



Bee County Law Enforcement Center

DOAS Installation



March 14, 2022



MD ENGINEERING

MD Engineering, LLP Texas

Registered Engineering Firm F-7489

TABLE OF CONTENTS

DIVISION 1 – GENERAL REQUIREMENTS

01 14 19	REFERENCE STANDARDS AND DEFINITIONS
01 25 00	PRODUCT SUBSTITUTION PROCEDURES
01 30 00	PROJECT ADMINISTRATION
01 73 13	APPLICATIONS FOR PAYMENT

DIVISION 23 – MECHANICAL

23 00 10	SUBMITTAL PROCESS
23 05 00	COMMON WORK RESULTS FOR HVAC
23 05 53	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
23 05 93	TESTING ADJUSTING AND BALANCING FOR HVAC
23 07 00	HVAC INSULATION
23 09 93	SEQUENCE OF OPERATIONS
23 31 13	AIR DISTRIBUTION
23 75 00	DEDICATED OUTSIDE AIR UNITS

DIVISION 26 – ELECTRICAL

26 00 10	ELECTRICAL SUBMITTAL PROCESS
26 05 00	COMMON WORK RESULTS FOR ELECTRICAL
26 05 02	ELECTRICAL WORK IN EXISTING FACILITIES
26 05 03	FIRESTOPPING
26 05 19	LOW VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES
26 05 26	GROUNDING & BONDING FOR ELECTRICAL SYSTEMS
26 05 29	SUPPORTING DEVICES
26 05 33.13	CONDUIT FOR ELECTRICAL SYSTEMS
26 05 33.16	BOXES FOR ELECTRICAL SYSTEMS
26 05 53	IDENTIFICATIONS FOR ELECTRICAL SYSTEMS
26 06 20	DISCONNECT SWITCHES

26 27 26	WIRING DEVICES
26 28 16	ENCLOSED SWITCHES
26 41 00	FACILITY LIGHTNING PROTECTION
28 31 10	FIRE DETECTION AND ALARM SYSTEMS.



SECTION 01 14 19 - REFERENCE STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Technical Specifications Sections, apply to this Section.

1.2 DEFINITIONS

- A. Approved: The term approved, when used in conjunction with the owner's action on the Contractor's submittals, applications, and requests, is limited to the owner's duties and responsibilities as stated in the Contract.
- B. Contract: Agreement executed between owner and contractor.
- C. Directed: Terms such as directed, requested, authorized, selected, approved, required, and permitted mean directed by the owner, requested by the owner, and similar phrases.
- D. Furnish: The term furnish means supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- E. Indicated: The term indicated refers to graphic representations, notes, or schedules on the Drawings or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as shown, noted, scheduled, and specified are used to help the reader locate the reference. There is no limitation on location.
- F. Install: The term install describes 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.
- G. Installer: An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, and similar operations. Installer is required to be experienced in the operations they are engaged to perform. The term experienced, when used with the term Installer, means having a minimum of five previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.
- H. Project Site: Is the space available to the Contractor for performing construction activities either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.
- I. Provide: The term provide means to furnish and install, complete and ready for the intended use.
- J. Regulations: The term regulations includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- K. Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no choice or option. However, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor. This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.
- L. Testing Agencies: A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

- M. Trades: Using terms such as carpentry is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as carpenter. It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.
- N. Work: The term "Work" or "Scope of Work" means the construction and service required by the Contract Documents, and includes all the labor, materials, equipment and services provided by Contractor to fulfill the Contractor's obligation.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with the standards in effect as of the date of the Contract Documents.
- C. Conflicting Requirements: Where compliance with two or more standards is specified and where the standards may establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different but apparently equal and other uncertainties to the Owner for a decision before proceeding.
- D. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to the Owner for a decision before proceeding.
- E. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
- F. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source.
- G. The owner reserves the right to require the Contractor to submit copies of standards as necessary for enforcement of requirements.
- H. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-generating organization, authority having jurisdiction, or other entity applicable to the context of the Text provision. Refer to the "Encyclopedia of Associations," published by Gale Research Co., available in most libraries.

1.4 GOVERNING REGULATIONS/AUTHORITIES

- A. The owner has contacted authorities having jurisdiction where necessary to obtain information necessary for preparation of Contract Documents. Contact authorities having jurisdiction directly for information and decisions having a bearing on the Work.

1.5 SUBMITTALS

- A. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012500 - PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 PRODUCT PERFORMANCE/SUBSTITUTIONS

- A. Intention of these requirements is to establish equality of any proposed substitute product or method with standard product/method specified. When a product is specified by using a proprietary name or the particular manufacturer or vendor, specific item mentioned shall be understood as establishing type, function, dimension, appearance and quality desired. Other manufacturer's products are encouraged, provided sufficient information is submitted that allows Owner to determine products proposed are approved substitutes to those named.
- B. **Prior to Bid Date:** Owner will consider only written requests from prime bidders for acceptance, received at least ten (10) calendar days prior to bid date; requests received after that time will not be considered. When a product is accepted, bidders shall be notified of acceptable alternate within five (5) days prior to bid opening.
- C. **After Bid Date:** Requests for substitution will not be accepted after bid date unless:
 - 1. Approved product or system is discontinued from Manufacturer.
 - 2. Owner requests substitution.
- D. Proposed Substitutions will not be considered if:
 - 1. Any discrepancies in test data, or if tests or submittals are incomplete.
 - 2. Acceptance will require substantial revision of Contract Documents.
 - 3. Product in opinion of Owner does not meet standards or performance of product originally specified.

1.2 SUBMITTALS

- A. Submit three (3) copies of "Substitution Request Form", located at end of Section. Include three (3) copies of all requested information.

PART 2 - PRODUCTS – (Not Used)

PART 3 - EXECUTION – (Not Used)

END OF SECTION

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**SUBSTITUTION
REQUEST
(During Bidding Phase)**

Project: _____ From: _____

To: _____ Date: _____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
Manufacturer: _____ Address: _____ Phone: _____
Trade Name: _____ Model No: _____

Attached data includes product description, specifications, drawings, photographs and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Pay for changes to building design and special inspection costs caused by use of product.

Submitted by: _____
Signed by: _____
Firm: _____
Address: _____

Telephone: _____

Similar Installation:

Project: _____ Architect: _____
Address: _____ Owner: _____
_____ Date Installed: _____

Supporting Data Attached: Drawings Product Data Samples Tests Reports _____

SUBSTITUTION FORM
MDE PROJECT 17877R
March 14, 2022

Substitution Request (During Bidding Phase)

01 25 00 - 2

OWNER'S REVIEW AND ACTION

- Substitution approved – Provide required submittals in accordance with Specifications.
- Substitution approved as noted – Provide required submittals in accordance with Specifications
- Substitution rejected – Use specified materials. Comments:

Signed by:

Date:

**SUBSTITUTION
REQUEST
(After the Bidding Phase)**

Project: _____ From: _____
To: _____ Date: _____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution _____
Manufacturer _____ Address: _____ Phone: _____
Trade Name: _____ Model No: _____
Installer _____ Address: _____ Phone: _____
History: New Product 2-5 years old 5-10 years old More than 10 years old
Differences between proposed substitution and specified product: _____

Point-by-point comparative data attached – REQUIRED BY A/E

Reason for not providing specified item: _____

Project: _____ Architect: _____
Address: _____ Owner: _____
Date Installed: _____
Proposed substitution affects other parts of Work: No Yes, explain _____

Savings to Owner for accepting substitution: _____ (\$ _____)
Proposed substitution changes Contract Time: No Yes; [Add] [Deduct] _____ days

Supporting Data Attached: Drawings Product Data Samples Tests Reports _____

SUBSTITUTION FORM
MDE PROJECT 17877R
JANUARY 17, 2022

Substitution Request (After Bidding Phase)

01 25 00 - 2

**SUBSTITUTION
REQUEST
(Continued)**

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____
Signed by: _____
Firm: _____
Address: _____

Telephone: _____
Attachments: _____

OWNER’S REVIEW AND ACTION

- Substitution approved – Provide required submittals in accordance with Specifications.
- Substitution approved as noted – Provide required submittals in accordance with Specifications.
- Substitution rejected – Use specified materials. Comments:

Signed by: _____ Date: _____

Additional Comments: Contractor Subcontractor Supplier Manufacturer A/E _____

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Administration of Contract: Provide administrative requirements for the proper coordination and completion of work including the following:
 - 1. Supervisory personnel.
 - 2. Preconstruction conference.
 - 3. Project meetings, minimum of two per month; prepare and distribute minutes.
- B. Reports: Submit daily and special reports.
- C. Work Schedule: Submit progress schedule, updated weekly.
- D. Submittal Schedule: Prepare submittal schedule; coordinate with progress schedule.
- E. Schedule of Values: Submit schedule of values. Schedule of values shall be broken down into the following as applicable:
 - 1. Material.
 - 2. Equipment.
 - 3. Labor.
- F. Perform Surveys: Lay out the work and verifying locations during construction.
- G. Emergency Contacts: Submit and post a list of emergency telephone numbers and address for individuals to be contacted in case of emergency.
- H. Record Documents: Submit record drawings and specifications; to be maintained and annotated by Contractor as work progresses.

1.2 SUBMITTALS

- A. Types of Submittals: Provide types of submittals listed in individual sections and number of copies required below.
 - 1. Shop drawings, reviewed and annotated by the Contractor.
 - 2. Product data.
 - 3. Inspection and test reports.
 - 4. Warranties.
 - 5. Survey data.
 - 6. Closeout submittals.
 - 7. Project photographs – Provide digital images of each mechanical room before and after renovation. Images shall be submitted on USB, or electronically, with pay application. Submit cumulative USB at end of project. Label each image with date.
- B. Submittal Procedures: Comply with project format for submittals. Comply with submittal procedures established by Architect including Architect's submittal and shop drawing stamp. Provide required resubmittals if original submittals are not approved. Provide distribution of approved copies including modifications after submittals have been approved.
- C. Samples and Shop Drawings: Samples and shop drawings shall be prepared specifically for this project. Shop drawings shall include dimensions and details, including adjacent construction and related work. Note special coordination required. Note any deviations from requirements of the Contract Documents.

- D. Warranties: Provide warranties as specified; warranties shall not limit length of time for remedy of damages Owner may have by legal statute. Contractor, supplier or installer responsible for performance of warranty shall sign warranties.

PART 2 PRODUCTS - Not applicable to this Section

EXECUTION Not applicable to this Section

END OF SECTION

SECTION 01 73 13 - APPLICATIONS FOR PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.

1.3 APPLICATION FOR PAYMENT AT SUBSTANTIAL COMPLETION

- A. Following issuance of Owners punch list establishing date of Substantial Completion, submit an Application for Payment. Contractor may submit application for payment after Substantial completion date is established at end of each phase of construction. A 10% retainage will be withheld from each Application for Payment until all three phases of construction are complete.
- B. Administrative actions and submittals that shall proceed or coincide with this application include:
 - 1. Owner's punch list.
 - 2. Occupancy permits.
 - 3. Warranties (guarantees) and maintenance agreements.
 - 4. Test/adjust/balance records.
 - 5. Maintenance instructions.
 - 6. Change-over information related to Owner's occupancy, use, operation and maintenance.
 - 7. Final cleaning.
 - 8. Asbestos-free Certification form.

1.4 FINAL PAYMENT APPLICATION

- A. Final payment is request for retainage.
- B. Administrative actions and submittals which must precede or coincide with submittal of the final payment Application for Payment include the following:
 - 1. Completion of Project closeout requirements.
 - 2. Completion of items specified for completion after Substantial Completion.
 - 3. Assurance that unsettled claims will be settled.
 - 4. Proof that taxes, fees and similar obligations have been paid.
 - 5. Removal of surplus materials, rubbish and similar elements.

PART 2 - PRODUCTS (Not used).

PART 3 - EXECUTION (Not used).

END OF SECTION

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SECTION 23 00 10 – MECHANICAL SUBMITTAL PROCESS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Comply with all submittal provisions of Division 1.
- B. Submit electronic copies of the submittal to the prime consultant (i.e. architect) in order to process and track the submittals properly in accordance with Division 1 and 23 submittal requirements. Architects and consultants are to submit all submittals and RFI's to the mechanical engineer electronically. Send to "**mdengca@md-eng.com**". Submittals shall be labeled by their project specification section or CSI specification section if not listed in project specifications.
- C. Contractor is responsible to separate submittals per specification section. Unseparated submittals are subject to rejection without review.
- D. Allow a minimum of ten (10) working days for the review of submittals and each re-submittal.
- E. Submittals that have been reviewed and marked as REJECTED (REJ) or REVISE & RESUBMIT (RES) should be resubmitted within 10 days to be reviewed again by engineer.
- F. Compliance with the Contract documents shall be the sole responsibility of the Contractor. Items on equipment that are were not accepted by the Architect in writing as an approved equal shall be replaced or revised to comply with the contract documents at the Contractor's expense.
- G. Resubmission of rejected submittals shall be limited to one (1) in number. Costs for processing subsequent resubmittals in excess of the first resubmittal, resulting from the Contractor's disregard of Architect/Engineer's primary submittal rejection comments, shall be borne by the Contractor. Costs shall be based on Architect/Engineer's hourly rates as published in their current professional fee schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost, plus ten percent (10%).

1.2 REQUIRED SPECIFICATIONS (PROJECT SPECIFIC)

- A. The chart below are the submittals required for the project.
 - 1. Submittals marked with an "X" are required for this project.
 - 2. Submittals without an "X" are not required for this project.

See required specifications on next page

Required X	Submittal Name	Spec Reference
X	Common Work Results for HVAC <i>-O&M manual, Shop Drawings</i>	23 05 00
X	Identification for HVAC Piping & Equipment <i>-Valve tags, Pipe markers, Equipment plates,</i>	23 05 53
X	Testing, Adjusting & Balancing for HVAC <i>-Certifications</i>	23 05 93
X	HVAC Insulation <i>-Piping Insulation, Duct insulation, Adhesives -Sealants, Covers, Aluminum UV covers.</i>	23 07 00
X	Sequence of Operations for HVAC Controls <i>-Control system, Shop drawings. Testing</i>	23 09 93
X	Air Distribution <i>-Duct Work, Flexible duct, Access doors</i>	23 31 13
X	Dedicated OSA Units <i>-Equipment</i>	23 75 00

END OF SECTION

SECTION 23 05 00 – COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 DESCRIPTION

- A. The General Requirements for Mechanical Work are intended to be complementary to the General Requirements of the Construction Contract.
- B. Work Included: Provide complete mechanical systems where shown on the drawings, as specified herein, and as needed for a complete and proper installation including, but not necessarily limited to the following summary of work:
 - 1. Furnish and install a complete ventilation system as shown on drawings and described herein.
 - 2. Other items and services required to complete the systems.

1.3 GENERAL REQUIREMENTS

- A. Unless otherwise specified, materials are to be new and of current U.S. manufacture, free from defects and of the best quality of their respective kinds.
- B. Equipment and/or materials damaged in shipment or handling, or otherwise damaged before installation, shall be replaced with new equipment and/or materials. Damaged equipment and/or materials shall not be repaired at the jobsite.
- C. Furnishing of the proper equipment and/or materials and to see that it is installed as recommended by the manufacturer is entirely the responsibility of the Contractor. If required for proper installation, the Contractor shall obtain advice and supervisory assistance from a representative of the specific manufacturer of the equipment being installed.
- D. Materials and adhesives to conform to Federal Standard Flame-Spread Properties, Inc., with composite fire and smoke hazard ratings, maximum 25 for flame spread and 50 for smoke developed. Adhesives to be waterproof.
- E. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions and shall obtain the Architect instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or such instructions from the Architect, he shall bear all costs arising in connection with the deficiencies.
- F. Belts, pulleys, chains, gears, couplings, projecting screws, keys or other rotating parts which are located so that a person can come in close proximity thereto shall be fully enclosed properly provided with a guard.

1.4 QUALITY ASSURANCE AND APPLICABLE STANDARDS

- A. Use adequate numbers of skilled workers that are thoroughly trained and experienced in the necessary crafts and are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of a complete and operating refrigeration and air handling system as indicated on the drawings and as specified.

- C. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation. The contractor must support all duct, pipe, equipment, and all other items furnished and installed under this scope from steel joists or structural steel frames. It is prohibited to support duct, pipe, equipment, and all other items furnished under this scope from the metal deck.
- D. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
- E. Codes: Perform all work in accordance with the latest edition of the following codes:
 - 1. State and city building, fire, plumbing and mechanical codes.
 - 2. International Fire Code
 - 3. International Mechanical Code
 - 4. International Plumbing Code
 - 5. International Electrical Code
 - 6. Energy Conservation Code
 - 7. National Fire Protection Association (NFPA)
 - 8. American with Disabilities Act (ADA)
 - 9. ICC/ANSI A117.1 Accessible and Useable Buildings and Facilities.
 - 10. All authorities having jurisdiction.
 - 11. Architectural code review drawing.
- F. The Contractor shall comply in every respect with all requirements of National Fire Protection Association, local Fire Department regulations and utility company requirements. In no case does this relieve the Contractor of the responsibility of complying with these Specifications and Drawings where specified conditions are of higher quality than the requirements of the above-specified authorities. Where requirements of the Specifications and Drawings are more lenient than the requirements of the above authorities having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above authorities with no extra compensation.
- G. Where conflicts occur between drawings, specifications or code requirements, the most stringent requirement shall take precedence.
- H. Standards: The specifications and standards of the following organizations are by reference made a part of these specifications. All work, unless otherwise indicated, shall comply with the requirements and recommendations wherever applicable:
 - 1. American National Standards Institute (ANSI).
 - 2. Air Conditioning and Refrigeration Institute (ARI).
 - 3. American Gas Association (AGA).
 - 4. American Society for Testing and Materials (ASTM).
 - 5. American Society of Mechanical Engineers (ASME).
 - 6. American Society of Refrigeration, Heating and Air Conditioning Engineers (ASHRAE).
 - 7. Electrical Testing Laboratories (ETL).
 - 8. National Bureau of Standards (NBS).
 - 9. National Electrical Manufacturer's Association (NEMA).
 - 10. National Fire Protection Association (NFPA).
 - 11. Sheet Metal and Air Conditioning National Association (SMACNA).
 - 12. Underwriters Laboratories, Inc. (UL).
- I. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. ASME Boiler and Pressure Vessel Code: Section IX.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

- A. The requirements and recommendations of the latest edition of the Occupational Safety and Health Administration (OSHA) Act are by reference made a part of these specifications. All work shall comply with the requirements and recommendations wherever applicable.

1.6 SUBMITTALS

- A. Comply with all submittal provisions of Division 1.
- B. Submit electronic copies of the submittal to the prime consultant (i.e. architect) in order to process and track the submittals properly in accordance with Division 1 and 23 submittal requirements. Architects and consultants are to submit all submittals and RFI's to the mechanical engineer electronically. Send to "**mdengca@md-eng.com**". Submittals shall be labeled by their project specification section or CSI specification section if not listed in project specifications
- C. Product Data: Submit the following:
 - 1. Materials list of items proposed to be provided under Division 23.
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements. The term "Compliance" is understood to mean that the Contractor certifies that the submitted equipment will meet or exceed the contract document requirements. Items that do not clearly meet this definition should be identified and explained as required in the following paragraph.
 - 3. Identify the difference between the specified item or function and the proposed. Explain with enough detail so that the Engineer/Owner can easily determine that the item complies with the functional intent. List any disadvantages or advantages of the proposed item versus the specified item. Submit technical data sheets and/or pictures and diagrams to support and clarify. Organize in a clear and concise format. All substitutions shall be approved in writing by Architect. The Architect's decision shall be final.
 - 4. Allow a minimum of ten (10) working days for the review of submittals and each re-submittal.
 - 5. Submittals that have been reviewed and marked as REJECTED (REJ) or MAKE CORRECTIONS NOTED (MCN) should be resubmitted within 10 days to be reviewed again by engineer.
 - 6. Compliance with the Contract documents shall be the sole responsibility of the Contractor. Items on equipment that are were not accepted by the Architect in writing as an approved equal shall be replaced or revised to comply with the contract documents at the Contractor's expense.
 - 7. Manufacturer's recommended installation procedures which, when reviewed by the Architect, shall become the basis for accepting or rejecting actual installation procedures used on the work.
 - 8. Sign the submittal as an indication of compliance with the contract documents. Any deviations from the contract documents shall be indicated on the submittal prior to signing. Any deviations not indicated shall be cause for rejection and removal of the non-complying equipment at the Contractor's expense.
- D. Submittals required of materials and equipment under this section include the following:
 - 1. Vibration Isolation and Sound Control Materials:
 - a. Submit shop drawings showing the structural design and details of inertia bases, steel beam bases, and other custom-fabricated work not covered by manufacturer's submitted data.
 - b. Furnish layouts of templates to be furnished to fabricators of equipment bases, foundations, and other support systems, as needed for coordination of vibration isolation units with other work.
 - c. Submit shop drawings indicating the scope of vibration isolation work, locations of units and flexible connections. Include support isolation points for piping, air handling units, inertia bases, etc.

- d. Include schedule of isolation units, showing size or manufacturer's part number, the weight supported and resulting deflection of each unit.
 - e. For spring isolation units, show wire size, spring diameter, free height, solid-compression height, operating height, fatigue characteristics and ratio of horizontal to vertical stiffness.
 - f. For spring-and-pad type isolation units, show the basis of spring rate selection for the range of loading weights.
2. Mechanical Identification Materials:
 - a. Clearly marked-up product literature or samples showing compliance with specified materials for: (Include model numbers and highlight products)
 - 1) Equipment marking.
 3. Insulation:
 - a. Manufacturer's certified data on thermal performance.
 - b. Details, when required, of methods to be used in providing for unusual piping expansion and contraction.
 - c. Manufacturer's data on any alternate insulation material of reduced thickness, including pre-insulated duct.
 - d. Manufacturer's data on all jacketing materials, sealants and fasteners.
 4. Refrigeration:
 - a. Provide clearly marked-up manufacturer's data showing compliance with scheduled values and specifications for: (Include model numbers and highlight products)
 - 1) Dedicated Outside Air Units
 - b. Provide all electrical characteristics.
 5. Air Distribution Materials:
 - a. Provide clearly marked-up manufacturer's data showing compliance with scheduled values and specifications for: (Include model numbers and highlight products)
 - 1) 1/4" scale ductwork shop drawings for all systems showing equipment locations, detailed data such as bottom of duct elevations, airstream sizes, all duct accessories, and duct construction details showing compliance with SMACNA requirements for the specified duct pressure of each system.
 6. Testing and Balancing:
 - a. Brief description of test and balance contractor experience.
 - b. Certificate of Qualification from AABC.
 - c. Biographical information of the Registered Professional Engineer and certified Test and Balance Supervisor proposed to manage the project.
 - d. List of instruments to be used with latest date of calibration test for each.
 - e. Test and balance reports.
 - f. VRF Certification from brand being installed on project.
 7. Record Documents: Reference the requirements detailed in this section.
 8. Operation and Maintenance Data: Reference the requirements detailed in this section.
- E. Resubmission of rejected submittals shall be limited to one (1) in number. Costs for processing subsequent resubmittals in excess of the first resubmittal, resulting from the Contractor's disregard of Architect/Engineer's primary submittal rejection comments, shall be borne by the Contractor. Costs shall be based on Architect/Engineer's hourly rates as published in their current professional fee schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost plus ten percent (10%).

