control circuit transformer and fuse, air flow proving device, load fuses. Number of stages as indicated on Drawings.
G. Air Filters: 1” inch thick glass fiber disposable media in metal frames. 25 to 30 percent efficiency based on ASHRAE 52.1.

2.3 CONDENSING UNIT
A. General: Factory assembled and tested air cooled condensing units, consisting of casing, compressors, condensers, coils, condenser fans and motors, and unit controls.
B. Unit Casings: Exposed casing surfaces constructed of galvanized steel with manufacturer's standard baked enamel finish. Designed for outdoor installation and complete with weather protection for components and controls, and complete with removable panels for required access to compressors, controls, condenser fans, motors, and drives.
C. Compressor: Single refrigeration circuit with scroll type compressor, resiliently mounted, with positive lubrication, and internal motor overload protection.
D. Condenser Coil: Constructed of copper tubing mechanically bonded to aluminum fins, factory leak and pressure tested. Condenser coils shall be furnished with corrosion resistant coating capable of withstanding salt spray test of 1,000 hours in accordance with ASTM B117, equal to E-Coat, applied by factory.
E. Controls: Furnish operating and safety controls including high and low pressure cutouts, control transformer. Furnish magnetic contactors for compressor and condenser fan motors.
F. Condenser Fan and Drive: Direct drive propeller fan statically and dynamically balanced. Wired to operate with compressor. Permanently lubricated ball bearing type motors with
built-in thermal overload protection. Provide “motor-on-top” arrangement with totally enclosed motor.

G. Condensing Unit Accessories: Furnish the following accessories:
   1. Time delay relay.
   2. Anti-short cycle timer.
   3. Disconnect switch.
   4. Condenser Coil Hail Guard: Condenser and fan openings furnished with painted steel wire safety guards.
   5. Suction and discharge pressure ports.

H. Refrigeration specialties: Furnish the following for each circuit:
   1. Charge of compressor oil.
   2. Holding charge of refrigerant.
   3. Replaceable core type filter drier.
   4. Liquid line sight glass and moisture indicator.
   5. Shut-off valves on suction and liquid piping.
   6. Charging valve, locking type.
   7. Oil level sight glass.
   8. Crankcase heater.

I. Refrigerant: Furnish charge of refrigerant R-410A.

2.4 CONTROLS
   A. Terminal strip for control by BAS. See specification 23 09 23.

2.5 CAPACITY – See Schedule on Drawings.

2.6 ELECTRICAL CHARACTERISTICS AND COMPONENTS
   A. Electrical Characteristics: See schedules on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Coordinate with General Contractor for verification of existing conditions before starting work.
   B. Verify concrete pads for condensing units and air handlers are ready for unit installation.

3.2 INSTALLATION - AIR HANDLING UNIT
   A. Connect air handling units to supply and return ductwork with flexible connections. Insulate over flexible connections with flexible uni-cellular insulation Arma-flex or equal.
   B. Install condensate piping with trap and route to floor drain as indicated on drawings.
   C. Install components furnished loose for field mounting.

3.3 INSTALLATION - CONDENSING UNIT
   A. Install units on concrete pad.
   B. Install refrigerant piping from unit to condensing unit. Install refrigerant specialties per equipment manufacturer’s instructions. Provide suction line insulation and weather protection as specified in Section 23 07 00.
   C. Evacuate refrigerant piping and install initial charge of refrigerant.
   D. Install electrical devices furnished loose for field mounting.
   E. Install control wiring between air handling unit, condensing unit, and field installed accessories.
3.4 CLEANING
A. Install temporary filters during construction period. Replace with new set of filters at Substantial Completion.

3.5 DEMONSTRATION
A. Coordinate with General Contractor for demonstration and training.
B. Demonstrate air handling unit operation and maintenance.
C. Demonstrate starting, maintenance, and operation of condensing unit.
D. Furnish services of manufacturer's technical representative for 2 hours to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days notice to Engineer of training date.

3.6 PROTECTION OF FINISHED WORK
A. Do not operate air handling units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION
SECTION 23 82 00
CONVECTION HEATING UNITS

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Electric unit heaters.

1.2 REFERENCES
A. Sheet Metal and Air Conditioning Contractors:
   1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 SUBMITTALS
A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
B. Shop Drawings: Indicate cross sections of grilles, bracing and reinforcing, and typical elevations. Indicate schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, access doors.
C. Product Data: Submit coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions. Submit mechanical and electrical service locations, capacities and accessories or optional items.
D. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.

1.4 CLOSEOUT SUBMITTALS
A. Section 01 77 00 - Execution and Closeout Requirements: Closeout procedures.
B. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access to valves.
C. Operation and Maintenance Data: Submit manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1.5 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Accept units on site in factory packing. Inspect for damage. Store under roof.

1.7 FIELD MEASUREMENTS
A. Verify field measurements prior to fabrication.
1.8 WARRANTY
A. Section 01 77 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 ELECTRIC UNIT HEATERS
A. Manufacturers:
   1. Markel.
   2. Redd-i.
   3. Reznor.
   4. Q-Mark.
   5. Substitutions: None.
B. Assembly: UL listed and labeled assembly with terminal box and cover, and built-in controls.
C. Heating Elements: Exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings.
D. Cabinet: 18 gauge thick steel with powder coat finish and with easily removed front panel and integral air outlet and inlet grilles.
E. Fan: Direct-drive propeller type, statically and dynamically balanced, with fan guard.
F. Motor: Permanently lubricated, PSC type.
G. Accessories:
H. Control: Factory provided unit or wall mounted thermostat with $35^\circ$-$65^\circ$F temperature range as indicated in Schedule on Drawings.
I. Electrical Characteristics: See Schedule on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
B. Verify wall/ceiling construction is ready for installation.
C. Verify concealed blocking and supports are in place and connections are correctly located.

3.2 INSTALLATION
A. Install equipment exposed to finished areas after walls and ceilings are finished and painted. Avoid damage.
B. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
C. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Install electrical wiring in accordance with manufacturer's submittals and Division 26 specifications.
3.3 CLEANING

A. Section 01 77 00 - Execution and Closeout Requirements: Final cleaning.

END OF SECTION
SECTION 26 05 00

GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Applicable provisions of General Conditions, Special Conditions, and Special Instructions to Bidders govern work of Division 26 sections.

B. Contractor shall provide items, articles, materials, operations, and methods listed, mentioned, or scheduled on the Drawings and specifications, including labor, materials, equipment, and incidentals required for their completion.

C. Work shall conform to requirements of locally adopted codes and ordinances; applicable building codes; applicable code sections of NFPA standards; and interpretations of the authority having jurisdiction.

1.2 SCOPE OF WORK

A. Requirements of Division 26 sections shall govern installation of materials specified, including those related to the work of other disciplines, even where not referenced by other division’s specification.

B. Where items specified in specific Division 26 section conflict with requirements in this section, the specific section shall govern.

C. Contractor shall supply labor, equipment, and materials in strict accordance with Drawings and specifications. Contractor shall provide conductors, cabling, connections, and accessories required for complete and functional systems, even where not specifically shown on the Drawings.

D. Finish prime and painting is specified in other Divisions. Prime and painting specified under Division 26 is limited to protective coatings, rust inhibiting, and identification.

1.3 REFERENCES

A. Where reference is made to standards, codes, specifications, and recommendations, it is understood that the latest edition of the publication adopted and published at the date of the Contract Documents is that which is referenced, unless a specific date is stated.

B. References to technical societies, organizations, governmental agencies, laws, and publications made in specifications are in accordance with the following abbreviations:

1. ADA  Americans with Disabilities Act
2. ANSI  American National Standards Institute
3. ASME  American Society of Mechanical Engineers
4. ASTM  American Society for Testing and Materials
5. CSD  Commodity Standards Division U.S. Dept of Commerce
6. IEEE  Institute of Electrical and Electronic Engineers
7. NFPA  National Fire Protection Association
8. NBS  National Bureau of Standards
9. NEC  National Electrical Code (NFPA 70)
10. NEMA  National Electrical Manufacturers Association
11. TAS Texas Accessibility Standards
12. UL Underwriters' Laboratories, Inc.

1.4 DEFINITIONS

A. Where the terms such as “Acceptable”, “Equal”, and “Equivalent” are used in Drawings and specifications, it is understood that judgment of Architect shall govern such decision.

B. Where terms such as “Approved”, “Directed”, “Requested”, “Authorized”, “Selected”, “Required”, and “Permitted” are used in Drawings and specifications, it is understood that instruction is that of the Architect.

C. Terms such as shown, noted, scheduled, and specified are intended to help the reader locate referenced information. Term should not be interpreted as limiting location(s) of applicable information.

D. Definitions of terms and expressions used in electrical work:
   1. Furnish: Supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
   2. Install: Operations at the Project site including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
   3. Provide: Both the furnishing and installation, complete and ready for operation.
   4. Indicated: Graphically represented, noted, or scheduled on the Drawings; cited by Paragraphs or Schedules in specifications; or similarly required in the Contract Documents.
   5. Listed: Tested, approved, and certified by a qualified product listing organization, as meeting appropriate safety standards as applicable to the product and intended installation application.

E. NEMA Classifications: (For complete definitions and listing see NEMA Standards)
   1. Type 1 General Purpose, Indoor.
   2. Type 2 Drip-proof, Non-corrosive, Indoor.
   3. Type 3R Rain proof, Outdoor.
   4. Type 4 Watertight and dust-tight, non-corrosive, indoor and outdoor.
   5. Type 4X Watertight and dust-tight, corrosion resistant, indoor and outdoor.
   6. Type 12 Dust-tight, watertight, non-corrosive, indoor.

1.5 DRAWINGS

A. Drawings and Instructions:
   1. Drawings for Division 26 work are in part diagrammatic, intended to convey the scope of work and general arrangement of equipment, fixtures, interlocks, conduit, and outlets. Division 26 installer shall follow Drawings in laying out the work, consult other trades and general construction drawings, and coordinate spaces in which the work will be installed.
   2. Drawings and specifications shall be considered as complementary parts of the Division 26 work and of the Contract Documents. Study Drawings and specifications for Division 26 work, as well as that of other trades to fully understand the work to be performed.
   3. As a qualification for bidding, visit the site and identify existing conditions that may affect Division 26 work prior to submitting a proposal.
B. Locations and Scaling:
   1. Prior to locating electrical equipment, outlets, switches, and similar devices, obtain approval from Architect as to exact location. Locations shall not be determined by scaling Drawings.
   2. Mounting heights shall be as directed by Architect and in accordance with the TAS and ADA.
   3. Material, equipment, and labor required to redo installation, restore structure, and repair finishes due to failure to comply with this requirement shall be the responsibility of Contractor.

C. Unless otherwise expressly agreed to in writing, all rights to the Electrical specifications and drawings prepared by Alderson & Associates, Inc. shall belong to Alderson & Associates, Inc. The sole exception is that the specifications and drawings may be used for construction of the project for which the specifications and drawings were prepared if all other contractual obligations have been complied with, including the payment of fees. Each page of the drawings, if prepared in whole or in part by Alderson & Associates, Inc., and all pages of these specifications of Section are covered by copyright and may not be reproduced, published or used in any way without the permission of Alderson & Associates, Inc.

1.6 DISCREPANCIES

A. Clarifications: Obtain necessary clarifications as to discrepancies, omissions, and questions regarding the intent of the Contract Documents, before submitting a proposal.

B. Contractor Agreement:
   1. Consideration will not be granted for misunderstanding of the amount of work to be performed. Tender of a proposal conveys full Contractor agreement of the items and conditions specified, shown, scheduled, or required by the nature of the project.

C. Changes required by job conditions, equipment employed, or structural conditions of the building shall be at no cost to the Owner.

D. Codes and Standards:
   1. Perform the work in strict accordance with requirements and recommendations of applicable codes and standards. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes.
   2. When two or more codes or standards are applicable to the same work, the stricter code or standard shall govern.
   3. Correct deficiencies caused by failure to comply with written codes or standards at no additional cost to Owner.

1.7 PRODUCT SUBSTITUTION PROCEDURES

A. Architect will consider requests for substitution, received a minimum of 10 days prior to scheduled bid date.

B. Substitutions will be considered when a product becomes unavailable through no fault of Contractor.
C. Document each Request for Substitution with complete data substantiating compliance of proposed substitution with Contract Documents.

D. Submission of Request for Substitution represents that Contractor:
   1. Has investigated proposed product and has determined that it meets or exceeds quality level of specified product.
   2. Will provide same warranty for substituted materials and installation as for specified product.
   3. Will coordinate and revise installation, including consideration for the work of other trades, to ensure the work is complete and operable.
   4. Waives claims for additional costs or time extension, except as specifically stated in the Request for Substitution.
   5. Will reimburse Owner and Architect for review and redesign services that may be required.
   6. Will pay additional review, permit, and inspection fees associated with securing re-approval of authorities having jurisdiction.

E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Submittals, without separate written request, or when acceptance will require revision to Contract Documents.

F. Substitution Submittal Procedure: As required by Division 1.

1.8 SUBMITTALS

A. Submittal Procedures: Division 1 - Requirements in addition to the following:
   1. Submittal Preparation:
      a. Digital Electronic Copy, or Hard Copy notebook (Minimum of six copies are required if hard copy), complete (all items submitted at one time), index to each Section of Specifications and include the following information and action taken.
         1) Project Name
         2) Date
         3) Name and Address of Architect
         4) Name and Address of Engineer (See Division 1 of Specifications)
         5) Name, Address and Telephone Number of Contractor and sub-contractors.
         6) Manufacturer's Name
         7) Published ratings or capacity data
         8) Detailed equipment drawing for fabricated items
         9) Wiring diagrams
         10) Installation instructions
         11) Other pertinent data
         12) All required submittals and data, bound together, submitted at one time.
      b. Where literature is submitted covering a group or series of similar items, the applicable items must be clearly indicated on each copy with a highlighter pen, or other means of identification clearly legible.
      c. Data and shop drawings shall be coordinated and included in a single submission. Multiple submissions are not acceptable except where prior
approval has been obtained from the Architect. In such cases, a list of data
to be submitted later shall be included with the first submission. Failure to
submit shop drawings that meet the requirements of the Drawings and
Specifications in ample time for review shall not entitle Contractor to an
extension of contract time, and no claim for extension due to such
Contractor default shall be allowed.

B. Submittal Organization:
   1. Organize all required data in digital electronic copy, or hard copy in a 3-ring black
      binder of sufficient size with index tabs with number and appropriate title of
      specification section.
   2. If submitted digitally, all sections shall be submitted at once, broken out by
      specification section into separate PDF documents. Each individual specification
      section submittal shall be provided with an individual cover sheet to allow for
      individual review of the submittal.

C. Provide a cover sheet and an index sheet listing all items submitted.

D. The second and third sheet shall be blank for stamping of submittals. All submittals are to be
   processed at same date; partial submittals will not and are not acceptable.

E. Show any revisions to equipment layout required by use of selected equipment. Architect
   shall receive submittals no later than thirty (30) working days from contract date with
   Contractor and Owner.

F. Review of submittals is only for confirmation of adherence to design of project and does not
   relieve Contractor of final responsibility for furnishing all materials required for a complete
   working system and in complying with the Contract Documents in all respects.

1.9 SHOP DRAWINGS

A. As soon as practical and within thirty days after the official award of contract and before any
   materials and equipment are purchased, Contractor shall submit to the Architect, for review,
   five (5) copies of the complete list of all materials and equipment identified and referenced
   to specification paragraphs together with applicable shop drawings. In addition, the names
   and addresses of the manufacturers, their catalog data, numbers, and trade names shall be
   furnished. Published performance data shall be furnished to indicate compliance with
   scheduled performance. This data will be marked "Reviewed" by the Architect, dated and
   distributed to the several parties involved, with two (2) copies returned to Contractor. The
   data shall include the following:
   1. Equipment-room layouts drawn to ¼” scale, including equipment and accessories, to
      show clearances for operating and servicing.
   2. Equipment and materials as indicated in each Section.
   3. Composite drawings of crowded locations where there is a possibility of conflict
      among trades.

B. Verification of Dimensions:
   1. Contractor shall be responsible for the coordination and proper relation of his work
      to the building structure and to the work of all trades. Contractor shall verify all
      dimensions in the field and advise the Architect of any discrepancy before
      performing the work. Adjustments to the work required to facilitate a coordinated
      installation shall be made at no additional cost to the Owner.
C. Equipment other than that shown should be used in bids only when approved by the Architect prior to bidding. Those models and manufacturers identified in drawings and specifications were selected to provide minimum acceptable performance. These models are used in sake of brevity to establish a basis of quality, weights, performance, capacities, etc., required. Any such alternate proposals must include all necessary changes and additions to the work occasioned by such substitution including but not limited to foundations, supports, connections, piping, etc. which shall be paid for by Contractor. In the event that Contractor submits for approval any material, equipment, etc., that are not in conformity with the specifications, the Architect reserves the right to reject this equipment, and Contractor shall submit data on other equipment which meets the requirements of the specifications for approval.

D. Installation Directions:
1. Obtain manufacturer's printed installation directions to aid in properly executing work on equipment requiring such directions.

E. Submit such directions to Architect prior to time of installation for use in review of the work.

F. Operating Instructions, Charts:
1. Furnish manufacturer's printed operating and maintenance instruction for equipment and systems, which, in opinion of Architect, require such instructions; obtain receipt for it.

G. When so specified or instructed, mount operating instructions in approved frame with glass over; locate where directed.

1.10 PROJECT RECORD DOCUMENTS

A. Keep a set of plans on the job, noting daily all changes to the final location and exact dimensions of switchgear, devices, fixtures, equipment, and site utilities.

B. Turn over record document submittals (as outlined in Division 1 - General Requirements of the Specifications) to the Architect, upon submitting his request for final payment.

C. Compile the following data daily during the work, and turn over to Architect two (2) copies, prepared in 3-ring binders for Owner’s records:
1. Cover page(s) identifying the names, addresses, and telephone numbers of the following: Contractor, all sub-contractors, and all major equipment suppliers.
2. Warranty and guarantee statements from manufacturers, Contractor, and each sub-contractor.
3. Manufacturer's equipment operations manual and equipment maintenance instructions.
4. Manufacturer’s documentation on preventative maintenance recommendations, seasonal changeover procedures, and troubleshooting procedures.
5. Repair parts lists for equipment and materials including name, address, and telephone number of local supplier or agent.
6. Documentation of test methods, including test reports, results, and logs, as required by specific sections of the specifications.
7. Shop Drawings, other data, and drawings required during course of the work.

1.11 GENERAL

A. Lines and Grades:
1. Construct work in conformity with lines and grades as indicated, using axis lines and benchmarks provided under General Construction; verify such axis lines and benchmarks.

2. Axis lines within building will be so spaced on each floor level that mechanical work may be laid out with tape measure having length of 50 feet maximum.

3. Benchmarks outside building will be at accessible points on building walls, from which lines and grades required for installation of mechanical and electrical work may be set.

B. Existing Services:
1. Active Services: When encountered in work, protect, brace and support existing active sewers, gas, piping and other services where required for proper execution of the work. If existing active services are encountered that require relocation, make request in writing for determination. Do not proceed with work until written directions are received. Do not prevent or disturb operation of active services that are to remain. Outages shall be kept to a minimum and allowed only as arranged with the Architect.

2. Inactive Services: When encountered in work, remove, cap, or plug inactive services.

3. Interruption of Services: Where work makes temporary shutdowns of services unavoidable, shut down at night or at such times as approved by Owner, which will cause the least interference with established operating routine. Arrange to work continuously, including overtime, if required, to assure that services will be shut down only during time required to make necessary connection to existing work.

C. Temporary Service and Lighting:
1. Maintain electrical service in operation to all portions of buildings at the construction site throughout construction. Provide temporary electrical service to all required areas of construction necessary to satisfy OSHA requirements.

2. Provide temporary lighting at a minimum of one 950-lumen (100-watt equivalent) lamp per 400 square feet of building area, or not less than one lamp per room of 150 square feet or more. Wiring and lamp holders shall meet all codes.

3. Provide temporary systems and remove before final acceptance of the work.

4. Pay metering, electrical service, and utility charges associated with temporary electrical service.

D. Related Work:
1. Specification sections for this division may or may not identify related work.

2. Related work of other trades shall be coordinated and provided by Division 26 installer regardless whether specifically identified or not.

E. Electrical Wiring and Equipment for Mechanical Systems
1. Division 26 installer shall provide:
   a. Line Voltage and hook-up to all HVAC Equipment
   b. All conduits into accessible attic space for thermostats and sensors.
   c. All lighting contactors, mechanically held with control relay, required coil voltage coordinated with Division 23 controls installer.
   d. Junction Boxes (Standard Two Gang) required for controls contactor, and coordination with Division 23 controls installer. One SPD power outlet at
each energy management control panel located at Division 23 controls installer.

e. A weatherproof receptacle within 25 feet of each piece of mechanical equipment mounted either on the roof or on the ground. This receptacle shall be GFCI type, connected to the nearest 120/208 panelboard.

2. Division 23 installer shall provide:
   a. All motor starters (with heaters as required).
   b. All thermostats.
   c. All HVAC Equipment.
   d. All relays, contactors, and switches required to start/stop Mechanical Equipment other than switches shown on and required by Division 26.

3. Division 23 controls installer shall provide:
   a. All required relays
   b. All Sensors
   c. All conduit required above ceiling.
   d. All control wiring.

4. Electrical Drawings are based on the equipment and devices scheduled or called for in the specifications. Should any mechanical equipment or device associated devices be changed or accepted from those which are shown or noted, all electrical and mechanical changes shall be made at the expense of the trade initiating the change with no expense to Owner, Architect, Engineer, or their representatives.