1.7 SUBSTITUTIONS

- A. Comply with all provisions of Division 1.
- B. The use of manufacturers' names and catalog numbers followed by the phrase "or equal" is generally used to establish a standard of quality and utility for the specified items and to provide a dimensional reference for construction documents that are drawn to scale.

- C. Submittals for "equal" items shall, where applicable, include the following data that are not necessarily required for specified items:
 - 1. Performance characteristics.
 - 2. Materials.
 - 3. Finish.
 - 4. Certification of conformance with specified codes and standards.
 - 5. Manufacturer's specifications and other data needed to prove compliance with the specified requirements. The term "Compliance" is understood to mean that the Contractor certifies that the submitted equipment will meet or exceed the contract document requirements. Items that do not clearly meet this definition should be identified and explained as required in Paragraph 6 below.
 - 6. Identify the difference between the specified item or function and the proposed. Explain with enough detail so that the Architect/ Engineer/Owner can easily determine that the item complies with the functional intent. List any disadvantages or advantages of the proposed item versus the specified item. Submit technical data sheets and/or pictures and diagrams to support and clarify. Include shop drawings for all piping and ductwork equipment per Paragraph 1.5 Submittals. Organize in a clear and concise format
- D. Submittals of "equal" components or systems may be rejected if:
 - 1. The material or equipment would necessitate the alteration of any portion of the mechanical, electrical, architectural or structural design.
 - 2. Dimensions vary from the specified material or equipment in such a manner that accessibility or clearances are impaired or the work of other trades is adversely affected.
- E. Proposed substitutions for materials or equipment must be submitted ten (10) days prior to final bid date for consideration as approved equals. Otherwise, such substitutions will not be permitted. Proposals for substitutions shall be made only by the prime bidders. Manufacturers, distributors, and sub-contractors shall not make proposals to the Architect for substitutions.
- F. All equipment installed on this project shall have local representation, local factory authorized service, and a local stock of repair parts
- G. No substitution shall be made unless authorized in writing by the Architect. Should a substitution be accepted, and should the substitute material prove defective or otherwise unsatisfactory for the service intended, and within the guarantee period, the Contractor shall replace this material or equipment with material or equipment specified, at his own expense, and to the satisfaction of the Architect.
- H. Contractors submitting bids on substitute materials and equipment must also provide a written performance guarantee certifying that the substitute materials and equipment will produce the specified effects and meet the approval of the Architect.

1.8 ORDINANCES, PERMITS, METERS, UTILITIES AND ROYALTIES

- A. Procure all permits and licenses necessary for completion of this project and pay all lawful fees required and necessary pursuant in obtaining said permits and licenses. All required certificates of approvals and inspections by local governing and regulating authorities shall be obtained and paid for by the Contractor.
- B. Pay all fees required for the connection of gas to utility mains, and any meter fees if required.
- C. Pay any royalty payments required or fees for the use of patented equipment or systems. Defend all law suits or claims for infringement of any patent rights and shall hold the Owner and/or Architect/Engineer harmless from loss as a result of said suits or claims.

1.9 COMPATIBILITY OF EQUIPMENT

- A. Assume full responsibility for satisfactory operation of all component parts of the mechanical systems to assure compatibility of all equipment and performance of the integrated systems in accordance with the requirements of the specifications. Should the Contractor consider any part of the specifications or drawings as rendering his acceptance of such responsibility impossible, prohibitive, or restrictive, he shall notify the Engineer before submitting his bid, and the bid shall be accompanied by a written statement of any objections or exceptions to the specifications and drawings.
- B. The size of mechanical and electrical equipment indicated on the Drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space. Fabrication Drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.
- C. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

1.10 CONSTRUCTION REQUIREMENTS

- A. The drawings show the arrangements of work. Should project conditions necessitate rearrangement, or if the materials or equipment can be installed to a better advantage in a different manner, the Contractor shall, before proceeding with the work, prepare and submit five copies of Drawings of the proposed arrangement for the Architect's review. Allow a minimum of ten (10) working days for review.
- B. Should the Contractor propose to install equipment requiring space conditions other than those shown, or rearrange the equipment, he shall assume responsibility for the rearrangement of the space and shall have the Architect review the change before proceeding with the work. The request for such changes shall be accompanied by shop drawings of the space in question. Identify monetary credits proposed or other benefits of the change. Allow a minimum of ten (10) working days for review.
- C. The Contractor shall be responsible for the proper location and size of all slots, holes or openings in the building structure pertaining to his work and for the correct location of pipe sleeves.

1.11 CONNECTIONS FOR OTHERS

- A. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, etc.
- B. Provide all air gap fittings required, using materials hereinbefore specified. In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve. On each drain not provided with a trap, provide a suitable trap.
- C. All pipe fittings, valves, traps, etc., exposed in finished areas and connected to chrome plated lines provided by others shall be chrome plated to match.
- D. Provide all galvanized sheet metal ductwork, transition pieces, etc., required for a complete installation. Exposed sheet metal shall be paint-grip type.

1.12 PROJECT RECORD DOCUMENTS

- A. Provide the record documents associated with the work of Division 23 in strict accordance with the provisions of these specifications.
- B. Throughout progress of the Division 23 Work, maintain an accurate record of changes in the Contract Documents that apply to work of Division 23. Changes shall include all addendums issued during bidding. Maintain an accurate record of the location of mechanical service lines and outlets and all outside utilities.
- C. Delegate the responsibility for maintenance of Record Documents to one person on the Contractor's staff as approved by the Architect.

- D. Accuracy of Records
 - 1. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each page of Specifications and each sheet of drawings and other documents where such entry is required to show the change properly. Match the symbology and format of the base documents.
 - 2. Accuracy of records shall be such that a future verification of items shown in the Contract Documents may rely reasonably on information obtained from the approved Project Record Documents.
- E. Maintain the job set of Record Documents completely protected from deterioration and from loss and damage until completion of the work and transfer of all recorded data to the final Project Record Documents.
- F. Making Entries on Drawings
 - 1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe the change by graphic line and note as required.
 - 2. Date all entries.
 - 3. Call attention to the entry by a "cloud" drawn around the area or areas affected.
 - 4. In the event of overlapping changes, use different colors for the overlapping changes.
 - 5. Make entries within 24 hours after receipt of information that the change has occurred.
 - 6. Maintain the base drawing format and use the same symbology.
 - 7. Convert field mark-ups to finished CADD record drawings when required in this section.
- G. Conversion of Schematic Layouts
 - 1. In some cases on the drawings, arrangements of ductwork and piping and similar items are shown schematically and are not intended to portray precise physical layout. Determine final physical arrangement subject to the Architect's approval. However, design of future modifications of the facility may require accurate information as to the final physical layout of items which are shown only schematically on the drawings.
 - 2. Show on the job set of record drawings, by dimension accurate to within one inch, the centerline of each run of items such as all sleeves and piping, etc., below grade, in walls, or in the concrete slab. A surface mounted device indicates the exact location:
 - a. Clearly identify the item by accurate note such as "Sanitary Sewer" and the like.
 - b. Show, by symbol or note, the vertical location of the item "under slab," "in ceiling plenum," "exposed," and the like.
 - c. Make all identification sufficiently descriptive that it may be related reliably to the specifications.
- H. Final Project Record Documents
 - 1. The purpose of the final Project Record Documents is to provide factual information regarding all aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive site measurement, investigation, and examination.
 - 2. Provide CAD electronic files in .dwg format using AutoCAD software. Upon written request, completion of a release form, and payment of the Engineer's standard fee of \$200 plus applicable sales tax for a set-up charge and \$50 per drawing plus applicable sales tax for copies of such files, Engineer will provide AutoCAD electronic files of base Contract Drawings in dwg format on compact discs. Engineer will also provide a list of drawing layers and names that shall be maintained.
 - 3. Provide completed record drawings on USB drive and one full size hard copy of each drawing.
 - 4. Refer to Division 1 for additional requirements.

1.13 OPERATION AND MAINTENANCE DATA

- A. Submit two copies of a preliminary draft of the proposed manual or manuals to the Architect for review and comments. Allow a minimum of ten (10) working days for review.
- B. Submit specified number copies of the approved manual to the Architect prior to indoctrination of operation and maintenance personnel.
- C. Prepare in accordance with the following standards:

Format:

Size: 8½" x 11"

Paper: White bond, at least 20 lb. weight

Text: Neatly written or printed

Drawings: 11" in height preferable; bind in with text; foldout acceptable; larger drawings acceptable but fold to fit within the Manual and provide a drawing pocket inside rear cover or bind in with text.

Flysheets: Separate each section of the Manual with neatly prepared flysheets briefly describing contents of the ensuing section; flysheets may be in color.

Binding: Use heavy-duty plastic or fiber-board covers with binding mechanism concealed inside the manual; 3-ring binders will be acceptable; all binding is subject to the Architect's approval.

Measurements: Provide all measurements in U.S. standard units such as feet-and-inches, lbs, and cfm. Where items may be expected to be measured within ten years in accordance with metric formulae, provide additional measurements in the "International System of Units" (SI).

- D. Provide front and back covers for each manual, using durable material approved by the Architect, and clearly identified on or through the cover with at least the following information:

OPERATING AND MAINTENANCE INSTRUCTIONS

- Title Page
 - Job Name
 - Site Address
 - Include Contact information of prime contractor.
- Table of contents
- Warranty Information.
 - Include all contractor warranties
 - Signed and dated documents
- Permits-Inspections
- Subcontractor list
 - Include all subcontractors.
 - Company name, Contact info.
 - Trade Responsibility.
- Vendor list
 - Include name and addresses of vendors
 - Warranty information
 - Replaceable parts
- Approved submittals
 - Include all approved product submittals
- Reports/Certificates/Redlines
 - Engineers Observation Reports
 - Contractor Start-up Report
 - Manufacturer Start-up Report
 - Test & Balance Report
 - As-builts for Duct, & refrigeration piping
 - Owners Training Report (All Trades)
- O&M Manuals
- Equipment Information.
 - Include Model, Serial and location.
- Signed Approval
 - Page for approval signature of the engineer and approval date.

OPERATING AND MAINTENANCE MANUAL (Required Layout)

- E. Contents: Include at least the following:
 - 1. Neatly typewritten index near the front of the manual, giving immediate information as to location within the manual of all emergency information regarding the installation.
 - 2. Complete instructions regarding operation and maintenance of all equipment provided including lubrication, disassembly, and reassembly.
 - 3. Complete nomenclature of all parts of all equipment.
 - 4. Complete nomenclature and part number of all replaceable parts, name and address of nearest vendor, and all other data pertinent to procurement procedures.
 - 5. Copy of all guarantees and warranties issued.
 - 6. Manufacturer's bulletins, drawings, and descriptive data, clearly indicating the precise items included in this installation and deleting, or otherwise clearly indicating, all manufacturers' data with which this installation is not concerned.
 - 7. Such other data as required in other sections of these specifications.

1.14 WARRANTY

- A. Contractor shall warranty all equipment and workmanship for a period of one year after date of substantial completion and replace or repair any faulty equipment or installation at no cost to the Owner for such service during this period, all in accordance with requirements of Division 1.
- B. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.
- C. Warranties shall be in writing in a form satisfactory to the Owner, and shall be delivered to the Owner before final payment is made.
- D. Upon completion of the work of Division 23, thoroughly clean all exposed portions of the mechanical installation, removing all traces of soil, labels, grease, oil and other foreign material and using only the type cleaner recommended by the manufacturer of the item being cleaned.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 TESTING AND INSPECTION

- A. Provide personnel and equipment, make required tests, and secure required approvals from the Architect and governmental agencies having jurisdiction.
- B. Make written notice to the Architect adequately in advance of each of the following stages of construction:
 - 1. When all rough-in is complete, but not covered.
 - 2. As specified in all Division 23 sections.
 - 3. At the completion of the work of Division 23.
- C. When material or workmanship is found to not comply with the specified requirements, remove the noncomplying items from the job site and replace them with items complying with the specified requirements at no additional cost to the Owner. This shall be performed within 3 days after receipt of written notice of noncompliance.

3.2 INSTALLATION METHODS

- A. Unless noted otherwise, piping and ductwork may be run exposed in mechanical rooms and janitor's closets. Piping and ductwork exposed in mechanical rooms and janitor's closets shall be run tight against the structure, as required by the Architect, allowing for expansion.
- B. Conceal piping and ductwork to be installed as hereinbefore specified.

- C. Piping suspended from the structure shall be adequately and properly supported on hanger rods or clamps as specified in Section 23 0529 "Hangers and Supports for HVAC Piping and Equipment". Perforated strap hangers will not be permitted. The contractor must support all duct, pipe, equipment, and all other items furnished and installed under this scope from steel joists or structural steel frames. It is prohibited to support duct, pipe, equipment, and all other items furnished under this scope from the metal deck.
- D. Where space is limited above ceilings, below concrete beams or other concrete projections, piping shall be sleeved through the beam or projection, rather than hung below. Provide sleeves where required and locate where approved by the Architect.
- E. Cut pipe accurately to measurements established at the building and install into position without springing or forcing. All open ends of pipes shall be capped or otherwise closed until the systems are closed with final connections.
- F. No pipe joints nearer than 12" to a wall, ceiling or floor penetration will be permitted, unless joint is of the welded type.
- G. Piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Piping shall be graded for proper drainage.
- H. Piping shall follow as closely as possible the routes shown on plans, which take into consideration conditions to be met at the site and in the building. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after approval from the Architect.
- I. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping and in connections to equipment.
- J. All piping shall be clean when it is installed; rust and/or dirt shall be removed.
- K. Screw joints shall be made with taper threads, properly cut. Threads shall be cut using graphite and oil applied to the pipe only. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs. Pipe shall be up-ended and hammered to remove all shavings and foreign material, before installing.
- L. Requirements for assembling joints in cast iron and copper lines are set forth elsewhere in these specifications. For any special materials, consult the manufacturers for the recommended procedures in assembling the joints.
- M. This Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed items of the HVAC system.
- N. Install roof pipe penetrations through sleeves, and flash with membrane flashing and roofing mastic compatible with roofing system. Roofing Supplier/Contractor shall approve roof penetration and flashing.
- O. For additional installation requirements, refer to individual sections in Division 23.

3.3 CUTTING AND PATCHING

- A. Perform cutting and patching associated with the work in strict accordance with the provisions of Division 1 of these Specifications and the following:
 - 1. Coordinate work to minimize cutting and patching work. Cut and patch walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction. If cutting and patching is required, it shall be performed by trades specializing in that type work.
 - 2. Perform Architect-approved cutting and demolition by methods which will prevent damage to other portions of the work and provide proper surfaces to receive installation of new work and/or repair.
 - a. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Architect. Impact-type equipment will not be used except where specifically acceptable to the Architect.
 - b. Openings in precast concrete slabs or walls for pipes, etc., shall be core drilled to exact size. Oversize the hole to allow for link seals, and to deter pipe corrosion condensation from forming.

- c. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect.
 - d. Openings cut through plaster or drywall shall be cut prior to plaster finish coat or texture coat on drywall. Cutting of the finish coat of plaster or texture coat of drywall will not be permitted unless written approval of the Architect is obtained.
 - e. Openings shall be restored and/or repaired as required to replace the cut surface to an "as-new" and/or "as original" condition. Refer to the appropriate section of the specifications for the material involved.
- 3. Perform fitting and adjusting of products to provide finished installation complying with the specified tolerances and finishes.
 - 4. Provide all core drilling of holes. Where sleeves and/or blockouts are required, they shall be cut or provided at locations required. On completion of this work or as work progresses, make all repairs and do all patching required as a result of work under this Contract. All patching shall be performed in a manner that will restore the surrounding work to its original condition to the satisfaction of the Architect.
 - 5. Assume responsibility for the proper size of all sleeves and/or blockouts in the building structure pertaining to the work and for providing the correct location of pipe sleeves and/or blockouts.
 - 6. No cutting, boring or excavating which will weaken the structure will be permitted.

3.4 JOBSITE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Include required work to correct conditions detrimental to the timely and proper completion of all Division 23 Work. Do not proceed until unsatisfactory conditions are corrected.
- B. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering; the installation of electric heaters in electrical switchgear and similar equipment to prevent moisture damage. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.
- C. Take particular care not to damage the building structure in performing work. All finished floors, step treads, and finished surfaces shall be covered to prevent any damage by workmen or their tools and equipment during the construction of the building.
- D. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these Specifications.

3.5 STORAGE AND PROTECTION

- A. Contractor shall provide the required protection of equipment and materials from the time of delivery until the completion of the Work. Protect from damage, rust, rain, humidity and dust.
- B. Do not receive equipment or materials on the jobsite until adequate space has been provided for storage.
- C. Provide adequate supports for protection from the ground and erect required shelters for items stored in the open.
- D. Items stored within the building are to be adequately protected and covered with tarpaulins or other protective covering.

- E. Protect the building at all times during construction from damage by workmen, their tools and/or equipment. Protect floors, steps, wall, ceilings, doors, windows and other finish surfaces.
- F. Equipment and materials found in a rusty condition at completion of the work will be thoroughly cleaned of rust and refinished as required to its original condition.

3.6 PREPARATION AND COORDINATION

- A. Perform coordination work in strict accordance with provisions of these specifications and the following:
 - 1. Coordinate as necessary with other trades to assure proper and adequate interface with all work.
 - 2. Where pipes or other HVAC items are shown in conflict with locations of structural members and other equipment, include labor and materials required for extensions, offsets and supports to clear the encroachment.
 - 3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation of the HVAC system.
 - 4. Coordinate accepted equipment changes from those scheduled or specified with other trades affected. Additional compensation to other trades for equipment changes is the responsibility of the Contractor making the change.
- B. The Mechanical, Electrical, Plumbing, and associated Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of standards referenced elsewhere in these specifications, and structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, plumbing and electrical Drawings do not give exact details as to the elevation of pipe, conduit and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved. Piping, exposed conduit and the duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.
- D. The general installation precedence of materials shall be as follows. Note that if an interference is encountered, this shall guide the contractor in the determination of which trade shall be given the "Right-of-Way".

Building lines
Structural Members
Soil and Drain Piping
Condensate Drains
Vent Piping
Supply, Return, and Outside Air Ductwork
Exhaust Ductwork
Fire Protection Piping
Gas Piping
Domestic Water (Cold and Hot)
Electrical Conduit

- E. Where items such as diffusers, thermostats, switches, and control panels are not specifically located on the Drawings, locate as determined in the field by the Architect. Where such items are installed without such specific direction, relocate as directed by the Architect and at no additional cost to the Owner.
- F. Verify all dimensions and distances. No additional compensation will be allowed because of differences between work shown on the Drawings and actual dimensions and distances at the jobsite.

3.7 PAINTING

- A. All equipment shall be delivered to the job with suitable factory finish. Should the finish be damaged in transit or during the installation, it shall be finished to match appearance of original finish. All work shall be subject to approval by Architect.
- B. All equipment, piping, conduit, insulation, etc., furnished and installed in exposed areas under Divisions 23 of these Specifications and as hereinafter specified shall be cleaned, prepared, and painted according to the following specification. In the event of a conflict between the specifications referenced, the provisions of this specification shall prevail only for Division 23 work.
- C. Before painting, materials and equipment surfaces shall be thoroughly cleaned of cement, plaster, and other foreign materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metal work shall be carefully brushed down with the steel brushes to remove rust and other spots and left smooth and clean.

3.8 TRAINING

- A. Contractors are responsible to provide owner with an adequate amount of training to be able to operate any system installed.
 - 1. Provide a sign in sheet that is to be added to the O&M manual
 - a. Owners & all building maintenance personal are required to have training.

END OF SECTION

SECTION 23 05 53 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SCOPE

- A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of all necessary identification items as indicated on the drawings and as specified.
- B. Work included:
 - 1. Valve tagging
 - 2. Pipe marking
 - 3. Equipment marking
- C. Submittals: Provide submittals as required in Section 23 00 10. "Submittal Process".

1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
- C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified. Marking system shall conform to ASME 13.1, latest edition and OSHA 29 CFR 1910.261 requirements.

PART 2 - PRODUCTS

2.1 EQUIPMENT PLATES

- A. Plate shall be black with white letters that appear when the plate is engraved.
- B. Plate material shall be specifically suited for conditions surrounding the equipment. Outdoor equipment shall require special plate material for outdoor use.
- C. Plate size shall be as required with lettering size appropriate for the information shown but in no case less than 1/8" high. Lettering style shall match existing facility standards.
- D. Nomenclature for plates shall be based on the equipment designations shown on the equipment schedules and as approved by the Architect.

2.2 MANUFACTURERS

- A. Provide marking system as manufactured by W. H. Brady Company, Seton, Craftmark, or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place all markers and plates in such locations that they are easily read by a person without assuming awkward or hazardous positions.

3.2 EQUIPMENT PLATES

- A. Provide engraved plates for all HVAC equipment and all remote mounted starter/disconnects.
- B. Secure all plates with two self-tapping metal screws with round heads. Alternately, plates may be fastened with "pop" rivets provided no cracking or injury occurs to the plate. Plates attached with adhesives shall not be permitted.

END OF SECTION

SECTION 23 05 93 – TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

- A. Testing and Balancing Agency Qualifications
 - 1. The testing, adjusting, and balancing of the heating, ventilating and air conditioning systems shall be performed by a technical firm or balancing agency certified in Air TAB and system commissioning by the Associated Air Balance Council (AABC). The testing and balancing agency shall possess calibrated instruments, qualified engineers, and skilled technicians to perform required tests in accordance with the AABC .
 - 2. The testing and balancing agency shall be an independent firm separate and distinct from; not to be associated with, or be subsidiary of a firm performing work under other Sections of Division 22 & 23 and shall be under contract directly to the Contractor.
- B. Testing and Balancing Agency Responsibilities
 - 1. Submittals
 - a. Engineer and Technicians Data: Submit proof that the agency, the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified.
 - b. Sample Form: Submit sample forms, proposed for use on this project, for approval.
 - c. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Certified Agency.
 - 2. Test, adjust and balance the heating, ventilating, and air conditioning systems in accordance with AABC National Standards for field measurement.
 - 3. Verify the operation, calibration, and set points of all heating, ventilating, and air conditioning systems controls installed in this project.
 - 4. Submit in writing to the Architect/Engineer a list of deficiencies for correction by the installing contractor. In the event a deficiency remains after being reported as corrected, the balancing agency may submit an itemized request for its lost time for payment by the installing contractor. All deficiencies that prevent proper T&B work from being completed shall be corrected prior to submittal of the Final T&B Report.
 - 5. Submit certified, bound, typewritten report for approval by the Owner and Architect/Engineer including all test report data, instrument calibration, and schematic drawings of the HVAC layout.
- C. Contractor Responsibilities
 - 1. The Contractor shall provide the T&B firm with copies of all Drawings, Specifications, Shop Drawings, Submittal Data, Up-to-Date Revisions, Change Orders, and other data required for planning, preparation and execution of the T&B work.
 - 2. Coordinate the HVAC installation and start up schedule with the T&B Agency and General Contractor to allow sufficient time prior to the completion date for testing and balancing to be conducted and deficiency items corrected and retested. Provide sufficient personnel and utilities to operate the HVAC systems during normal and overtime hours to meet the completion date and testing and balancing schedule.

3. The Mechanical Contractor shall install all systems complete and provide volume dampers, splitter dampers, etc. necessary for T&B work. All equipment shall be operated at the Contractor's expense for a minimum of three consecutive days prior to balancing in order to make certain the equipment is free from mechanical defects, runs smoothly and quietly, and performs satisfactorily to meet the requirements set forth in the contract documents.
4. Provide written notification to the T&B agency and General Contractor the systems are ready for balancing. Should the systems not be ready for balancing, it shall be the Contractor's responsibility to compensate the T&B Agency for time lost.
5. Correct any deficiency items noted during testing and balancing including controls calibration, installation of balancing devices, sheave replacements, and motor replacements at no additional cost to the Owner. Provide written notification to the Testing and Balancing Agency and General Contractor when systems are ready for retesting. Should the systems not be ready for retesting it shall be the Contractors responsibility to compensate the T&B Agency for time lost.
6. It shall be the responsibility of the Contractor to install all dampers, and other adjustment devices in a manner that will leave them accessible and readily adjustable.
7. Perform all tests of mechanical system and equipment as specified herein and as required to obtain approvals from all authorities having jurisdiction.
8. Provide all instruments, materials and labor to perform the testing and to obtain and record all measurements.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. The balancing agency shall have a complete set of instruments as required by AABC standards.
- B. Calibration histories for each instrument used for measurement shall be available for examination. Calibration, accuracy, and maintenance of all instruments shall be in accordance with AABC standards.

PART 3 - EXECUTION

3.1 EQUIPMENT AND SYSTEM TESTS

- A. General: The Test and Balance firm shall test all HVAC equipment and systems and make final adjustments and corrections necessary to place the systems in proper operating condition.
 1. After testing and balancing, patch insulation, ductwork, and housings, using materials identical to those removed. Air test drilled openings shall be sealed with plastic plugs to allow future access. Seal insulation to re-establish integrity of the vapor barrier.
 2. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices to show final settings.
- B. Ductwork:
 1. The contractor shall perform duct leakage testing on 25% of the supply, return and exhaust ductwork in accordance with SMACNA - HVAC Air Duct Leakage Test Manual. Seal any ductwork not meeting the following acceptable leakage rates and retest until test is successful.

Duct System
Low Pressure Supply

Allowable % Leakage
2% @ construction pressure class

3.2 SYSTEM OPERATING TESTS

- A. After the successful completion of all equipment start-up and test requirements, the following formal testing and balancing shall be performed on the complete mechanical system:
1. Temperature Controls - The balancing agency shall be assisted by the temperature controls contractor in the commissioning of the operation and calibration of all temperature control systems. The following tests are required:
 - a. Verify all controlling devices are calibrated and set for design operating conditions.
 - b. Verify all components are installed and functional.
 - c. Verify the accuracy of each temperature sensor by temperature measurement.
 - d. Check the sequence of operation for all control modes to ensure that they are in accordance with the contract documents.
 - e. Verify that default setpoints are correct if different from the normal operating set points.
 - f. Verify all interlock systems function.
 - g. Perform all system verifications to assure the safety of the system and its components.
 - h. Verify changeover from heating to cooling occurs as specified.
 - i. Calibrate and adjust all thermostats and other controlling devices.
 - j. Replace defective controllers at no cost to the Owner.
 2. Mechanical Contractor Responsibility
 - a. Final Operating Test: An operating test shall be performed by the Contractor to the satisfaction of the Architect and the Owner for a period of not less than 8 hours. Should any element of the system not perform properly, the Contractor shall make all required corrections, and the test shall be repeated until successfully performed

3.3 AIR SYSTEM PROCEDURES

- A. The balancing agency shall perform the following testing and balancing functions in accordance with the AABC National Standards for TAB.
1. Outside Air - Test and adjust system minimum outside air by Pitot-tube traverse. If a Pitot-tube traverse is not practical, the percentage of outside air may be determined by calculations from the return air, outside air, and mixed air temperatures when the temperature differential between the return and outside air is greater than 20oF.
 2. Air Temperature - Take wet bulb and dry bulb air temperatures on the entering and leaving side of each cooling coil. Dry bulb temperature shall be taken on the entering and leaving side of each heating coil.
 3. Main Ducts - Adjust main ducts to within design CFM requirements and traverse for total CFM quantities.
 4. Branch Ducts - Adjust branch ducts to within design CFM requirements. Multi-diffuser branch ducts shall have at least one volume damper completely open.
 5. Tolerances
 - a. Test and balance each fan and air-handling unit to within plus 10% and minus 5% of design requirements. Test and balance units having filters with clean filters in place.
 6. If inspections or tests reveal defects, such defective work or material shall be replaced or repaired as necessary and inspections and tests shall be repeated. Repairs to piping shall be made with new materials. Patching of screwed joints or holes shall not be acceptable.

3.4 TEST AND BALANCE REPORT

- A. The Final TAB Report shall be typewritten on 8.5 x 11 inch white bond paper, in bound form with an index and tabs to segregate the data into logical sections. The summary shall include information on special testing conditions and results. A listing of the TAB Agency, Contractor, Owner, Architect, and Engineer shall be included.
- B. The report shall present data entered on AABC standard forms (modified as necessary to include additional data hereinafter required) or pre-approved acceptable equivalent thereof.
- C. The report shall contain copies of pump curves, fan curves, field test reports and as-built plans (size 11 x 17 inches) of the HVAC systems.
- D. Include a certification sheet containing the seal and name, corporate address, telephone number, and signature of the Certified Test and Balance Engineer.
- E. Include a listing of the instrumentation's used for the procedures along with the proof of calibration.
- F. System Identification - Each supply, return, and exhaust opening shall be identified and numbered on reduced plans no larger than 11 x 17 inches to correspond to the numbers used on the report data sheets.
- G. Air Handling Unit Test Report Forms - Record the manufacturer, model number and motor nameplate data and all design and manufacturer-rated data including supply, return, and outside airflows, fan rpm, sp, and bhp. Report the following.
 - 1. Total actual CFM by traverse. Include duct traverse form. If not practical, the sum of the outlets may be used, or a combination of each of these procedures.
 - 2. Inlet and outlet static pressures at the fan, coil and filter sections.
 - 3. Actual outside air and return air total CFM.
 - 4. Actual operating current, voltage, and brake horsepower of each fan motor.
 - 5. Final RPM of the fan and motor.
 - 6. Fan and motor sheave sizes and center distance. Belt size and quantity.
 - 7. For VAV air handling systems, report the minimum static pressure set point required to achieve design CFM to the last terminal box in the system while maintaining design airflow at the air handler.
 - 8. Coil EAT and LAT (db/wb), EWT, LWT, and air pressure drops.
 - 9. Outside air temperature (DB/WB).

3.5 SYSTEM PERFORMANCE VERIFICATION:

- A. Testing and Balancing Agency
 - 1. At the time of final inspection, the Test and Balance Agency may be required to recheck, in the presence of the Owner's representative, specific and random selections of data, air quantities, and air motion recorded in the Certified Report.
 - 2. Points and areas for recheck shall be selected by the Owner's representative.
 - 3. Measurement and test procedures shall be the same as approved for work forming basis of Certified Report.
 - 4. If random tests elicit a measured flow deviation of 10% or more from that recorded in the Certified Report the report will be rejected, all systems shall be retested, new data recorded, new Certified Report submitted, and new inspection tests made, at no additional cost to Owner.

END OF SECTION

SECTION 23 07 00 – HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

- A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the insulation of the mechanical systems as indicated on the drawings and as specified herein.
- B. Factory insulated equipment is excluded from this section of the specifications except that the insulating material characteristics shall equal or exceed those of specified materials for similar service.
- C. Work Included:
 - 1. Piping:
 - a. Cooling coil condensate drain lines.
 - 2. Ductwork:
 - a. Outside Air duct:
 - 1) Insulated internally.
- D. Submittals: Provide submittals as required in Section 23 00 10, "Submittal Process".

1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
- C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified.
- D. Pipe joints or cuts, shall be sealed with manufacturers glue. Any type of duct tape, foil tape, electrical tape or any other product that what the manufacturer supplies will be rejected and all insulation will be removed and replaced at the contractors cost.
- E. Splits or exposed piping will not be acceptable. All incorrectly installed insulation will be repaired at contractors cost.
- F. Acceptable Manufacturers:
 - 1. Fiberglass Insulation:
 - a. Knauf Insulation
 - b. Manson Insulation
 - c. Owens-Corning Fiberglas
 - d. Manville
 - e. Certain Teed
 - 2. Urethane Insulation:
 - a. Armstrong (Armalok)
 - b. Thermacor
 - 3. Mastics:
 - a. Benjamin Foster
 - b. Insul-Coustic
 - c. Chicago Mastic
 - d. Childers Products
 - 4. PVC Fittings: Zeston, Inc.

1.4 GENERAL

- A. All materials shall be applied by workmen skilled in this trade. Mechanical fasteners shall be used whenever possible to assure permanent construction. Unskilled work shall be cause for rejection.
- B. Materials will be applied only after all surfaces have been tested and cleaned.
- C. All material, jacket, coverings, sealers, mastics and adhesives shall not exceed flame spread rating of 25 and smoke developed of 50 in accordance with ASTM Method E84, UL Standard 723 and NFPA Bulletins 255 and 90A.
- D. Insulation shall be vermin resistant.
- E. Fiberglass insulation shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or poly-brominated diphenyl ether fire retardants.
- F. Fiberglass insulation products shall have a minimum of 50 percent recycled glass content certified and UL Validated.
- G. Fiberglass insulation products shall be constructed with 100% formaldehyde-free thermosetting resin binder and bio-soluble glass.
- H. Sizing, paint, pipe shield or saddle, and internal duct insulation shall be provided under other sections of Division 23.
- I. Insulation of cold surfaces shall be vapor sealed.
- J. Minimum thickness of insulation shall be as listed or energy code as adopted by authority having jurisdiction. However, sufficient insulation shall be provided to eliminate condensation on the cold surfaces and to maintain a maximum exterior insulation surface of 125°F. (OSHA Standard) on the hot surfaces.

PART 2 - PRODUCTS

2.1 PIPING SYSTEMS

- A. Pipe Insulation:
 - 1. Condensate drain lines shall be Type L hard drawn copper insulated from AC unit to indirect waste termination points and first 10'-0" of horizontal drain line at floor drains receiving condensate. Material shall be closed cell type with 3/4" thick molded pipe covering with a density of 7 lbs. thermal conductivity at 0.28 at 75°F. Do not split the insulation. All joints shall be glued with manufacturer's adhesive.
 - 2. Pipe insulation shall be protected by white, water based, 100% acrylic coating equal to Armaflex WB finish. Color shall be standard white.

2.2 DUCTWORK SYSTEMS

- A. Fibrous-Glass Duct Liner: Duct liner shall be rotary-fiber bonded with 100% formaldehyde free, bio-based binder, having a bonded black mat-faced airstream surface, factory-applied edge coating, meeting requirements of NFPA 90A and 90B, ASTM C1071, and NAIMA AH124, "Fibrous Glass Duct Liner Standard". Duct liner shall comply with the fiberglass requirements set forth in Part 1.4 of this specification.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - 2. Maximum Thermal Conductivity: .24 Btu/(ft² x hr. x °F) @ 75°F mean temperature.
 - 3. Maximum Service Temperature: ASTM C411 – 250°F (121°C)
 - 4. Noise Reduction Coefficient (NRC) : ASTM C423 – 1"=.70, 1-1/2"=.80, 2"=.95
 - 5. Maximum Rated Air Velocity: ASTM C1071 – 6,000 ft. /min. (30.5 m/sec.)
 - 6. Mold & Mildew Growth / Fungi Resistance: ASTM C1338, ASTM G21/G22 – Pass
 - 7. Water Vapor Sorption: ASTM C1104 – Less than 3%
 - 8. Corrosiveness/Corrosion: ASTM C665/C1617 - Does Not Accelerate / Pass

- 9. Duct liner adhesive shall be applied to the sheet metal with a minimum coverage of 90%. Adhesive shall meet the requirements of ASTM C916.
- 10. All duct liner products shall avoid air erosion up to velocities of 6,000 feet per minute.
- B. Other fiberglass manufacturers are Manson Insulation AK board, Certainteed, and Owens Corning or pre-approved equal.
- C. Solvent-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

2.3 ADHESIVES

- A. Water based, polymeric, UL classified lagging adhesive for applying canvas and glass cloth; Foster 30-36 or Childers CP-50.
- B. A fast setting, rubber based, UL classified, vapor barrier lap and attachment adhesive; Foster 85-15 or Childers CP-85.
- C. Same adhesive, except non-flammable when wet; Foster 85-20 or Childers CP-82.
- D. A rubber based, UL classified, fast setting contact adhesive for adhering flexible cellular insulation; Foster 82-40 or Armstrong 520.

2.4 INSULATION THICKNESS

- A. Piping insulation thickness based on a maximum k value of 0.23 Btu in/hr ft² °F at a mean temperature of 75°F.

System	Pipe Sizes				
	Runouts To 8 ft. Max.	1" and Less	1-1/4" to 1-1/2"	2" & 4	6" and Up
Condensate drain piping.	1"	1"	1"	1"	1"

- B. Outdoor Internal Duct Insulation: All outside air ductwork, shall be minimum insulation 2" thick, with a minimum installed R value of 8.0.

2.5 DUCT SEALANTS

- A. A fast setting, rubber based, UL classified, high velocity duct sealer; Foster 32-14 or 3M EC-800.
- B. Same sealer, except non-flammable when wet; Foster 30-02.

PART 3 - EXECUTION

3.1 GENERAL

- A. The installation of all insulation shall be made by experienced craftsmen in a neat, workmanlike manner and shall be in accordance with the manufacturer's published recommendations for service intended, as interpreted by the Architect.
- B. All adhesives used in conjunction with insulation shall be compatible with the insulation and vapor barrier used and be vermin-proof and mildew resistant.

3.2 APPLICATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Piping – Paint all condensate piping insulation with a minimum of 2 coats of white Armstrong ArmaFlex WB finish for UV protection
- C. Ductwork:
 - 1. Internal Duct Liner: All insulation shall be installed such that it does not interfere with access panels, damper quadrants or any other movable component of the ductwork. The duct liner shall be applied to the inside of the duct with the faced side to the airstream and shall be secured to the duct with adhesive, pins, and washers. Adhesives shall completely coat the metal. Joints shall be firmly butted together. Duct liner shall also be installed in accordance with the requirements of the Sheet Metal and Air Conditioning Contractor's National Association (SMACNA), Duct Liner Application Standard. Sheet metal dimensions shall be increased to accommodate addition of liner. Ductwork sizes shown are net free area.
- D. No part of any system shall be insulated until all required tests have been completed.
- E. Complete vapor barriers to prevent sweating shall be installed on all cold systems and equipment. If a single tape adhesive system or staples are used for closure of the longitudinal lap, a vapor barrier mastic must be used to ensure a vaporproof closure. All edges and abutments shall be sealed, waterproof and vaporproof. Supplier of jacket materials shall certify that the material proposed is approved for use in return air plenums, where applicable.
- F. The vapor barrier and finish shall be continuous at all support points.

END OF SECTION

SECTION 23 09 93 – SEQUENCE OF OPERATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The General Provisions of the Contract, including General and Supplementary Conditions, apply to the Work specified in this Section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. All other Sections of Division 15
- B. All other Divisions of the Contract Documents. Refer to each Division's specifications and drawings for all requirements.

1.3 SCOPE

- A. Control sequence is hereby defined to mean the manner in which, and methods by which, the controls function. The requirements for each type of operation are specified in this section.

1.4 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

1.5 SUBMITTALS

- A. Provide submittals as required in Section 23 00 10, "Submittal Process".

PART 2 - SEQUENCE OF OPERATION FOR THE MECHANICAL SYSTEM

2.1 GENERAL

- A. All HVAC systems shall be controlled with Direct Digital Control (DDC).

2.2 DEDICATED OUTSIDE AIR UNITS

- A. The unit shall be in occupied mode any time the facility is occupied. This facility is continuously occupied.
- B. Outdoor Air Damper (OD):
 - 1. After the unit goes into Occupied Mode, the Outdoor Air (OA) damper will open. As the OA damper opens, the Outdoor Air Damper Actuator (OADA) auxiliary switches close.
 - 2. The OA damper stays open until the system reaches the end of the Occupied Mode period. It will remain open until the supply fan turns off. After the supply fan turns off, the OA damper will close.
- C. Supply Fan (SF):
 - 1. As the OA damper opens, the OADA auxiliary switch will close and the SF will turn on.
 - 2. The SF will run for 60 seconds (fixed) before cooling, dehumidification, or heating will be enabled:
 - a. The SF shall operate continuously while the unit is in the Occupied Mode. When the system reaches the end of the Occupied Mode period, the SF will continue to run for an additional 2 minutes before turning off.

- b. For constant air volume (CAV) input the required speed (%) as determined in the field by Test and Balancing.
- D. Internal factory Make-up Air controls are to cycle cooling/heating and hot gas reheat to maintain supply air discharge temperature based on outside air temperature.
 - 1. Below 55°F Outside Air Temp – The unit shall provide heat to 70-72°F or the highest temperature the heat pumps can provide. Existing equipment has heat to supplement and provide heat for space.
 - 2. Between 55°F to 80°F Outside Air Temp – The unit shall provide cooling to 52-55°F of the cooling coil and then the hot gas reheat coil shall provide a unit discharge supply air temperature between 70-72°F
 - 3. Above 80°F Outside Air Temp – The unit shall provide cooling to 52-55°F discharge supply air temperature from the unit.
 - 4. All temperatures listed in the sequence shall be adjustable through the DDC system or the manufacturer's internal controller. Controls contractor shall coordinate with equipment manufacturer for points list.
- E. Alarms: The unit shall communicate any system alarms with the DDC system.

2.3 ELECTRICAL INTERLOCKS

- A. Provide electrical interlocks as listed herein, in other sections of these specifications and as noted in the equipment schedules.
- B. Electrical interlocks shall be made by means of auxiliary contacts on motor starters or shall be accomplished with separate relays unless indicated otherwise. No motor power lead shall be utilized in an interlock circuit, unless indicated otherwise. Each separate control power lead serving a starter shall be provided with a disconnecting switch suitably identified and housed, which may be a toggle switch or other suitable disconnecting device, or proper capacity and number of poles.

END OF SECTION

SECTION 23 31 13 – AIR DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

- A. Provide all equipment, materials, labor, supervision and services necessary for or incidental to the installation of all air distribution items as indicated on the drawings and as specified.
- B. Work Included:
 - 1. Ductwork.

1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
- C. When requested, provide the Architect with manufacturer's certificate that materials and methods meet or exceed minimum requirements as specified.
- D. Under no circumstances shall OBD's or butterfly dampers be used on any registers. In accessible areas manual dampers shall be used. In hard lid ceiling areas, remote cable dampers shall be used. Access panels shall not be used to access any damper in a hard lid ceiling.
- E. Outside Air ducts shall be steel duct work connections.
- F. Exterior Duct & Serviceability
 - 1. Exterior duct shall have a minimum 18" clearance from the roof deck.
 - 2. If required, provide engineered stamped & OSHA approved steps over duct to easily access all areas of the roof.

1.4 SUBMITTALS

- A. Provide submittals as required in section 23 00 10, "Submittal Process."

PART 2 - PRODUCTS

2.1 SHEET METAL DUCTWORK

- A. Ducts shall be constructed of new-galvanized steel sheets and erected in a first class manner, straight and smooth, with joints neatly finished, anchored securely to the building and free from vibration.
- B. All elbows shall be curved elbows with a centerline radius equal to 1-1/2 times the width of the duct. Air turns consisting of curved metal vanes, arranged to permit the air to follow abrupt turns without appreciable turbulence shall be installed in square elbows, only where approved by the engineer. Air turns shall be the manufacturer's standard products, and shall be quiet and free from vibration.