5. Conduit and boxes for thermostats and sensors shall be provided by Division 26 installer. A thermostat or sensor junction box and 1/2” conduit to accessible attic and/or to corridor shall be provided for each room served with HVAC equipment. Coordinate with the mechanical drawings for exact locations and requirements. Control conduits required in attic, clear spaces, and on roof shall be by Division 23 installers. Details on Electrical drawings showing HVAC, mechanical, and control equipment providing of various relays devices, wiring, and other equipment shall be provided by Division 26 installer.

6. Provide required hook-up to line voltage at all electromagnetic door holder/release, fire/smoke dampers, and smoke dampers. See Mechanical drawings for all locations of required devices. Provide required relays and wiring to fire alarm panels and coordinate with other specified work.

F. Objectionable Noise and Vibration:
   1. Electrical equipment shall operate without objectionable noise or vibration.
   2. If such objectionable noise or vibration should be produced and transmitted to occupied portions of building or other parts of Electrical work, make necessary changes and additions, as approved, without extra cost to Owner.

G. Uniformity:
   1. Equipment and devices for communication, control, and alarm systems shall be products of a single manufacturer, for each system.
   2. Equipment and material of same type and classification shall be products of a single manufacturer and shall be interchangeable to the greatest extent possible.

1.12 PERMITS AND FEES

A. Pay for building permits, and associated permit and inspection fees.
B. Pay for utility extensions and meter fees, and associated metering equipment costs and installation whether furnished by the utility company or as a part of the work.

1.13 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacture of products and materials specified, with a minimum five years of documented experience.
B. Installer Qualifications: Workers skilled in the trade involved.
C. Product Listing Organization Qualifications: Organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to the authority having jurisdiction.
D. Materials furnished under this Contract shall be new and free from defects, and shall be of the quality and design specified.
E. Materials furnished under this Contract shall conform to applicable safety standards and shall be listed for their intended application and installation location.
F. Equipment and accessories shall be standard products of a type that has been in satisfactory use for two (2) years. Major system components shall be of the same manufacturer and shall include manufacturer's nameplate stating address, catalog model number, and capacity.
G. Equipment and accessories not specifically described or identified by manufacturer's catalog numbers shall be designed in conformity with ASME, IEEE, and other applicable technical standards, and shall have neat and finished appearance.

1.14 DELIVERY, STORAGE, AND HANDLING
A. Receive, inspect, handle, and store materials and equipment in accordance with manufacturer’s instructions.
B. Protect materials and equipment, using temporary shelters or approved offsite storage facilities, from damage, injury, theft, and contamination from dirt, dust, and moisture.
C. Provide necessary supports, frames, and foundations to adequately support and protect materials and equipment, during storage, while transporting, and at final installation.
D. Replace materials and equipment damaged prior to final acceptance, as directed by Architect.

1.15 FLAME SPREAD PROPERTIES OF MATERIALS
A. Materials and adhesives incorporated in this project shall conform to ASTM Standard E84, "Test Method of Surface Burning Characteristics of Building Materials" and NFPA 90. The classification shall not exceed a flame spread rating of 25 for all materials, adhesives, finishes, etc., specified for each system, and shall not exceed a smoke developed rating of 50.
PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor shall be responsible for means and methods required to complete the work, including, but not limited to:
   1. Determine depth, routing, and exact location of existing underground utilities.
   2. Relocate and repair existing underground utilities damaged during the work.
   3. Maintain all utility services during the work to existing portion of the facility that are to remain.
   4. Periodically clean, remove rubbish, and repair surfaces marred by the work.
   5. Protect work from damage by other trades.
   6. Erect barricades, protective fencing, and signs as required to prevent accidents, injuries, and theft.
   7. Revise indicated equipment locations, device arrangements, and raceway and cable routing, as required to coordinate space and clearance requirements, securing approval of Architect through submission of Shop Drawings.
   8. Accomplish all demolition and remodeling work involving his trade in a manner and completeness to provide the appearance of new construction work.
   9. Replace equipment, materials, building finishes, and structure damaged during the work.

B. Install materials and equipment in accordance with established standards, best practices for the type of work involved, and applicable technical societies' standards.

C. Design and construct supporting structures of strength to safely withstand stresses to which they may be subjected and to distribute properly the load and impact over the building areas.

D. Submit detailed Shop Drawings of supports, and obtain approval before fabricating or constructing.

3.2 CUTTING AND PATCHING

A. Ensure sleeves are set at proper times to avoid delay of the Work. Cut walls, floors, partitions, and ceilings as required for the proper installation of the work in a neat and workmanlike manner, and as approved by the Architect.

B. Joists, beams, girders, and columns shall not be cut without first obtaining written permission from Architect.

C. Seal openings and conduit penetrations in fire-rated and smoke-rated assemblies:
   1. Ensure seals are made completely air tight.
   2. Sealing material shall be noncombustible and listed for the application.
   3. Provide materials and installation to ensure rating of assembly is not decreased.
   4. Provide materials and methods in accordance with NFPA standards, acceptable to Architect and authority having jurisdiction.

D. Patch openings and alterations in interior walls, as approved by Architect, and prepare surfaces for accepting scheduled finish.
E. Patch openings in exterior walls and seal to a watertight condition.

3.3 MANUFACTURER’S INSTRUCTIONS

A. Equipment and devices shall be installed in accordance with Drawings and specifications, manufacturer's instructions, and applicable codes.

B. Where specifications call for installation of a product to be in accordance with manufacturer's instructions, obtain applicable manufacturer's instructions.

C. Install products in accordance with manufacturer's written instructions.

D. Contact manufacturer to request advice and supervisory assistance during the installation, when required to ensure proper and complete installation.

3.4 CIRCUITING

A. Maintain raceway systems serving systems of up to 150 volts to ground, separate from those serving systems of 151 to 600 volts to ground.

B. Provide dedicated neutral conductors for branch circuits, except where multiwire branch circuits are specifically indicated to serve equipment or furniture, or where multipole branch circuits are utilized to serve equipment that does not require a neutral.

C. Where multiwire branch circuits are specifically indicated to serve equipment or furniture, install in accordance with NEC 210.4.

3.5 INSTALLATION

A. Cooperation with trades of adjacent, related or affected materials or operations, and trades performing continuations of this work under separate contracts is considered a part of this work to effect timely and accurate placing of work and to bring together, in proper and correct sequence, the work of such trades, including trade in general contractor allowance and Division 26.

B. Coordinate installation of Division 26 work with the work of other trades to ensure systems are installed, complete, and functioning.

C. Conduit and boxes, except mechanical controls specified otherwise, shall be provided by the Division 26 installer. Where permitted by specific specification section, low voltage wiring may be installed using open wiring methods in accessible attic space. Coordinate with, and verify with these specifications to provide required conduit and boxes at locations and heights required.

D. Conceal electrical work in walls, floors, chases, under floors, underground and above ceilings. Branch circuits may be installed in the slab. Install in slab as directed by Structural Engineer. Coordinate the actual electrical outlets and equipment with building features and mechanical equipment as indicated on architectural, structural and mechanical drawings. Review with the Architect any proposed changes in outlet or equipment location. Relocation of outlets before installation, of up to 3 feet from the position indicated, may be directed without additional cost. Remove and relocate outlets placed in an unsuitable location when so requested by the Architect.
E. Conduits shall not be installed in structural walls, slabs, columns, beams, and other structural elements, except where permitted on Structural Drawings or written approval of Structural Engineer.

F. Erect equipment in neat and workmanlike manner. Align, level, and adjust for satisfactory operation and so that all parts are easily accessible for inspection, operation, maintenance and repair.

3.6 SPACE REQUIREMENTS

A. Determine in advance of purchase that equipment and materials proposed for installation will fit into the confines indicated. Allow for adequate clearances as required by applicable codes, and for repair, maintenance, and replacement.

B. Base equipment arrangements and clearance requirements on equipment Contractor intends to install, creating Shop Drawings and making note during submittal process of potential spatial conflicts.

C. Final arrangements of equipment to be installed shall be subject to the Architect’s review.

D. Equipment Arrangements:
   1. Arrange equipment and conduit as shown in the Drawings, making minor rearrangements where necessary to suit the equipment approved, to comply with equipment manufacturer recommendations, and to fit the structural conditions.
   2. Provide Shop Drawings and obtain agreement of the Architect before proceeding with such rearrangements.
   3. Ensure that the combination of proposed equipment will fit into the allotted space shown on Drawings with adequate clearances for maintenance and servicing.
   4. Allow adequate space for clearance in accordance with the Code requirements and the requirements of the local inspection department.

E. Equipment that is too large to permit access through available stairways, doorways, shafts and windows along path to final location shall be delivered and set in place prior to constructing partitions that would create such obstructions.

3.7 RELATED ELECTRICAL PROVISIONS

A. Electric control, motors, relays, thermostats, terminal, limiting switches, and similar devices and components on equipment shall be furnished as part of the equipment. Connections, controls, and interlocks to equipment shall be installed in accordance with Division 26 Drawings and specifications. Provide raceway system, conductors, control cabling, grounding, and disconnecting means as required for a complete system.

B. Install connections required to systems of greater than 50 volts to ground, as part of the Division 26 work, even when associated equipment is furnished by another trade.

C. Low voltage control, communication, and temperature control wiring shall be the responsibility of the trade installing the associated system.
   1. Where open wiring systems are permitted, trade installing each system shall provide appropriate supports dedicated to the specific system.
   2. Provide raceway systems where open wiring is not permitted, such as within walls, exposed in area subject to physical damage, and above areas with open ceilings.
3.8 TESTING

A. During the progress of the work and upon completion, test systems as specified and as required by authorities having jurisdiction, Owner, and Architect. Test systems as part of Division 26 work. Provide services of qualified personnel, testing equipment, and apparatus.

B. Test wiring systems to ensure they are free of short circuits and ground faults, and have insulation resistance from phase and neutral conductors to ground in accordance with ANSI and IEEE standards.

C. Prior to the execution of testing, submit proposed test procedures recording forms, list of personnel, and test equipment to Architect for review.

D. Fire Alarm and Communication System Test: Demonstration and operation test of each device and all interlocks and controls of the fire alarm and communication system, as required by and to the approval of the authorities having jurisdiction.

3.9 CLOSE OUTS AND GUARANTEES

A. Final Acceptance Review:
   1. Make a careful inspection of the entire project and ensure that the work is ready for final acceptance before contacting Architect to make final observation visit.
   2. Deliver to Architect all necessary bonds, warranties, receipts, affidavits, certifications of payment, and releases of liens, prepared and signed in advance, together with a letter of transmittal listing each paper included, at or before final observation visit. Verify that each document is consistent with requirements of the Contract Documents.
   3. The following will be required at time of final acceptance:
      a. Final clean-up completed.
      b. Systems are fully operational; material and devices installed and tested.
      c. Ground tests (megger readings) performed and documented with two (2) copies of method used and results attached.
      d. Project Record Documents.

B. Training:
   1. Upon completion of the work and at a time designated by Architect, provide formal training session for the Owner's operating personnel.
   2. Training session shall include instruction on proper operation and maintenance of electrical equipment and systems and shall identify location of components.
   3. In addition to time requirements of specific sections, provide 4-hour training session.

C. Adjustments:
   1. Adjust equipment and devices and run reasonable operating tests together with more specific tests indicated in the separate sections of the specifications.
   2. If equipment does not function satisfactorily after the first adjustments are made, continue the work until satisfactory corrections and adjustments have been made.
   3. Ensure proper performance, functioning, integration, and balance of equipment.
   4. Where tests are required by Architect to ascertain equipment capacities in the installed condition, run approved tests, provide required instruments and apparatus, and submit certified statements of test results.
   5. Ensure instruments are in proper calibration and meet approval of Architect.
D. Completeness:
1. Ensure absolute completeness of the work, including adjustments, balancing, testing, and commissioning; and ensure proper operation in all respects.
2. Install systems complete and functional in all respects, including installation of such items as trim, fittings, cabling, and accessories.
3. Protect the work from damage. Provide required temporary shelters to adequately protect apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.
4. Replace equipment and rework installation, where equipment has been damaged during the course of the project.

E. Cleaning: Equipment shall be thoroughly cleaned and degreased, cuttings and other foreign substances.

F. Warranty:
1. Guarantee work, equipment, and materials for a period of one (1) year from date of substantial completion acceptance. Defects in labor and materials occurring during this period shall be immediately repaired or replaced by Contractor at no additional cost to the Owner.
2. Warranty shall not be construed to include the normal maintenance of the various components of the system covered by these specifications.
3. Neither the final payment nor any provisions in Contract Documents shall relieve Contractor of the responsibility for faulty materials or workmanship.
4. Remedy any defects due faulty materials and workmanship and pay for damage to other work resulting therefrom.
5. Owner shall give notice of observed defects with reasonable promptness.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes building wire; metal clad cable; and wiring connectors and connections. Armored Cable (Type AC) is not permitted for any installations as part of this specification.

B. Related Sections:

1.2 REFERENCES

A. International Electrical Testing Association:

B. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.
   2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

C. Underwriters Laboratories, Inc.:
   1. UL 1277 - Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.3 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:
   1. Conductors #10 AWG and smaller shall be solid. Conductors #8 AWG and larger shall be stranded.
   2. Stranded conductors for control circuits.
   3. Conductor not smaller than #12 AWG for power and lighting circuits.
   4. Conductor not smaller than #14 AWG for control circuits.
   5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.

B. Wiring Methods: Provide the following wiring methods:
   1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
   2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
   3. Wet or Damp Interior Locations: Use only building wire, Type XHHW insulation, in raceway.
   4. Exterior Locations: Use only building wire, Type XHHW insulation, in raceway.

C. Conductors shall be installed as single conductor building wire installed in raceway systems, except that Type MC cable may be installed as follows:
   1. For final connections to light fixtures, in lengths not to exceed 6 feet.
2. For final connections to vibration producing equipment in dry locations, in lengths not to exceed 5 feet.
3. For horizontal cabling concealed within walls, except that homeruns shall be single conductor building wire installed in raceway systems.
4. For individual drops of branch circuits, where concealed in ceilings, walls, and partitions, except that homeruns shall be single conductor building wire installed in raceway systems.

D. Type AC cables shall not be permitted.

1.4 DESIGN REQUIREMENTS
A. Conductor sizes are based on copper.

1.5 SUBMITTALS
A. Product Data:
   1. Submit for building wire and each cable assembly type.

B. Design Data:
   1. Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.

C. Test Reports:
   1. Indicate procedures and values obtained.

1.6 CLOSEOUT SUBMITTALS
A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents:
   1. Record actual locations of components and circuits.

1.7 QUALITY ASSURANCE
A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.

1.8 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.9 FIELD MEASUREMENTS
A. Verify field measurements are as indicated on Drawings.

1.10 COORDINATION
A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Manufacturers:
   1. AETNA
   2. American Insulated Wire Corp.
   3. Colonial Wire
   4. Encore Wire
   5. General Cable Co.
   6. Republic Wire
   7. Rome Cable
   8. Service Wire Co.
   9. Southwire
  10. Superior Essex
  11. Substitutions: Section 01 60 00 - Product Requirements

B. Product Description: Single conductor insulated wire.

C. Conductor: Copper.

D. Insulation Voltage Rating: 600 volts.

E. Insulation Temperature Rating: 90 degrees C.

F. Insulation Material: Thermoplastic.

2.2 METAL CLAD (MC) CABLE

A. Manufacturers:
   1. AFC Cable
   2. Southwire
   3. Substitutions: Section 01 60 00 - Product Requirements

B. Product Description: Multiconductor cable, insulated wire. Galvanized, interlocking steel cover.

C. Conductor: Copper.

D. Insulation Voltage Rating: 600 volts.

E. Insulation Temperature Rating: 90 degrees C.

F. Insulation Material: Thermoplastic.

G. Exterior jacket shall be painted for ready identification of conductor size and quantity and special listings.

2.3 TERMINATIONS

A. Terminal Lugs for Wires #6 AWG and Smaller:
   1. Solderless, compression type copper.

B. Lugs for Wires #4 AWG and Larger:
   1. Color keyed compression type copper, with insulating sealing collars.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
B. Verify interior of building has been protected from weather.
C. Verify mechanical work likely to damage wire and cable has been completed.
D. Verify raceway installation is complete and supported.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 EXISTING WORK

A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.
E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.4 INSTALLATION

A. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.
B. Route wire and cable to meet Project conditions.
C. Neatly train and lace wiring inside boxes, equipment, and panelboards.
D. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
E. Minimum Conductor Size – Building Wire in Raceway:
   1. Minimum #14 AWG for control circuits.
   2. Minimum #10 AWG for power homeruns.
   3. Minimum #10 AWG for special outlets, dedicated outlets, and hard-wired connections to equipment.
   4. Minimum #10 AWG for 20-ampere, 120- and 277-volt branch circuits. The backbone of all 20-ampere lighting and power branch circuits shall be #10 AWG. Drops to individual receptacles and light fixtures may be #12 AWG.
F. Special Techniques - Building Wire in Raceway:
   1. Pull conductors into raceway at same time.
   2. Install building wire #4 AWG and larger with pulling equipment and lubricant.
G. Special Techniques - Cable:
1. Protect exposed cable from damage.
2. Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
3. Use suitable cable fittings and connectors.

H. Special Techniques - Wiring Connections:
1. Clean conductor surfaces before installing lugs and connectors.
2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
4. Install split bolt connectors for copper conductor splices and taps, #6 AWG and larger.
5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, #8 AWG and smaller.
6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, #10 AWG and smaller.

I. Special Techniques – Type MC Cable:
1. Install per manufacturer’s instructions, in accordance with local amendments as adopted by the AHJ.
2. Route perpendicular to building lines and be installed in a workmanlike manner.
3. Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
4. Use suitable cable fittings and connectors.

J. Where permitted for use, install Type MC cable in accordance with NEC Article 330.

K. Install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.

L. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.

M. Size lugs in accordance with manufacturer’s recommendations terminating wire sizes. Install 2-hole type lugs to connect wires #4 AWG and larger to copper bus bars.

N. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

3.5 WIRE COLOR

A. Phase Conductors, including Switch Legs – Color code conductors as indicated in the Wire Color Code Table below, or as per AHJ standards:
1. For wire sizes #6 AWG and smaller, install wire with insulation color per the table.
2. For wire sizes #4 AWG and larger, install wire with insulation color per the table, or identify wire with colored tape at terminals, splices and boxes, with color per the table.
B. Neutral Conductors - Color code conductors as indicated in the Wire Color Code Table below. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
1. For wire sizes #6 AWG and smaller, install wire with insulation color per the table.
2. For wire sizes #4 AWG and larger, install wire with insulation color per the table, or identify wire with colored tape at terminals, splices and boxes, with color per the table.

C. Ground Conductors – Color code conductors as indicated in the Wire Color Code Table below.
1. For wire sizes #6 AWG and smaller, install wire with insulation table per table.
2. For wire sizes #4 AWG and larger, install wire with insulation color per the table, or identify with colored tape at terminals, splices and boxes, with color code per the table.

<table>
<thead>
<tr>
<th>Phase Conductor</th>
<th>480Y/277 3 Phase</th>
<th>208Y/120 3 Phase</th>
<th>120/240V 1 Phase</th>
<th>240/120V, Delta, 3 Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>A or L1</td>
<td>Purple</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
</tr>
<tr>
<td>B or L2</td>
<td>Brown</td>
<td>Red</td>
<td>Red</td>
<td>Orange (High Leg)</td>
</tr>
<tr>
<td>C or L3</td>
<td>Yellow</td>
<td>Blue</td>
<td>---</td>
<td>Blue</td>
</tr>
<tr>
<td>Neutral</td>
<td>Gray</td>
<td>White</td>
<td>White</td>
<td>White</td>
</tr>
<tr>
<td>Ground</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
</tr>
<tr>
<td>Isolated Ground</td>
<td>---</td>
<td>Green with Yellow Tracer</td>
<td>Green with Yellow Tracer</td>
<td>Green with Yellow Tracer</td>
</tr>
<tr>
<td>Switch Leg</td>
<td>Same Color as Branch Circuit Conductor</td>
<td>Same Color as Branch Circuit Conductor</td>
<td>Same Color as Branch Circuit Conductor</td>
<td>Same Color as Branch Circuit Conductor</td>
</tr>
</tbody>
</table>

3.6 FIELD QUALITY CONTROL
A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
B. Inspect and test in accordance with NETA ATS, except Section 4.
C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION
SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Rod electrodes.
   2. Wire.
   3. Mechanical connectors.
   4. Exothermic connections.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:
   2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

B. International Electrical Testing Association:

C. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

1.3 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms maximum.

1.4 SUBMITTALS

A. Product Data:
   1. Submit data on grounding electrodes and connections.

B. Test Reports:
   1. Indicate overall resistance to ground and resistance of each electrode.

C. Manufacturer's Certificate:
   1. Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

1.6 QUALITY ASSURANCE

A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

1.7 QUALIFICATIONS

A. Manufacturer:
1. Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer:
   1. Company specializing in performing work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
D. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.9 COORDINATION
A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES
A. Manufacturers:
   1. Erico, Inc.
   2. O-Z Gedney Co.
   3. Thomas & Betts, Electrical.
   4. Substitutions: Section 01 60 00 – Product Requirements Not Permitted.

B. Product Description:
   1. Material: Copper-clad steel Copper.
   2. Diameter: ¾ inch.
   3. Length: 10 feet.

2.2 WIRE
A. Material: Stranded copper.
B. Foundation Electrodes: 4 AWG.
C. Grounding Electrode Conductor: Copper conductor bare insulated.
D. Bonding Conductor: Copper conductor bare insulated.