- C. All primary and secondary ductwork of constant volume, shall be fabricated in accordance with the Sheet Metal and Air Conditioning Contractor's National Association, Inc. (SMACNA) "HVAC Duct Construction Standards, Metal and Flexible, Second Edition, 2005". The duct static pressure rating for this duct shall be two times the external static pressure of the system fan. The requirements for the seal class corresponding to the above static pressure shall be met.
- D. Joints shall be Ductmate, TDC/TDF or types fabricated according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. At each major branch from a primary rectangular or square trunk duct, and where shown on the drawings, install a splitter damper or multiblade adjustable air pickup. Splitter damper shall have end bearings and consist of a blade constructed of 20 gauge-galvanized steel securely riveted or welded to a square operating rod. The length of the splitter blade shall be 1-1/2 times the width of the split in the main duct, but in no case less than 12". Multi-blade adjustable pickup shall be as manufactured by Titus Model AG-45 or approved equal with operator adjustable from the duct exterior.
- F. Each individual duct tap shall be equipped with a volume control device for the manual adjustment of airflow in each tap.
- G. Volume dampers shall have end bearings and be multi-blade type with opposed acting blades linked together and controlled by a single operator. Multi-blade dampers shall be not less than No. 16-gauge galvanized steel mounted to plenum or ductwork per SMACNA requirements.
- H. Regulators shall be stamped galvanized steel, lever type with locking screw mounted on face of ductwork or concealed type with adjustable cover plate as manufactured by Young Regulator Model No. 315 with 2-1/4" diameter cover plate or approved equal.
- I. Dampers handles shall be extended so the damper is not obstructed by any insulation and easily adjustable.
- J. Damper quadrants, volume dampers and other duct flow control quadrants shall be as manufactured by Young Regulator or approved equal and shall be damper sleeves.
- K. On the inlet and outlet of each piece of air moving equipment or terminal unit, unless noted otherwise, install a flexible connection made with sufficient slack to render it flexible.

2.2 PRE-INSULATED HVAC DUCTWORK SYSTEM (CONTRACTORS ALTERNATE)

- A. Pre-Insulated HVAC Ductwork System: Provide Kingspan KoolDuct System for supply, return, fresh-air and exhaust air duct as shown in the contract drawings. System shall include panels, fabrication methods, coupling systems, and accessories to provide a complete system to meet the following performance criteria.
 1. Classification: UL listed as a Class 1 Air Duct, to UL 181, NFPA 90A and NFPA 90B.
 2. Fire & Smoke Performance must meet ASTM E84 or UL 723.
 - a. Flame Spread ≤ 25
 - b. Smoke Developed ≤ 50
 3. Materials: CFC/HCFC free, zero Ozone Depletion Potential, fiber free rigid thermoset phenolic insulation core faced with 1mil low vapor permeability aluminum foil reinforced with glass scrim.
 4. Nominal Density: 3.4 to 3.75 pcf (55 to 60 kg/m³).
 5. Closed Cell Content: minimum 90 percent
 6. Compressive Strength: Minimum 29 psi (200 kPa) at 10 percent compression.
 7. Air Leakage: SMACNA Air Leakage Class 3.
 8. Mean Air Velocity Maximum 5000 fpm (25.4 m/s) with all joints sealed.

9. Design Pressures:
 - a. Positive Pressure: Maximum 4 inch w.g. (1000 Pa).
 - b. Negative Pressure: Maximum 3 inch w.g. (750 Pa).
 10. Commissioning Pressures - As designed to, max commissioning 4 inch w.g. (1000Pa.).
 11. Temperature Range: Internal air temperature range -15 to 185 deg. F (-26 to 85 C) during continuous operation, inside ducts or ambient surrounding temperature.
 12. Thermal Resistance, Wall Thickness and R-Value:
 - a. 7/8 inch (22 mm) thick, R 6.0 square feet per hour F/Btu (1.047 square meter K/W).
 - b. 1-3/16 inch (30 mm) thick, R 8.1 square feet per hour F/Btu (1.428 square meter K/W).
 - c. meter K/W).
 - d. 1-25/32 inch (45mm) thick, R 12 square feet per hour F/Btu (2.15 square meter K/W).
 - e. meter K/W).
 13. Thermal Conductivity: at 50 to 74 deg. F (10 to 23 deg C), mean 0.146 Btu inch per square foot per hour deg. F (0.021 W/m K) per ASTM C518.
 14. Typical Configuration: Rectangular.
- B. ACCESSORIES
1. Fittings: In accordance with SMACNA Phenolic Duct Construction Standards or the ASHRAE Design Fundamentals Handbook Chapter 35 or the SMACNA HVAC Duct Systems Design Manual.2.
 2. Support Systems: Tiger Support and Wire Hanger Assembly. Steel Channel Support and Threaded Rods.
 3. Coupling System: Tiger Clip Coupling System. Aluminum Grip Coupling System. 4-Bolt Coupling System.
 4. Access Doors: Metal insulated access doors. Fabricated from the Kingspan KoolDuct System including the same insulation system, and to ensure a continuous vapor barrier.
 5. Turning Vanes
 6. V-Groove Sealant: Silicone with VOC content of 250 g/L or less.
- C. FABRICATION
1. Fabricate ductwork with panels, joints, seams, transitions, reinforcements, supports, elbows, connections, and accessories in accordance with SMANCA Phenolic Duct Construction Standards and the manufacturer guidelines.
 - a. 90 degree mitered elbows shall include turning veins.
 - b. Interior Ductwork: Standard finish.
 - c. Exterior Ductwork: Dual-Tech pre-fabricated, double layer ducting system.
 - 1) Inner layer shall be R-8 Kingspan KoolDuct
 - 2) Outer layer shall be R-8 Kingspan KoolDuct
 - 3) Exterior layer shall be .032 aluminum.

2.3 EXTERIOR DUCTWORK

- A. Exterior duct system shall be Dual-Tech system, by PTM Manufacturing, LLC. Newark, DE, 19713. (302) 455-9733. PTM design guidelines shall be strictly adhered too. Duct work shall be Double Wall Kingspan KoolDuct encased with PTM beaded and silicone sealed white .032 Aluminum or Approved equal.
- B. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

- C. Outdoor Ductwork Insulation Material:
1. Duct work shall be double wall R8 (30mm) Kingspan KoolDuct. The panels used in the fabrication of Dual-Tech ductwork from the Kingspan KoolDuct System shall be Kingspan KoolDuct rigid phenolic insulation panels of nominal dimensions 12.89 ft x 3.94 ft and minimum compressive strength 29 psi, as manufactured by Kingspan Insulation Ltd and detailed in App. A1.
 2. Kingspan KoolDuct rigid phenolic insulation panels shall comprise a 3.4–3.75 pcf nominal density CFC/HCFC–free rigid phenolic insulation core with zero Ozone Depletion Potential (ODP), autohesively bonded on both sides to a 1 mil low vapor permeability aluminum foil facing reinforced with a 0.2” glass scrim.
 3. Kingspan KoolDuct rigid phenolic insulation panels are available in thicknesses of 1 3/16” (R-8.1 ft².hr.[°]F/Btu), as per design Thermal Requirements for double wall and a combined R16 thermal value.
 4. All other components required for the fabrication of ductwork from the Kingspan KoolDuct System including the silicone sealant, contact adhesive, aluminum tape, self–adhesive gasket, ductwork reinforcements, closures, connectors and flanges shall be as approved / supplied by Kingspan Insulation Ltd.
 5. Weather barrier shall be fabricated of mill finished white aluminum sheeting, 0.032” in thickness. Exposed seams to be covered with 1” butyl and a 8” embossed aluminum beaded bands, secured with #10 self tapping, stainless screws with weather seal washers.
 6. At weather barrier abutment locations, an industrial grade RTV silicone caulk shall be utilized, where applicable.
 7. Seams exposed to the weather shall be covered and sealed with a 1” wide by 1/8” thick butyl compound.
 8. All screws utilized to fasten panel system together shall be #10 x 1/2” self-tapping, stainless steel, weather seal washer screws painted white.
 9. Contact cement or 2-sided adhesive tape shall be utilized for laminating insulation material to the weather barrier sheeting.
 10. 8. Foil tape used for sealing the insulation edges shall be a minimum thickness of 1.25 mil.
- D. Fabrication
1. Sizing: Panel system shall be sized in four overlapping sections to provide a complete seal surrounding KoolDuct ducting. Shall be laminated to the weather barrier and sized to allow for sufficient overlap as indicated in section 3.0 above. Second wall ducting shall be adhered utilizing appropriate contact method.
 2. Where feasible all general fabrication shall be performed in the shop and be based off of approved project drawing or direct field measurements.
 3. Field fabrication should be limited to routing and sealing of the ducting sections to allow for duct angle, supports, gauges or other duct related necessities. All routed areas shall be resealed with appropriate foil faced cast tape. No insulation/phenolic material shall be exposed to the environment.
- E. Fire & Smoke Performance
1. The rigid phenolic insulation panels used in the fabrication of KoolTech ductwork and / or ductwork sections fabricated from the Kingspan KoolDuct System shall achieve the following fire and smoke performance requirements:
 - a. ASTM E 84–08a – unfaced or composite (insulation, facing and adhesive) of low contribution to fire growth not exceeding 25 Flame Spread and 50 Smoke Developed indices;
 - b. UL 723 – unfaced or composite (insulation, facing and adhesive) of low contribution to fire growth not exceeding 25 Flame Spread and 50 Smoke Developed indices; and
 - c. UL 181 – UL/ULC classification as a Class 1 Air Duct to NFPA Standards 90A & 90B.

- F. Sealants
 - 1. All internal seams must be fully sealed with an unbroken layer of silicone sealant.
 - 2. Each ductwork section must be duly connected with a jointing system approved Kingspan Insulation Ltd., and sufficient silicone sealant should be applied in order to seal the rigid phenolic insulation panel and ensure minimum air leakage.
 - 3. Ductwork reinforcement, if necessary, shall be applied to protect against side deformation from both positive and negative pressure.
 - 4. All external seams where two separate panels join must be taped to achieve a permanent bond and a smooth wrinkle free appearance.
- G. Hangers & Supports
 - 1. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - a. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
 - b. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
 - 2. Hanger Materials: Galvanized sheet steel or threaded steel rod.
 - a. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
 - b. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards—Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
 - c. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

PART 3 - EXECUTION

3.1 INSTALLATION - METAL DUCTS

- A. All ductwork shall be installed as recommended by SMACNA and as shown or indicated on the drawings. Coordinate ductwork with all other trades and elements of the building construction.
- B. All ductwork accessories shall be provided as specified or shown or indicated on the drawings, install as recommended by SMACNA and the manufacturer.
- C. Ductwork shall be installed in a neat, workmanlike manner with ducts generally parallel to structure. Provide offsets as necessary to avoid obstructions, piping, or structural members, It is contractors responsibility to communicate with other trades to reduce the amount of offsets needed. The additional cost of offsets and fittings shall not be passed onto the owner.
- D. Install outdoor, field-applied aluminum jacket on ductwork pitched to shed water and prevent water ponding on top of the duct.
- E. At each major branch from a primary rectangular or square trunk duct, and where shown on the drawings, install a splitter damper or multi-blade adjustable air pickup. Refer to section 2.1 for requirements.
- F. Volume dampers shall be installed within ducts or plenums where shown on the drawings and on all taps for balancing of system.
- G. **All Dampers shall be marked with a flag for easy identification of location.**
- H. On the inlet and outlet of each piece of air moving equipment, unless noted otherwise, install a flexible connection made with sufficient slack to render it flexible.

3.2 INSTALLATION SECTION 2.2 – (CONTRACTORS ALTERNATE)

- A. Clean & Prepare surfaces using methods recommended by the manufacturer.

- B. Install in accordance with manufacturer's instructions using the fewest joints as possible.
- C. Support: Installer is responsible to ensure duct system is properly and adequately supported using materials that are compatible with the duct system, with supports typically located in straight runs, changes in direction, branch connections, tee fittings, and with SMANCA practices.
- D. Install joint sections in accordance with SMANCA Phenolic Duct Construction Standards.
- E. Tape External seams to ensure a permanent, smooth, wrinkle-free bond
- F. Apply Kingspan silicone sealant at each internal seam to ensure minimum air leakage.

3.3 FIELD QUALITY CONTROL

- A. Commissioning: Include testing and verification of functional and operational performance at intended pressure and temp ranges, training for operations maintenance and documentation. Commissioning test pressure shall not exceed the pressure rating to which the ductwork has been designed and fabricated.
- B. Air Leakage Testing: Test in accordance with ASHRAE 90.1 and with SMANCA HVAC Air Duct Leakage Test Manual, including operation at static pressure on at least 25 percent of the total installed duct area.

3.4 DUCT SEALING

- A. All exposed duct shall be internally sealed, or gasket sealed fittings shall be used.
 - 1. Duct sealer on exposed joints will not be acceptable.
- B. All seams, joints and taps must be sealed with a water and air tight sealant.
- C. Sealer must be a Water Based Duct Sealer designed for use in high velocity air conditioning, refrigeration, ventilating, and air distributing systems up to 15w.g.. It must be suitable for use in both indoor and outdoor applications and exceeds all SMACNA Pressure and Sealing Classes.
 - 1. Duct tape and Foil tape is not an approved sealer.

END OF SECTION

SECTION 23 75 00 – DEDICATED OUTSIDE AIR UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 REFERENCES

- A. AFBMA 9—Load Ratings and Fatigue Life for Ball Bearings.
- B. AMCA 99—Standards Handbook
- C. AMCA 210—Laboratory Methods of Testing Fans for Rating Purposes
- D. AMCA 500—Test Methods for Louver, Dampers, and Shutters.
- E. ARI 340/360 - Unitary Large Equipment
- F. IBC 2000 – International Building Code
- G. NEMA MG1—Motors and Generators
- H. National Electrical Code.
- I. NFPA 70—National Fire Protection Agency.
- J. UL 900—Test Performance of Air Filter Units.

1.3 SUBMITTALS

- A. **Submittals: Provide submittals as required in Section 23 00 10, “Submittal Process”.**
- B. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, electrical characteristics and connection requirements.
- C. Product Data:
 - 1. Provide literature that indicates dimensions, weights, capacities, ratings, fan performance, and electrical characteristics and connection requirements.
 - 2. Provide computer generated fan curves with specified operating point clearly plotted.
 - 3. Manufacturer’s Installation Instructions.

1.4 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Provide instructions for installation, maintenance and service

1.5 QUALITY ASSURANCE

- A. All models shall be ETL listed and comply to safety standards UL 1995, the Standard for Safety for Heating and Cooling Equipment.
- B. Startup must be done by trained personnel experienced with rooftop equipment.
- C. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters and remote controls are in place, bearings lubricated, and manufacturers’ installation instructions have been followed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site.
- B. Accept products on site and inspect for damage.
- C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
- D. The unit shall be tested in accordance to the following standards:
 - 1. ANSI/AHRI Standard 340/360
 - 2. ANSI/ASHRAE Standard 37
 - 3. AHRI Standard 270/370

1.7 WARRANTY

- A. All units shall be provided with the following standard warranties:
 - 1. 2-Year (non-prorated) parts warranty.
 - 2. 5-Year (non-prorated) compressors warranty.

- B. This warranty shall not apply if:
1. The equipment is not installed by a qualified installer per the manufacturer's installation instructions shipped with the product.
 2. The equipment is not installed in accordance with Federal, State, and Local codes and regulations.
 3. The equipment is misused, neglected, or not maintained per the manufacturer's maintenance instructions.

PART 2 - PRODUCTS

1.1 MANUFACTURER

- A. Products shall be provided by the following manufacturers:
1. AAON
 2. Substitute equipment may be considered for approval that includes at a minimum:
 - a. R-410A refrigerant
 - b. Variable capacity compressor with 10-100% capacity control
 - c. Direct drive supply fans
 - d. Double wall cabinet construction
 - e. Insulation with a minimum R-value of 13
 - f. Stainless steel drain pans

1.2 ROOFTOP UNITS

- A. General Description
1. Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fans, dampers, air-cooled condenser coils, condenser fans, reheat coil, and unit controls.
 2. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
 3. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
 4. Unit components shall be labeled, including refrigeration system components and electrical and controls components.
 5. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
 6. Installation, Operation, and Maintenance manual shall be supplied within the unit.
 7. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
 8. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.
- B. Construction
1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
 2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.
 3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.

4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
 5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
 6. Access to filters, dampers, cooling coils, reheat coil, heaters, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
 7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
 8. Units with cooling coils shall include double sloped 304 stainless steel drain pans.
 9. Unit shall be provided with horizontal discharge and horizontal return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
 10. Unit shall include lifting lugs on the top of the unit.
- C. Electrical
1. Unit shall be provided with factory installed and factory wired circuit breaker.
 2. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.
- D. Supply Fans
1. Unit shall include direct drive, unhooded, backward curved, plenum supply fans.
 2. Blowers and motors shall be dynamically balance and mounted on rubber isolators.
 3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
 4. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.
- E. Cooling Coils
1. Evaporator Coils
 - a. Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.
 - b. Coils shall have interlaced circuitry and shall be 6 row high capacity.
 - c. Coils shall be hydrogen or helium leak tested.
 - d. Coils shall be furnished with factory installed expansion valves.
- F. Refrigeration System
1. Unit shall be factory charged with R-410A refrigerant.
 2. Compressors shall be scroll type with thermal overload protection and carry a 5 year non-prorated warranty, from the date of original equipment shipment from the factory.
 3. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.
 4. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.
 5. Each refrigeration circuit shall be equipped with expansion valve type refrigerant flow control.

6. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides and a factory installed replaceable core liquid line filter driers.
 7. Heat pump units shall include reversing valve.
 8. Unit shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity.
 9. Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.
- G. Condensers
1. Air-Cooled Condenser
 - a. Condenser fans shall be a vertical discharge, axial flow, direct drive fans.
 - b. Coils shall be designed for use with R-410A refrigerant. Coils shall be multi-pass and fabricated from aluminum microchannel tubes.
 - c. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
 - d. Coils shall be hydrogen or helium leak tested.
- H. Filters
1. Unit shall include 4 inch thick, pleated panel filters with an ASHRAE MERV rating of 13, upstream of the cooling coil. Unit shall also include 2 inch thick, pleated panel pre filters with an ASHRAE MERV rating of 8, upstream of the 4 inch standard filters.
 2. Unit shall include a clogged filter switch.
- I. Outside Air Intake Hood
1. Unit shall include 100% motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge and end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return, 2 position actuator. Unit shall include outside air opening bird screen and outside air hood.
- J. Controls
1. Factory Installed and Factory Provided Controller
 - a. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested. Controller shall be capable of stand-alone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.
 - b. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
 - c. Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.
 - d. Makeup Air Controller
 - 1) Unit shall modulate cooling with constant airflow to meet ventilation outside air loads. Cooling capacity shall modulate based on supply air temperature.
 - e. Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of

communicating and integrating with a Lon Works or BACnet network.
[Watt Master Orion Controls System]

- K. Accessories
 - 1. Unit shall be provided with a smoke detector sensing the supply air of the unit, wired to shut off the unit's control circuit.

1.3 CURBS

- A. Curbs shall to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit.
- B. Knockdown curb (with duct support rails) shall be factory furnished for field assembly.
- C. Solid bottom curb shall be factory assembled and fully lined with 1 inch neoprene coated fiberglass insulation and include a wood mailer strip. (Curb shall be adjustable up to 3/4 inch per foot to allow for sloped roof applications.

PART 1 - EXECUTION

3.1 INSTALLATION, OPERATION, AND MAINTENANCE

- A. Installation, Operation, and Maintenance manual shall be supplied with the unit.
- B. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation, and Maintenance manual instructions.
- C. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

END OF SECTION

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SECTION 26 00 10 – ELECTRICAL SUBMITTAL PROCESS

PART 1 – GENERAL

1.1 SUBMITTALS

- A. Comply with all submittal provisions of Division 1.
- B. Submit electronic copies of the submittal to the prime consultant (i.e. architect) in order to process and track the submittals properly in accordance with Division 1 and 26 submittal requirements. Architects and consultants are to submit all submittals and RFI's to the mechanical engineer electronically. Send to “**mdengca@md-eng.com**”. Submittals shall be labeled by their project specification section or CSI specification section if not listed in project specifications.
- C. Contractor is responsible to separate submittals per specification section. Unseparated submittals are subject to rejection without review.
- D. Allow a minimum of ten (10) working days for the review of submittals and each re-submittal.
- E. Submittals that have been reviewed and marked as REJECTED (REJ) or MAKE CORRECTIONS NOTED (MCN) should be resubmitted within 10 days to be reviewed again by engineer.
- F. Compliance with the Contract documents shall be the sole responsibility of the Contractor. Items on equipment that are were not accepted by the Architect in writing as an approved equal shall be replaced or revised to comply with the contract documents at the Contractor's expense.
- G. Resubmission of rejected submittals shall be limited to one (1) in number. Costs for processing subsequent resubmittals in excess of the first resubmittal, resulting from the Contractor's disregard of Architect/Engineer's primary submittal rejection comments, shall be borne by the Contractor. Costs shall be based on Architect/Engineer's hourly rates as published in their current professional fee schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost-plus ten percent (10%).

1.2 REQUIRED SPECIFICATIONS (Project specific)

- A. The chart below are the submittals required for the project.
 - 1. Submittals marked with an “**X**” are required for this project.
 - 2. Submittals without an “**X**” are not required for this project.

See required specifications on next page

Required X	Submittal Name	Spec Reference
X	Common Work Results for Electrical -Submittals, Shop Drawings.	26 05 00
X	Fire Stopping -Materials	26 05 03
X	Low Voltage Electrical Power Conductors -Conductors, Cables	26 05 19
X	Grounding & Bonding -Materials, Chemical ground rod	26 05 26
X	Hangers & Supports for Electrical -Hanger & clamps, Fabricated devices	26 05 29
X	Conduit for Electrical System	26 05 33.13
X	Boxes for Electrical Systems	26 05 33.16
X	Identification for Electrical Systems -Submit all marking systems per spec.	26 05 53
X	Disconnect Switches -Manufacturer, Switches, Components	26 06 20
X	Wiring Devices -Receptacles, Switches, Wall plates	26 27 26
X	Enclosed Switches -Components	26 28 16
X	Facility Lightning Protection -Components	26 41 00
X	Fire Detection and Alarm Systems	28 31 10

END OF SECTION

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

- A. General Requirements for Electrical Work are intended to be complementary to General Requirements of Construction Contract.
- B. Work Included: Provide complete electrical systems where shown on Drawings, as specified herein, and as needed for complete and proper installation including, but not necessarily limited to following summary of Work.
 - 1. Interior and exterior lighting
 - 2. Emergency exit and egress lighting
 - 3. Fire detection and alarm system
 - 4. Telephone raceway system
 - 5. Switchboards
 - 6. Lighting and distribution panelboards
 - 7. Power feeds to mechanical, plumbing and fire protection equipment:
 - a. Provide conduit, wire, disconnect switch, overcurrent and short circuit protection for all equipment, whether shown on the drawings or not, including, motorized dampers, smoke dampers, electric heat trace, power for energy management system, water softening equipment, water treatment systems, air dryers, electric flush valves, electric trap primers, electric solenoids, shower valves, and other miscellaneous equipment.
 - 8. Surge protective devices
 - 9. Occupancy sensors
 - 10. Packaged generator set
 - 11. Automatic transfer switch
 - 12. Electrical service entrance
 - 13. Digital control system
 - 14. Other items and services required to complete electrical systems
- C. Rough-in (only) for the Electronic Security System.
- D. Rough-in (only) for the IT/AV System.

1.3 QUALITY ASSURANCE AND APPLICABLE STANDARDS

- A. Use adequate numbers of skilled workers thoroughly trained and experienced in necessary crafts and completely familiar with specified requirements and methods needed for proper performance of Work of this Division. Ensure that there is a minimum of one journeyman electrician, on job site whenever Division 26 Work is being performed.
- B. Without additional cost, provide labor and materials as required to complete Work of this Division in accordance with requirements of Governmental Agencies having jurisdiction, regardless of whether materials and associated labor are called for elsewhere in these Contract Documents.
- C. Codes: Electrical and fire alarm work shall conform to requirements and recommendations of the following codes. Refer to the most recent code adopted by the Authority Having Jurisdiction (AHJ).
 - 1. National Electrical Code
 - 2. International Energy Code

3. International Fire Code
 4. International Building Code
 5. Local amendments to the above codes
- D. Standards: Specifications and Standards of following organizations are by reference made part of these Specifications. Electrical Work, unless otherwise indicated, shall comply with requirements and recommendations wherever applicable:
1. Association of Edison Illuminating Companies (AEIC)
 2. American National Standards Institute (ANSI)
 3. American Society of Mechanical Engineers (ASME)
 4. American Society for Testing and Materials (ASTM)
 5. Certified Ballast Manufacturers (CBM)
 6. Electrical Testing Laboratories (ETL)
 7. Institute of Electrical and Electronic Engineers (IEEE)
 8. Insulated Power Cable Engineers Association (IPCEA)
 9. National Bureau of Standards (NBS)
 10. National Electrical Contractors Association (NECA)
 11. National Electrical Manufacturer's Association (NEMA)
 12. National Fire Protection Association (NFPA)
 13. Radio-Television Manufacturer's Association (RTMA)
 14. Reflector Luminaire Manufacturers (RLM)
 15. Underwriters' Laboratories, Inc. (UL)

1.4 REQUIREMENTS OF REGULATORY AGENCIES

- A. Requirements and recommendations of latest editions of Occupational Safety and Health Act (OSHA), and Americans with Disabilities Act (ADA), are by reference made part of these Specifications. Work shall comply with requirements and recommendations wherever applicable.

1.5 DEFINITIONS

- A. Terms furnish, install, and provide are used interchangeably and shall mean to furnish and install, complete and ready for intended use.

1.6 SUBMITTALS

- A. Comply with pertinent provisions of Division 01.
- B. Submit electronic copies of the submittal to the prime consultant (i.e. architect) in order to process and track the submittals properly in accordance with Division 1 and 26 submittal requirements. Architects and consultants are to submit all submittals and RFI's to the mechanical engineer electronically. Send to "**mdengca@md-eng.com**". Submittals shall be labeled by their project specification section or CSI specification section if not listed in project specifications
- C. Resubmission of rejected submittals shall be limited to one (1) in number. Costs for processing subsequent resubmittals in excess of the first resubmittal, resulting from the Contractor's disregard of Architect/Engineer's primary submittal rejection comments, shall be borne by the Contractor. Costs shall be based on Architect/Engineer's hourly rates as published in their current professional fee schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost plus ten percent (10%).
- D. Submittals required of materials and equipment include following:
1. Materials list of items proposed to be provided under Division 26.
 2. Manufacturer's specifications and other data needed to prove compliance with specified requirements. Term "Compliance" is understood to mean that Contractor certifies that submitted equipment meets or exceeds Contract Document requirements. Items that do not clearly meet this definition should be identified and explained as required in following paragraph.

3. Identify difference between specified item and proposed item. Explain with enough detail so that it can easily be determined that item complies with functional intent. List the disadvantages or advantages of proposed item versus specified item. Submit technical data sheets and/or pictures and diagrams to support and clarify. Organize in clear and concise format. Substitutions shall be approved in writing by Engineer. Engineer's decision shall be final.
 4. Allow minimum of 10 working days for review of each submittal and re-submittal.
 5. Items of equipment that are not accepted in writing as approved equal shall be replaced or revised to comply with Contract Documents at Contractor's expense.
 6. The manufacturers recommended installation procedures shall become basis for accepting or rejecting actual installation procedures used on Work.
 7. Shop drawings shall consist of detailed drawings with dimensions, schedules, weights, capacities, installation details and pertinent information needed to describe the material or equipment.
- E. Submittals required of materials and equipment under this Division include following listed items not supplied by Owner. These submittal requirements are intended to be complimentary to requirements that may be listed in individual sections. In event of conflict, more stringent requirement shall apply.
1. Conductors and Cables:
 - a. Submit product data for each specified product.
 - b. Submit tabular list of wire and wiring systems that will be increased in capacity or size to comply with Section 26 05 19 and/or similar requirements shown on Drawings. List shall include size shown on Drawings, proposed increase to comply with Section 26 0519, and proposed installed length.
 2. Raceways and Boxes:
 - a. Submit product data for surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
 - b. Submit Shop Drawings including layout drawings showing components and wiring for nonstandard boxes, enclosures, and cabinets.
 3. Wiring Devices:
 - a. Submit product data for each specified product.
 - b. Submit operation and maintenance data for wiring devices, for inclusion in "Operating and Maintenance Manual" specified in this Section.
 - c. Submit dimension plan for locations of all non-standard devices including but not limited to floor boxes, ceiling boxes, cord reels and welding boxes.
 4. Switchboards:
 - a. Submit product data for each product and component specified.
 - b. Submit Shop Drawings for each switchboard including dimensioned plans and elevations, component and device lists, and single-line diagram showing main and branch bus current ratings and short-time and short-circuit ratings of switchboard.
 - c. Submit schedule of features, characteristics, ratings, and factory settings of individual protective devices.
 - d. Submit manufacturer's schematic wiring diagram.
 - e. Submit point-to-point control wiring diagram, differentiating between manufacturer-installed and field-installed wiring.
 - f. Submit qualification data for field-testing organization certificates, signed by Contractor, certifying that organization complies with requirements specified in Quality Assurance below. Include list of completed projects with project names, addresses, names of Engineers and Owners, plus other information specified.
 - g. Submit maintenance data for materials and products, for inclusion in Operating and Maintenance Manual as specified in this Section.

5. Grounding:
 - a. Submit product data for grounding rods, connectors and connection materials, and grounding fittings.
6. Dry-Type Transformers:
 - a. Submit product data for each product specified, including dimensioned plans, sections, and elevations. Show minimum clearances and installed features and devices.
 - b. Submit wiring diagrams of products differentiating between manufacturer-installed and field-installed wiring.
 - c. Submit product certificates signed by manufacturers certifying that their products comply with specified requirements.
 - d. Submit operation and maintenance data for materials and products to include in "Operating and Maintenance Manual" specified in this Section.
7. Panelboards:
 - a. Submit product data for each type panelboard, accessory item, and component specified.
 - b. Submit Shop Drawings prepared by the manufacturers including dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include enclosure type with details for types other than NEMA Type 1; bus configuration and current ratings; short-circuit current rating of panelboard; and features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
 - c. Submit typewritten panelboard schedules to the Engineer for approval prior to installation.
 - d. Submit maintenance data for panelboard components, for inclusion in Operating and Maintenance Manual specified in this Section. Include instructions for testing circuit breakers.
8. Disconnect Switches:
 - a. Submit product data for disconnect switches and specified accessories.
9. Automatic Transfer Switches:
 - a. Submit Shop Drawings or product data for each transfer switch, including dimensioned plans, sections, and elevations showing minimum clearances; conductor entry provisions; gutter space; installed features and devices; and materials lists.
 - b. Submit wiring diagrams, elementary or schematic, differentiating between manufacturer-installed and field-installed wiring.
 - c. Submit operation and maintenance data for each type of product, for inclusion in Operating and Maintenance Manual specified in this section. Include features and operating sequences, both automatic and manual. List factory settings of relays and provide relay setting and calibration instructions.
 - d. Submit manufacturer's certificate of compliance to referenced standards and tested short-circuit closing and withstand ratings applicable to protective devices and current ratings.
10. Engine-Generator Set:
 - a. Submit exhaust emissions. Submit prototype test data.
 - b. Submit wiring diagrams for system, showing power and control connections and distinguishing between factory-installed and field-installed wiring.
 - c. Submit product data for products specified in this Section. Include data on features, components, ratings, and performance. Include a dimensioned outline plan and elevation drawings of the engine generator set, the weatherproof enclosure, sub-base fuel tank and other system components.

- d. Submit maintenance data for system and components for inclusion in Operating and Maintenance Manual specified in this Section.
 - e. Submit detailed operating instructions, covering operation under both normal and emergency conditions and sound test reports.
 - f. Submit certification of torsional vibration compatibility: Conform to NFPA 110.
 - g. Submit factory test reports for units to be shipped for this Project showing evidence of compliance with specified requirements.
11. Motor Controllers:
- a. Submit product data for specified products. Include dimensions, ratings, and data on features and components.
 - b. Submit maintenance data for products for inclusion in Operating and Maintenance Manual specified in this Section.
12. Interior Lighting:
- a. Submit product data describing fixtures, lamps, ballasts, and emergency lighting units. Arrange product data for fixtures in order of fixture designation. Include data on features and accessories.
 - b. Submit outline drawings indicating dimensions and principal features of fixtures, including color.
 - c. Submit electrical ratings and photometric data including certified results of laboratory tests for fixtures and lamps.
 - d. Submit battery and charger data for emergency lighting units.
 - e. Submit Shop Drawings detailing nonstandard fixtures and indicating dimensions, weights, and methods of field assembly, components, features, and accessories.
 - f. Submit wiring diagrams detailing wiring for control system showing both factory-installed and field-installed wiring for each specific system which differentiates between factory-installed and field-installed wiring.
 - g. Submit maintenance data for fixtures to include in operation and maintenance manual specified in this Section.
 - h. Submit lamp data for each fixture.
13. Fire Alarm System:
- a. Submit product data for each type of system component specified including dimensioned plans and elevations showing installed features and devices. Include list of materials and nationally recognized testing laboratory-listing data. Submit to Engineer after being reviewed and approved by local authority having jurisdiction.
 - b. Submit wiring diagrams from manufacturer differentiating clearly between factory- and field-installed wiring. Include diagrams for equipment and for system with terminals and interconnections identified. Make diagrams specific to this Project and distinguish between field and factory wiring.
 - c. Submit device address list.
 - d. Submit system operation description covering this specific Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are unacceptable.
 - e. Submit operating instructions for mounting at fire alarm control panel.
 - f. Submit battery hours of operation calculations for loss of normal power operation.

- g. Submit maintenance data for fire alarm systems to include in operation and maintenance manual specified in this Section. Include data for each type of product, including features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at site. Provide names, addresses, and telephone numbers of service organizations that carry stock of repair parts for system to be furnished.
 - h. Submit design drawings approved by local authority having jurisdiction.
14. Provide a dimension layout of electrical rooms(s) and elevator equipment room(s) if applicable.

1.7 SUBSTITUTIONS

- A. The Contract Documents list manufacturers' names and catalog numbers followed by phrase "or equal" are to establish a standard of quality and utility for the specified items and to provide a dimensional reference to the scaled drawings.
- B. Submittals for "equal" items shall include the following data, which is not necessarily required for specified items, which list the manufacturer and catalog number:
 - 1. Performance characteristics.
 - 2. Materials.
 - 3. Finish.
 - 4. Certification of conformance with specified codes and standards.
 - 5. Manufacturer's specifications and other data needed to prove compliance with specified requirements. Term "compliance" is understood to mean that the submitted equipment will meet or exceed the Contract Document requirements. Items that do not clearly meet this definition shall be identified and explained as required in following Paragraph.
 - 6. Identify all differences between the specified item and proposed item. Explain all differences with sufficient detail to permit the Engineer to easily determine that the substituted item complies with the functional intent. List disadvantages and advantages of proposed item versus specified item. Submit technical data sheets and/or pictures and diagrams to support and clarify. Organize in clear and concise format. Engineer shall approve substitutions in writing. Engineer's decision shall be final.
- C. Submittals of "equal" components or systems may be rejected if:
 - 1. Material or equipment would necessitate alteration of mechanical, electrical, architectural, or structural design.
 - 2. Dimensions vary from specified material or equipment so that accessibility or clearances are impaired or Work of other trades is adversely affected.
- D. Proposed substitutions for materials or equipment must be submitted 10 days prior to final bid date for consideration as approved equals. Otherwise, substitutions will not be permitted. Only the prime bidders shall be permitted make proposals for substitutions.
- E. No substitution shall be made unless authorized in writing by the Engineer. Should substitution be accepted, and should substitute material prove defective or otherwise unsatisfactory for service intended, and within guarantee period, replace this material or equipment with material or equipment specified, to satisfaction of Engineer and at no cost to Owner.

1.8 ORDINANCES, PERMITS, METERS, UTILITIES AND ROYALTIES

- A. Purchase all necessary permits and licenses necessary for completion of the Work. Pay all lawful fees required and necessary pursuant in obtaining said permits and licenses. Required certificates of approvals and inspections by local governing and regulating authorities.
- B. Pay all fees required for connection of utility power and telephone services required for the Work.

- C. Pay royalty payments or fees required for use of patented equipment or systems. Defend lawsuits or claims for infringement of patent rights and hold Owner and/or Engineer harmless from loss as result of said suits or claims.

1.9 COMPATIBILITY OF EQUIPMENT

- A. Assume full responsibility for satisfactory operation of component parts of electrical systems. Assure compatibility of equipment and performance of integrated systems in accordance with requirements of the Construction Documents. Notify the Engineer before submitting a bid should Specifications or Drawings make acceptance of responsibility impossible, prohibitive, or restrictive. The bid shall be accompanied by a written statement listing any objections or exceptions to the applicable specification section and/or drawing.

1.10 UTILITIES AND TEMPORARY POWER

- A. Verify location and capacity of all existing utility services before starting Work. The locations and sizes of electrical lines are shown in accordance with data secured from Owner's survey. The data shown is offered as estimating guide without guarantee of accuracy.
- B. Pay all utility charges for temporary power. Provide temporary lighting and power required. Install in accordance with OSHA requirements and as described in General Requirements Division 01.

1.11 FLASHINGS, SLEEVES, AND INSERTS

- A. Furnish and install flashings where conduits pass through outside walls. Flashings shall be properly formed to fit around conduit and shall be caulked, with 790 Silicone Building Sealant by Dow Corning Corporation, so as to make watertight seal between conduit and building.
- B. Unless otherwise specified, install sleeves for each conduit where it may pass through interior walls or floors. Galvanized 22-gage sheet iron sleeves shall be used. Finish flush with each finished wall surface. In pipe chases, the sleeve shall extend 1-1/2 inches above floor slab and shall be watertight.
- C. Raceways that pass through concrete beams or walls and masonry exterior walls shall be provided with galvanized wrought iron pipe sleeves, unless shown otherwise on drawings. Inside diameter of these sleeves shall be at least 1/2 inch greater than outside diameters of service pipes. After pipes are installed in these sleeves, fill annular space between pipes and sleeves with 790 Silicone Building Sealant by Dow Corning Corporation. Completed installation shall be watertight.
- D. Roof penetrations shall be provided with counter flashings arranged to provide weatherproof installation.
- E. Penetrations through walls, floors and ceilings shall be done in manner to maintain integrity of fire rating of respective wall, floor, or ceiling.
- F. Reference Division 7 for additional sealant requirements. Where conflicts occur with the specified requirements, the more stringent shall apply.

1.12 CUTTING AND PATCHING

- A. Perform cutting and patching in strict accordance with provisions of these Specifications and following:
 - 1. Coordinate Work to minimize cutting and patching.
 - 2. Use adequate number of skilled workers who are thoroughly trained and experienced in necessary crafts and who are completely familiar with specified requirements and methods needed for proper performance of Work.
- B. Request for Engineer's consent:
 - 1. Prior to cutting which affects structural safety, submit a written request to Engineer for permission to proceed with cutting.

2. When conditions of Work or schedule require a change of materials or methods for cutting and patching, notify Engineer and secure written permission to proceed with the work.
- C. Perform cutting and demolition using methods that will prevent damage to other portions of Work.
- D. Perform fitting and adjusting to provide a finished installation complying with specified tolerances and finishes.

1.13 SURFACE CONDITIONS

- A. Examine areas and conditions under which Work of this Division will be performed. Work required to correct conditions detrimental to timely and proper completion of Work shall be included as part of Work of this Division. Do not proceed until unsatisfactory conditions are corrected.

1.14 CONSTRUCTION REQUIREMENTS

- A. Drawings show arrangements of Work. Rearrangement of spaces and equipment will be considered when Project conditions make this necessary and/or materials or equipment can be installed to better advantage. Prior to proceeding with Work, coordinate with various trades to prepare and submit five (5) copies of Drawings of proposed arrangement for Engineer's review. Allow minimum of 10 working days for review.
- B. Installation or rearrangement of equipment and space for Contractor's convenience or to accommodate material or equipment substitutions will be considered. Assume responsibility for rearrangement of equipment and space and have Engineer review change before proceeding with Work. Request for changes shall be accompanied by Shop Drawings of affected equipment and space. Identify proposed monetary credits or other benefits. Allow minimum of 10 working days for review.
- C. Properly locate and size all required pipe sleeves and slots, holes, or openings in structure.

1.15 PREPARATION AND COORDINATION

- A. Coordinate the work in strict accordance with the Contract Documents as follows:
 1. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members and mechanical or other equipment, provide required supports and wiring to clear encroachment.
 2. Install power and control wiring for installation of equipment furnished under Divisions 21, 22 and 23. Furnish disconnect switches and other equipment as required for proper operation of equipment unless equipment is specified to be factory mounted.
- B. Information on the Drawings and in these Specifications is as accurate as could be secured, but absolute accuracy is not guaranteed. The drawings are diagrammatic, and the exact locations, distances, levels, and other conditions shall be governed by actual construction. The drawings and specifications shall be for guidance.
- C. Where receptacle locations are not dimensioned on either the Architectural or Engineering Drawings, the J-box may be located on the nearest stud. When receptacles are dimensioned on the Drawings, Provide a cross brace and mount the receptacle as dimensioned.
- D. Field-verify measurements. No extra compensation will be allowed because of differences between Work shown on Drawings and actual site measurements.
- E. Branch circuit wiring and arrangement of home runs have been designed for maximum economy consistent with adequate sizing and other considerations. Increase size of wiring and wiring systems to accommodate more stringent requirements listed in these Specifications or on Drawings. Install wiring with circuits arranged as shown on Drawings. Deviations shall be approved in advance by Engineer.

1.16 PROJECT RECORD DOCUMENTS

- A. Provide Project record documents associated with Work in accordance with provisions of these Specifications. Refer to Division 1 for additional requirements.
- B. Throughout progress of the Work, maintain accurate record of all changes in Contract Documents (Drawings and Specifications). Changes shall include Addendums issued during bidding and location of electrical service lines, receptacles, and outside utilities.
- C. Delegate responsibility for maintenance of record documents to one person on Contractor's staff.
- D. Accuracy of Records
 1. Thoroughly coordinate changes within record documents, making adequate and proper entries on each page of Specifications and each sheet of Drawings and other documents where required to show change properly. Match symbology and format of base documents.
 2. Accuracy of records shall be such that future searches for items shown in Contract Documents may rely reasonably on information obtained from approved Project record documents.
- E. Maintain a job set of record documents protected from deterioration and from loss and damage until completion of Work. Transfer all recorded data to final Project record documents.
- F. Making Entries on Drawings
 1. Using erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
 2. Date entries.
 3. Call attention to entry by "cloud" drawn around area or areas affected.
 4. In event of overlapping changes, use different colors for overlapping changes.
 5. Make entries within 24 hours after receipt of information that changes have occurred.
 6. Maintain base drawing format and use the same symbols.
 7. Convert field mark-ups to finished CADD record drawings when required in this Section.
- G. Conversion of Schematic Layouts
 1. In some cases on Drawings, arrangements of conduits, circuits, and similar items, are shown schematically and are not intended to portray precise physical layout. Determine final physical arrangement, subject to Engineer's approval. The design of future modifications of facility may require accurate information as to final physical layout of items that are shown only schematically on Drawings. Show by dimension accurate to within one inch, centerline of each run of sleeves and conduit below grade, in walls, or in concrete slab, etc. Surface mounted device indicates exact location:
 - a. Clearly identify item by accurate note (e.g., "Rigid Conduit").
 - b. Show, by symbol or note, vertical location of item "under slab," "in ceiling plenum," "exposed," etc.
 - c. Make identification sufficiently descriptive that it may be related reliably to Specifications.
- H. Final Project Record Documents
 1. The purpose of the final Project Record Documents is to provide factual information regarding all aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive site measurement, investigation, and examination.

2. Provide CADD electronic files in dwg Format using AutoCAD Release 2002 or later software. Upon written request, completion of a release form, and payment of the Engineer's standard fee of \$200 plus applicable sales tax for a set-up charge and \$50 per drawing plus applicable sales tax for copies of such files, Engineer will provide AutoCAD Release 2002 electronic files of base Contract Drawings in dwg format on compact discs. Engineer will also provide a list of drawing layers and names that shall be maintained.
3. Provide completed record drawings on CD and one mylar film reproducible of each drawing.
4. Refer to Division 01 for additional requirements.

1.17 OPERATION AND MAINTENANCE DATA

- A. Submit two copies of preliminary draft of proposed manual or manuals to Engineer for review and comments. Allow minimum of 10 working days for review.
- B. Submit approved manual to Engineer prior to indoctrination of operation and maintenance personnel.
- C. Where instruction manuals are required for submittal, they shall be prepared in accordance with the following:

Format:

Size: 8-1/2-inch by 11-inch

Paper: White bond, at least 20 pound weight

Text: Neatly written or printed

Drawings: 11 inches in height preferable; bind in with text; foldout acceptable; larger drawings acceptable but fold to fit within Manual and provide drawing pocket inside rear cover or bind in with text.

Flysheets: Separate each section of Manual with neatly prepared flysheets briefly describing contents of ensuing section; flysheets may be in color.

Binding: Use heavy-duty plastic or fiberboard covers with binding mechanism concealed inside manual; 3-ring binders will be acceptable; binding is subject to Engineer's approval.