2.3 MECHANICAL CONNECTORS
A. Manufacturers:
   1. Erico, Inc.
   2. ILSCO Corporation.
   3. O-Z Gedney Co.
   4. Thomas & Betts, Electrical.
5. Substitutions: Section 01 60 00 - Product Requirements.

B. Description:
   1. Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS

A. Manufacturers:
   1. Copperweld, Inc.
   2. ILSCO Corporation.
   3. O-Z Gedney Co.
   4. Thomas & Betts, Electrical.
   5. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:
   1. Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

3.2 PREPARATION

A. Remove surface contaminants at connection points.

3.3 INSTALLATION

A. Install in accordance with IEEE 142 or 1100.

B. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground.

C. Install grounding and bonding conductors concealed from view.

D. Install grounding electrode conductor and connect to reinforcing steel in foundation footings as indicated on Drawings. Electrically bond steel together.

E. Equipment Grounding Conductor:
   1. Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

F. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.

G. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.
H. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed grounding conductor to grounding bus.

I. Ground electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.

J. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.4 FIELD QUALITY CONTROL

A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground resistance testing in accordance with IEEE 142.

E. **Perform leakage current tests in accordance with NFPA 99**

F. Perform continuity testing in accordance with IEEE 142.

G. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION
SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Conduit supports.
2. Formed steel channel.
4. Sleeves.
5. Mechanical sleeve seals.
6. Firestopping relating to electrical work.
7. Firestopping accessories.
8. Equipment bases and supports.

B. Related Sections:
1. Section 03 30 00 - Cast-In-Place Concrete: Product requirements for concrete for placement by this section.

1.2 REFERENCES

A. ASTM International:

B. FM Global:

C. National Fire Protection Association:
1. NFPA 70 - National Electrical Code.

D. Underwriters Laboratories Inc.:
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
5. UL - Fire Resistance Directory.

E. Intertek Testing Services (Warnock Hersey Listed):
1. WH - Certification Listings.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System):
1. Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.
1.4 SYSTEM DESCRIPTION
A. Firestopping Materials:
   1. UL 1479, to achieve fire ratings of adjacent construction in accordance with FM.
B. Surface Burning:
   1. UL 723 with maximum flame spread / smoke developed rating of 25/450.
C. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS
A. Firestopping:
   1. Conform to applicable code FM for fire resistance ratings and surface burning characteristics.
   2. Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS
A. Shop Drawings:
   1. Indicate system layout with location and detail of trapeze hangers.
B. Product Data:
   1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
   2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
C. Firestopping Schedule:
   1. Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
D. Design Data:
   1. Indicate load carrying capacity of trapeze hangers and hangers and supports.
E. Manufacturer's Installation Instructions:
   1. Hangers and Supports: Submit special procedures and assembly of components.
   2. Firestopping: Submit preparation and installation instructions.
F. Manufacturer's Certificate:
   1. Certify products meet or exceed specified requirements.

1.7 QUALITY ASSURANCE
A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
   1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
   2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
   3. Floor Penetrations within Wall Cavities: T-Rating is not required.
B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies:
   1. Materials to resist free passage of flame and products of combustion.

3. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies:
   1. UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.

D. Fire Resistant Joints between Floor Slabs and Exterior Walls:
   1. ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.

E. Surface Burning Characteristics:
   1. 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.8 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer:
   1. Company specializing in performing work of this section with minimum three years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING
A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS
A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

PART 2 - PRODUCTS
2.1 CONDUIT SUPPORTS
A. Manufacturers:
   1. Allied Tube & Conduit Corp.
   2. Electroline Manufacturing Company.
   3. O-Z Gedney Co.
   4. Substitutions: Section 01 60 00 - Product Requirements.
2. Hanger Rods:
   1. Threaded high tensile strength galvanized carbon steel with free running threads.

3. Beam Clamps:
   1. Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

4. Conduit clamps for trapeze hangers:
   1. Galvanized steel, notched to fit trapeze with single bolt to tighten.

5. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.

6. Cable Ties:
   1. High strength nylon temperature rated to 185 degrees F. Self locking.

2.2 FORMED STEEL CHANNEL

A. Manufacturers:
   1. Allied Tube & Conduit Corp.
   4. Unistrut Corp.
   5. Kindorf.
   6. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:

2.3 SLEEVES

A. Sleeves through Non-fire Rated Floors:
   1. 18 gage thick galvanized steel.

B. Sleeves through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors:
   1. Steel pipe or 18 gage thick galvanized steel.

C. Sleeves through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing:
   1. Prefabricated fire rated sleeves including seals, UL listed.

D. Fire-stopping Insulation:
   1. Glass fiber type, non-combustible.

2.4 MECHANICAL SLEEVE SEALS

A. Manufacturers:
   1. Thunderline Link-Seal, Inc.
   2. NMP Corporation.
   3. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:
   1. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.5 FIRESTOPPING

A. Manufacturers:
1. Dow Corning Corp.
2. Fire Trak Corp.
3. Hilti Corp.
4. International Protective Coating Corp.
5. 3M fire Protection Products.
7. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:
1. Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
2. Silicone Firestopping Elastomeric Firestopping: Silicone elastomeric compound and compatible silicone sealant.
4. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
5. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
6. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
7. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.

2.6 FIRESTOPPING ACCESSORIES

A. Primer:
1. Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Installation Accessories:
1. Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

C. General:
1. Furnish UL listed products.
2. Select products with rating not less than rating of wall or floor being penetrated.

D. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify openings are ready to receive sleeves.
C. Verify openings are ready to receive firestopping.

3.2 PREPARATION
A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
B. Remove incompatible materials affecting bond.
C. Install backing materials to arrest liquid material leakage.
D. Do not drill or cut structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS
A. Anchors and Fasteners:
   1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors and preset inserts.
   2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
   3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
   5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
   7. Wood Elements: Provide wood screws.
B. Inserts:
   1. Install inserts for placement in concrete forms.
   2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
C. Install conduit and raceway support and spacing in accordance with NEC.
D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
E. Install multiple conduit runs on common hangers.
F. Supports:
   1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
   2. Install surface mounted cabinets and panelboards with minimum of four anchors.
   3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
   4. Support vertical conduit at every other floor.

3.4 INSTALLATION - FIRESTOPPING
A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

F. Place intumescent coating in sufficient coats to achieve rating required.

G. Remove dam material after firestopping material has cured.

H. Fire Rated Surface:
   1. Seal opening as follows:
      a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
      b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
      c. Pack void with backing material.
      d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

   2. Where cable tray, bus, cable bus, conduit, wireway, and trough, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

I. Non-Rated Surfaces:
   1. Seal opening through non-fire rated surface as follows:
      a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
      b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
      c. Install type of firestopping material recommended by manufacturer.

   2. Install escutcheons or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.

   3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

   4. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment. Refer to Section 03 30 00.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
3.6 INSTALLATION - SLEEVES
A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
C. Set sleeves in position in forms. Provide reinforcing around sleeves.
D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
G. Install chrome plated steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL
A. Section 01 40 00 - Quality Requirements Field inspecting, testing, adjusting, and balancing.
B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING
A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
B. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK
A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
B. Protect adjacent surfaces from damage by material installation.

END OF SECTION
SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes conduit and tubing, wireways, outlet boxes, pull and junction boxes, and handholes.

B. Related Sections:
   1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   2. Section 26 05 29 - Hangers and Supports for Electrical Systems.
   3. Section 26 05 34 - Floor Boxes for Electrical Systems.
   4. Section 26 05 53 - Identification for Electrical Systems.
   5. Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI C80.1 - Electric Rigid Steel Conduit.
   2. ANSI C80.3 - Electrical Metallic Tubing – Steel (EMT-S).
   3. ANSI C80.5 - Electrical Rigid Metal Conduit - Aluminum (ERMC-A).
   4. ANSI C80.6 - Electrical Intermediate Metal Conduit.

B. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NEMA FB 1 - Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
   3. NEMA FB 2.10 - Selection and Installation Guidelines for Fittings for use with Non-Flexible Conduit or Tubing (RMC, IMC, and EMT).
   4. NEMA FB 2.20 - Selection and Installation Guidelines Fittings for Use with Flexible Electrical Conduit and Cable.
   5. NEMA OS 1 – Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
   6. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
   7. NEMA RN 1 – Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit.
   8. NEMA RV 3 - Application and Installation Guidelines for Flexible and Liquidtight Flexible Metal and Nonmetallic Conduits.
   9. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
   10. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SUBMITTALS

A. Product Data: Submit for the following:
   1. Flexible metal conduit.
   2. Liquidtight flexible metal conduit.
   3. Nonmetallic conduit.
   4. Raceway fittings.
   5. Conduit bodies.
6. Wireway.
7. Pull and junction boxes.

B. Manufacturer's Installation Instructions:
1. Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.4 CLOSEOUT SUBMITTALS
A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
B. Project Record Documents:
1. Record actual routing of conduits larger than 2 inch.
2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
C. Protect PVC conduit from sunlight.

1.6 COORDINATION
A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
B. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.
C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

1.7 SYSTEM DESCRIPTION
A. Raceway and boxes located as indicated on Drawings and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
B. Conduit Size:
1. 3/4-inch minimum unless otherwise indicated.
2. 1-inch minimum for underground conduits, unless otherwise indicated.

1.8 CONDUIT REQUIREMENTS
A. Outdoor Locations, Above Grade:
1. RMC or IMC.
2. Enclosures: Painted steel or stainless steel; NEMA 3R, 4, or 4X listed.
3. Outlet Boxes: Cast metal outlet and junction boxes.
B. Underground Conduits, direct buried, encased in flowable or in concrete:
1. Within five feet from foundation, RMC or IMC.
2. More than five feet from foundation, RMC, IMC, or PVC.
3. Where PVC conduit is used:
a. Transition to RMC or IMC conduit for changes of direction, for turn ups, and where emerging from grade or concrete.

b. Use Schedule 80 PVC where routed below drivable surfaces, except where encased in concrete.

4. Where RMC or IMC is used:
   a. Wrap or coat conduit to prevent corrosion where installed in contact with concrete, soil, or flowable fill.

5. Enclosures: Provide cast metal outlet, pull, and junction boxes. Provide in-ground pullboxes, handholes, and manholes where indicated in the Drawings.

C. Within Concrete Slabs and Structural Members:
   1. RMC, IMC, or PVC.
   3. Where Permitted:
      a. Only permitted where required to serve floor boxes or islands,
      b. Proposed locations and routing of conduits within concrete slabs and structural members must be submitted to Structural Engineer for review and approval prior to installation.

D. Interior Wet and Damp Locations:
   1. RMC or IMC
   2. Enclosures: Painted steel or stainless steel; NEMA 3R, 4, or 4X listed.
   3. Outlet Boxes: Cast metal outlet and junction boxes; flush mounted in finished areas.

E. Interior Dry Locations, Concealed:
   1. Branch Circuits: EMT, RMC, or IMC.
   2. Feeders: EMT, RMC, or IMC.
   3. Enclosures: Steel or stainless steel; NEMA 1 listed. Include hinges on enclosures with any single dimension larger than 24 inches.
   4. Outlet Boxes: Sheet-metal boxes; flush mount in finished areas.

F. Interior Dry Locations, Exposed:
   1. Branch Circuits: EMT, RMC, IMC, except as noted below:
      a. Less than 10 feet above finished floor in mechanical rooms, electrical rooms, gymnasiums, warehouses, and similar areas subject to physical damage, use only RMC or IMC.
   2. Feeders: EMT, RMC, or IMC, except as noted below:
      a. Less than 10 feet above finished floor in mechanical rooms, electrical rooms, gymnasiums, warehouses, and similar areas subject to physical damage, use only RMC or IMC.
   3. Enclosures: Steel or stainless steel; NEMA 1 listed. Include hinges on enclosures with any single dimension larger than 24 inches.
   4. Outlet Boxes: Sheet-metal boxes; flush mount in finished areas.

G. Equipment Connections:
   1. FMC or LFMC.
   2. Maximum Length: 60 inches.
PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT (RMC) AND INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:
1. AFC Cable
2. Alflex
3. Allied Tube & Conduit
4. Anamet Electrical
5. Electri-Flex
6. Manhattan/CDT
7. Maverick Tube
8. O-Z Gedney
9. Wheatland Tube
10. Substitutions: Section 01 60 00 - Product Requirements.

B. RMC: Galvanized steel, except where otherwise indicated.

C. Galvanized Steel Rigid Conduit (GRC): ANSI C80.1.

D. Aluminum Rigid Conduit (ARC): ANSI C80.5.

E. IMC: Galvanized steel, except where otherwise indicated; ANSI C80.6.

F. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
1. AFC Cable
2. Alflex
3. Allied Tube & Conduit
4. Anamet Electrical
5. Electri-Flex
6. Manhattan/CDT
7. Maverick Tube
8. O-Z Gedney
9. Wheatland Tube
10. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:
1. Interlocked steel construction.

C. Fittings: NEMA FB 1.

2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
1. AFC Cable
2. Alflex
3. Allied Tube & Conduit
4. Anamet Electrical
5. Electri-Flex
6. Manhattan/CDT
7. Maverick Tube
8. O-Z Gedney
9. Wheatland Tube
10. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:
1. Interlocked steel construction with PVC jacket.

C. Fittings: NEMA FB 1.

2.4 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
1. AFC Cable
2. Alflex
3. Allied Tube & Conduit
4. Anamet Electrical
5. Electri-Flex
6. Manhattan/CDT
7. Maverick Tube
8. O-Z Gedney
9. Wheatland Tube
10. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:
1. ANSI C80.3; galvanized tubing.

C. Fittings and Conduit Bodies:
1. NEMA FB 1; steel, compression set screw type.

2.5 PVC CONDUIT

A. Manufacturers:
1. Carlon Electric Products
2. Ethyl Corp.
3. Can-Tex Industries
4. Condux

B. Product Description:
1. NEMA TC 2, PVC Tubing and Conduit.

C. Fittings:
1. NEMA TC 3, PVC fittings for use with rigid PVC Conduit and Tubing.

2.6 OUTLET BOXES

A. Manufacturers:
1. Cooper
2. Appleton
3. Erickson
4. Haffman
5. Hubbell
6. O-Z/Gedney
7. Thomas & Belts
8. Walker
10. Substitutions: Section 01 60 00 - Product Requirements.

B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
   1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2-inch male fixture studs where required.
   2. Concrete Ceiling Boxes: Concrete type.

C. Nonmetallic Outlet Boxes: NEMA OS 2.

D. Cast Boxes:
   1. NEMA FB 1, Type FD, cast ferroalloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.

E. Wall Plates for Finished Areas:
   1. As specified in Section 26 27 26.

F. Wall Plates for Unfinished Areas:
   1. Furnish gasketed cover.

2.7 PULL AND JUNCTION BOXES

A. Manufacturers:
   1. Carlon Electrical Products.
   2. Hubbell Wiring Devices
   3. Thomas & Betts Corp.
   5. The Wiremold Co.
   6. Substitutions: Section 01 60 00 - Product Requirements.

B. Sheet Metal Boxes:
   1. NEMA OS 1, galvanized steel.

C. Hinged Enclosures:
   1. As specified on the drawings sheets.

D. Surface Mounted Cast Metal Box:
   1. NEMA 250, Type 4; flat-flanged, surface mounted junction box:
      a. Material: Galvanized cast iron.
      b. Cover: Furnish with ground flange, neoprene gasket, and stainless-steel cover screws.

E. In-Ground Cast Metal Box:
   1. NEMA 250,
      a. Type 6, inside flanged, recessed cover box for flush mounting:
         1) Material: Galvanized cast iron.
         2) Cover: Nonskid cover with neoprene gasket and stainless-steel cover screws.
         3) Cover Legend: "ELECTRIC".

F. Concrete composite Handholes:
   1. Die-molded, glass-fiber concrete composite hand holes:
a. Cable Entrance: Pre-cut 6 inch x 6 inch cable entrance at center bottom of each side.
b. Cover: Glass-fiber concrete composite, weatherproof cover with nonskid finish.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
   B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK
   A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
   B. Remove concealed abandoned raceway to its source.
   C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
   D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
   E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
   F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION
   A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
   B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
   C. Identify raceway and boxes in accordance with Section 26 05 53.
   D. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.4 INSTALLATION - RACEWAY
   A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
   B. Arrange raceway supports to prevent misalignment during wiring installation.
   C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
   D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29.
   E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports.
F. Do not attach raceway to ceiling support wires or other piping systems.
G. Construct wireway supports from steel channel specified in Section 26 05 29.
H. Route exposed raceway parallel and perpendicular to walls.
I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
J. Maintain clearance between raceway and piping for maintenance purposes.
K. Maintain 12-inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.
L. Cut conduit square using saw or pipe cutter; de-burr cut ends.
M. Bring conduit to shoulder of fittings; fasten securely.
N. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
O. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
P. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2-inch size.
Q. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
R. Install fittings to accommodate expansion and deflection where raceway crosses seismic control and expansion joints.
S. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
T. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
U. Close ends and unused openings in wireway.

3.5 INSTALLATION - BOXES
A. Install wall mounted boxes at elevations to accommodate mounting heights specified in section for outlet device.
B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.
H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
I. Install stamped steel bridges to fasten flush mounting outlet box between studs.
J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
K. Install adjustable steel channel fasteners for hung ceiling outlet box.
L. Do not fasten boxes to ceiling support wires or other piping systems.
M. Support boxes independently of conduit.
N. Install gang box where more than one device is mounted together. Do not use sectional box.
O. Install gang box with plaster ring for single device outlets.

3.6 INTERFACE WITH OTHER PRODUCTS
A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Section 07 84 00.
B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified.
C. Locate outlet boxes to allow luminaires positioned as indicated on lighting plan.
D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.7 ADJUSTING
A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
B. Adjust flush-mounting outlets to make front flush with finished wall material.
C. Install knockout closures in unused openings in boxes.

3.8 CLEANING
A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
B. Clean interior of boxes to remove dust, debris, and other material.
C. Clean exposed surfaces and restore finish.

END OF SECTION
SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Nameplates.
   2. Labels.
   3. Wire markers.
   5. Stencils.
   7. Lockout Devices.

B. Related Sections:
   1. Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this section.

1.2 SUBMITTALS

A. Product Data:
   1. Submit manufacturer’s catalog literature for each product required.
   2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

B. Manufacturer’s Installation Instructions:
   1. Indicate installation instructions, special procedures, and installation.

1.3 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents:
   1. Record actual locations of tagged devices; include tag numbers.

1.4 QUALIFICATIONS

A. Manufacturer:
   1. Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer:
   1. Company specializing in performing Work of this section with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept identification products on site in original containers. Inspect for damage.
C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Install nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Product Description:
   1. Laminated three-layer plastic with engraved white letters on black contrasting background color.

B. Letter Size (Switchboards):
   1. 1/2-inch-high letters for identifying individual equipment.
   2. 1/4-inch-high letters for identifying miscellaneous information.
   3. Refer to details for additional information.

C. Letter Size (Panelboards, Transformers, Disconnects, etc.):
   1. 1/4-inch-high letters for identifying individual equipment.
   2. 1/8-inch-high letters for identifying miscellaneous information.
   3. Refer to details for additional information.

D. Minimum nameplate thickness: 1/8 inch.

E. Mounting Method: Corrosion Resistant Rivets

2.2 WIRE MARKERS

A. Description:
   1. Split sleeve or tubing type wire markers.

B. Legend:
   1. Power and Lighting Circuits: Branch circuit or feeder number.
   2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams.

2.3 CONDUIT AND RACEWAY MARKERS

A. Description:
   1. Nameplate fastened with adhesive Labels fastened with adhesive.
   2.

B. Color:
   1. Medium Voltage System: Black lettering on white background.
   2. 480 Volt System: Black lettering on white background.
3. 208 Volt System: Black lettering on white background.

C. Legend:
1. Medium Voltage System: HIGH VOLTAGE.
2. 480 Volt System: 480 VOLTS.
3. 208 Volt System: 208 VOLTS.

2.4 STENCILS
A. Stencils:
   1. With clean cut symbols and letters of following size:
      a. Up to 2 inches Outside Diameter of Raceway: 1/2-inch-high letters.
      b. 2-1/2 to 6 inches Outside Diameter of Raceway: 1-inch-high letters.

B. Stencil Paint:
   1. As specified in Section 09 90 00 semi-gloss enamel, colors conforming to the following:
      a. Black lettering on white background.
      b. White lettering on gray background.
      c. Red lettering on white background.
      d. Blue lettering on white background.

2.5 UNDERGROUND WARNING TAPE
A. Manufacturers:
   1. Marking Services, Inc.; or Equal.

B. Description:
   1. Detectable, 3-inch-wide solid aluminum foil core tape, colored red with suitable warning legend describing buried electrical lines. Tape shall have black letters stating “CAUTION BURIED ELECTRIC LINE BELOW.”

2.6 LOCKOUT DEVICES
A. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

PART 3 - EXECUTION
3.1 PREPARATION
A. Degrease and clean surfaces to receive adhesive for identification materials.
B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 EXISTING WORK
A. Install identification on existing equipment to remain in accordance with this section.
B. Install identification on unmarked existing equipment.
C. Replace lost nameplates.
D. Re-stencil existing equipment.