Measurements: Provide measurements in U.S. standard units (e.g., feet, inches, and pounds). Where items may be expected to be measured within 10 years in accordance with metric formulae, provide additional measurements in "International System of Units" (SI).

- D. Provide front and back covers for each manual, using durable material approved by Engineer, and clearly identified on or through cover with at least following information

O&M Manual Requirements <i>MEP & Fire Suppression</i>	
•	Title Page <ul style="list-style-type: none"> ○ Job Name ○ Site Address ○ Include Contact information of prime contractor.
•	Table of contents
•	Warranty Information. <ul style="list-style-type: none"> ○ Include all contractor warranties <ul style="list-style-type: none"> ▪ Signed and dated documents
•	Permits-Inspections
•	Subcontractor list <ul style="list-style-type: none"> ○ Include all subcontractors. <ul style="list-style-type: none"> ▪ Company name, Contact info. ▪ Trade Responsibility.
•	Vendor list <ul style="list-style-type: none"> ○ Include name and addresses of vendors <ul style="list-style-type: none"> ▪ Warranty information ▪ Replaceable parts
•	Approved submittals <ul style="list-style-type: none"> ○ Include all approved product submittals
•	Reports/Certificates/Redlines <ul style="list-style-type: none"> ○ Engineers Observation Reports ○ Electrical tests. ○ Grounding test Report ○ Generator testing ○ Overcurrent Protection Study ○ Sequence of operations report ○ Surge Protection Commissioning Report ○ Contractor Start-up Report ○ Manufacturer Start-up Report ○ Owners Training Report. (All Trades)
•	O&M Manuals
•	Equipment Information. <ul style="list-style-type: none"> ○ Include Model, Serial and location.
•	Signed Approval <ul style="list-style-type: none"> ○ Page for approval signature of the engineer and approval date.

OPERATING AND MAINTENANCE INSTRUCTION

Name and Address of Work

Name of Contractor

General subject of this manual

Space for approval signature of Engineer and approval date[s]

- E. Contents: Include at least following:
1. Neatly typewritten index near front of Manual, giving immediate information as to location within manual of emergency information regarding installation.
 2. Complete instructions regarding operation and maintenance of equipment involved including lubrication, disassembly, and reassembly.
 3. Complete nomenclature of parts of equipment.

4. Complete nomenclature and part number of replaceable parts, name and address of nearest vendor and other data pertinent to procurement procedures.
5. Copy of guarantees and warranties issued.
6. Manufacturer's bulletins, cuts, and descriptive data, where pertinent, clearly indicating precise items included in this installation and deleting, or otherwise clearly indicating, manufacturers' data with which this installation is not concerned.
7. Other data as required in pertinent Sections of these Specifications.

1.18 EQUIPMENT FOUNDATIONS

- A. Provide equipment foundations in accordance with provisions of these Specifications.
- B. Provide concrete bases for main switchboard, distribution panelboards, floor-mounted transformers and other equipment that is to be pad- or floor-mounted. Bases shall be 4 inches high above finished floors or grades (unless otherwise noted) and shall protrude 2 inches beyond sides of equipment and shall have exposed chamfered edges. Construct bases from ready-mixed hard rock concrete, ASTM C94, reinforced with #3 Rebars, ASTM A615, Grade 40. Rebars shall be located at 18 inches on center each way.
- C. Field-verify exact location of outdoor pad mounted equipment with Engineer. Supply necessary fill and grade site to provide natural drainage away from equipment.
- D. Provide structural concrete foundations for generator, pad mounted transformers and lighting pole bases.

1.19 TESTING AND INSPECTION

- A. Provide personnel and equipment, make required tests, and secure required approvals from Engineer and Governmental Agencies having jurisdiction
- B. Make written notice to Engineer adequately in advance of each of following stages of construction:
 1. When rough in is complete, but not covered
 2. At completion of Work of this Division
 3. In underground condition prior to placing backfill, concrete floor slab, and when associated electrical Work is in place
- C. When material or workmanship is found to not comply with specified requirements, remove items from job site and replace them with items complying with specified requirements at no additional cost to Owner. This shall be performed within 3 days after receipt of written notice of noncompliance.
- D. In Engineer's presence, test parts of electrical system and prove that items provided under this Division function electrically in required manner.

1.20 SITE VISITS BY FACTORY PERSONNEL

- A. Pay for travel expenses, living expenses, and miscellaneous expenses associated with site visits of factory personnel to perform on site testing, inspections, and reviews.

1.21 WARRANTY

- A. Warrant equipment and workmanship for period of one year after date of substantial completion and replace or repair faulty equipment or installation at no cost to Owner for service during this period, in accordance with requirements of Division 1.
- B. Warranty shall not void specific warranties issued by manufacturers for greater periods of time or void rights guaranteed to Owner by law.
- C. Warranties shall be in writing in form satisfactory to Owner, and shall be delivered to Owner before final payment is made.
- D. All manufacturers shall provide the manufacturers warranties starting at time of start-up and not at time of delivery.

1.22 PROJECT COMPLETION

- A. Upon completion of Work of this Division, thoroughly clean exposed portions of electrical installation, removing traces of soil, labels, grease, oil, and other foreign material, and using only type cleaner recommended by manufacturer of item being cleaned.
- B. Thoroughly indoctrinate Owner's operation and maintenance personnel in contents of operations and maintenance manual required to be submitted as part of this Division of these Specifications.

1.23 TRAINING

- A. Contractors are responsible to provide owner with an adequate amount of training to be able to operate any system installed.
 - 1. This includes training for any Lighting Controls, Generator, Digital Controls, Security systems,
 - 2. Provide a sign in sheet that is to be added to the O&M manual
 - 3. Owners & all building maintenance personal are required to have training.

END OF SECTION

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SECTION 26 05 03 - FIRESTOPPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

Only tested firestop systems shall be used in specific locations as follows:

Penetrations for the passage of conduit and other electrical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.

- A. Completion of firestop installations to maintain the rating integrity of the barrier penetrated.
- B. **SUBMITTALS: Provide submittals as required in section 26 00 10, "submittal Process."**

1.3 DEFINITIONS

- A. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, water and hot gases through penetrations in fire rated wall and floor assemblies.

1.4 REFERENCES

- A. Test Requirements: ASTM E-814, "Standard Method of Fire Tests of Through Penetration Fire Stops" (July 1997).
- B. Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually.
 - 1. UL Fire Resistance Directory:
 - a. Through-Penetration Firestop Devices (XHCR)
 - b. Fire Resistance Ratings (BXUV)
 - c. Through-Penetration Firestop Systems (XHEZ)
 - d. Fill, Voids, or Cavity Material (XHHW)
 - e. Forming Materials (XHKU)
- C. Inspection Requirements: ASTM E 2174-01 "Standard Practice For On-Site Inspection of Installed Fire Stops".
- D. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.
- E. ASTM E-84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- F. All major building codes: ICBO, SBCCI, BOCA, and IBC.
(Note to specifier: Retain or delete building codes listed above as applicable).
- G. NFPA 101 - Life Safety Code
- H. NFPA 70 – National Electric Code.

1.5 QUALITY ASSURANCE

- A. A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

- B. Firestop System installation must meet requirements of ASTM E-814 or UL 1479 tested assemblies that provide a fire rating equal to that of construction being penetrated.
- C. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- D. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- E. For those firestop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by the International Firestop Council (September 7, 1994 as may be amended from time to time).

1.6 SUBMITTALS

- A. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with Section 1300.
- B. Manufacturer's engineering judgment identification number and drawing details when no UL system is available for an application. Engineer judgment must include both project name and contractor's name that will install firestop system as described in drawing.
- C. Submit material safety data sheets provided with product delivered to job-site.

1.7 INSTALLER QUALIFICATIONS

- A. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary experience, staff, and training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.
- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- E. Do not use damaged or expired materials.

1.9 PROJECT CONDITIONS

- A. Do not use materials that contain flammable solvents.
- B. Scheduling
 - 1. Schedule installation of CAST IN PLACE firestop devices **after** completion of floor formwork, metal form deck, or composite deck but **before** placement of concrete.
 - 2. Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- D. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

PART 2 – PRODUCTS

2.1 FIRESTOPPING, GENERAL

- A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- C. Firestopping materials are either “cast-in-place” (integral with concrete placement) or “post installed”. Provide cast-in-place Firestop devices prior to concrete placement.

2.2 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:
 - 1. Hilti, Inc., Tulsa, Oklahoma
800-879-8000
 - 2. Tremco Sealants & Coatings, Beechwood, Ohio
(216) 292-5000
 - 3. 3M Fire Protection Products, St. Paul, Minnesota
(612) 736-0203
 - 4. Johns-Manville Firetemp
 - 5. Other manufacturers listed in the U.L. Fire Resistance Directory – Volume 2

2.3 MATERIALS

- A. Use only firestop products that have been UL 1479, ASTM E-814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- B. Cast-in place firestop devices are installed prior to concrete placement for use with non-combustible and combustible plastic conduit penetrating concrete floors, the following products are acceptable:
 - 1. Hilti CP 680 Cast-In Place Firestop Device
 - 2. Hilti CP 681 Tub Box Kit
 - 3. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- C. Sealants or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
 - 1. Hilti FS-ONE Intumescent Firestop Sealant
 - 2. Hilti CP 604 Self-leveling Firestop Sealant
 - 3. Hilti CP 620 Fire Foam
 - 4. 3M Fire Stop Sealant 2000
 - 5. 3M Fire Barrier CP25 WB
 - 6. Tremco Tremstop Fyre-Sil Sealant
 - 7. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- D. Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:
 - 1. Hilti CP 601s Elastomeric Firestop Sealant
 - 2. Hilti CP 606 Flexible Firestop Sealant
 - 3. Hilti FS-ONE Intumescent Firestop Sealant
 - 4. Hilti CP 604 Self-leveling Firestop Sealant
 - 5. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2

- E. Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
 - 1. Hilti FS-ONE Intumescent Firestop Sealant
 - 2. 3M Fire Barrier CP25 WB
 - 3. Tremco Tremstop WBM Intumescent Firestop Sealant
 - 4. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- F. Intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles, the following products are acceptable:
 - 1. Hilti FS-ONE Intumescent Firestop Sealant
 - 2. Hilti CP 620 Fire Foam
 - 3. Hilti CP 618 Firestop Putty Stick
 - 4. 3M Fire Barrier CP25 WB
 - 5. Tremco Tremstop WBM Intumescent Firestop Sealant
 - 6. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- G. Non curing, re-penetrable intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles, the following products are acceptable:
 - 1. Hilti CP 618 Firestop Putty Stick
 - 2. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- H. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:
 - 1. Hilti CP 617 Firestop Putty Pad
 - 2. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 1
- I. Firestop collar or wrap devices attached to assembly around combustible plastic conduit, the following products are acceptable:
 - 1. Hilti CP 642 Firestop Collar
 - 2. Hilti CP 643 Firestop Collar
 - 3. 3M Fire Barrier PPD Plastic Pipe Device
 - 4. Hilti CP 645 Wrap Strip
 - 5. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- J. Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
 - 1. Hilti CP 637 Firestop Mortar
 - 2. Hilti FS 657 FIRE BLOCK
 - 3. Hilti CP 620 Fire Foam
 - 4. 3M Firestop Foam 2001
 - 5. 3M Fire Barrier CS-195 Composite Sheet
 - 6. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- K. Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
 - 1. Hilti FS 657 FIRE BLOCK
 - 2. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2
- L. Provide a firestop system with an "F" Rating as determined by UL 1479 or ASTM E814, which is equal to the time rating of construction being penetrated.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - 1. Verify penetrations are properly sized and in suitable condition for application of materials.
 - 2. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that

- may affect proper adhesion.
- 3. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
- 4. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
- 5. Do not proceed until unsatisfactory conditions have been corrected

3.2 COORDINATION

- A. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
- B. Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

3.3 INSTALLATION

- A. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.
 - 1. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
 - 2. Protect materials from damage on surfaces subjected to traffic.

3.4 FIELD QUALITY CONTROL

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- B. Keep areas of work accessible until inspection by applicable code authorities.
- C. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" or other recognized standard.
- D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.5 ADJUSTING AND CLEANING

- A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

END OF SECTION

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SECTION 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

- A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of conductors as indicated on the Drawings and as specified.
- B. Work included:
 - 1. Wiring connections and terminations, 600 Volt rating and below.
- C. **SUBMITTALS: Provide submittals as required in section 26 05 10, "Submittal Process."**

1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance to the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
- C. When requested, provide the manufacturer's certifications that confirm that materials meet or exceed minimum requirements as specified.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Provide conductors made of soft-drawn, annealed copper with conductivity not less than that of 98% pure copper.
- B. Building Wire:
 - 1. Thermoplastic-insulated building wire: NEMA WC 5.
 - 2. Feeders and branch circuits: Copper, stranded conductor, 600-volt insulation, THHN/THWN-2.
 - 3. Control circuits: Copper, stranded conductor 600-volt insulation, THHN/THWN-2.
 - 4. Where more than one conductor of the same phase or more than one neutral conductor occurs at the same outlet or junction box, these conductors shall be identifiable from each other by use of stripes or distinguishing markings.
 - 5. Use the following color code system:

	240/120 Volt Systems	208Y/120 Volt Systems	480Y/277 Volt Systems
Phase A	Black	Black	Brown
Phase B	Orange	Red	Orange
Phase C	Blue	Blue	Yellow
Neutral	White	White	Gray
Ground	Green	Green	Green

Switch	Purple	Purple	Purple
--------	--------	--------	--------

- 6. Type MC and AC cable shall not be used.
- C. Remote Control and Signal Cable:
 - 1. Control cable for Class 2 or Class 3 remote control and signal circuits: Copper conductor, 300-volt insulation, rated 60-degree C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.
 - 2. Plenum cable for Class 2 or Class 3 remote control and signal circuits: Copper conductor, 300-volt insulation, rated 60-degree C, individual conductors twisted together, shielded, and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.2 ACCEPTABLE MANUFACTURERS

- A. Provide products by the following manufacturers:
 - 1. Rome
 - 2. Pirelli
 - 3. Belden
 - 4. Southwire
 - 5. Encore Wire
 - 6. Or approved equal

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS (LESS THAN 600 VOLTS)

- A. Install conductor sizes as indicated. Provide No. 10 AWG conductor for the entire circuit length for single-phase, 20-ampere circuits for which the distance from panelboard to the last outlet is more than 100 feet for 120-volt circuits or 200 feet for 277-volt circuits. The minimum wire size shall be 12 AWG for power and lighting circuits, and no smaller than 18 AWG for control wiring. Remote control wiring shall not be less than 14 AWG for installed lengths of 50 feet or less. Remote control conductors shall be increased one size (per NEC Table 310) for each additional 50 feet of length. Increase the raceway system to accommodate the increased wire size.
- B. Provide an equal number of conductors of equal size for each phase of a circuit in same raceway or cable.
- C. Splice only in junction boxes, outlet boxes, pullboxes, or manholes.
- D. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- E. Make conductor lengths for parallel circuits equal.
- F. Phasing shall be consistent throughout each installation from the service connection to every device connection and outlet. Where interface is made to an existing system, the existing phasing configuration shall be maintained.

3.2 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL listed wire-pulling lubricant for pulling 4 AWG and larger wires.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.

3.3 CABLE INSTALLATION

- A. Provide protection for exposed cables where subject to damage.
- B. Support cables above accessible ceilings. Do not rest on ceiling tiles, light fixtures or air devices. Use spring metal clips or metal cable ties to support cables from structure. Include bridle rings or drive rings.

- C. Use suitable cable fittings and connectors.

3.4 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice only in accessible boxes or manholes.
- B. Use solderless pressure connectors with insulating covers for copper wire splices and taps 8 AWG and smaller.
- C. Use split bolt connectors for copper wire splices and taps 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.
- D. Thoroughly clean wires before installing lugs and connectors.
- E. Make splices, taps and terminations to carry full capacity of conductors without perceptible temperature rise.
- F. Terminate spare conductors with electrical tape.
- G. Field Testing. Insulation resistance of all feeder conductors served by a protective device rated 200A or higher shall be tested. Each conductor shall have its insulation resistance tested after the installation is completed and all splices, taps and connections are made except connection to or into its source and point (or points) of termination. Insulation resistance of conductors which are to operate at 600 volts or less shall be tested by using a Biddle Megger of not less than 1000 volts d-c. Insulation resistance of conductors rated at 600 volts shall be free of shorts and grounds and have a minimum resistance phase-to-phase and phase-to-ground of at least 10 megohms. Conductors that do not exceed insulation resistance values listed above shall be removed at Contractor's expense and replaced and test repeated. The Contractor shall furnish all instruments and personnel required for tests, shall tabulate readings observed, and shall forward copies of the test readings to the Owner in accordance with Section 26 0593. These test reports shall identify each conductor tested, date and time of test and weather conditions. Each test shall be signed by the party making the test.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under applicable provisions of Division 26.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Torque test conductor connections and terminations to manufacturers recommended values.
- D. Perform continuity tests on all power and equipment branch circuit conductors. Verify proper phasing of all connections.

3.6 WIRE AND CABLE INSTALLATION SCHEDULE

- A. All locations: Building wire in raceways.

3.7 600-VOLT INSULATED CONDUCTORS

- A. Size: Install conductor sizes as indicated. Provide No. 10 AWG conductor for the entire circuit length for single-phase, 20-ampere circuits for which the distance from panelboard to the last outlet is more than 100 feet for 120-volt circuits or 200 feet for 277-volt circuits.
- B. Home Runs: Except where specifically indicated, provide branch circuit home runs with not more than two different line conductors and a common neutral in a single raceway for 3-wire, single-phase systems, nor more than three different line conductors and a common neutral in a single raceway for 4-wire, 3-phase systems. Use home run circuit numbers as indicated for panelboard connections.
- C. Where more than one conductor of the same phase or more than one neutral conductor occurs at the same outlet or junction box, these conductors shall be identifiable from each other by use of stripes or distinguishing markings.

END OF SECTION

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SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

- A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of electrical systems grounding as shown or indicated on the Drawings and/or as specified.
- B. Work Included:
 - 1. Building systems grounding.
 - 2. Electrical equipment and raceway grounding and bonding.
 - 3. Generators grounding and bonding.
 - 4. Lighting poles grounding and bonding.
 - 5. Lightning protection system bonding.
- C. SUBMITTALS: **Provide submittals as required in section 26 05 10, "Submittal Process."**

1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
- C. When requested, provide the Engineer with the manufacturer's certificate that materials meet or exceed minimum requirements as specified.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide electrical grounding system indicated with assembly of materials, including but not limited to:
 - 1. Wires and cables.
 - 2. Connectors.
 - 3. Terminals.
 - 4. Ground rods.
 - 5. Bonding jumper braid.
 - 6. Surge arrestors.
- B. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE, and established industry standards for applications indicated.

2.2 CHEMICAL GROUND ROD

- A. Self-contained ground rod(s) using electrolytically enhanced grounding shall be provided for power system grounding where indicated on the drawings. The ground rod shall operate by hygroscopically extracting moisture from the air to activate the electrolytic process improving performance. The ground rod system shall be UL listed and have been manufactured for a minimum of 10 years. The ground rod system shall be 100% self activating sealed and maintenance free. The system shall not require the addition of chemical or water solutions.
- B. Electrode unit
 1. The copper ground rod shall consist of 2" nominal diameter hollow copper tube with a wall thickness of not less than .083". The tube shall be permanently capped on the top and bottom. Air breather holes shall be provided in the top of the tube and drainage holes shall be provided in the bottom of the tube for electrolyte drainage into the surrounding soil. Shaft configuration: Straight Shaft Model No: K2-1020CS; UL Listing: 467.
 2. The ground rod shall be filled from the factory with non-hazardous Calsolyte to enhance grounding performance.
 3. Ground rod shall be twenty feet long for straight (vertical) installation.
 4. A stranded 4/0 AWG Cu ground wire shall be Cadwelded to the side of rod for electrode conductor connection. A clamping "U-bolt" with pressure plate on the tip end of the tube shall be provided for testing and temporary connections.
- C. Ground Access Box
 1. Provide a precast concrete box with slots for conduit entrances. Minimum size shall be ten-inch diameter by twelve high. Provide a cast iron, flush traffic rated cover with "breather" slots, XIT model #XB-12.
- D. Backfill Material
 1. Natural volcanic, non-corrosive form of bentonite clay grout backfill material free of polymer sealant. XIT model #LNC.
 2. Shall absorb approximately 14 gallons of water per 50# bag for optimal 30% solids density.
 3. PH value 8-10 with maximum resistivity of 3 ohm-m at 30% solids density.
- E. Manufacturer: Lyncole XIT Grounding, 3547 Voyager St., Torrance, CA 90503, Phone 800-962-2610; or approved equal.
- F. Ground Wire Termination: Exothermic connection to 4/0 conductor. U-bolt with pressure plate provided as test point.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install electrical grounding systems in accordance with applicable portions of NEC, with NECA's "Standard of Installation," and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.
- B. Provide a separate, insulated equipment grounding conductor in feeder circuits. Terminate each end on a grounding lug, bus, or bushing.
- C. Connect grounding electrode conductors to metal water pipe using a suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.
- D. Installation of Chemical Ground Rod
 1. Install a supplemental ground rod system in compliance with manufacturer's instruction or recommendation.
 2. Bore minimum 6" diameter hole, 6" deeper than the length of rod to be buried. Insure that the top of the copper chemical ground rod will not come in contact with the metal grate of the protective box or hand-hole cover.
 3. Remove sealing tape from leaching holes
 4. Place chemical ground rod in hole, so that the top of unit is about 6" below grade.

5. Backfill.
6. Lynconite backfill is specific clay (bentonite clay) included with the system. Mix each 50# backfill grout material with 14 gallons water to form a slurry and pour around chemical ground rod up to "bury to here sticker".
7. Place protective box in accordance with the drawings
8. Remove sealing tape from the top breather holes to activate.
9. Connect grounding electrode conductor to ground rod pigtail exothermically(Cadweld or Thermoweld).
10. Bury grounding conductor 30" below grade. Cover conductor with a small amount of backfill for protection against corrosion.

3.2 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Electrical Tests:
 1. Perform fall-of-potential test or alternative in accordance with IEEE Standard 81-1991 on the main grounding electrode or systems.
 2. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
- C. Test Values:
 1. The resistance between the main grounding electrode and ground should be no greater than one ohm. Install additional grounding electrodes, as required, to achieve the specified resistance value.
 2. Investigate point-to-point resistance values which exceed 0.5 ohm. Correct deficiencies at no additional cost. Retest to prove compliance
- D. Provide written certification to the Engineer that the grounding system has been tested and complies with the specified requirements.
- E. Provide test report.

END OF SECTION

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SECTION 26 05 29 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

- A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of support systems as shown or indicated on the Drawings and/or as specified.
- B. Work Included:
 - 1. Conduit and equipment supports
 - 2. Fastening hardware
- C. **SUBMITTALS: Provide submittals as required in section 26 05 10, "Submittal Process."**

1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work in this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
- C. When requested, provide the Architect with manufacturer's certificates that confirm materials meet or exceed minimum requirements as specified.

PART 2 - PRODUCTS

2.1 HANGERS AND CLAMPS

- A. Provide supporting devices of types, sizes, and materials indicated, and having the following construction features:
 - 1. Clevis Hangers: For supporting 2" rigid metal conduit; galvanized steel; with 1/2" diameter hole for round steel rod, approximately 54 pounds per units.
 - 2. Riser Clamps: For supporting 5" rigid metal conduit; black steel; with 2 bolts and nuts, and 4" ears, approximately 510 pounds per 100 units.
 - 3. Reducing Couplings: Steel rod reducing coupling, 1/2" x 5/8", black steel, approximately 16 pounds per 100 units.
 - 4. C-Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2", approximately 52 pounds per 100 units.
 - 5. I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2"; approximately 52 pounds per 100 units.
 - 6. One-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; approximately 7 pounds per 100 units.
 - 7. Two-Hole Conduit Straps: For supporting 3/4" rigid metal conduit, galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.
 - 8. Hexagon Nuts: For 1/2" rod size; galvanized steel; approximately 4 pounds per 100 units.

9. Round Steel Rod: Black steel; 1/2" diameter; approximately 67 pounds per 100 feet.
10. Offset Conduit Clamps: For supporting 2" rigid metal conduit; black steel; approximately 200 pounds per 100 units.
- B. Anchors: Provide anchors of types, sizes, and materials indicated, and having the following construction features:
 1. Lead Expansion Anchors: 1/2", approximately 38 pounds per 100 units.
 2. Toggle Bolts: Springhead; 3/16" x 4"; approximately 5 pounds per 100 units.
- C. Sleeves and Seals: Provide sleeves and seals, of types, sizes and materials indicated; and having the following construction features:
 1. Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals, of types and sizes indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
- D. Conduit Cable Supports: Provide cable supports with insulating wedging plug for non-armored type electrical cables in risers; construct for 2" rigid metal conduit; 3-wires, type wire as indicated; construct body of malleable iron casting with hot dip galvanized finish.
- E. U-Channel Strut Systems: Provide U-channel strut system for supporting electrical equipment, 16-gage hot dip galvanized steel, of types and sizes indicated; construct with 9/16" diameter holes, 8" O.C. on top surface, with standard green finish, and with the following fittings which mate and match with U-channel:

Fixture hangers	Channel hangers
End caps	Beam clamps
Thin wall conduit clamps	Wiring stud
Rigid conduit clamps	Conduit hangers
U-bolts	

2.2 FABRICATED SUPPORTING DEVICES

- A. Provide pipe sleeves of one of the following:
 1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gages: 3" and smaller, 20 gauge; 4" to 6", 16 gauge; over 6", 14 gauge.
 2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
 3. Iron Pipe: Fabricate from cast iron or ductile iron pipe; remove burrs.
 4. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe; remove burrs.
- B. Sleeve Seals: Provide sleeve seals for sleeves located in foundation walls below grade, or in exterior walls, of one of the following:
 1. Dow # 790 Silicone Building Sealant by Dow Corning Corporation.

PART 3 - EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, preset inserts, or beam clamps.
- B. Install hangers, supports, clamps, and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with maximum spacing indicated.
- C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or present inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

- D. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- E. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- F. Install freestanding electrical equipment on concrete pads.
- G. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- H. Bridge studs top and bottom with channels to support surface and flush-mounted cabinets and panelboards in stud walls.
- I. Tighten sleeve seal nuts until sealing grommets have expanded to form watertight seal.

END OF SECTION

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26 05 33.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

- A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of a complete and operating electrical raceway system, as indicated on the Drawings and as specified.
- B. Work included:
 - 1. Rigid metal conduit and fittings
 - 2. Electrical metallic tubing and fittings
 - 3. Flexible metal conduit and fittings
 - 4. Non-metallic conduit and fittings
 - 5. Surface-mounted raceway
- C. SUBMITTALS: **Provide submittals as required in section 26 05 10, "Submittal Process."**

1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance to the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
- C. When requested, provide the Architect with manufacturer's certificates that confirm that materials meet or exceed minimum requirements as specified.

PART 2 - PRODUCTS

2.1 CONDUITS AND FITTINGS

- A. Provide metal conduits, tubing, fittings, and couplings of types, grades, sizes, and weights (wall thickness) for each service indicated. Where types and grades are not indicated, provide proper selection determined by installer to fulfill wiring requirements and comply with applicable portions of NEC for raceways.
- B. Rigid Metal Conduit and Fittings
 - 1. Rigid steel conduit: ANSI C80.1
 - 2. Fittings and conduit bodies: ANSI/NEMA FB 1; threaded type, material to match conduit.
- C. Electrical Metallic Tubing (EMT) and Fittings
 - 1. EMT: ANSI C80.3 galvanized tubing
 - 2. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel compression type
- D. Flexible Metal Conduit and Fittings
 - 1. Conduit: FS WW-C-566; steel
 - 2. Fittings and Conduit Bodies: ANSI/NEMA FB 1
- E. Liquid tight Flexible Conduit and Fittings
 - 1. Conduit: Flexible metal conduit with PVC jacket
 - 2. Fittings and Conduit Bodies: ANSI/NEMA FB 1

- F. Plastic Conduit and Fittings
 - 1. Conduit: NEMA TC 2; Schedule 40 PVC
 - 2. Fittings and Conduit Bodies: NEMA TC 3

2.2 CONDUIT SUPPORTS

- A. Conduit Clamps, Straps, and Supports: Steel or malleable iron.

PART 3 - EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. Size of conduit shall be as indicated on the drawings or sized for conductor type installed, whichever is larger. Size all conduits in accordance with the NEC. Minimum conduit size shall be $\frac{3}{4}$ inch.
- B. Arrange conduit to maintain headroom and present a neat appearance.
- C. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
- D. Maintain minimum 6-inch clearance between conduit and piping. Maintain 12-inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.
- E. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.
- F. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps.
- G. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.

3.2 CONDUIT INSTALLATION

- A. Cut conduit square using a saw or pipe cutter; de-burr cut ends.
- B. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- C. Use conduit hubs for fastening conduit to cast boxes and for fastening conduit to sheet metal boxes in damp or wet locations.
- D. Install no more than the equivalent of three 90-degree bends between boxes.
- E. Use conduit bodies to make sharp changes in direction, as around beams.
- F. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2-inches in size.
- G. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- H. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
- I. Provide a pull tape for spare empty conduits. The tape shall be fiberglass reinforced polyester tape with distance marking in feet continuous along its length. Furnish T&B or Greenlee products.
- J. Install expansion joints where conduit crosses building expansion joints.
- K. Where conduit penetrates fire-rated walls and floors, provide mechanical firestop fittings with UL listed fire rating equal to wall or floor rating. Seal opening around conduit with UL listed foamed silicone elastomer compound.
- L. Route conduit through roof openings for piping and ductwork where possible; otherwise route through roof jack with pitch pocket.
- M. Maximum size conduit in slabs above grade: $\frac{3}{4}$ inch.
- N. Use PVC-coated rigid steel factory elbows for bends in plastic conduit runs longer than 100 feet or in plastic conduit runs, which have more than two bends regardless of length.
- O. Make joints in accordance with manufacturers' written instructions.

- P. Provide plastic warning tape for underground conduit or duct bank installations. Install warning tape directly above conduit one foot below finished grade or as shown on drawings.
- Q. Sand for intermediate fill around underground conduits shall be washed sand, suitable for concrete or masonry. Reference Section 26 0500 for additional backfill and excavation requirements.

3.3 CONDUIT INSTALLATION SCHEDULE

- A. Underground installations more than two feet from foundation wall: Rigid steel conduit or Schedule 40 plastic conduit.
- B. Installations in or under concrete slab, or underground within 2 feet of foundation wall: Rigid steel conduit.
- C. In slab above grade: Rigid steel conduit.
- D. Exposed outdoor locations: Rigid steel conduit.
- E. Wet interior locations: Rigid Steel Conduit.
- F. Concealed dry interior locations: Electrical metallic tubing.
- G. Exposed dry interior locations: Electrical metallic tubing.

3.4 CONDUIT IN DETENTION AREAS

- A. Conduits shall be concealed in CMU walls.
- B. Conduits shall be concealed in concrete walls and ceilings.
- C. Conduits may be exposed in electric rooms, mechanical rooms and plumbing chases.

END OF SECTION

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SECTION 26 05 33.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

- A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of outlets, pull and junction boxes as indicated on the Drawings and specified.
- B. Work included:
 - 1. Wall and Ceiling Outlet Boxes
 - 2. Pull and Junction Boxes
 - 3. Combination power/data flush floor boxes

1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
- C. When requested, provide the Engineer with manufacturer's certificates that confirm that materials meet or exceed minimum requirements as specified.

1.4 SUBMITTALS

- A. **SUBMITTALS: Provide submittals as required in section 26 05 10, "Submittal Process."**

PART 2 - PRODUCTS

2.1 BOXES

- A. Provide standard, stamped galvanized steel boxes except as hereinafter noted, by Steel City or approved equal.
- B. Outlet Boxes
 - 1. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, with 1/2 inch male fixture studs where required.
 - 2. Cast Boxes: Aluminum or cast ferroalloy, deep type, gasket and cover, threaded hubs.
- C. Pull and Junction Boxes
 - 1. Sheet metal boxes: ANSI/NEMA OS 1, galvanized steel.
 - 2. Cast metal boxes for outdoor and wet location installation shall be NEMA 250;, Type 4 and Type 6, flat-flanged, surface-mounted junction boxes, UL listed as rain tight. Galvanized cast iron or cast aluminum box and cover with ground flange, neoprene gasket, and stainless-steel cover screws.
 - 3. Cast Metal Boxes for Underground Installations: NEMA 250 Type 4, outside flanged, recessed cover box for flush mounting, UL listed as raintight.

Galvanized cast iron or cast aluminum box and plain cover with neoprene gasket and stainless-steel cover screws.

2.2 FLUSH FLOOR BOXES – CAST IN CONCRETE FLOOR

- A. Combination Flush Floor Boxes
 - 1. Where indicated in plan, furnish and install Wiremold/Walker Resource RFB series four compartment floor boxes.
 - 2. Boxes located on the First Floor shall be Cast Iron, with a maximum depth of 3-7/16”.
 - 3. Boxes located on the Second Floor shall be Shallow Stamped Steel, with a maximum depth of 2-7/16”.

PART 3 - EXECUTION

3.1 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned.
- C. Locate and install boxes to allow access.
- D. Locate and install to maintain headroom and to present a neat appearance.

3.2 OUTLET BOX INSTALLATION

- A. Do not install boxes back-to-back in walls. Provide a minimum 6-inch separation between boxes. Provide a minimum 24-inch separation between boxes in acoustic-rated walls.
- B. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.
- C. Provide knockout closures for unused openings.
- D. Support boxes securely and independently of conduit.
- E. Use multiple gang boxes where more than one device is mounted together. Do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- F. Install boxes in walls without damaging wall insulation.
- G. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- H. Position outlets to locate luminaires as shown on reflected ceiling plans.
- I. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- J. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- K. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- L. Provide cast outlet boxes in exterior locations and wet locations.

3.3 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
- B. Support pull and junction boxes independent of conduit.
- C. Set underground pull and junction boxes level and flush with finished grade.

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

- A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of identification for electrical equipment as shown or as specified.
- B. Work Included:
 - 1. Nameplates and Tape Labels
 - 2. Wire and Cable Markers
 - 3. Buried Conduit Markers

1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance to the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
- C. When requested, provide the manufacturer's certificates that confirm that materials meet or exceed minimum requirements as specified.

1.4 SUBMITTALS

- A. SUBMITTALS: Provide submittals as required in section 26 05 10, "Submittal Process."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Nameplates: Engraved three-layer laminated plastic, white letters on a black background.
- B. Wire and Cable Markers: Cloth markers, split sleeve or tubing type.
- C. Buried Conduit Marker: Continuous printed plastic tape.
- D. Outdoor Equipment Cables: Manufacturer's Standards
 - 1. Weather and sun resistant
 - 2. Vandal resistant

EQUIPMENT AND RACEWAYS OVER 600 VOLTS

- E. Provide "WARNING - HIGH VOLTAGE - KEEP OUT" signs on all equipment. With 2-inch high lettering, mark exposed raceways containing conductors operating in excess of 600 volts every 100 feet with the words "WARNING - HIGH VOLTAGE".

2.2 SPECIAL RACEWAY IDENTIFICATION

- A. Special Systems. Brady Series 55200, 2" wide, pipe banding tape or colored conduit.
 - 1. Fire Alarm. red.
 - 2. Telephone. blue.
 - 3. Data/Communications. blue.
 - 4. Low Voltage controls. black.
 - 5. Sound Systems. yellow.

2.3 WIRE AND CABLE MARKERS

- A. Lighting and Power Circuit Wire Markers.
 - 1. Sizes #12 through 3/0 AWG. Brady SCN clip-sleeve wire markers.
 - 2. Sizes 4/0 AWG and larger. Brady HSA heat shrink sleeves, custom printed.
 - 3. Legends. Panel and circuit description; for example "EP1-1", "E1 - 2", "LPA-14"

2.4 EQUIPMENT AND WIRING DEVICE NAMEPLATES

- A. General: White core laminated plastic. White lettering on black background, same style throughout.
- B. Emergency Equipment Nameplates: White lettering on red background.
- C. Fasteners: Stainless steel self-tapping screws. Use epoxy adhesive only when NEMA enclosure rating is compromised by screws and for wiring device nameplates.
- D. Switchboard, Motor Control Center, Panelboard, Dry-type Transformer and Control Panel Main Nameplate: 5/8" high block letters.
- E. Other Nameplates: 3/8" high block or condensed letters.
- F. Legends:
 - 1. General. Description as indicated on drawings, i.e., "PANEL EP-1", "XFRM ET-1", "TS-1".
 - 2. Voltage. Description of operating voltage, i.e., "120 Volts", "120/208 Volts", "208 Volts", "277/480 Volts", or "480 Volts", "Single Phase" or "Three Phase".
 - 3. Source: Description of source; i.e., "FED FROM PANEL EP-1, CKT. #1".
 - 4. Available fault current and data calculated.

2.5 PANELBOARD CIRCUIT BREAKER IDENTIFICATIONS

- A. Manufacturer's standard labels supplied with panelboard.
- B. AIC Rating: Short Circuit current rating, fully rated; i.e., "10,000 Amperes, Fully Rated",

2.6 EQUIPMENT CONTROL PANEL NAMEPLATES

- A. White core laminated plastic. White lettering on black background, same style throughout, 3/8" high block or condensed letters.
- B. Legends:
 - 1. Manufacturer's Short Circuit Current Rating (SCCR).

2.7 TERMINAL IDENTIFICATIONS

- A. Brady B-500 vinyl cloth pre-printed self-adhesive terminal markers. Legends: 1 through 96, A through Z.

2.8 FUSE IDENTIFICATION LABELS

- A. Obtain original label from fuse box or carton or from fuse manufacturer, indicating manufacturer's name, fuse type, voltage and ampere rating. Attach with contact cement.

2.9 GROUND TERMINAL AND BUS IDENTIFICATION

- A. Type: Green paint or dye, factory applied to terminal and bus.
- B. Self-Adhesive Label Legend: "Ground", "Ground Bus", "Equipment Ground Bus" or "Isolated Ground Bus."

- 2.10 EMERGENCY FIXTURE AND OUTLET IDENTIFICATION
- A. Self-adhesive red vinyl dots, 1/4" diameter. Brady QD-25-RD.
- 2.11 CONCEALED EQUIPMENT IDENTIFICATION
- A. Brady ceiling tacks, 7/8" diameter with 7/16" long point.
1. Electrical equipment. #23255 (orange).
 2. Fire alarm equipment. #23252 (red).
- 2.12 UNDERGROUND DUCT RUNS
- A. Brady "Identoline" 6" wide over coated polyethylene film 3.5 mils thick, underground warning tapes.
1. Electric line. #91296 (red).
 2. Telephone line. #91297 (orange).
 3. Customized. Orange
 - a. Fire alarm line.
 - b. Communications line.
 - c. Data line.
 - d. Data/communications line
 - e. Security line.
 - f. CCTV line.
- 2.13 DUCT RUN MARKERS
- A. General.
1. Construction. Class A concrete.
 2. Size. 6 inches square or round, 24 inches long. 45" chamfer on top edges.
 3. Markings. Impressed or cast Letter "D" and two arrows. Locate one arrow below letter, pointing to duct run. Locate second arrow at right of letters, pointing parallel to duct run.
 4. Marking sizes. V-shaped 1/4" wide at surface and 1/4" deep. 3" long for letter and arrow to right. 2" long for arrow below letter.
- B. Change of Direction Markers. Angle arrow to right of letter to correspond to angular change of duct run direction.
- 2.14 DISTRIBUTION TRANSFORMER WARNING SIGN
- A. Construction. Indoor/outdoor type, plastic or fiber glass, non-corrosive, impervious to weather.
- B. Legend. "Danger" upper legend, white block letters on red panel on black panel. "High Voltage" lower legend, black condensed block letters on white.
- C. Manufacturer. Brady, #71565.
- D. Size. 7 inches high x 10 inches wide.
- 2.15 2GENERATOR WARNING SIGNS
- A. Construction. Indoor/outdoor type. Plastic or fiber glass, non-corrosive, impervious to weather.
- B. Legend. "Danger" upper legend white block letters on red panel on black panel. "Warning" middle legend, red block letters on white panel, underlined in red. "This machine is automatically controlled" lower middle legend, black condensed block letters on white panel. "It may start at any time" bottom legend, red block letters on white panel.
- C. Manufacturer. Brady, #47161.
- D. Size. 7 inches high x 10 inches wide.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install nameplates, signs and labels, and engraved wall plates parallel to equipment lines. Embossed tape will not be permitted for any application.

3.2 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Secure nameplates to equipment fronts using stainless steel screws. Secure nameplate to inside face of recessed panelboard doors in finished locations.
- D. Outdoor equipment labels shall be installed by the manufacturer as specified.

3.3 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

3.4 NAMEPLATE ENGRAVING SCHEDULE

- A. Provide nameplates to identify all electrical distribution and control equipment, and loads served. Letter Height: 1/4 inch for individual switches and loads served, 1/4 inch for distribution and control equipment identification.

3.5 EQUIPMENT NAMEPLATES

- A. General: Identify panelboards, dry-type transformers and control panels with nameplates showing descriptions or designations on Drawings.
- B. Identify disconnect and transfer switches with nameplates describing loads served and panelboard circuit controlling load.
- C. Identify conduits, connected to pull and junction boxes, with nameplates describing the complete circuit number of the conductors contained in each conduit.
- D. Identify receptacles, where the nominal voltage between contact pairs is greater than 150 volts, with nameplates describing the complete circuit number, voltage, and phases.
- E. Identify wall switches, where the equipment served is not in sight of the wall switch, with nameplates describing the equipment served by the wall switches.
- F. Locations.
 - 1. Switchboards, Motor Control Centers, Distribution Panelboards. Locate main nameplate in center over top wiring gutter. Locate individual nameplates for switches and starters centrally on device doors. Locate individual nameplates adjacent and to the side of circuit breakers.
 - 2. Lighting and Appliance Panelboards. Locate main nameplate in center of cover approximately 2" down from top of panel.
 - 3. Dry-type transformers. In middle of front cover panel.
 - 4. Receptacles and Wall Switches. On wall directly above device plate.
 - 5. Other equipment: In middle near top of equipment.

3.6 PANELBOARD CIRCUIT BREAKER IDENTIFICATIONS

- A. General. Attach numbered identification to each panelboard circuit breaker in space provided by manufacturer.
- B. Sequence. Arrange numbering to correspond to panelboard pole positions. For two pole breakers, number according to the upper pole only. For three pole breakers, number according to middle pole only. For multiple breakers occupying poles on both left and right side, number according to left side only.

- C. Numbering Convention. Number poles from top to bottom. Utilize consecutive odd numbers for left side and consecutive even numbers for right side.
- D. Separate Sub-feed Breakers. Number with last number of panelboard sequence.
- E. Circuit Directory. Prepare a neatly typed circuit directory behind clear heat resistant plastic in a metal frame attached to the inside of the door for each panelboard. Identify circuits by equipment served and by room numbers where room numbers exist. Indicate spares and spaces with light, erasable pencil marking. An adhesive mounted directory pocket is not acceptable.

3.7 BURIED CONDUIT OR DIRECT BURIED CABLE IDENTIFICATION

- A. Underground-Type Plastic Line Marker: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick.
- B. Provide tape with printing of "Buried Electrical Conduit" or other similar warning. Install directly above buried conduit or cable one half the distance to conduit below finished grade.

END OF SECTION

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SECTION 26 06 20 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The General Provisions of the Contract, including General and Supplementary Conditions, apply to the Work specified in this Section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. All other Sections of Division 26.
- B. All other Divisions of the Contract Documents. Refer to each Division's Specifications and Drawings for requirements.

1.3 SCOPE

- A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of disconnect switches as shown or indicated on the Drawings and/or as specified.
- B. Work Included:
 - 1. Circuit disconnects
 - 2. Motor disconnects

1.4 SUBMITTALS

- A. Provide submittals as required in section 26 05 10, "Submittal Process."

1.5 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance to the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents
- C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Provide disconnect switches manufactured by one of the following:
 - 1. General Electric Company
 - 2. Siemens Energy and Automation
 - 3. Square D Schneider Electric
 - 4. Eaton, Cutler Hammer

2.2 HEAVY-DUTY SAFETY SWITCHES

- A. Provide surface-mounted, heavy-duty type, sheet-steel enclosed safety switches, of types, sizes and electrical characteristics indicated; fusible type, rated 600 volts, and incorporating quick-make, quick-break type switches; construct so that switch blades are visible in OFF position with door open. Equip with operating handle which is pad lockable in OFF position; construct current carrying parts of high-conductivity copper, with silver-tungsten type switch contacts, and positive pressure type reinforced fuse clips. Provide NEMA Type 3R enclosures at exterior equipment..