3.3 INSTALLATION
A. Install identifying devices after completion of painting.
B. Nameplate Installation:
1. Install nameplate parallel to equipment lines.
2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant screw, rivets or with bolt and nut.
3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant screws, rivets or with bolt and nut.
4. Secure nameplate to equipment front using corrosive-resistant screws, rivets or with bolt and nut.
5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
6. Install nameplates for the following:
   a. Switchboards.
   b. Panelboards.
   c. Transformers.
   d. Service Disconnects.
7. Name plate requirements as indicated in table below:

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>SIZE LETTERING</th>
<th>INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW-VOLTAGE SWITCHBOARDS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Name/Ratings         | 1/2” / 1/4”    | Switchboard designation/ampere rating and voltage characteristics 
                     | 1/8”           | EX: SWBD 1                                       |
| Devices              |                | Load served                                      |
|                      |                | EX: Transformer for Panel 1LB3                  |
| PANELBOARDS          | 1/4” / 1/8”    | Panelboard designation/ampere rating and voltage characteristics 
<pre><code>                 |                | EX: 1LB3                                         |
</code></pre>
<p>| Name/Ratings         | 1/4” / 1/8”    | Load served and circuit number                   |
|                      |                | EX: PANEL 1LB3                                  |
|                      |                | CKT SWBD1-1                                     |
| TRANSFORMERS         | 1/8”           | Load served and circuit number                   |
|                      |                | EX: PANEL 1LB3                                  |
|                      |                | CKT SWBD1-1                                     |</p>
<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>SIZE LETTERING</th>
<th>INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAFETY SWITCHES</td>
<td>1/8”</td>
<td>Load served and circuit number EX: ELEVATOR NO. 1 CKT 1LB3 – 37,39,41</td>
</tr>
<tr>
<td>MOTOR STARTERS</td>
<td>1/8”</td>
<td>Load served and circuit number EX: AHU-1 CKT 1LB3 – 38, 40, 42</td>
</tr>
<tr>
<td>MOTOR CONTROL DEVICES</td>
<td>1/8”</td>
<td>Load served EX: AHU-2</td>
</tr>
<tr>
<td>TIME SWITCHES OR CONTACTORS</td>
<td>1/8”</td>
<td>Load served EX: Exterior Lights</td>
</tr>
</tbody>
</table>

C. Label Installation:
1. Install label parallel to equipment lines.
2. Install label for identification of individual control device stations.
3. Install labels for permanent adhesion and seal with clear lacquer.

D. Wire Marker Installation:
1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and each load connection.
2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
3. Install labels at data outlets identifying patch panel and port designation as indicated on Drawings.

E. Conduit Marker Installation:
1. Install conduit marker for each conduit longer than 12 feet.
2. Conduit Marker Spacing: 20 feet on center.
3. Raceway Painting: Identify conduit using field painting in accordance with Section 09 90 00.
   a. Paint colored band on each conduit longer than 6 feet.
   b. Paint bands 20 feet on center.
   c. Color:
      1) 480 Volt System: Blue.
      2) 208 Volt System: Yellow.

F. Stencil Installation:
1. Apply stencil painting in accordance with Section 09 90 00.
G. Underground Warning Tape Installation:
1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION
SECTION 26 08 00

COMMISSIONING OF ELECTRICAL

PART 1 GENERAL

1.1 SUMMARY

A. The purpose of this guideline is to describe the technical requirements for the application of the Commissioning Process as described in Section 01 91 13 that will verify the Electrical System achieves the Owner’s Project Requirements and are compliant with the Basis of Design.

B. Section Includes:
   1. Electrical commissioning description.
   2. Electrical commissioning responsibilities.

C. Related Sections:
   1. List related sections.
   2. Section 01 91 00: Commissioning.
   3. Section 23 08 00: Commissioning of HVAC.
   4. Section 22 08 00: Commissioning of Plumbing.

1.2 REFERENCES

A. Institute of Electrical and Electronic Engineers (IEEE).
B. National Electric Code (NEC).
C. Others as specified.

1.3 COMMISSIONING DESCRIPTION

A. Electrical commissioning process includes the following tasks:
   1. Testing and startup of Electrical equipment and systems.
   2. Equipment and system readiness checklists.
   3. Provide qualified personnel to assist in commissioning tests, including seasonal testing.
   4. Complete and endorse functional performance test checklists provided by Commissioning Authority to assure equipment and systems are fully operational and ready for functional performance testing.
   5. Provide equipment, materials, and labor necessary to correct deficiencies found during commissioning process to fulfill contract and warranty requirements.
   6. Provide operation and maintenance information and record drawings to Commissioning Authority for review verification and organization, prior to distribution.
   7. Provide assistance to Commissioning Authority to develop, edit, and document system operation descriptions.
   8. Provide training for systems specified in this Section with coordination by Commissioning Authority.

B. Equipment and Systems to Be Commissioned:
   1. Lighting Control Systems
1.4 COMMISSIONING SUBMITTALS
   A. Section 01 91 13 - Commissioning: Requirements for commissioning submittals.
   B. Test Reports: Indicate data on system verification form for each piece of equipment and system as specified.
   C. Field Reports: Indicate deficiencies preventing completion of equipment or system verification checks equipment or system to achieve specified performance.

1.5 CLOSEOUT SUBMITTALS
   A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
   B. Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.
   C. Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when necessary revisions are discovered during commissioning.

1.6 QUALITY ASSURANCE
   A. Perform Work in accordance with specified codes, the OPR and BOD.
   B. Perform Work in accordance with all governing building codes as specified in the contract documents.

1.7 COMMISSIONING RESPONSIBILITIES
   A. Equipment or System Installer Commissioning Responsibilities:
      1. Attend commissioning meetings.
      2. Provide instructions and demonstrations for Owner's personnel.
      3. Ensure subcontractors perform assigned commissioning responsibilities.
      4. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
      5. Develop startup and initial checkout plan using manufacturer’s startup procedures and functional performance checklists for equipment and systems to be commissioned.
      6. Installation Contractor, under the direction of the Construction Manager (CM), with the Commissioning Authority (CxA) observing and documenting the results, will execute the Functional Performance Testing procedures for the various systems and pieces of equipment associated with the requirements for the electrical system.
      7. During verification check and startup process, execute electrical related portions of checklists for equipment and systems to be commissioned.
      8. Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Authority.
      9. Provide manufacturer’s representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
      10. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
      11. Provide personnel to assist Commissioning Authority during equipment or System Readiness Checks (SRC’s) and Functional Performance Tests (FPT’s).
13. Prior to FPT’s, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.

14. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.

15. Provide factory supervised startup services for equipment and systems. Coordinate work with manufacturer and Commissioning Authority.

16. Perform verification checks and startup on equipment and systems as specified.

17. Assist Commissioning Authority in performing FPT’s on equipment and systems as specified.

18. Perform operation and maintenance training sessions scheduled by Commissioning Authority.

19. Conduct electrical system orientation and inspection.

20. Perform training sessions to instruct Owner’s personnel in hardware operation, software operation, programming, and application in accordance with commissioning plan and specifications.

21. Demonstrate system performance and operation to Commissioning Authority during functional performance tests including each mode of operation.

22. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

1.8 COMMISSIONING MEETINGS

A. Section 01 91 13 - Commissioning: Requirements for commissioning meetings.

B. Attend initial commissioning meeting and progress commissioning meetings as required by Commissioning Authority.

1.9 SCHEDULING

A. Prepare schedule indicating anticipated start dates for the following:
   1. Normal electric power.
   2. Emergency electric power (if applicable).
   3. Lighting control system.
   4. Electrical system orientation and inspections.
   5. Operation and maintenance manual submittals.
   6. Training sessions.

B. Schedule seasonal tests of equipment and systems during peak weather conditions to observe full-load performance.

C. Schedule occupancy sensitive tests of equipment and systems during conditions of both minimum and maximum occupancy or use.

1.10 COORDINATION

A. Notify Commissioning Authority minimum of 5 days in advance of the following:
   1. Scheduled equipment and system startups.

B. Coordinate programming of automatic temperature control system with construction and commissioning schedules.
PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 INSTALLATION
   A. Place electrical systems and equipment into full operation and continue operation during each working day of commissioning.

3.2 COMMISSIONING
   A. Be responsible to participate in initial and alternate peak season test of systems required to demonstrate performance.
   B. Occupancy Sensitive Functional Performance Tests:
      1. Test equipment and systems affected by occupancy variations at minimum and peak loads to observe system performance.
      2. Participate in testing delayed beyond final completion to test performance with actual occupancy conditions.

END OF SECTION
SECTION 26 09 43

NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Networked lighting control system and components.

B. Related Sections:
   1. Section 23 09 23 - Direct-Digital Control System for HVAC: Execution requirements for interfacing direct digital control systems with lighting control system specified in this section.
   2. Section 25 50 00 - Integrated Automation Facility Controls: Execution requirements for interfacing with lighting control system specified in this section.
   3. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.
   4. Section 26 05 33 - Raceway and Boxes for Electrical Systems: Product requirements for raceway and boxes for placement by this section.
   5. Section 26 05 53 - Identification for Electrical Systems: Product requirements for electrical identification items for placement by this section.
   6. Section 26 27 26 - Wiring Devices: Product requirements for wiring devices for placement by this section.

1.2 REFERENCES

A. Federal Communications Commission:

B. Government Electronics and Information Technology Association:

C. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.
   2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

E. Underwriters Laboratories Inc.:
   1. UL 50 - Enclosures for Electrical Equipment.
   2. UL 67 - Panelboards.
   3. UL 508 - Industrial Control Equipment.
   4. UL 916 - Energy Management Equipment.

1.3 SYSTEM DESCRIPTION

A. Provide networked lighting control system consisting of components manufactured by single source.

B. Provide networked lighting control system consisting of:
   1. Multiple relay panels linked over network wiring using open protocol for communications.
2. Multiple relay panels linked over network wiring using open protocol for communications, and are fully compliant with EIA 709.1.

3. Relay panels and programmable switches connected together by networked wiring system extending from panel locations with single communications bus to allow switches to communicate with panels.

4. System connected to single time clock mounted in interior of relay panel at remote location.

C. Networked lighting control system performs lighting control in the entire building, as detailed on the drawings.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:
   1. Indicate dimensioned drawings of lighting control system components and accessories.
   2. One Line Diagram: Indicating system configuration indicating panels, number and type of switches, data line, and network time clock.
   3. Drawings for each panel showing hardware configuration and numbering.
   4. Panel wiring schedules.
   5. Include typical wiring diagrams for each component.

C. Product Data:
   1. Submit manufacturer’s standard product data for each system component.

D. Manufacturer’s Installation Instructions:
   1. Submit for each system component.

E. Manufacturer’s Certificate:
   1. Certify Products meet or exceed specified requirements. Submit in writing system has been installed, adjusted, and tested in accordance with manufacturer's recommendations.

F. Manufacturer’s Field Reports:
   1. Submit system startup report indicating date of completion and acknowledgment of programming completion. Indicate acceptance of component and equipment installation, interconnecting wiring, and start-up of system software.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents:
   1. Record the following information:
      a. Wiring diagrams reflecting field installed conditions with identified and numbered system components and devices.
      b. Drawings for each panel showing hardware configuration and numbering.

C. Operation and Maintenance Data:
   1. Submit manufacturer’s published installation instructions, operating instructions, programming instructions, and operator’s guide.
   2. System user's guide and programmer's guide.
   3. Instruction books and manufacturer’s printed materials.
4. Recommended renewal parts list.

1.6 QUALITY ASSURANCE
A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.
B. Comply with NFPA 70 as applicable to electrical wiring work.
C. Comply with NEMA 250 for type of electrical equipment enclosures.
D. Provide panelboards with UL listing in accordance with UL 50, UL 67, and UL 916.
E. Provide equipment complying with FCC emissions' standards in part 15 subpart J for Class A application.
F. Perform Work in accordance with State Municipality of Highways Public Work's standard.
G. Maintain one copy copies of each document on site.

1.7 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing lighting control system listed in this section, with minimum three five years’ experience.
B. Installer:
   1. Company specializing in performing work of this section with minimum years documented experience approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS
A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING
A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
B. Accept system components on site in manufacturer’s packaging. Inspect for damage.
C. Protect components by storing in manufacturer’s containers indoor protected from weather.

1.10 WARRANTY
A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
B. Furnish five year manufacturer’s warranty for each system component.

1.11 MAINTENANCE SERVICE
A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.
B. Furnish service and maintenance of system for one year from Date of Substantial Completion. Include maintenance items as shown in manufacturer's operating and maintenance data, including checkout and adjustments.

C. Furnish 24-hour emergency service during working hours on breakdowns and malfunctions for this maintenance period.

D. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, with maximum 4 hour response time.

E. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.

F. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

1.12 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for extra materials.

B. Furnish 20 percent of total number of relays.

C. Furnish two of each switch type.

D. Furnish two of each occupancy sensor type.

E. Furnish two of each photocell type.

F. Furnish one replacement key for each locking switch panelboard.

PART 2 - PRODUCTS

2.1 NETWORKED LIGHTING CONTROL SYSTEM

A. Manufacturers:
   1. nLight (basis of design)
   2. General Electric
   3. Leviton
   4. Watt Stopper
   5. Lutron
   6. Hubbell
   7. Substitutions: Section 01 60 00 - Product Requirements Not Permitted

B. Product Description:
   1. Networked lighting control system consisting of the following components: relay panels, network wiring, programmable network wired switches, programmable clock, software, and capability of integration into building automation system.

2.2 RELAY PANELS

A. UL listed, NEMA 250 Type 1 enclosure sized to accept up to 8 12 16 24 32 48 relays.

B. Power Supply:
   1. Transformer assembly with two 40 VA transformers with separate secondaries. Transformers include internal overcurrent protection with automatic reset and metal oxide varistor protection against power line spikes.
C. Voltage: 277 VAC, 60 Hertz, plus or minus 10 percent.
D. Mounting: Surface Flush.
E. Cover: Hinged, locking configuration with wiring schedule directory card.
F. Interior:
   1. Bracket and intelligence board backplane with factory mounted and tested relays.
G. Furnish with integral DIN rail mounting bar to allow for installation of system components. Furnish terminals to accept network wiring for connection of switches to system, or to allow network wiring to be run between multiple panels for network communications between panels.
H. Furnish with individual on-off switches for both panel and network wiring power.
I. Furnish 8 channels in each interior regardless of size, each with associated pushbutton to toggle channel on-off, and terminal block for separate dry contact input. Each relay in panel capable of being assigned to each channel, with overlapping allowed. Furnish each channel pushbutton with LED state indication.
J. Furnish each channel pushbutton with LED status indication.
K. Relays:
   1. Type: Momentary-pulsed mechanically latching contactors rated at 20 amps, 120 to 277 VAC attached to interior by plug-in type connector.
   2. Locate next to each relay individual override button and LED to indicate status - relay on, relay off, or relay failure.
   3. Furnish screw terminations for each wiring connection.
   4. Furnish each channel button’s dry control contact input terminal with capability of accepting 2 or 3 wire, maintained or momentary inputs and 2 wire toggling input.
   5. Furnish each channel with isolated contact for use with status feedback or pilot light control.
   6. Relay Panel records channel wiring assignments and current status of each relay, in non-volatile memory to prevent data loss on power failure.
   7. Furnish LED status indication of power supply status. Furnish access to 24 VAC and 24 V rectified power for accessory devices within panel.
   8. Interior uses relays with pilot contact to provide individual relay feedback to other systems. Locate terminal blocks next to each relay to allow standard low voltage switching devices to control relay state. Devices can be either 2 or 3 wire, maintained or momentary inputs. Devices also accept 2 wire toggling input.
   9. System to comply with EIA 709.1 lighting controller profile and furnish capability for network connecting to EIA 709.1 compliant building automation system components without use of dry contacts, gateways, protocol converters or additional devices.

2.3 NETWORK WIRING
A. Material:
   1. 18/4 twisted conductor with shield meeting Class 2 2P requirements. Data line can be run in loop, serial, or star configuration. Minimum 1 turn for each 3 inches; 50 picofarads/foot maximum.
B. Maximum length: 1,500 feet.
2.4 PROGRAMMABLE NETWORK WIRED SWITCHES

A. Function:
1. Allow individual overrides. Switches terminated to network wiring of each panel.

B. Configuration:
1. Single, dual, quad, or octal.

C. Switch module buttons capable of being individually programmed and assigned to each of the following four functions:
1. Control each individual relay in single panel.
2. Control each group of relays in single panel.
3. Control each of 8 channels in single panel.
4. Control similar channel letter in each chosen group of panels in system.

D. For applications requiring pattern switching, each button performs function using “on-off-not controlled” pattern of relays instead of normal “all on-all off.”

E. Features:
1. Equipped with bi-color LED pilot light for individual buttons to indicate status of controlled relay or group of relays.
2. Equipped with locator light.
3. Furnish individual buttons with removable clear cover for labeling controlled loads.
4. Furnish single dual quad and octal switches with single master button capable of overriding every relay controlled by individual buttons to off position or capable of restoring them to their original state. Each switch unit master button function is capable of being configured to perform desired function.
5. Furnish dip switches on back of module prevent switch from turning off lights accidentally.
6. Each module available locking version. When key is inserted, individual buttons function for five minutes.

2.5 PROGRAMMABLE CLOCK

A. From each plug-in point on network wiring, time clock can be used to:
1. Schedule each 8 channel groups in relay panel network.
2. Program network wired switches.

B. Includes user selectable functions to handle standard lighting control functions for each channel independently. Selectable functions include:
1. Scheduled on and scheduled off.
3. Astronomical on and astronomical off with optional offset.
4. Astronomical on and scheduled off with optional offset.

C. Each channel capable of being assigned the following:
1. Time delay from 1 to 256 minutes.
2. Automatic blinking of lights before turning off to allow occupants opportunity to enter override. Time interval configurable.

D. Features:
1. Furnish clock with display and user interface.
2. Capable of being adjusted for leap year, daylight savings dates, and holidays.

2.6 SOFTWARE
A. Furnish plug-in capability for use in system commissioning, programming, monitoring, and control. Software capable of functioning with EIA 709.1 compliant network tool.
B. After programming of system parameters is completed, system allows each user-definable feature such as schedules, relay groups, and switch assignments to be field modified without need for configuration software or system integration expertise.

2.7 BAS INTEGRATION
A. In addition to hardwired channel inputs, furnish system with capability for integration into building automation and control system direct digital control system without use of dry contact, gateways or protocol converters. Integration accomplished via network connections of EIA 709.1 compliant devices.
B. Refer to Section 25 50 00 23 09 23.

PART 3 - EXECUTION
3.1 INSTALLATION
A. Mount switches occupancy sensors and photocells as indicated on Drawings.
B. Label each low voltage wire clearly indicating connecting relay panel. Refer to Section 26 05 53.
C. Use only properly color coded, stranded wire. Install wire sizes as indicated on Drawings.
D. Mount relay panels as indicated on Drawings. Wire numbered relays in panel to control power to each load.
E. Identify power wiring with circuit breaker number controlling load. When multiple circuit breaker panels are feeding into relay panel, label wires to clearly indicate originating panel’s designation.
F. Terminate communication conductors and associated conduits external to factory supplied equipment.
G. Test relays and switches after installation to confirm proper operation.
H. Label each low voltage wire with relay number at each switch or sensor.
I. Install wiring schedule directory card affixed to rear of panel cover to identify circuits, relays, and loads controlled.

3.2 FIELD QUALITY CONTROL
A. Section 01 40 00 - Quality Requirements 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
B. Test relays and switches after installation to confirm proper operation and confirm correct loads are recorded on directory card in each panel.

3.3 MANUFACTURER'S FIELD SERVICES
A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer’s field services.
B. System Startup:
   1. Furnish manufacturer trained, factory authorized technician to confirm proper
      installation and operation of system components.

C. Furnish services of factory trained representative for minimum of one day days for
   factory check, test, and start-up supervision. Perform the following services:
   1. Check installation of panelboards.
   2. Test operation of remote controlled devices.
   3. Test operation of telephone override phone lines.
   4. Test operation of network connections.
   5. Test operation of central operator's station and associated printer.
   6. Repair or replace defective components.

D. Programming:
   1. Furnish services of factory trained representative to perform programming of
      system.
   2. Assist Owner’s personnel in developing control scenario for each application.
   3. Owner furnished control scenario.
   4. Explain operation of control programs to Owner and conduct demonstration of
      project.
   5. Provide programs on CD Rom.
   6. Maintain copy of programmed information at factory.

3.4 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and
   adjusting.

B. Furnish factory trained technicians to functionally test each system component after
   installation to verify proper operation.

3.5 DEMONSTRATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for
   demonstration and training.

B. Demonstrate operation of the following system components:
   1. Index system to occupied cycle and unoccupied cycle.
   3. Operation of each type of occupancy sensors. Demonstrate for zones.
   4. Operation of each type of photocell. Demonstrate for zones.

C. Furnish services of manufacturer's technical representative for 4 hours to instruct Owner's
   personnel in operation and maintenance of system. Schedule training with Owner.
   Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.

3.6 SCHEDULES

A. Lighting Relay Panel Schedule:

<table>
<thead>
<tr>
<th>Panel Name and Location</th>
<th>Panel Number</th>
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</thead>
<tbody>
<tr>
<td>Relay Number</td>
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807 N. Upper Broadway
Remodel and Tenant Infill
Project Number 1916

January 10, 2020
26 09 43 - 8
NETWORK LIGHTING CONTROLS
<table>
<thead>
<tr>
<th>Panel and Circuit</th>
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<tbody>
<tr>
<td>Description</td>
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<tr>
<td>Switch or Sensor</td>
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<tr>
<td>Other Controls</td>
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</table>

END OF SECTION
SECTION 26 22 00

LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes two-winding transformers; shielded transformers; autotransformers; and buck-and-boost transformers.

B. Related Sections:
   1. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA ST 1 - Specialty Transformers (Except General Purpose Type).
   2. NEMA ST 20 - Dry Type Transformers for General Applications.

B. International Electrical Testing Association:

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data:
   1. Submit outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, k-rating (when applicable) and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

C. Test Reports:
   1. Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents:
   1. Record actual locations of transformers.

1.5 QUALIFICATIONS

A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum three years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

A. Manufacturers:
   1. ABB; GE Industrial Solutions.
   2. Eaton Corporation; Cutler Hammer.
   3. Schneider Electric; Square D.
   5. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:
   1. NEMA ST 20, factory-assembled, air-cooled, dry type transformers, ratings as indicated on Drawings.

C. Insulation system and average winding temperature rise for rated kVA as follows:
   1. 1-15 kVA: Class 185 with 115 degrees C rise.
   2. 16-500 kVA: Class 220 with 80 degrees C rise.

D. Case temperature:
   1. Do not exceed 35 degrees C rise above ambient at warmest point at full load.

E. Winding Taps:
   1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
   2. 2. Transformers 15 kVA and Larger: NEMA ST 20.

F. Sound Levels: NEMA ST 20.

G. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

H. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.

I. Mounting:
   1. 1-15 kVA: Suitable for wall mounting.
   2. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
   3. Larger than 75 kVA: Suitable for floor or trapeze mounting.

J. Coil Conductors:
   1. Continuous copper windings with terminations brazed or welded.

K. Electrostatic Shield (when specified on the drawings):
   1. Cooper, between primary and secondary windings.

L. Enclosure:
   1. NEMA ST 20, Type 1 or Type 3R ventilated or non-ventilated as indicated on the electrical drawings. Furnish lifting eyes or brackets.
M. Isolate core and coil from enclosure using vibration-absorbing mounts.

N. Nameplate:
   1. Include transformer connection data and overload capacity based on rated allowable temperature rise.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
   B. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.2 INSTALLATION
   A. Set transformer plumb and level.
   B. Use flexible conduit, in accordance with Section 26 05 33, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
   C. Support transformers in accordance with Section 26 05 29.
      1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.
      2. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
      3. Mount trapeze-mounted transformers as indicated on Drawings.
   D. Provide seismic restraints.
   E. Install grounding and bonding in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL
   A. Field inspecting, testing, adjusting and balancing.
   B. Inspect and test in accordance with NETA ATS, except Section 4.
   C. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.4 ADJUSTING
   A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
   B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION
PART 1 - GENERAL

1.1 CONDITIONS:

A. The Contractor, Subcontractors, Trade Contractors, and Suppliers are responsible for understanding the requirements of the General Conditions, the Supplementary General Conditions, all Specification Sections, all Drawings, and all Bid Documents that govern or may otherwise impact their Work.

B. The Contractor, Subcontractors, Trade Contractors, and Suppliers shall compare the requirements of the Specifications to the requirements of the Drawings as part of the bidding process and report any discrepancies to the Architect prior to bidding.

C. The Contractor, Subcontractors, Trade Contractors, and Suppliers shall bid fully operational systems that represent, to the best of their understanding, the intent of the system installation and operation for the system being proposed and installed.

D. Additionally, all Work performed under this Section of the Specifications shall be in strict accordance with the provisions of the SECTION 22 01 00: SPECIAL CONDITIONS FOR ALL MECHANICAL AND ELECTRICAL WORK, and the Basic Materials and Methods Sections of Divisions 21, 22, 23 & 26.

1.2 SUMMARY

A. This Section includes low-voltage power service and distribution switchboards and associated auxiliary equipment rated 600 V or less.

B. Related Sections: The following Division 26 Sections contain requirements that relate to this Section:

1. "Overcurrent Protection System" for circuit breakers, fusible switches, fuses, and other similar devices used in switchboards.
2. "Electrical Identification" for identification and warning signs for switchboards and switchboard components.
4. “Surge Protection Devices (SPD)”

1.3 SUBMITTALS

A. Refer to General and Supplementary General Conditions of Contract and Division 01 Specification Sections and submit the following:

1. Descriptive catalog data edited for content to identify the specific model, style, capacities, accessories, etc. for each product and component including, but not limited to, voltages, number of phases, frequencies, short-circuit and continuous current ratings, application data for main and branch devices, Sections, buses, and basic insulation levels.

2. Shop Drawings of each switchboard, bus duct and cable tap box, which contain accurately dimensioned equipment layouts, elevations, installation details, Sections, and single line diagram showing main and branch bus current ratings, and short time and
short circuit ratings of switchboard, including appropriate auxiliary components, insulation, and barrier information.

3. Point to point wiring diagrams for each switchboard showing connections to electrical power feeders and distribution branches, control and accessory wiring, grounding, and bonding. Clearly differentiate between manufacturer-installed and field-installed wiring.

4. Manufacturer's written installation instructions for each product and component.

5. Schedule of features, characteristics, rating, and factory settings of individual protective devices.

B. Maintenance data for inclusion in Operation and Maintenance Manual specified in Division 01 and Division 22, Section 22 01 00: SPECIAL CONDITIONS FOR ALL MECHANICAL AND ELECTRICAL WORK.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with the following:
   1. National Electric Code, NFPA No. 70 as applicable to wiring methods, components, and installation.
   2. UL Standard 891.
   3. ANSI requirements applicable to switchboards.
   4. NEMA Standards No. PB 2 and PB 2.1.
   5. Listing and Labeling: Provide switchboard assemblies, bus ducts, cable tap boxes, and components that are UL-listed and labeled.

B. Lighting and Labeling: Provide switchboard assemblies, bus ducts, cable tap boxes, and components that are UL-listed and labeled.

C. Field Testing Organization Qualifications: To qualify for acceptance based on evaluation of organization-submitted criteria, testing organization must demonstrate experience and capability in conformance to ASTM E699.

1.5 SPACE RESTRICTIONS

A. Do not exceed maximum dimensions and provide clearance indicated. New switchboard must fit within the space indicated on the Drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Refer to General and Supplementary General Conditions of Contract and Division 01 Specification Sections.

B. Ship and deliver in the largest factory assembly that can be transported and unloaded. Use factory-installed lifting provisions.

C. Handle in accordance with NEMA Standard PB 2.1.

D. Store to prevent condensation on or in equipment. Provide temporary heaters to avoid condensation.

1.7 EXTRA MATERIALS

A. Indicating Lights: Provide six spare lamps of each size and type used.

B. Paint: Provide one-gallon containers of each type and color used.
PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturers:
   1. ABB; GE Industrial Solutions.
   2. Eaton Corporation; Cutler Hammer.
   3. Schneider Electric; Square D.
   5. Substitutions: Section 01 60 00 - Product Requirements.

B. Description: Front-accessible, group mounted main and branches, Sections front aligned, with extension capability as indicated. Provide configuration for proper interface with transformers serving switchboard.

2.2 FABRICATION AND FEATURES

A. Enclosure: Steel, Nema 3R or Nema 1 as indicated and as required by location.

B. Buses and Connections: 3 phase, 4 wire except as otherwise indicated. Features as follows:
   2. Use copper for feeder circuit breaker and fused switch line connections.

C. At load terminals of feeder breakers and switches, provide silver-plated copper bus extensions equipped with pressure terminal connectors for outgoing circuit conductors.

D. Ground Bus: 1/4-inch by 4-inch minimum size, hard-drawn copper of 98 percent conductivity, and equipped with pressure connector terminations for feeder and branch circuit ground conductors. For bus way feeders extend insulated equipment grounding cable to bus way ground connection and support cable at intervals in vertical run.

E. Supports and Bracing for Buses: Adequate strength for indicated short circuit currents. (100,000 ampere RMS minimum).

F. Contact Surfaces of Buses: Silver-plated.

G. Main Phase Buses, Neutral Bus, and Equipment Ground Bus: Uniform capacity the entire length of the switchboard main and distribution Sections.

H. Neutral Buses: 100 percent of the ampacity of the phase buses except as indicated and equipped with approved pressure connector terminations for outgoing circuit neutral cables. Provide braced neutral bus extensions for bus way feeders with neutral conductors.

I. Bonding Jumpers: Provide bussed main and equipment bonding jumpers.

J. Ground Fault Protection per NEC Article 230.95.

K. Separate Switchboard Section for Fire Pump Feeder Connection and per NEC Article 695 when Fire Pump is indicated.

2.3 OVERCURRENT PROTECTIVE DEVICES (OCPDs)

A. Comply with requirements of Division 26 Section "Overcurrent Protection System" for types of OCPDs indicated. Provide ground fault protection and trip accessories and other indicated features, ratings, characteristics, and settings.
B. Programmable Trip: Provide programmable trip units for all devices rated 600A and above

C. Adjustable Trip: Provide adjustable trip capabilities (Long Time, Short Time, Instantaneous, and Ground Fault) for all circuit breakers rated 1000A and above.

D. Arc Fault Reduction...

E. Future Devices: Where provision for future overcurrent protective devices or space is indicated, equip compartments with mounting brackets, supports, bus connections, and necessary appurtenances, designed for the OCPD types and ampere ratings indicated for future installation of devices.

2.4 OTHER CIRCUIT CONTROL AND PROTECTIVE DEVICES

A. General: Factory-installed and -tested devices of types listed below, with indicated ratings, settings, and features.

B. Multifunction Digital Metering Monitor: Provide in Main Switchboard a UL listed or recognized microprocessor based unit suitable for 3- or 4-wire systems and with the following features:
   1. Inputs: From sensors or current transformers from 100/5 through 1200/5 ratings and potential terminals up to 600 V on the mains of Switchboard.
   2. Display: Switch selectable digital display of the following values with maximum accuracy tolerances as indicated:
      a. Phase currents, each phase, plus or minus 1 percent.
      b. Phase-to-phase voltages, 3 phase, plus or minus 1 percent.
      c. Phase-to-neutral voltages, 3 phase, plus or minus 1 percent.
      d. Kilowatts, plus or minus 2 percent.
      e. Kilovars, plus or minus 2 percent.
      f. Power factor, plus or minus 2 percent.
      g. Frequency, plus or minus 0.5 percent.
      h. Kilowatt demand with demand interval programmable from 5 to 60 minutes, plus or minus 2 percent.
      i. Accumulated energy, kilowatt hours, plus or minus 2 percent. Accumulated values unaffected by power outages up to 72 hours.
      j. Fused connections for remote annunciation of voltage and current.
      k. Dedicated 4 - 20 MA KW signal output from meter.
   3. Mounting: Display and control unit flush- or semi-flush-mounted in instrument compartment door.

C. Phase failure and/or low voltage relays: Provide phase failure relay complete with contact outputs for connection to the Temperature Controls and/or Emergency Power Transfer Switch as noted on the Drawings.

D. Relays: IEEE C37.90, "Relays and Relay Systems Associated with Electric Power Apparatus". Types, settings, and control sequences as indicated. Provide test blocks and plugs.

E. Provide Integral Surge Protection Device (SPD) with disconnect.
2.5 CONTROL POWER:
A. General: Where electrically operated devices or ground fault relays requiring external power are indicated, provide 120V control circuits supplied through secondary disconnect devices from control power transformer.
B. Control Power Fuses: Include primary and secondary fuses for current limiting and overload protection of transformer and fuses for protection of control circuits.
C. Control Wiring: Factory-installed, complete with bundling, lacking, and protection. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 RATINGS:
A. Provide nominal system voltage and continuous main bus amperage ratings as indicated:
   1. Nominal System Voltage: 480/277 V, 60 Hz.
   2. Main Bus Continuous: As indicated for the applicable switchboard.

2.7 ACCESSORY COMPONENTS AND FEATURES:
A. Accessory Set: Include tools and miscellaneous items as required for overcurrent protective device test, inspection, maintenance, and operation.

2.8 IDENTIFICATION:
A. General: Refer to Division 26 Section "Electrical Identification." Identify units, devices, controls, and wiring with factory-applied labels and signs.
B. Compartment Nameplates: Engraved laminated plastic or metal nameplate for each compartment, mounted with corrosion-resistant screws.

PART 3 - EXECUTION
3.1 INSTALLATION:
A. General: Install switchboards, bus duct, enclosures, and accessory items in accordance with manufacturer's written installation instructions and the following Specifications. Provide 4"-high housekeeping pad for each switchboard.
B. Anchor each switchboard in accordance with manufacturer's recommendations. Attach by bolting.
C. Strength, Spacing, and Placement of Equipment Housekeeping Pads: Provide a 1 1/2" high min., 3 1/2" high max. concrete housekeeping pad.
   1. Coordinate size of equipment bases with actual unit sizes provided. Fabricate base 1-inch larger in both directions than the overall dimensions of the supported unit.
D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units, enclosure, and components.
E. Leave each main and branch enclosure closed when not attended.
F. Operating Instructions: Frame and mount printed, basic operating instructions for switchboards, including control and key interlocking sequences, and emergency
procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on the front of the switchboards.

3.2 IDENTIFICATION:
A. Identify field installed wiring and components and provide warning signs as specified in Division 26 Section "Electrical Identification."

3.3 GROUNDING:
A. Connections: As indicated, tighten connections to comply with tightening torques specified in UL 486A and 486B.
B. Ground equipment to main electrical ground bus indicated. Provide minimum 5 ohm ground resistance at switchboard location.

3.4 CONNECTIONS:
A. Tighten switchboard bus joint bolts and electrical connector and terminal bolts in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not stated, use those specified in UL 486A and UL 486B.
B. Contractor shall coordinate with the various Trades, in particular the Electrical and the HVAC DDC Control System Trades, the installation and final connections to devices such as “phase failure relay,” “low voltage relays,” “KW analog or pulse meter pulse signals,” etc.

3.5 FIELD QUALITY CONTROL
B. Manufacturer's Field Services: (A Special Service) Arrange and pay for the services of a factory-authorized service representative to supervise the pretesting and adjustment of switchboard components for a total of 1 working day.
C. Pretesting: Upon completing installation of the system, perform the following preparations for tests:
   1. Make insulation resistance tests of switchboard buses, components, and connecting supply, feeder, and control circuits.
   2. Make continuity tests of circuits.
   3. Provide manufacturer's instructions for installation and testing of switchboard to test organization.
D. Quality Control Testing Program: Conform to the following:
   1. Program Objectives: To assure switchboard installation meets specified requirements, is operational within specified tolerances, provides appropriate protection for systems and equipment, and is suitable for energizing.
   2. Procedures: Make field tests and inspections and prepare switchboard for satisfactory operation in accordance with manufacturer's recommendations and these Specifications.
   3. Schedule tests and notify Architect/Engineer at least one week in advance of test commencement.

5. Labeling: Upon satisfactory completion of tests and related effort. Apply a label to tested components indicating test results, person responsible, and date.

6. Protective Device Ratings and Settings: Verify indicated ratings and settings and make the final system adjustments of OCPDs in accordance with Division 26 Section "Overcurrent Protection System."

E. Visual and Mechanical Inspections: Include the following inspections and related Work.
   1. Inspect for defects and physical damage, testing laboratory, labels, and nameplate compliance with up-to-date circuit connections.
   2. Verify that potential transformers, including their overcurrent protection and current transformers meet specified requirements.
   3. Perform operational test and exercise of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
   4. Check switchboard anchorage, area clearances, and alignment and fit of components.
   5. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
   6. Clean switchboard interior and exterior using manufacturer's approved methods and materials.
   7. Perform visual and mechanical inspection and related Work for OCPDs as specified in Section "Overcurrent Protection System."

F. Electrical Tests: Include the following items performed in accordance with manufacturer's instruction:
   1. Insulation resistance test of buses and portions of control wiring that disconnect from solid state devices through normal disconnecting features. Insulation resistance less than 100 megohms is not acceptable.
   2. Ratio and polarity tests on current and voltage transformers.
   3. Ground resistance test on system and equipment ground connections.
   4. Verify appropriate capacity, overcurrent protection, and operating voltage of control power elements including control power transformer and control power wiring.
   5. Test overcurrent protective devices as specified in Section "Overcurrent Protection System."

G. Retesting: Correct deficiencies identified by tests and observations and retest switchboards.

H. Verify by the retests that switchboards meet specified requirements.

3.6 CLEANING

A. Upon completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots, dirt, and debris. Touch-up scratches and mars of finish to match original finish.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat in accordance with manufacturer's recommendation within each Section of switchboards throughout periods during which the
switchboard is not in a space that is continuously under normal control of temperature and humidity.

3.8 DEMONSTRATION

A. Training: Arrange and pay for the services of factory-authorized service representatives to demonstrate switchboards and train Owner's maintenance personnel. The Contractor shall provide training to the Owner's maintenance personnel on Panelboards. These training sessions shall be videotaped, and the videotaped training sessions shall be provided to the Owner on CD.

B. Training: Conduct a minimum of one-half day of training in operation and maintenance as specified under "Instructions to Owner Employees" in the Division 01 Section "Project Closeout." Include both classroom training and hands-on equipment operation and maintenance procedures.

C. Schedule training with at least seven days advance notification.

3.9 COMMISSIONING

A. Infrared Scanning: After Substantial Completion, but not more than 2 months after Final Acceptance, perform an infrared scan of switchboard bus joints and connections. Open or remove metal doors, covers, inspection plates, and barriers to make joints and connections accessible to a portable scanner. Scanning shall be performed under full building load. Notify Architect/Engineer and Owner of date and time of scanning, so they can attend and witness.

B. Instrument: Use an infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.

C. Record of Infrared Scanning: Prepare a certified report identifying all connections checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

END OF SECTION
SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution and branch circuit panelboards.

B. Related Sections:
   1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   2. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:
   1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:
   1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
   2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
   3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
   4. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
   5. NEMA PB 1 - Panelboards.
   6. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

C. International Electrical Testing Association:

D. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

E. Underwriters Laboratories Inc.:
   1. UL 67 - Safety for Panelboards.
   2. UL 1283 - Electromagnetic Interference Filters.
   3. UL 1449 - Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:
   1. Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

C. Product Data:
   1. Submit catalog data showing specified features of standard products.
1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents:
   1. Record actual locations of panelboards and record actual circuiting arrangements.

C. Operation and Maintenance Data:
   1. Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum three years’ experience.

1.6 MAINTENANCE MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance products.

B. Furnish two of each panelboard key. Panelboards keyed alike to Owner’s current keying system.

PART 2 - PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

A. Manufacturers:
   1. ABB; GE Industrial Solutions.
   2. Eaton Corporation; Cutler Hammer.
   3. Schneider Electric; Square D.
   5. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:
   1. NEMA PB 1, circuit breaker type panelboard.

C. Panelboard Bus:
   1. Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.

D. Minimum integrated short circuit rating: 10,000 amperes rms symmetrical for 240-volt panelboards; 14,000 amperes rms symmetrical for 480-volt panelboards. Panelboards shall be fully rated.

E. Molded Case Circuit Breakers:
   1. NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

F. Circuit Breaker Accessories:
   1. Trip units and auxiliary switches as indicated on Drawings.
G. Enclosure: NEMA PB 1, Type 1.

H. Cabinet Front:
   1. Surface type, fastened with hinged door with flush lock, metal directory frame, finished in manufacturer’s standard gray enamel.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Manufacturers:
   1. ABB; GE Industrial Solutions.
   2. Eaton Corporation; Cutler Hammer.
   3. Schneider Electric; Square D.
   5. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:
   1. NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Panelboard Bus:
   1. Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard including insulated ground bus as indicated on Drawings.

D. For non-linear load applications subject to harmonics furnish 200 percent rated, plated copper, solid neutral, where indicated on the electrical drawings.

E. Minimum Integrated Short Circuit Rating; 10,000 amperes rms symmetrical for 240-volt panelboards; 14,000 amperes rms symmetrical for 480-volt panelboards or as indicated.

F. Molded Case Circuit Breakers:
   1. NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.

G. Enclosure: NEMA PB 1, Type 1.

H. Cabinet Box: 6 inches deep, 20 inches wide.

I. Cabinet Front:
   1. Flush cabinet front, door-in-door, with concealed trim clamps, concealed hinge, metal directory frame and flush lock keyed alike. Finish in manufacturer’s standard gray enamel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.

B. Install panelboards plumb.

C. Install recessed panelboards flush with wall finishes.
D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

E. Install filler plates for unused spaces in panelboards.

F. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.

G. Install engraved plastic nameplates in accordance with Section 26 05 53.

H. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: 5 empty, 1 inch. Identify each as SPARE.

I. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.

3.2 FIELD QUALITY CONTROL

A. Section 01 70 00 – Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

D. Perform switch inspections and tests listed in NETA ATS, Section 7.5.

E. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.3 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.

B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes commercial-grade, standard, GFCI, and twist-locking receptacles; cord and plug sets; toggle switches; occupancy sensors, and wall-box dimmers; outdoor photoelectric switches; floor service fittings and poke-through assemblies; and wall plates.

1.2 REFERENCES
A. National Electrical Contractors Association (NECA) Standards
B. National Electrical Manufacturers Association (NEMA)
   1. NEMA WD1 General Color Requirements for Wiring Devices
   2. NEMA WD6 Wiring Devices – Dimensional Specifications
   3. Wiring Device Configurations (e.g. NEMA L5-20R)
C. National Fire Protection Association (NFPA)
   1. NFPA 70 National Electrical Code
D. UL Standards
E. Federal Specification Standards

1.3 DEFINITIONS
A. AFCI: Arc-fault circuit interrupter.
B. BAS: Building automation system.
C. EMI: Electromagnetic interference.
D. GFCI: Ground-fault circuit interrupter.
E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
F. RFI: Radio-frequency interference.
G. SPD: Surge protective device.

1.4 SUBMITTALS FOR REVIEW
A. Product Data: For each type of product, provide manufacturer’s catalog information, showing dimensions, colors, and configurations.
B. Samples: One for each type of device and wall plate specified, in each color specified.
C. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
D. Close Out Documentation:
   1. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.
1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Floor Service-Outlet Assemblies: One for every 10, but no fewer than one.
   2. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Acceptable Manufacturers: Products meeting the specification and Basis of Design, from the following manufacturers will be considered acceptable:
   1. Eaton Wiring Devices (formerly Cooper Wiring Devices).
   3. Leviton Manufacturing Co., Inc.

B. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Comply with NFPA 70.

D. RoHS compliant.

E. Comply with NEMA WD 1.

F. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
   1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
   2. Devices shall comply with requirements in this Section.

G. Devices for Owner-Furnished Equipment:
   1. Receptacles: Match plug configurations.
   2. Cord and Plug Sets: Match equipment requirements.

H. Device Color:
   1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
   2. Isolated-Ground Receptacles: As specified above, with orange triangle on face.
   3. Where a blank character “_” is included in a Basis of Design part number, letter(s) are intended to be substituted to identify color.

I. Wall Plate Color: For plastic and painted covers, match device color.

J. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:
   1. Basis of Design: Hubbell #5352A_; Hubbell #BR20_.
   2. Description: Two pole, three wire, and self-grounding.
   3. Configuration: NEMA WD 6, Configuration 5-20R.
   4. Standards: Comply with UL 498 and FS W-C-596.
B. Isolated-Ground Duplex Receptacles, 125 V, 20 A:
1. Basis of Design: Hubbell #IG5352__.
2. Description: Straight blade; equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

C. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:
1. Basis of Design: Hubbell #BR20_TR.
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

D. Weather-Resistant Duplex Receptacle, 125 V, 20 A:
1. Basis of Design: Hubbell #BR20_WR.
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" articles.

E. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:
1. Basis of Design: Hubbell #BR20_WRTR.
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.3 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:
1. Basis of Design: Hubbell #GFR5362SG__; Hubbell #GFRST20__.
2. Description: Integral GFCI with "Test" and "Reset" buttons, self-test with power denial, and LED indicator light. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:
1. Basis of Design: Hubbell #GFTRST20__.
2. Description: Integral GFCI with "Test" and "Reset" buttons, self-test with power denial, and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:
1. Basis of Design: Hubbell #GFTWRST20_.
2. Description: Integral GFCI with "Test" and "Reset" buttons, self-test with power denial, and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-15R.
4. Type: Feed through.
5. Standards: Comply with UL 498 and UL 943 Class A.
6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.4 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles, 120 V, 20 A:
2. Configuration: NEMA WD 6, Configuration L5-20R.

B. Twist-Lock, Single Receptacles, 250 V, 20 A:
2. Configuration: NEMA WD 6, Configuration L6-20R.

C. Twist-Lock, Single Receptacles, 277 V, 20 A:
2. Configuration: NEMA WD 6, Configuration L7-20R.

D. Twist-Lock, Isolated-Ground, Single Receptacles, 125 V, 20 A:
2. Grounding: Equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
3. Configuration: NEMA WD 6, Configuration L5-20R.

E. Twist-Lock, Isolated-Ground, Single Receptacles, 250 V, 20 A:
2. Grounding: Equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
3. Configuration: NEMA WD 6, Configuration L6-20R.
2.5 CORD AND PLUG SETS

A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.

B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.6 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:
1. Basis of Design: Hubbell #CSB120_
2. Standards: Comply with UL 20 and FS W-S-896.

B. Two-Pole Switches, 120/277 V, 20 A:
1. Basis of Design: Hubbell #CSB220_
2. Comply with UL 20 and FS W-S-896.

C. Three-Way Switches, 120/277 V, 20 A:
1. Basis of Design: Hubbell #CSB320_
2. Comply with UL 20 and FS W-S-896.

D. Four-Way Switches, 120/277 V, 20 A:
1. Basis of Design: Hubbell #CSB420_
2. Standards: Comply with UL 20 and FS W-S-896.

E. Pilot-Light, Single-Pole Switches: 120/277 V, 20 A:
1. Basis of Design: Hubbell #HBL1221PLC
2. Description: Illuminated when switch is on.
3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

F. Lighted Single-Pole Switches, 120/277 V, 20 A:
1. Basis of Design: Hubbell #HBL1221ILC
2. Description: Handle illuminated when switch is off.
3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

G. Key-Operated, Single-Pole Switches, 120/277 V, 20 A:
1. Basis of Design: Hubbell #HBL1221L_
2. Description: Factory-supplied key in lieu of switch handle.
3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

H. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:
1. Basis of Design: Hubbell #HBL1556_
2. Description: For use with mechanically held lighting contactors.
3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

I. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:
1. Basis of Design: Hubbell #HBL1556L_
2. Description: For use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
2.7 INDOOR OCCUPANCY SENSORS

A. Manufacturers:
1. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
   a. nLight
   b. Lutron Maestro
   c. Hubbell Building Automation, Inc.
   d. Sensor Switch.
   e. Wattstopper.

B. General Requirements for Sensors:
1. Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
4. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
5. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
6. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
7. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
8. Bypass Switch: Override the "on" function in case of sensor failure.
9. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. PIR Type:
1. Ceiling mounted; detect occupants in coverage area by their heat and movement.
2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
3. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
4. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.

D. Ultrasonic Type:
1. Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
2. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch-high ceiling.
4. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
5. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.
6. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.

E. Dual-Technology Type:
1. Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
2. Sensitivity Adjustment: Separate for each sensing technology.
3. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.

2.8 SWITCHBOX-MOUNTED OCCUPANCY SENSORS
A. Manufacturers:
1. Subject to compliance with requirements, provide products by one of the following:
a. Lutron
b. Hubbell Building Automation, Inc.
c. Sensor Switch
d. Watt Stopper.

B. General Requirements for Sensors:
1. Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
4. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

2.9 DIMMERS
A. Wall-Box Dimmers:
2. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
3. Control: Continuously adjustable slider; with single-pole or three-way switching.
5. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
a. 600 W; dimmers shall require no derating when ganged with other devices.

6. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.10 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers:
   1. Subject to compliance with requirements, provide comparable product by one of the following:
      a. Lutron
      b. Cooper Industries, Inc.
      c. Intermatic, Inc.
      d. NSi Industries LLC; TORK Products.
      e. Tyco Electronics; ALR Brand.

B. Description:
   1. Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
   2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   3. Time Delay: Fifteen second minimum, to prevent false operation.

C. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.11 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.12 FLOOR SERVICE FITTINGS

A. Basis of Design: As indicated on Drawings.

B. Description: Type: Modular, flush-type, dual-service units suitable for wiring method used, with cover flush with finished floor.

C. Compartments: Barrier separates power from voice and data communication cabling.

D. Standards: Comply with scrub water exclusion requirements in UL 514.

E. Size: Matched to floor thickness; core holes in floor to match selected assembly.
F. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

G. Closure Plug: Arranged to close unused cored openings and reestablish fire rating of floor.

2.13 POKE-THROUGH ASSEMBLIES

A. Basis of Design: As indicated on Drawings.

B. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.

C. Compartments: Barrier separates power from voice and data communication cabling.

D. Standards: Comply with scrub water exclusion requirements in UL 514.

E. Size: Matched to floor thickness; core holes in floor to match selected assembly.

F. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

G. Closure Plug: Arranged to close unused cored openings and reestablish fire rating of floor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA “Standard of Installation”, unless otherwise indicated.

B. Coordination with Other Trades:
   1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
   2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
   3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
   4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
   1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
   2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
   3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.

D. Device Installation:
   1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
   2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
   3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. Connect ground terminals of wiring devices to grounded box using equipment bonding jumper, except as allowed by NEC for isolated ground receptacles.
6. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
7. Use a torque screwdriver when a torque is recommended or required by manufacturer.
8. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
9. Tighten unused terminal screws on the device.
10. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. Switch Orientation:
1. For single-throw switches, install switches vertically, with the load on when the handle is in the off position.
2. For three-way and four-way switches, install switches vertically, with the load off when the handle of all devices on the control circuit are in the down position.

G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

H. Dimmers:
1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Do not share neutral conductors on the load side of dimmers.
4. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

I. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multigang wall plates. Mount device and wall plates level and plumb.

J. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

3.2 MOUNTING HEIGHT AND COORDINATION

A. Coordinate installation of wiring devices with furniture and millwork prior to commencing device rough-in to avoid conflicts.

B. Install the following devices at 44 inches above finished floor to the bottom of the box, except where otherwise noted:
1. Switches.
2. Dimmers.

C. Install the following devices at 18 inches above finished floor to the bottom of the box, except where otherwise noted:
1. Receptacles.
2. Telephone and Communications Outlets.

D. Where the following devices are designated “AC” (above counter), install at 3 inches above the back splash to the bottom of the box and mount horizontally:
   1. Receptacles.
   2. Telephone and Communications Outlets.

E. Telephone outlets for wall mounted phones shall be located such that the top of the telephone is located as follows:
   1. Forward-Reach Locations: 44 inches above finished floor.
   2. Side-Reach Locations: 54 inches above finished floor.

3.3 IDENTIFICATION
A. Comply with Section 26 05 53 "Identification for Electrical Systems."
B. Identify each receptacle with panelboard identification and circuit number, using approved label maker.

3.4 FIELD QUALITY CONTROL
A. Test Instruments: Use instruments that comply with UL 1436.
B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
C. Perform the following tests and inspections:
   1. Test Instruments: Use instruments that comply with UL 1436.
   2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Receptacles:
   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.
   6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

E. Tests for Switches and Dimmers:
   1. Operate each switch and dimmer to verify proper operation of control device and lighting equipment.
   2. Where portions of a lighting circuit are to remain energized, such as for emergency ballasts and night lights, verify correct operation.

F. Cleaning and Adjustment:
   1. Adjust devices and wall plates to be flush and level.
   2. Adjust floor outlets to ensure covers and flanges are tight to floor with minimum impact to pedestrian traffic.
   3. Clean exposed surfaces to remove splatters and restore finishes.

G. Wiring device will be considered defective if it does not pass tests and inspections.
H. Prepare test and inspection reports.

END OF SECTION
SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes fuses and spare fuse cabinet.

1.2 REFERENCES
A. National Electrical Manufacturers Association:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.3 DESIGN REQUIREMENTS
A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for the following components: wire, cable, bus structures, and other equipment. Design system to maintain component damage within acceptable levels during faults.
B. Select fuses to coordinate with time current characteristics of other overcurrent protective elements, including other fuses, circuit breakers, and protective relays. Design system to maintain operation of device closest to fault operates.

1.4 FUSE PERFORMANCE REQUIREMENTS
A. Main Service Switches Larger than 600 amperes: Class L (time delay).
B. Main Service Switches: Class RK1 (time delay).
C. Power Load Feeder Switches: Class RK1 (time delay).
D. Motor Load Feeder Switches: Class RK5 (time delay).
E. Lighting Load Feeder Switches: Class RK1 (time delay).
F. Motor Branch Circuits: Class RK5. (time delay).

1.5 SUBMITTALS
A. Product Data:
   1. Submit data sheets showing electrical characteristics, including time-current curves.

1.6 CLOSEOUT SUBMITTALS
A. Section 01 70 00 – Execution and Closeout Requirements: Closeout procedures.
B. Project Record Documents:
   1. Record actual sizes, ratings, and locations of fuses.

1.7 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum three years documented experience.
1.8 MAINTENANCE MATERIALS
   A. Section 01 70 00 – Execution and Closeout Requirements: Spare parts and maintenance products.
   B. Furnish one fuse pullers.

1.9 EXTRA MATERIALS
   A. Section 01 70 00 – Execution and Closeout Requirements.
   B. Furnish three spare fuses of each Class, size, and rating installed.

PART 2 - PRODUCTS
2.1 FUSES
   A. Manufacturers:
      1. Bussman.
      2. Ferraz Shawmut.
      3. Littleton.
      4. Substitutions: Section 01 60 00 - Product Requirements.
   B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
   C. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.2 CLASS RK1 (TIME DELAY) FUSES
   A. Dimensions and Performance: NEMA FU 1.
   B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.3 CLASS RK1 (NON-TIME-DELAY) FUSES
   A. Dimensions and Performance: NEMA FU 1.
   B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.4 CLASS RK5 FUSES
   A. Dimensions and Performance: NEMA FU 1.
   B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.5 CLASS J (TIME DELAY) FUSES
   A. Dimensions and Performance: NEMA FU 1.
   B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.6 CLASS J (NON-TIME-DELAY) FUSES
   A. Dimensions and Performance: NEMA FU 1.
   B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.7 CLASS T FUSES
   A. Dimensions and Performance: NEMA FU 1.
B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.8 CLASS L (FAST-ACTING) FUSES
A. Dimensions and Performance: NEMA FU 1.
B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.9 CLASS L (TIME DELAY) FUSES
A. Dimensions and Performance: NEMA FU 1.
B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.10 CLASS G FUSES
A. Dimensions and Performance: NEMA FU 1.
B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.11 SPARE FUSE CABINET
A. Product Description: Wall-mounted sheet metal cabinet with shelves, suitably sized to store spare fuses and fuse pullers specified.
B. Doors: Hinged, with hasp for Owner's padlock.
C. Finish: Gray enamel.

PART 3 - EXECUTION

3.1 EXISTING WORK
A. Remove fuses from abandoned circuits.
B. Maintain access to existing fuses and other installations remaining active and requiring access. Modify installation or provide access panel.

3.2 INSTALLATION
A. Install fuse with label oriented so manufacturer, type, and size are easily read.
B. Install spare fuse cabinet in Main Electrical Room.

END OF SECTION
SECTION 26 28 19
ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes fusible and non-fusible switches.
B. Related Sections:
   1. Section 26 28 13 - Fuses.

1.2 REFERENCES
A. National Electrical Manufacturers Association:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.
   2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
B. International Electrical Testing Association:

1.3 SUBMITTALS
A. Product Data:
   1. Submit switch ratings and enclosure dimensions.

1.4 CLOSEOUT SUBMITTALS
A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
B. Project Record Documents:
   1. Record actual locations of enclosed switches and ratings of installed fuses.

1.5 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES
A. Manufacturers:
   1. ABB; GE Industrial Solutions.
   2. Eaton Corporation; Cutler Hammer.
   3. Schneider Electric; Square D.
   5. Substitutions: Section 01 60 00 - Product Requirements.
B. Product Description:
   1. NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.
C. Fuse clips:
1. Designed to accommodate NEMA FU 1, Class R fuses.

D. Enclosure:
   1. NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
   2. Interior Dry Locations: Type 1.
   3. Exterior Locations: Type 3R.
   4. Industrial Locations: Type 4 or 4X as indicated on drawings.

E. Service Entrance:
   1. Switches identified for use as service equipment are to be labeled for this application. Furnish short circuit and overcurrent protective devices in enclosed assembly, with solid neutral assembly and equipment ground bar.

F. Furnish switches with entirely copper current carrying parts.

2.2 NONFUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:
   1. ABB; GE Industrial Solutions.
   2. Eaton Corporation; Cutler Hammer.
   3. Schneider Electric; Square D.
   5. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:
   1. NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Enclosure:
   1. NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
   2. Interior Dry Locations: Type 1.
   3. Exterior Locations: Type 3R.
   4. Industrial Locations: Type 4 or 4X as indicated on drawings.

D. Service Entrance:
   1. Switches identified for use as service equipment are to be labeled for this application. Furnish short circuit and overcurrent protective devices in enclosed assembly, with solid neutral assembly and equipment ground bar.

E. Furnish switches with entirely copper current carrying parts.

2.3 SWITCH RATINGS

A. Switch Rating:
   1. Horsepower rated for AC or DC as indicated on Drawings.

B. Short Circuit Current Rating:
   1. UL listed for 10,000 rms symmetrical amperes when used with or protected by Class H or K fuses (30-600 ampere). 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes). 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200 ampere).
PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.
   B. Height: 5 feet (1500 mm) to operating handle.
   C. Install fuses for fusible disconnect switches. Refer to Section 26 28 13 for product requirements.
   D. Install engraved plastic nameplates in accordance with Section 26 05 53.
   E. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.2 FIELD QUALITY CONTROL
   A. Section 01 40 00 - Quality Requirements.
   B. Inspect and test in accordance with NETA ATS, except Section 4.
   C. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION
SECTION 26 41 13
LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. System design.
B. Air terminals, interconnecting conductors, and other system components and accessories.
C. Grounding and bonding for lightning protection.
D. System inspection and certification.

1.2 RELATED WORK

A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for lightning protection systems.
   1. Section 26 05 00 - Electrical Requirements
   2. Section 26 05 33 - Raceways and Boxes for Electrical Systems
   3. Section 26 05 26 - Grounding and Bonding for Electrical Systems
B. In the event of conflict involving requirements of lightning protection systems between this Section and any other Sections, the provisions of this Section shall govern.

1.3 APPLICABLE CODES AND STANDARDS

A. The materials and installation shall conform to the minimum requirements and latest revisions of the following codes, standards and regulations wherein they apply:
   1. NFPA 70 - National Electrical Code
   2. UL 96 - Lightning Protection Components
   3. UL 96A – Installation Requirements for Lightning Protection Systems
   4. NFPA 780 - Lightning Protection Systems
   5. LPI 175 - Standard of Practice for the Design - Installation - Inspection of Lightning Protection Systems

1.4 SYSTEM DESCRIPTION

A. Lightning Protection System: UL 96A Master Labeled system consisting of air terminals on roofs, roof mounted mechanical equipment, stacks, bonding of structure and other metal objects; grounding electrodes; and interconnecting conductors. Lightning protection systems shall be incorporated into the building system by the lightning protection contractor as required for a complete master labeled system.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in lightning protection equipment with minimum three years documented experience and member of the Lightning Protection Institute.
B. Installer: The Contractor for the work covered by this specification shall be recognized as being regularly engaged in the design and installation of lightning protection systems. The Contractor must have minimum three years documented experience and member of the
Lightning Protection Institute (LPI). Installer shall be a certified LPI master installer of lightning protection systems. Acceptable Installers:
1. Bonded Lightning Protection Systems, LTD
2. Thompson Lightning Protection, Inc.

1.6 COORDINATION
A. Coordinate the work of this Section with concrete, roofing and exterior and interior finish installations.
B. Coordinate all provisions for down conductors and system connections with all trades.
C. Coordinate air terminal installation with roof structure, with air terminals attached to the back side of roof parapets to avoid penetration of parapet roofing.

1.7 SUBMITTALS
A. Provide submittals for the following information in addition to and in accordance with Section 26 05 00 - Electrical Requirements and Division 01 for submittal requirement.
   1. Shop drawings showing layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.
   2. Shop drawings shall include locations of conductors, roof penetrations, floor penetrations, etc., and their compatibility with provisions made during the construction. Once the contract has been established the Contractor shall make a review of provisions being made for the system installation and comment, in writing, with changes or compliance within two weeks of finalizing the contract. Contractor shall coordinate locations of conductors in walls and all penetrations with the appropriate trades: Failure to coordinate these requirements shall not relieve lightning protection Contractor from properly completing its work. This Contractor shall employ the proper trades to provide the chases in walls and roof and floor penetrations required to install the conductors if not coordinated before the floors, walls and roof are installed.
   3. Product data showing dimensions and materials of each component, and include indication of listing in accordance with UL 96.
   4. As Built Record Drawings: The Contractor shall maintain a master set of As Built Record Drawings that shows changes and any other deviations from the Base Drawings in accordance with Section 26 05 00.

1.8 MASTER LABEL
A. The system design shall equal to or exceed the requirement of UL 96A for a Master “C” Label. Upon completion, the lightning protection systems shall be inspected by a representative of Underwriters Laboratories, Inc. The lightning protection systems must pass UL inspection and wear UL label.

1.9 WARRANTY
A. Provide a warranty for material and installation per Section 26 05 00 - Electrical Requirements, unless a longer warranty period is required in specific product specifications.
PART 2 - PRODUCTS

2.1 GENERAL

A. The system provided under this specification shall be the standard product of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer’s latest approved design.

B. Materials used in connection of the installation of the lightning protection system shall be proved for lightning protection systems by UL. No combination of materials shall be used that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture. Where unusual conditions exist which would cause corrosion of conductors, conductors with protective coatings or oversized conductors shall be used.

C. Where a mechanical hazard is involved, conductor size shall be increased to compensate therefore, or suitable protection shall be provided. The conductors may be protected by covering them with molding or tubing made of nonmetallic material.

D. Aluminum materials may not be used except on roofs that utilize aluminum roofing components. When aluminum materials are used, provide all materials of aluminum composition to ensure compatibility, except down conductors and grounding. Provide copper down conductors with bimetal transition at the roof assembly rated for the application.

2.2 CONDUCTORS

A. All conductors shall be stranded copper and of the grade ordinarily required for commercial electrical work generally designated as being 98 percent conductive when annealed. Aluminum conductors may only be used on roofs that are built of aluminum roofing components. Conductor minimum size shall be in compliance with NFPA 780.

2.3 AIR TERMINALS

A. Air terminals shall be copper or copper alloy per UL 96. A copper or copper alloy air terminal intended for use on a chimney shall have a hot-dipped lead coating or equivalent. Class II air terminal shall be of solid construction. Air terminal minimum diameter shall be in compliance with NFPA 780.

2.4 GROUND ROD

A. Ground rod shall be copper-clad steel, ¾-inch diameter by 10 feet in length.

2.5 CONNECTIONS

A. Connector fittings shall be coper or copper alloy per UL 96 and compatible with material type used for air terminals and conductors.

B. Conductor splices and connectors shall be compression fittings that are installed with hydraulically operated tools, or exothermic welds, approved for use with the class type.

C. All belowground and concealed connections shall be made with exothermic welded connections.
2.6 ROOF PENETRATIONS
A. Roof penetrations shall be accomplished with through-roof fittings specially designed for this purpose. Through-roof fittings shall utilize solid rods with appropriate hardware. Fittings shall incorporate a positive means for sealing around the rod.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Verify that surfaces are ready to receive work.
B. Verify that field measurements are as shown on the shop drawings.
C. Beginning of installation means installer accepts existing conditions.

3.2 PROTECTION OF SURROUNDING ELEMENTS
A. Protect elements surrounding work of this Section from damage or disfiguration.

3.3 CONDUCTORS
A. Install in accordance with manufacturer's instructions. Conceal down conductors. Concealed down conductors shall be installed in continuous insulating PVC raceways. Metallic raceways shall not be used.
B. PVC conduit shall not be installed in plenums. If PVC conduit has to be installed in plenum space, the PVC conduit shall have fire rated walls installed creating a chase space for the conduit.
C. The Contractor shall bond each down conductor to the ground rod (Cad-Weld or equivalent) which is bonded to the counterpoise conductors creating a common ground.
D. No bend of a conductor shall form an angle beyond 90 degrees nor shall have a bend radius less than 8 inches per NFPA 780.

3.4 AIR TERMINALS
A. Air terminal height and support shall be in compliance with the requirement of NFPA 780.
B. Air terminals shall not be mounted such they have to be moved to perform maintenance on the equipment they protect.

3.5 GROUND RING ELECTRODE
A. A ground ring electrode encircling the building or structure shall be installed. Lightning protection systems down conductors shall be connected to the ground ring electrode.
B. Interconnect lightning protection ground ring electrode with building ground electrode system.

3.6 ROOF CONNECTIONS
A. Make direct connections to lightning protection system with copper conductor for all roof mounted equipment, enclosures, mast, fan stacks and all metallic objects alike. Provide
bonding jumpers across all equipment mounting isolators and ductwork isolators to provide a complete ground path.

B. All antennas shall be grounded.

3.7 ROOF ATTACHMENT AND PENETRATIONS

A. Roof penetration. Contractor shall inform Owner’s representative, in advance, of any required roof penetrations and shall obtain approval. Wherever the system penetrates the roof, approved through-roof fittings or sleeves shall be furnished by the lightning protection contractor and installed by the roofing contractor. All patching masonry and structural work shall be furnished and installed by the general contractor.

B. All attachments to roofs must be in strict accordance with the roof manufacturer’s recommendations. The lightning protection contractor shall submit details of all roof attachment to the appropriate roof manufacturer for approval prior to installation. Once the lightning protection system installation is complete, the lightning protection contractor shall engage the appropriate roof manufacturer to inspect all roof attachments on that manufacturer’s roof. Subsequent to the inspection, the roof manufacturer shall furnish the Owner with a letter indicating that all lightning protection systems component roof attachment and penetration are satisfactory and such attachments and penetrations will not in any way to void or reduce the warranty on roof. Any fees for services or inspections provided by the roof manufacturer to accomplish the above related requirements shall be at the expense of the lightning protection contractor.

3.8 COVER-UP INSPECTION

A. Prior to cover-up of concealed components and connections, notify the Owner so that a cover-up inspection can be performed. Correct any deficiencies prior to concealment of components and connections.

3.9 INSPECTION AND MASTER LABEL

A. Upon completion, the lightning protection systems shall be inspected by the representative of the Owner.

B. Obtain the services of Underwriters Laboratories, Inc. to provide inspection and certification of the lightning protection systems. If the system does not pass UL inspection, the Contractor must make corrections to the system in order to pass inspection. Contractor shall furnish the Owner with appropriate approval certificate.

C. Obtain UL Master Label and attach to building at a location as directed by Owner.

3.10 CONFLICTS

A. In the event a conflict exists between this specification and any of the referenced standards, the requirements of referenced standards govern. Necessary variances or corrections shall be made at the expense of the lightning protection contractor in order to obtain UL Master Label.

END OF SECTION
SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes interior luminaires, lamps, ballasts, and accessories.
B. Related Sections:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections apply to this Section.
   2. Section 23 37 00 - Air Outlets and Inlets: For interface with air handling fixtures.
   3. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   4. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
   5. Section 26 52 00 - Emergency Lighting.
   6. Section 26 09 23 - Lighting Control Devices

1.2 REFERENCES
A. American National Standards Institute:
   1. ANSI C78.377 - Chromaticity for White Light LED
   3. ANSI C82.4 - American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).
   4. ANSI C82.16 – Light-Emitting Diode Drivers.

1.3 SUBMITTALS
A. Shop Drawings:
   1. Indicate dimensions and components for each luminaire not standard product of manufacturer.
B. Wiring Diagrams:
   1. Provide complete wiring diagrams for all lighting control components and systems.
C. Product Data:
   1. Submit dimensions, ratings, and performance data.
   2. Submit catalog cut sheets identified by fixture type for all lighting fixtures.
D. Samples:
   1. Submit two color chips 3 x 3 inch in size illustrating luminaire finish color where so indicated in the Lighting Fixture Schedule.

1.4 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Alternate Manufacturer:
1. Fixtures on the Lighting Fixture Schedule on the electrical drawings are specified as the basis of design. Contractor may submit alternate equal fixtures, matching the appearance and electrical and lighting characteristics of those fixtures specified.

2. Contractor shall submit complete photometric submittal in Autocad format for all cases where Contractor proposes alternate fixtures from those specified.

3. Lighting fixtures that do not meet the requirements of those scheduled in the Lighting Fixture Schedule, the photometric requirements and the lighting control requirements will be rejected.

1.5 FIELD MEASUREMENTS
   A. Verify field measurements prior to fabrication.

1.6 MAINTENANCE MATERIALS
   A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
   B. Furnish two of each plastic lens type.
   C. Furnish two of each ballast type.
   D. Furnish 5% of each type of lamp.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES
   A. Product Description:
      1. Complete interior luminaire assemblies, with features, options, and accessories as scheduled on the electrical drawings.
   B. Refer to Section 01 60 00 - Product Requirements for product options.

2.2 LED FIXTURES
   A. Product Description
      1. LED fixtures shall meet the following requirements:
         a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
         b. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
         c. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
         e. Bulb shape complying with ANSI C79.1.
         f. Lamp base complying with ANSI C81.61 or IEC 60061-1.
         g. CRI of minimum 80. CCT of 4100 K.
         h. Rated lamp life of 50,000 hours.
         i. Lamps dimmable from 100 percent to 0 percent of maximum light output.
         j. Internal driver.
         k. Nominal Operating Voltage; as indicated on schedule.
         l. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
m. **Housings:**
   1) Extruded-aluminum housing and heat sink.
   2) Powder coat finish

**PART 3 - EXECUTION**

3.1 **INSTALLATION**

   A. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.

   B. Support luminaires independent of ceiling framing.

   C. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

   D. **Exposed Grid Ceilings:**
      1. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips. Provide additional support wire equal to support wire from fixture to structure at each corner. These wires are separate and independent of ceiling supports.

   E. Install recessed luminaires to permit removal from below.

   F. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

   G. Install clips to secure recessed grid-supported luminaires in place.

   H. Install wall-mounted luminaires at height as indicated on Drawings.

   I. Install accessories furnished with each luminaire.

   J. Connect luminaires to branch circuit outlets provided under Section 26 05 33 using flexible conduit.

   K. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

   L. Install specified lamps in each luminaire.

   M. Ground and bond interior luminaires in accordance with Section 26 05 26.

3.2 **FIELD QUALITY CONTROL**

   A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

   B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.3 **ADJUSTING**

   A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

   B. Aim and adjust luminaires as indicated on Drawings.
3.4 CLEANING
A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
B. Remove dirt and debris from enclosures.
C. Clean photometric control surfaces as recommended by manufacturer.
D. Clean finishes and touch up damage.

3.5 PROTECTION OF FINISHED WORK
A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished work.
B. Re-lamp luminaires having failed lamps at Substantial Completion.

END OF SECTION
SECTION 26 52 00

EMERGENCY LIGHTING

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes emergency lighting units and exit signs.
B. Related Sections:
   1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
   3. Section 26 51 00 - Interior Lighting: Exit signs.

1.2 REFERENCES
A. National Electrical Manufacturers Association:
   1. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SYSTEM DESCRIPTION
A. Emergency lighting to comply with requirements.

1.4 SUBMITTALS
A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
B. Product Data:
   1. Submit dimensions, ratings, and performance data.

1.5 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing products specified in this section with
      minimum three years experience.

1.6 MAINTENANCE MATERIALS
A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance
   products.
B. Furnish one replacement lamps for each type lamp installed.
C. Furnish one replacement battery for each battery type and size.

PART 2 - PRODUCTS

2.1 EMERGENCY LIGHTING UNITS
A. Manufacturers:
   1. Cooper Industries
   2. General Signal Corp.
   3. Lithonia
   4. Lightolier
   5. Cooper
6. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:
   1. Self-contained incandescent fluorescent emergency lighting unit.

C. Battery: Nickel-cadmium lead calcium type, with 1.5 hour capacity.

D. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.

E. Lamps: 12 watt minimum, sealed beam type in nickel or chrome plated steel housing.

F. Indicators: Lamps to indicate AC ON and RECHARGING. Voltmeter to indicate battery voltage.

G. TEST Switch:
   1. Transfers unit from external power supply to integral battery supply.

H. Electrical Connection: 6 foot cord with plug cap, NEMA WD 6, Type 5-15 configuration. Conduit connection.

I. Input Voltage: 277 volts.

2.2 EXIT SIGNS

A. Manufacturers:
   1. Cooper Industries
   2. Lithonia
   3. Lightolier
   4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description:
   1. Exit sign fixture suitable for use as emergency lighting unit.

C. Housing: Precision-molded thermoplastic, impact and scratch-resistant.

D. Face: Precision-molded thermoplastic stencil face with red green letters.

E. Directional Arrows: Universal type for field adjustment.

F. Mounting: Universal, for field selection.

G. Battery:
   1. Nickel-cadmium lead calcium type, with 1.5-hour capacity.

H. Battery Charger:
   1. Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.

I. Lamps:
   1. LED Compact fluorescent Manufacturers standard.

J. Input Voltage: 277 volts.

K. Lamp Ratings:
   1. One F40CW lamp providing 1100 lumens, minimum.
L. Battery:
   1. Sealed lead calcium type, rated for 10 year life.

M. Include TEST switch and AC ON indicator light, installed to be operable and visible from outside of assembled luminaire.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned emergency lighting units, exit signs, lamps, and accessories.

B. Extend existing emergency lighting and exit sign installations using materials and methods compatible with existing installations, or as specified.

C. Clean and repair existing emergency lighting units and exit signs remaining or are to be reinstalled.

3.2 INSTALLATION

A. Install suspended exit signs using pendants supported from swivel hangers. Install pendant length required to suspend sign at indicated height.

B. Install surface-mounted emergency lighting units and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

C. Install wall-mounted emergency lighting units and exit signs at height as indicated on Drawings.

D. Install accessories furnished with each emergency lighting unit and exit sign.

E. Connect emergency lighting units and exit signs to branch circuit outlets provided in Section 26 05 33 as indicated on Drawings.

F. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within unit.

G. Install specified lamps in each emergency lighting unit and exit sign.

H. Ground and bond emergency lighting units and exit signs in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements:

B. Operate each unit after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Aim and adjust lamp fixtures as indicated on Drawings.

C. Position exit sign directional arrows as indicated on Drawings.
3.5 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished work.

B. Relamp emergency lighting units and exit signs having failed lamps at Substantial Completion.

END OF SECTION
SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Exterior luminaries and accessories.
B. Poles.

1.2 RELATED SECTIONS
A. Section 033000 – Cast-In-Place Concrete: Foundations for poles.

1.3 REFERENCES
A. ANSI C78.379 Electric Lamps – Incandescent and High-Intensity Discharge Reflector Lamps – Classification of Beam Patterns.
B. ANSI C82.1 Ballasts for Fluorescent Lamps – Specifications.
C. ANSI C82.4 Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps Multiple-Supply Type).
D. ANSI 05.1 Specifications and Dimensions for Wood Poles.
E. IES RP-8 Recommended Practice for Roadway Lighting.
F. IES RP-20 Lighting for Parking Facilities.
G. NFPA 70 National Electrical Code.

1.4 SUBMITTALS FOR REVIEW
A. Section 26 05 00 – Submittals: Procedures for submittals.
B. Shop Drawings:
   1. Indicate dimensions and components for each luminaire which is not a standard Product of the manufacturer.
C. Product Data:
   1. Provide dimensions, ratings, and performance data.

1.5 SUBMITTALS FOR INFORMATION
A. Section 26 05 00 – Submittals: Submittals for information.
B. Test Reports:
   1. Indicate measured illumination levels.
C. Submit manufacturer’s installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.6 SUBMITTALS FOR CLOSEOUT
A. Section 26 05 00 – Contract Closeout: Submittals for project closeout.
B. Maintenance Data: For each luminaire.
1.7 QUALIFICATIONS
A. Manufacturer:
   1. Company specializing in manufacturing the Products specified in this section with
      minimum three years experience.

1.8 REGULATORY REQUIREMENTS
A. Conform to requirements of NFPA 70.
B. Products:
   1. Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose
      specified and indicated.

1.9 DELIVERY, STORAGE, AND HANDLING
A. Section 26 05 00 – Material and Equipment: Transport, handle, store, and protect products.
B. Store and handle solid wood poles in accordance with ANSI 05.1.

1.10 COORDINATION
A. Section 26 05 00 – Coordination.
B. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

1.11 EXTRA PRODUCTS
A. Section 26 05 00 – Contract Closeout.
B. Furnish two of each type and wattage lamp installed.
C. Furnish one gallon of touch-up paint.

PART 2 - PRODUCTS
2.1 LUMINAIRES AND ACCESSORIES
A. Furnish Products as scheduled. Refer to Section 26 05 00 for substitutions and product
   options.

2.2 POLES
A. Manufacturers: As scheduled.
B. Material and Finish: Aluminum tapered round, finish bronze.
C. Each pole shall have handhole.
D. Submit color selection samples on full manufactures cooler to architect for selection.

2.3 LED FIXTURES
A. All LEDs used in the LED fixture shall be high brightness and of proven quality from
   established and reputable LED manufacturers.
B. LED fixtures shall meet lumen maintenance standards as defined in IESNA LM-80-08.
C. The luminaire shall meet ANSI 2G vibration standards. Labeling shall be in accordance
   with ANSI standards. All units shall be UL labeled.
D. The LED driver shall start and operate the light engine at ambient temperatures from 20
   degrees to 120 degrees Fahrenheit.
E. The light engine assembly shall use high brightness light emitting diodes with average CCT
   of 6000K and CRI greater than 65.
F. Manufacturer shall provide a five (5) year warranty from date of substantial completion.
G. Lumen depreciation shall be in accordance with LM-80. The system shall be rated at L70/B50 for not less than 50,000 hours.

H. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

PART 3- EXECUTION

3.1 INSTALLATION
A. Provide concrete bases for lighting poles at locations indicated, in accordance with Section 03 30 00.
B. Construction details are indicated on Structural Drawings as structural specifications.
C. Install poles plumb. Provide shims and double nuts to adjust plumb. Grout around each base.
D. Install lamps in each luminaire.
E. Bond luminaries, metal accessories and metal poles to branch circuit equipment grounding conductor. Provide supplementary grounding electrode at each pole.

3.2 FIELD QUALITY CONTROL
A. Section 26 05 00 – Quality Assurance.
B. Operate each luminaire after installation and connection. Inspect for improper connections and operation.
C. Measure illumination levels to verify conformance with performance requirements.
D. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.3 ADJUSTING
A. Section 26 05 00 – Contract Closeout: Adjusting installed work.
B. Aim and adjust luminaries to provide illumination levels and distribution as directed.

3.4 CLEANING
A. Section 26 05 00 – Contract Closeout: Cleaning installed work.
B. Clean electrical parts to remove conductive and deleterious materials.
C. Remove dirt and debris from enclosure.
D. Clean photometric control surfaces as recommended by manufacturer.
E. Clean finishes and touch up damage.

3.5 PROTECTION OF FINISHED WORK
A. Section 26 05 00 – Contract Closeout: Protecting installed work.
B. Relamp luminaries which have failed lamps at Substantial Completion.

END OF SECTION
SECTION 26 60 00

ARC FLASH, SHORT CIRCUIT AND PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. Description of Work:
   1. This section describes in general work required to prepare the Short Circuit Study, Protective Device Coordination Study and Device Setting, and Arc Flash Hazard Study and Labeling.
   
   B. It is the intent of this specification to obtain a complete study of all low voltage (480 volt and below) equipment furnished under this contract, including all field setting of protective devices, and provision and installation of Arc Flash labels on equipment.

1.2 REFERENCE ELECTRICAL SINGLE LINE DIAGRAM

A. Electrical Single Line Diagrams – The electrical single line provides an overview of the electrical system and equipment under the scope of this study.

B. This study includes the complete electrical system downstream of the electric utility company 480Y/277V, 3 phase, 4 wire service point of delivery.

1.3 REFERENCE STANDARDS

A. American National Standards Institute, latest edition (ANSI):
   1. ANSI C37.16 Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
   2. ANSI C37.46 Power Fuses and Fuse Disconnecting Switches
   3. ANSI C37.50 Switchgear Low-Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures

B. Institute of Electrical and Electronics Engineers, latest edition (IEEE):
   2. IEEE C37.2 Electrical Power System Device Function Numbers
   3. IEEE C37.13 Low-Voltage AC Power Circuit Breakers Used in Enclosures
   4. IEEE C37.90 Relays and Relay Systems Associated with Electric Power Apparatus
   5. IEEE C57.13 Instrument Transformers
   6. IEEE Std. 242 IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
   7. IEEE Std 399 Recommended Practice for Industrial and Commercial Power Systems Analysis

C. National Electrical Manufacturers Association (NEMA):
   1. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches
   2. NEMA FU 1 Low Voltage Cartridge Fuses
   3. NEMA SG 3 Low-Voltage Power Circuit Breakers
   4. NEMA SG 5 Power Switchgear Assemblies

E. Underwriters Laboratories, latest edition (UL).
   1. UL 198B Class H Fuses
   2. UL 198C High-Interrupting-Capacity Fuses, Current-Limiting Types
   3. UL 198D Class K Fuses
   4. UL 198E Class R Fuses
   5. UL 198H Class T Fuses
   6. UL 489 Molded-Case Circuit Breakers and Circuit-Breaker Enclosures

1.4 SUBMITTALS
   A. Submit in accordance with the Study Report requirements listed in 2.1 G.
   B. Date of license and experience record of Licensed Professional Engineer under whose direction report was prepared.

PART 2 - PRODUCTS

2.1 SCOPE OF WORK

A. Coordinated Power System Protection:
   1. Analysis shall be prepared to demonstrate that equipment selected and system constructed meet contract requirements for ratings, coordination, and protection. They shall include fault current analysis, and protective device coordination study. Studies shall be performed by licensed professional engineer with demonstrated experience in power system coordination.

B. Scope of Analysis:
   1. Fault current analysis and protective device coordination study shall begin at the secondary of the CPS Energy transformer, and extend complete to include all panelboards.
   2. Fault current contributions shall include CPS Energy (Electric Utility) contribution in determination of device ratings, settings and labeling.

C. Equipment Data:
   1. Time-current characteristics, features, and nameplate data for each new protective device shall be determined and documented. Contractor shall coordinate with CPS Energy and obtain fault current availability at the point of delivery. Installing electrical contractor shall provide feeder lengths, conduit types and other information as required.

D. Single Line Diagram:
   1. A single line diagram shall be prepared to show electrical system buses, devices, transformation points, and sources of fault current. Each bus, device or transformation point shall have unique identifier. Location of switches, breakers, and circuit interrupting devices shall be shown on diagram together with available fault data, and device interrupting rating.

E. Fault Current Analysis:
   1. Method: Fault current analysis shall be performed in accordance with methods described in IEEE Std. 242, and IEEE Std. 399.
   2. Data: Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedance shall be those installed. Data shall be documented in report.
   3. Fault Current Availability: Balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage
transformation point and at each power distribution bus. Maximum values of fault current available at each location shall be shown in tabular form on diagram or in report.

F. Coordination Study:
1. Study shall demonstrate that maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. Study shall include description of coordination of protective devices in this project. Written narrative shall be provided describing which devices may operate in event of fault at each bus; logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (analysis of device curves which overlap); coordination between upstream and downstream devices; and relay settings. Recommendations to improve or enhance system reliability shall be provided. Composite coordination plots shall be provided.

G. Fault Current and Coordination Study Report:
1. Report shall include narrative describing analyses performed; bases and methods used; desired methods of coordinated protection of power system.
2. Report shall document utility company data including system voltages and fault MVA.
3. Report shall contain fully coordinated composite time-current characteristics curves for each bus in system, as required to ensure coordinated power system protection between protective devices or equipment. Report shall include recommended ratings and settings of protective devices in tabulated form.
4. Report shall provide calculation performed for analyses, including computer analysis programs utilized. Name of software package, developer, and version number shall be provided.

H. Arc Flash Study Report:
1. Provide an arc flash hazard study for the electrical distribution system as shown on the single line diagram for the equipment pad electrical power system. The intent of this study is to determine hazards that exist at each piece of electrical distribution equipment. The study will include creation of arc flash hazard warning labels in accordance with NFPA 70E. These labels shall be installed on the electrical distribution equipment.
2. The arc flash hazard study shall be performed after completion of the short circuit and protective device coordination study.
3. The study shall be in accordance with the latest NFPA 70E, OSHA and IEEE standards.
4. The arc flash study report shall include:
   a. Report summary with analysis methodology, findings and recommendations.
   b. Summary of input data for source, equipment and cables.
   c. Available fault current at each equipment location with comparison to equipment rating.
   d. Incident energy level for each equipment location and recommended PPE.
   e. Arc Flash warning labels.
PART 3 - EXECUTION

3.1 INSTALLATION/APPLICATION

A. In accordance with requirements of Part 2.

END OF SECTION
SECTION 28 31 00
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes design and installation of a complete fire detection and alarm system, including fire alarm control panels, manual fire alarm stations, automatic smoke and heat detectors, fire alarm signaling appliances, and auxiliary fire alarm equipment and power and signal wire and cable.

B. Related Sections:
1. Section 08 71 00 - Door Hardware: Door closers, electric locks, electric releases.
3. Section 23 33 00 - Air Duct Accessories: Smoke dampers.
4. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
5. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
6. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.2 REFERENCES
A. National Fire Protection Association:

B. International Code Council:

C. Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

1.3 SUBMITTALS
A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate system wiring diagram showing each device and wiring connection; indicate annunciator layout, and design calculations.

C. Product Data: Submit catalog data showing electrical characteristics and connection requirements.

D. Test Reports: Indicate procedures and results for specified field testing and inspection.

E. Manufacturer's Field Reports: Indicate activities on site, adverse findings, and recommendations.

1.4 CLOSEOUT SUBMITTALS
A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
B. Project Record Documents: Record actual locations of fire alarm equipment.
C. Operation and Maintenance Data: Submit manufacturer’s standard operating and maintenance instructions.

1.5 QUALITY ASSURANCE
A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet when tested in accordance with NFPA 262.
B. Perform Work in accordance with Authority having jurisdiction.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of project.
B. Installer: Certified fire alarm installer with service facilities within 100 miles of Project.
C. Designer: Design fire alarm under direct supervision of NICET Level III or IV certified fire alarm technician or registered fire protection engineer licensed in the State of Texas, employed by system installer or fire alarm control panel manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
B. Protect equipment from damage, corrosion, and contamination from debris.
C. Store electronic equipment and components in a dry location, protected from weather and temperature extremes.
D. Protect equipment by transporting and storing in factory provided boxes and containers.

1.8 COORDINATION
A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
B. Coordinate installation of outlet boxes for equipment connected under Section 26 05 33.
C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

1.9 MAINTENANCE SERVICE
A. Section 01 70 00 - Execution and Closeout Requirements: Maintenance service.
B. Furnish service and maintenance of fire alarm equipment for one year from Date of Substantial Completion.

1.10 MAINTENANCE MATERIALS
A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
B. Furnish six keys of each type.
1.11 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish five of each type of smoke detector and heat detector.

C. Furnish five of each type of notification appliance.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Fire Alarm System: Non-coded, UL-certified, addressable system with multiplexed signal transmission and horn/strobe evacuation annunciation; NFPA 72 compliant; with manual and automatic activation.

B. Source Limitations:
   1. Components: Compatible with, and operate as, a single system; and listed for use with the selected system
   2. Electrical Components and Devices: Products of a single manufacturer.
   3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 ACCEPTABLE MANUFACTURERS

A. Products of the following manufacturers will be considered acceptable, where they are shown to meet the basis of design, provide the coverages and functionality required by the Drawings and specifications, and are supported by qualified designers and installers:
   1. ADT.
   2. EST (Edwards); UTC Climate, Controls & Security.
   5. Notifier; Honeywell International.
   7. SilentKnight; Honeywell International.
   8. Simplex; Tyco SimplexGrinnell.

2.3 ALARM SEQUENCY OF OPERATION

A. Fire alarm signal initiation shall be by one or more of the following devices and systems:
   2. Smoke, heat, and flame detectors.
   3. Duct smoke detectors.
   4. Automatic sprinkler system water flow.
   5. Preaction system.
   6. Fire extinguishing system operation.
   7. Fire standpipe system.
   8. Dry system pressure flow switch.

B. Fire alarm signal shall initiate the following:
1. Continuously operate alarm notification appliances.
2. Identify specific device initiating the event at Fire Alarm Control Panel.
3. Display system status on graphic annunciator.
4. Record the event to system memory.
5. Transmit an alarm signal to the remote alarm receiving station.
6. Unlock electric door locks in designated egress paths.
7. Release fire and smoke doors held open by magnetic door holders.
8. Activate alarm communication system.
9. Switch heating, ventilating, and air-conditioning equipment controls to firealarm mode.
10. Close smoke dampers in air ducts of designated air-conditioning duct systems.
11. Activate preaction system.
12. Recall elevators to primary or alternate recall floors.
13. Activate elevator power shunt trip.

C. Supervisory signal initiation shall be by one or more of the following devices and systems:
1. Valve supervisory switch.
2. High- or low-pressure switch of a dry-pipe or preaction sprinkler system.
3. Elevator shunt-trip supervision.
4. Fire pump running, loss of power, and power phase reversal.
5. Independent fire detection and suppression systems.
6. User disabling of zones or individual devices.
7. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and systems:
1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, or remote annunciator, or Ethernet module.
4. Loss of primary power at Fire Alarm Control Panel.
5. Ground or a single break in internal circuits of Fire Alarm Control Panel.
6. Abnormal AC voltage at Fire Alarm Control Panel.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at Fire Alarm Control Panel or annunciator.

E. Supervisory signal and system trouble signal shall initiate the following:
1. Initiate notification appliances.
2. Identify specific device initiating the event at Fire Alarm Control Panel, and remote annunciators.
3. Display system status on graphic annunciator.
4. Record the event to system memory.
5. After a time-delay of 200 seconds, transmit a supervisory signal or system trouble signal to the remote alarm receiving station.

F. Drill Sequence of Operation: Manual drill function causes alarm mode sequence of operation.
2.4 **FIRE ALARM CONTROL PANEL**

A. **Product Description:** Modular fire alarm control panel with surface wall-mounted enclosure.

B. **Power supply:** Adequate to serve control panel modules, remote detectors, remote annunciators, smoke dampers, relays, and alarm signaling devices. Include battery-operated emergency power supply with capacity for operating system in standby mode for 24 hours followed by alarm mode for 5 minutes.

C. **System Supervision:** Component or power supply failure places system in trouble mode.

D. **Initiating Device Circuits:** Supervised zone module with alarm and trouble indication; occurrence of single ground or open condition places circuit in trouble mode but does not disable circuit from initiating alarm.

E. **Indicating Appliance Circuits:** Supervised signal module, sufficient for signal devices connected to system; occurrence of single ground or open condition places circuit in trouble mode but does not disable circuit from signaling alarm.

F. **Remote Station Signal Transmitter:** Electrically supervised digital alarm communicator transmitter, capable of transmitting alarm and trouble signals over telephone lines to central station receiver.

G. **Auxiliary Relays:** Sufficient SPDT auxiliary relay contacts for each detection zone to provide accessory functions specified.

2.5 **MANUAL FIRE ALARM STATIONS**

A. **General:** Stations shall comply with UL 38, shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box, except where indicated to be surface mounted.

1. **Double-action mechanism requiring two acts to initiate alarm, pull-level type; with integral addressable module arranged to communicate status (normal, alarm, or trouble) to Fire Alarm Control Panel.**

2. **Station Reset:** Key- or wrench-operated switch.

3. **Protective Shields:** Provide Device Guard at Manual Fire Alarm Station locations subject to damage, such as main entrance.

2.6 **SYSTEM SMOKE DETECTORS**

A. **General Requirements for System Smoke Detectors:**

1. Comply with UL 268; operating at 24-V dc, nominal.

2. Detectors shall be four-wire type.

3. **Integral Addressable Module:** Arranged to communicate detector status (normal, alarm, or trouble) to Fire Alarm Control Panel.

4. **Base Mounting:** Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.

5. **Self-Restoring:** Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

6. **Integral Visual-Indicating Light:** LED type, indicating detector has operated and power-on status.
   a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at Fire Alarm Control Panel for 15 or 20 deg F per minute.
   b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at Fire Alarm Control Panel to operate at 135 or 155 deg F.
   c. Multiple levels of detection sensitivity for each sensor.
   d. Sensitivity levels based on time of day.

B. Photoelectric Smoke Detectors:
   1. Detector address shall be accessible from Fire Alarm Control Panel and shall be able to identify the detector's location within the system and its sensitivity setting.
   2. An operator at Fire Alarm Control Panel, having the designated access level, shall be able to manually access the following for each detector:
      a. Primary status.
      b. Device type.
      c. Present average value.
      d. Present sensitivity selected.
      e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
   1. Detector address shall be accessible from Fire Alarm Control Panel and shall be able to identify the detector's location within the system and its sensitivity setting.
   2. An operator at Fire Alarm Control Panel, having the designated access level, shall be able to manually access the following for each detector:
      a. Primary status.
      b. Device type.
      c. Present average value.
      d. Present sensitivity selected.
      e. Sensor range (normal, dirty, etc.).
   3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
   4. Each sensor shall have multiple levels of detection sensitivity.
   5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

2.7 SYSTEM HEAT DETECTORS
A. General Requirements for Heat Detectors: Comply with UL 521.
B. Temperature sensors shall test for and communicate the sensitivity range of the device.
C. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
   1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to Fire Alarm Control Panel.

D. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
   1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to Fire Alarm Control Panel.

2.8 [CARBON MONOXIDE DETECTORS

A. General: Carbon monoxide detector listed for connection to fire alarm system.
   1. Mounting: Adapter plate for outlet box mounting.
   2. Testable by introducing test carbon monoxide into the sensing cell.
   3. Detector shall provide alarm contacts and trouble contacts.
   4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
   5. Comply with UL 2075.
   6. Locate, mount, and wire according to manufacturer's written instructions.
   7. Provide means for addressable connection to fire alarm system.
   8. Test button simulates an alarm condition.

2.9 ADDRESSABLE INTERFACE DEVICE

A. General:
   1. Include address-setting means on the module.
   2. Store an internal identifying code for control panel use to identify the module type.
   3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal, such as to elevator controller to initiate elevator recall or to circuit-breaker shunt trip for power shutdown.
   1. Allow the control panel to switch the relay contacts on command.
   2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:
   1. Operate notification devices.
   2. Operate solenoids for use in sprinkler service.

2.10 NOTIFICATION APPLIANCES

A. [General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.]

B. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.
D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

E. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

F. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
   1. Rated Light Output: 15/30/75/110 cd, selectable in the field.
   2. Mounting: Wall mounted unless otherwise indicated.
   3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
   4. Flashing shall be in a temporal pattern, synchronized with other units.
   5. Strobe Leads: Factory connected to screw terminals.

2.11 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
   1. Electromagnets: Require no more than 3 W to develop 25-lbf holding force.
   2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
   3. Rating: 24-V ac or dc.

B. Material and Finish: Match door hardware.

2.12 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of Fire Alarm Control Panel for alarm, supervisory, and trouble indications. Manual switching functions shall match those of Fire Alarm Control Panel, including acknowledging, silencing, resetting, and testing.

B. Mounting: Flush cabinet, NEMA 250, Type 1.

C. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of Fire Alarm Control Panel. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.13 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from Fire Alarm Control Panel and automatically capture [one] [two] telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
C. Local functions and display at the digital alarm communicator transmitter shall include the following:
   1. Verification that both telephone lines are available.
   2. Programming device.
   3. LED display.
   5. Communications failure with the central station or Fire Alarm Control Panel.

D. Digital data transmission shall include the following:
   1. Address of the alarm-initiating device.
   2. Address of the supervisory signal.
   3. Address of the trouble-initiating device.
   4. Loss of ac supply.
   5. Loss of power.
   6. Low battery.
   7. Abnormal test signal.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.14 DEVICE GUARDS

A. Wire Guards: Welded wire mesh of size and shape of manual station, smoke detector, gong, or other device requiring protection.
   1. Factory fabricated and furnished by device manufacturer.
   2. Finish: Paint of color to match the protected device.

B. Manual Fire Alarm Station Protective Covers: STI Stopper II #, or equivalent, durable, clear plastic cover.

2.15 WIRE AND CABLE

A. Product Description: Non-power limited fire-protective signaling cable, copper conductor; 150-volt insulation rated 60 degrees C.

B. Cable Located Exposed in Plenums: Power limited fire-protective signaling cable classified for fire and smoke characteristics, copper conductor, 300 volts insulation rated 105 degrees C, suitable for use in air handling ducts, hollow spaces used as ducts, and plenums.

C. Fire alarm circuit conductors have insulation color or code as required by NFPA.

2.16 INSTRUCTION CHARTS

A. Printed instruction charts, detailing to operators the steps that should be taken when a signal (normal, alarm, supervisory, or trouble) is received and when the operator desires to perform a test or drill.
   1. Locate for easy access from Fire Alarm Control Panel, Remote Annunciator, and any other location where operations are to be performed.
   2. Frame and secure to wall at location directed by Owner. Frame: Stainless steel or aluminum with polycarbonate cover.
   3. Provide one additional copy with each copy of operation and maintenance data submittal.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for compliance with environmental conditions affecting performance of the Work. Verify that manufacturer's recommended conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
   1. Devices placed in service before all other trades have completed cleanup shall be replaced.
   2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Manual Fire Alarm Stations:
   1. Install stations in the normal path of egress within 60 inches of the exit doorway.
   2. Mount stations on a background of a contrasting color.
   3. The operable part of stations shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:
   1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smok edetector spacing.
   2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat detector spacing.
   3. Smooth ceiling spacing shall not exceed 30 feet.
   4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
   5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
   6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
   7. In lay-in grid ceilings, locate detectors centered in ceiling tile.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

H. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

I. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

L. Mount outlet box for electric door holder to withstand 80 pounds pulling force.

3.3 PATHWAYS

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed, mounted on j-hooks.
   1. Exposed pathways located less than 96 inches above the floor shall be installed in EMT.

B. Connect conduit and wire to door release devices, sprinkler flow switches, sprinkler valve tamper switches, fire suppression system control panels, and duct smoke detectors.

3.4 CONNECTIONS

A. For fire protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 "Door Hardware" specification. Connect hardware and devices to fire alarm system.
   1. Verify that hardware and devices are listed for use with installed fire alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Smoke dampers in air ducts of designated HVAC duct systems.
   2. Magnetically held-open doors.
   3. Electronically locked doors and access gates.
   4. Alarm-initiating connection to elevator recall system and components.
   5. Supervisory connections at valve supervisory switches.
   6. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
   7. Supervisory connections at elevator shunt-trip breaker.
   8. Supervisory connections at firepump power failure including a dead-phase or phase-reversal condition.
9. Supervisory connections at fire pump engine control panel.

3.5 IDENTIFICATION
  A. Identify system components, wiring, cabling, and terminals.
  B. Install framed instructions in a location visible from Fire Alarm Control Panel.

3.6 GROUNDING
  A. Ground fire alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire alarm control unit.
  B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL
  A. Field tests shall be witnessed by authorities having jurisdiction.
  B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
  C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
    1. Visual Inspection: Conduct visual inspection prior to testing.
       a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
       b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
    3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
    4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
    5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
    6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
  E. Fire alarm system will be considered defective if it does not pass tests and inspections.
  F. Prepare test and inspection reports.
G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

H. Annual Test and Inspection: One year after date of Substantial Completion, test fire alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for twoyears.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within twoyears from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
   1. Upgrade Notice: At least 30days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire alarm system. Furnish 4 hours of instruction each for two persons, to be conducted at project site with manufacturer's representative.

END OF SECTION
SECTION 32 31 32

VEHICULAR SLIDE GATE OPERATOR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electric gate operators.
   1. DoorKing Model 9100.

B. Parking gates and operators.

C. Sensors and controls.

1.2 RELATED SECTIONS

A. Section 03 30 00 – Cast-in-Place Concrete: Concrete mounting pads.

B. Division 16 – Requirements for electrical connections.

1.3 REFERENCES


B. Canadian Standards Association (CSA): CSA C22.2 No. 247.


1.4 SUBMITTALS

A. Submit under provisions of Section 01 30 00 – Administrative Requirements.

B. Product Data: Manufacturers data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements.
   3. Installation methods.

C. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, edge connections, and accessories.
   1. Operation, installation, and maintenance manuals including wire diagrams.
   2. Risers, layouts, and special wiring diagrams showing any changes to standard drawings.
1.5 DELIVERY, STORAGE, AND HANDLING
   A. Deliver, store, and handle materials and products in strict compliance with manufacturer’s instructions and industry standards.
   B. Store products indoors in manufacturer’s original containers and packaging with labels clearly identifying product name and manufacturer. Protect from damage.

1.6 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Substantial transformation and final assembly shall occur in the United States of America per Section 1605 of the ARRA-09.
   B. Installer Qualifications: Installation performed by factory authorized dealer contractor specifically trained in gate operator systems of the type found within this section.
      1. Provide documentation of maintenance and repair service availability for emergency conditions.
      2. Provide quarterly maintenance for one year following Substantial Completion of the Project.

1.7 WARRANTY
   A. Manufacturers standard five (5) year warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS
   A. Acceptable Manufacturer: DoorKing, Inc.; 120 S. Glasgow Ave; Inglewood, CA 90301; Toll-Free Tel: 800-826-7493; Tel: 310-645-0023; Fax: 310-641-1586; Email: ghendrix@doorking.com; Web: doorking.com.
   B. Substitutions: Not permitted.
   C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 – Product Requirements.

2.2 SLIDING GATE OPERATORS
   A. Microprocessor based solid-state control board interacting with card readers, RF transmitters, access control systems, ticket machines, other activating devices as required, external devices (photo-eyes, contact edges) for entrapment protection and vehicle (loop) sensing systems. Control board shall include built-in close timer (1-25 seconds), built-in ports for two (2) plug-in loop detectors, partial open input, programming switches to set various operating modes, inherent magnetic pulse obstruction sensing reverse system. System shall employ Fail-Safe operation upon primary (AC) power outage.
      1. Compliance: Compliant to UL 325, UL 991 and CSA C22.2 No. 247 and listed by Intertek Testing Laboratories NA, Inc. (ETL), a Nationally Recognized Testing Laboratory.
         a. This model is intended for use in Class I, II, III and IV vehicular slide gate applications.
      2. Warranty: Five (5) year manufacturer’s standard warranty.
3. Maximum Gate Length: 30-feet
   a. Actual Gate Lengths: 16’, 20’ and 24’
4. Maximum Gate Weight: 1000 Lbs.
5. Operator speed: approximately 11-inches per second.
6. Enclosure:
   a. 12 gage, 0.108 inch (2.6 mm) G90 hot-dipped galvanized steel, finished with polyester powdercoat, exterior grade semi-gloss texture gray.
   b. Polypropylene, 0.157 (4 mm) texture gray, conforms to UL746C, UV (f1) and V0 flame rating.
7. Configuration: Left or right hand mount; front, center or rear mounting configurations.
8. Mounting: Pad or post mount.
9. Electrical Power Requirements: 115 VAC.
10. Motor: 1/2 HP, continuous duty.
11. Dead Bolt Lock: Solenoid dead bolt engages if an attempt is made to force the gate open.
12. Fail-Safe Operation: Upon loss of primary (AC) power, system shall automatically be transferred to a fail-safe mode allowing the gate to be pushed open without the use of special knowledge, keys or other releasing mechanisms.
13. Primary Reduction: Adjustable clutch, single cog belt drive train.
14. Pulling Medium: #40 roller chain
15. Magnetic Limit Switches: Automatic setting with no mechanical switches to set, wear out or break.
16. Operating Switches: Built-in power (on-off), reset and operating switches.
17. Convenience Outlets: Two (2) 115 VAC for accessory transformers.
18. Entrapment Protection
   a. Photo-electric eye (non-contact sensor).
   b. Sensing edge (contact sensor).
19. Accessories: Provide the optional accessories listed below.
   a. Chain tray kit – to support roller chain on long gates.
   b. Plug-in loop detectors.
   c. Electric reversing edge – reverses direction of gate on contact with an obstruction.
   d. Photo-electric beams – reverses direction of gate if the light beam is obstructed.
   e. Backup power inverter – allows system to remain operation upon loss of primary (AC) power.

PART 3 - EXECUTION

3.1 INSTALLATION

   A. Installed by a qualified technician who is certified by the Institute of Door Dealer Education and Accreditation (IDEA) as a Certified Automatic Gate Operator Installer (CAGOI).
   B. Model 9100 shall be mounted, firmly secured, plumb and level, as required.
   C. Wiring shall be uniform and in accordance with national electric codes and manufacturer’s instructions.
D. All splices shall be in easily accessible junction boxes or on terminal boards.
E. All cable runs in all junction boxes shall be tagged and identified.
F. Coordinate all work with other effected trades and contractors.

3.2 SYSTEM INITIALIZING AND PROGRAMMING

A. System shall be turned on and adjustment made to meet requirements of specifications and on-site conditions.
B. System shall function as specified.

3.3 SYSTEM TEST PROCEDURES

A. System shall be completely tested to assure that all components and accessories are hooked-up and in working order.
B. System shall be pre-tested by contractor and certified to function in accordance with plans and specifications.
C. System shall be tested in presence of owner's representative.

3.4 OWNER INSTRUCTIONS

A. Installation contractor shall conduct up to (1) hour of instruction in use and operation of the system to designated owner representatives, within (30) days of acceptance.
B. Installation contractor shall conduct up to (1) hour of technical training, in troubleshooting and service of the system, to designated owner representatives within (90) days of system acceptance.

3.5 MANUALS AND DRAWINGS

A. Contractor shall provide owner with (2) copies of standard factory prepared operation, installation and maintenance manuals. Manuals shall include typical wiring diagrams.
B. Contractor shall provide owner with (2) copies of any risers, layouts, and special wiring diagrams showing any changes to standard drawings, if required on project.

3.6 MAINTENANCE

A. The manufacturer recommends periodic maintenance at one (1), three (3) and 12 month intervals as described in the installation and maintenance manual.
B. External reversing devices should be checked at least once a month.

END OF SECTION