2.3 COMPONENTS

- A. Motor and circuit disconnects shall have an Underwriters' Laboratory label.
- B. Single Phase Disconnect Switches: Two pole toggle switch equal to Square D Type F with thermal overloads in appropriate enclosure.
- C. Three Phase Motor Disconnect Switches: 3 pole heavy duty 250 or 600 volt as required in NEMA Type 1 or 3 enclosures as indicated and as required.
- D. Enclosures
 - 1. Normal indoor locations – heavy duty NEMA 1
 - 2. Outdoor or wet locations – heavy duty NEMA 3R

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install circuit and motor disconnect switches as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SCOPE OF WORK

- A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of wiring devices, including related systems and accessories.

1.3 SUBMITTALS

- A. **SUBMITTALS: Provide submittals as required in section 26 05 10, "Submittal Process."**

1.4 REFERENCE STANDARDS

- A. The wiring devices specified herein shall be designed, manufactured, tested and installed according to the latest version of the following standards:
 - 1. National Electrical Manufacturers Association (NEMA) WD-1
 - 2. Federal Specification (FS) WC-596
 - 3. Federal Specification (FS) WS-896
 - 4. Underwriters Laboratories (UL)
- B. All wiring devices shall be UL listed.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Pass & Seymour
- B. Hubbell
- C. Leviton
- D. Cooper

2.2 RECEPTACLES

- A. General
 - 1. Receptacles shall be standard style as indicated herein. They shall be constructed of high-impact resistant thermoplastic material with a nylon face and thermoplastic back body. Unless noted otherwise, they shall be 2-pole, 3-wire with a green equipment ground screw or an automatic grounding system attached to the strap.
 - 2. Receptacle color shall be ivory unless noted otherwise.
- B. Specification Grade
 - 1. Specification Grade receptacles shall be standard style. The face shall be constructed of a high-impact resistant thermoplastic. The contacts shall be a triple wipe, T-slot, one-piece copper alloy design. The device shall have a green ground screw or an automatic grounding system attached to the strap. The device shall be 20-ampere, 125-volts, NEMA configuration 5-20R, back and side-wired.
- C. Special purpose receptacles shall be of the specific NEMA configuration indicated on the Drawings.
- D. Ground Fault Circuit Interrupter (GFCI)
 - 1. GFCI receptacles shall be a feed-through type wired for single receptacle protection thus not affecting receptacles downstream on the same circuit. They shall be UL rated Class 1 with 5-milliampere ground fault trip level and a 20-ampere feed-through rating. GFCI receptacles shall be NEMA configuration 5-20R.

- E. Isolated Ground (IG)
 - 1. Isolated ground receptacles shall be standard style. The contacts shall be a triple wipe, T-slot, one-piece copper alloy design. The ground contacts shall be isolated from the mounting strap and conduit system. The device shall have a green ground screw that totally isolates the grounding contacts, and it shall require that the insulated ground conductor run uninterrupted to the neutral at the service entrance. The device shall also have an automatic grounding system and center rivet attached to the mounting strap allowing the use of a metal wall plate. The device shall carry an identifying triangle on the face to signify Isolated Ground. The device shall be 20-ampere, 125-volts, NEMA configuration 5-20R, back and side-wired, orange.

2.3 SWITCHES

- A. General
 - 1. Switches shall be toggle or decorative rocker type as indicated herein. The body of the switch shall be made of an arc-resistant thermoset material. All toggle switch handles shall be constructed of a thermoplastic material. All rocker switch handles shall be constructed of a thermoset material. All wall switches shall be of the quiet AC type.
 - 2. Switches shall be SPST, DPST, 3-way or 4-way as indicated on the Drawings.
 - 3. Switch color shall be ivory unless noted otherwise.
- B. Specification Grade
 - 1. Specification Grade switches shall be toggle type. The contact arms shall be made of one-piece copper alloy material. The switch shall include a green ground screw attached to the mounting strap. The switch shall be 20-ampere, 120/277-volts AC, horsepower rated, back and side-wired.
- C. Incandescent Wallbox Dimmers
 - 1. Manufacturer
 - a. Lutron
 - 2. Performance
 - a. All devices shall be capable of operating at rated capacity without adversely affecting design lifetime.
 - b. All devices shall mount individually in a single gang switchbox. Devices shall be gangable without removing side sections or derating capacity.
 - c. Devices shall operate in an ambient temperature range of 0°C (32°F) to 40°C (104°F).
 - d. All dimmers and switches shall incorporate an air gap switch which shall be accessible without removing the faceplate. The air gap switch shall be capable of meeting all applicable requirements of UL 20 for air gap switches in incandescent dimmers.
 - e. All dimmers and switches shall provide power-failure memory. Should power be interrupted and subsequently returned, the lights will come back on to the same levels set prior to the power interruption. Restoration to some other default level is not acceptable, unless noted otherwise.
 - f. Dimmers and switches shall not be susceptible to damage or loss of memory due to static discharge.
 - g. Dimmers and switches shall be tested to withstand voltage surges of up to 600V and current surges of up to 200A without damage per ANSI/IEEE std. C62.41-1980.
 - h. Dimmers and switches shall meet the UL 20 limited short circuit test requirement for snap switches.
 - 3. Dimmer Controls
 - a. Dimmer control of light intensity shall be via a linear slide.
 - b. Linear slide dimmer shall provide intensity and on/off control with movement of slider. This shall apply to single pole and 2-location dimmers.

- c. Dimmer shall include voltage compensation circuitry that adjusts the firing angle of the dimmer in such a manner as to compensate light output for variations in the AC line voltage. Dimmers in which the firing angle is merely held constant with varying AC line voltage shall not be acceptable.
- d. All dimmers shall provide a smooth and continuous Square Law Dimming curve.
- e. Dimmers shall utilize a filtering network to minimize interference with properly installed radio, audio and video equipment.
- f. Dimmer control slider shall be captured.
- g. All dimmers shall meet UL 20 and be appropriately marked.
- 4. Switches
 - a. All dimmer related on/off switches shall be single pole, 3-Way and 4-Way configuration as indicated on the Drawings.
 - b. Switch rating shall be 20A, 120 VAC, for tungsten or inductive loads.
- 5. Wall Plates
 - a. Wall plates shall include mounting frame for proper device alignment and faceplate attachment.
 - b. Wall plates shall be constructed of high impact, scratch-resistant ABS plastic. Color shall be ivory unless noted otherwise.
 - c. Wall plates shall snap on to device with no visible means of attachment.
 - d. Heat fins shall not be visible on front of device.
 - e. At locations with multiple devices, one seamless, multi-gang faceplate shall be provided. Coordinate proper switch box size and wall plate type.

2.4 WALL PLATES

- A. Wall plates shall be provided for all switches, receptacles, blanks, telephone and special purpose outlets. The wall plates shall be of suitable configuration for the device for which it is to cover with color matched mounting screws. Color of the wall plates shall match the device, unless noted otherwise.
- B. Weatherproof: Wiring devices in wet and damp locations shall be installed with a hinged metal outlet cover/enclosure clearly marked "Suitable for Wet Locations While in Use" and "UL Listed". There shall be a gasket between the cover/enclosure and the mounting surface, and between the hinged cover and mounting plate/base to assure proper seal. The cover/enclosure shall employ stainless steel mounting hardware and be constructed of impact resistant polycarbonate. The cover/enclosure shall be specification grade as manufactured by Pass and Seymour or equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES

- A. Each wiring device shall be mounted in a metallic outlet box. In general, devices in finished spaces shall be flush mounted and devices in unfinished spaces, i.e. mechanical and electrical equipment rooms shall be surface mounted. Verify the requirements of all spaces with the Architect.
- B. Wall Plates
 - 1. Each device shall have a cover plate appropriate for the application.
 - 2. Cover plates shall be installed true and plumb with building lines, mortar joints and architectural features.
 - 3. Adjacent devices shall be mounted under a common cover plate suitable for the application.
- C. Mount receptacles and special systems outlets above finish floor to the device centerline, unless noted or required otherwise.
- D. Place conductor under wiring device screw terminals and draw up snugly.

- E. Mount switches above finish floor to the device centerline and 6" from a door strike, unless noted or required otherwise.
- F. Grounding continuity shall be maintained between devices and metallic raceway system in addition to the green equipment grounding conductor run with circuit conductors. Care shall be taken when installing receptacles having an isolated ground pole so as to not bond the equipment ground conductor to the conduit system.
- G. Wire each receptacle using correct polarity (i.e., neutral to neutral terminal, etc.).
- H. Mount receptacles throughout the project with ground pole at the top of the configuration when mounted vertically, on the right when horizontally mounted.
- I. All exterior wiring devices shall be provided with a weatherproof cover/enclosure. Exterior receptacles shall be GFCI type.
- J. De-rate dimmer capacity as required by the manufacturer if side sections are removed.
- K. Run separate neutral wire for each phase of a three phase system when dimmers are installed on multiple phases and for each dimmer when multiple dimmers are installed on the same phase.
- L. Receptacles located in secure areas shall be GFCI type.

END OF SECTION

SECTION 26 28 16 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

- A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of disconnect switches as shown or indicated on the Drawings and/or as specified.
- B. Work Included:
 - 1. Circuit disconnects.
 - 2. Motor disconnects.

1.3 SUBMITTALS

- A. SUBMITTALS: Provide submittals as required in section 26 05 10, "Submittal Process."

1.4 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance to the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
- C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Provide disconnect switches manufactured by one of the following:
 - 1. General Electric Company
 - 2. Siemens Energy and Automation
 - 3. Square D Schneider Electric
 - 4. Eaton, Cutler Hammer

2.2 HEAVY-DUTY SAFETY SWITCHES

- A. Provide surface-mounted, heavy-duty type, sheet-steel enclosed safety switches, of types, sizes and electrical characteristics indicated; fusible type, rated 600 volts, and incorporating quick-make, quick-break type switches; construct so that switch blades are visible in OFF position with door open. Equip with operating handle which is pad lockable in OFF position; construct current carrying parts of high-conductivity copper, with silver-tungsten type switch contacts, and positive pressure type reinforced fuse clips. Provide NEMA Type 3R enclosures at exterior equipment..

2.3 COMPONENTS

- A. Motor and circuit disconnects shall have an Underwriters' Laboratory label.
- B. Single Phase Disconnect Switches: Two pole toggle switch equal to Square D Type F with thermal overloads in appropriate enclosure.
- C. Three Phase Motor Disconnect Switches: 3 pole heavy duty 250 or 600 volt as required in NEMA Type 1 or 3 enclosures as indicated and as required.
- D. Enclosures
 - 1. Normal indoor locations – heavy duty NEMA 1.
 - 2. Outdoor or wet locations – heavy duty NEMA 3R

2.4 FUSES

- A. Acceptable manufacturers: Cooper Bussman, Littelfuse, or Ferraz Shawmut.
- B. Provide fuse types as follows:
 - 1. Motors – current limiting, dual element, Class RK-1.
 - 2. Feeders – current limiting,

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install circuit and motor disconnect switches as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

END OF SECTION

SECTION 26 41 00 - FACILITY LIGHTNING PROTECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 CODES AND STANDARDS

- A. The following specifications and standards of the latest issue form a part of this specification.
 - 1. Lightning Protection Institute
 - 2. Installation Standard, LPI 175
 - 3. Underwriters Laboratories, Inc.
 - 4. Installation Requirements, LPI 175
 - 5. National Electrical Code (NEC)
 - 6. National Fire Protection Association
 - 7. Lightning Protection Code, NFPA 780
- B. All materials tested by Underwriter's Laboratories shall bear their labels A, B and C for materials and installation.

1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents
- C. The lightning protection system shall conform to the requirements and standards for lightning protection systems of the LPI, UL, NFPA, and NEC. Upon completion, application shall be made to the Underwriters Laboratories, Inc. for inspection and certification. In addition, the Lightning Protection Institute certified system shall be delivered to the owner ensuring that the concealed components have also been monitored during job progress.
- D. The system to be furnished under this specification shall be the standard product of manufacturers regularly engaged in the production of lightning protection equipment and shall be the manufacturer's latest approved design. The equipment shall be UL listed and properly UL labeled.

1.4 SUBMITTALS

- A. Provide submittals as required in section 26 05 10, "Submittal Process."
- B. Product Data - Submit manufacturer's data on lightning protection systems and components.
- C. Shop Drawings - Submit dimensioned layout drawings of lightning protection system equipment and components, including conductor routing and connections.
- D. UL Certificate - Provide Owner with UL Master Label for overall system which is suitable for fastening to building for display. Comply with UL 96A, "Master Labeled Lightning Protection Systems."

PART 2 – PRODUCT

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer - Subject to compliance with requirements, provide lightning protection components of one of the following (for each type of component):
 - 1. Advanced Lightning Technology
 - 2. East Coast Lightning Equipment

3. Harger Lightning Protection
4. Robbins Lightning Protection
5. Thompson Lightning Protection, Inc.

2.2 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. Standard - All equipment used this installation shall be UL listed and properly labeled. All equipment shall be new, and of a design and construction to suit the application where it is used in accordance with accepted industry standards and LPI, UL, NFPA, and NEC code requirements.
- B. Lighting Protection Equipment - All materials shall be copper and bronze and of the size, weight, and construction to suit the application and used in accordance with LPI, UL, and NFPA code requirements. Class 1 components may be utilized on roof levels 75 feet and below in height. Class II size components are required for roof levels over 75 feet in height. Bolt type connectors and splicers shall be utilized on Class I and Class II structures. Pressure squeeze clamps are not acceptable. All mounting hardware shall be stainless steel to prevent corrosion.
- C. Aluminum Components - Aluminum materials may not be used except on roof that utilize aluminum roofing components. On aluminum metal roofs or where aluminum parapet caps exist, the entire roof lightning protection equipment shall utilize aluminum components to insure compatibility. However, the downleads and grounding are to utilize copper with the bimetal transition occurring at the through roof assembly with and approved bimetal through roof assembly. Lead coating is not acceptable as a bimetal transition.
- D. Materials below grade to 18" above grade: Copper, except ground rods to be stainless steel.
- E. Air Terminals:
 1. Point: Solid copper, 12" height x 3/8" diameter
- F. Fasteners and Attachments: Same material as air terminals.
- G. Main Conductors: Copper cable, minimum weight 187.5 lbs/1,000 ft; minimum wire size No.17 AWG (Class
- H. Secondary Conductors: Copper cable; minimum 13 strand No. 17 AWG.
- I. Fasteners:
 1. Same material as conductor
 2. Galvanized fasteners not acceptable
- J. Connectors and Disconnectors
 1. Compression type designed to withstand 2,000 lbs. pull
 2. Exothermic Welding Type, below grade and in non-accessible areas
- K. Ground Electrodes: 10 ft. stainless steel rods 3/4" diameter.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. The installation shall be accomplished by an experienced installation company that is a UL listed, a member of the Lightning Protection Institute, United Lightning Protection Association qualified and an employer of Certified Master Installers of lightning protection systems. A Certified Master Installer shall directly supervise the work.
- B. All equipment shall be installed in a neat, workmanlike manner. The system shall consist of a complete conductor network at the roof and include air terminals, connectors, splicers, bonds, copper downleads, and proper terminals.
- C. Air Terminals: Install in plumb position securely fastened to withstand overturning.
- D. Conductors:
 1. Fastening:
 - a. Fasten conductors to building at 3 feet maximum intervals
 - b. On masonry, set fasteners in brick, block or stone, but not in mortar joints
- E. Conductor Runs:
 1. Bend to radii greater than 8 inches
 2. Limit angle of turns to 90 degrees
 3. Route horizontal conductors around obstructions in horizontal plane

- 4. Route connectors in horizontal or vertical planes only
- 5. Install roof conductors concealed under roofing system
- F. Connect conductor to metal bodies of inductance located within 6 feet by secondary conductor.
- G. Ground: Extend minimum of 10 ft into earth.

3.2 COORDINATION

- A. The lightning protection installer will work with other trades to insure a correct, neat and unobtrusive installation.
- B. It shall be the responsibility of the lightning protection installer to assure a sound bond to the main water service and the main electrical service ground bar and to assure interconnection with other ground systems.
- C. Install approved SPD's on power service.

3.3 COMPLETION

- A. Upon completion of the installation, the lightning protection installer shall secure and deliver to the Owner the Underwriters Laboratories, Inc. Master Label certification and the Lightning Protection Institute Certified System certification. The system will not be accepted without the UL Master Label plate and the LPI certificate.

3.4 PERSONNEL TRAINING

- A. Building Maintenance Personnel Training: Train Owner's building maintenance personnel in procedures for testing and determining resistance-to-ground values of lightning protection system.

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SECTION 28 31 10 - FIRE DETECTION AND ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

- A. This is a performance based specification. The Fire Alarm Contractor will be responsible for the complete system design. The Contractor shall submit shop drawings sealed by a Professional Engineer or a licensed Fire Alarm Planning Superintendent.
- B. Design, furnish and install all material and labor necessary to meet or exceed the performance criteria identified in this specification.
- C. All fire alarm device locations shall be coordinated with architectural finishes and millwork.
- D. Provide all design, equipment, material, labor, supervision and services necessary for or incidental to the installation of a complete and fully operating fire alarm and detection system meeting or exceeding all applicable codes and regulations governing the project and meeting the approval of all authorities having jurisdiction.
- E. Drawings are diagrammatic and may not show all required fire alarm devices. Provide devices, wiring, equipment, and accessories necessary to comply with requirements of this Specification and local and state building codes, NFPA, and ADA requirements.

1.3 REFERENCES

- A. This building occupancy classification is Group B. Equipment and installation shall comply with current provisions of following standards:
 - 1. International Building Code 2009 Edition
 - 2. Texas Commission on Jail Standards (TCJS)
 - 3. Americans with Disabilities Act (ADA)
 - 4. Local and State Building Codes
 - 5. Authorities Having Jurisdiction
 - 6. National Fire Protection Association (NFPA) Standards:
 - a. NFPA 70 National Electrical Code
 - b. NFPA 72 National Fire Alarm Code
 - c. NFPA 101 Life Safety Code
 - 7. Underwriters Laboratories, Inc., (UL), shall list system and components for use in fire protective signaling system under following standards as applicable:
 - a. UL 864/UOJZ, APOU Control Units for Fire Protective Signaling Systems
 - b. UL 268 Smoke Detectors for Fire Protective Signaling Systems
 - c. UL 268A Smoke Detectors for Duct Applications
 - d. UL 521 Heat Detectors for Fire Protective Signaling Systems
 - e. UL 464 Audible Signaling Appliances
 - f. UL 1638 Visual Signaling Appliances
 - g. UL 346 Waterflow Indicators for Fire Protective Signaling Systems
 - h. UL 1481 Power Supplies for Fire Protective Signaling Systems
 - i. UL 1711 Amplifiers for Fire Protective Signaling Systems

1.4 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Provide proof of Factory qualifications and Authorization and Factory Training for the products specified. These qualification credentials shall not be more than 2 years old, to ensure up-to-date product and application knowledge. Shall provide evidence of at least five (5) years experience as a company, in installation and servicing the specified fire alarm system of similar size and scope.
- C. Supplier shall have sufficient stock on hand and have fully equipped service organization capable of guaranteeing response time within 8 hours of service calls, 24 hours per day, 7 days per week to service completed systems.
- D. Provide a copy of the certificate of successful completion of authorized Training Course given by manufacturer of Fire Alarm Equipment.
- E. When requested, provide the manufacturer's certificate that materials meet or exceed minimum requirements as specified.
- F. Shall be a licensed fire alarm contractor with the state of Texas.
- G. Shall have a permanent full time NICET Level III fire alarm manager on staff.

1.5 SUBMITTALS

- A. SUBMITTALS: Provide submittals as required in section 26 05 10, "Submittal Process."
- B. Submit 1 complete set of documentation. Document the type, size, rating, style, catalog number, manufacturer name, photographs, and/or catalog data sheets for items proposed to meet these specifications. Proposed equipment shall be subject to approval of Engineer and no equipment shall be ordered or installed without that approval.
- C. Submit complete set of Shop Drawings, one for each unit sub-assembly that requires that field wire be connected to it. Shop Drawings shall be reproduced electronically from Master Copy supplied in digital format.
 - 1. Operating manuals for the fire alarm system.
 - 2. Point-to-point diagrams of entire system. This shall include connected initiating devices, notification devices, powers supplies and addressable field modules. Drawings shall be provided in standard DXF format. Also provide vellum plots of each sheet. System-generated point-to-point diagrams are required to ensure accuracy.
 - 3. Equipment cutsheets of all equipment proposed for installation.
 - 4. Name, address, and telephone number of authorized factory representative and factory authorized servicing agent.
 - 5. Drawings must reflect device address and programmed characteristics.
 - 6. Battery calculations for all integral and remote power supplies.
 - 7. Provide name and telephone number of full time NICET Level III fire alarm manager on duty responsible for this project.
 - 8. Provide evidence of at least five (5) experience as a company, in installation and servicing the specified fire alarm systems of similar size and scope.
 - 9. Provide a complete set of fire alarm and detection system design documents indicating all equipment required to meet all applicable codes, regulations, standards and requirements of the authorities having jurisdiction. Provide written certification that whether specifically identified in the shop drawing submittals or not, design, labor and materials shall be furnished and installed meeting or exceeding all applicable codes, regulations, standards and requirements of the authorities having jurisdiction.
 - 10. Provide proof of training of key individuals installing personnel involved on project.
- D. Close out submittal: Provide three (3) copies of all documents as described in the submittal Division 01, in addition to all drawings and backup documentation identifying as built conditions.

1.6 WARRANTY

- A. Provided the local IDS installer contact (name, address and phone number). The installer shall respond on-site within eight (8) hours of trouble call after receipt of call to address where warranty is.
- B. Guarantee all labor, workmanship, and materials for the new and existing system for a period of one year from date of final acceptance. Should a failure occur within the first year of the system, provide all labor and materials necessary to restore the system to the condition require for testing and acceptance for this contract, at no additional cost.
- C. During the warranty period, additional detectors may be connected and their use entered in the database. New devices will be connected in the same manner as shown on the drawings and the existence of the new connections shall not void this warranty.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Life Safety/Fire Alarm System shall be microprocessor-based network system. Control Panel Assemblies and connected Field Appliances shall be both designed and manufactured by same company, and shall be tested and cross-listed as compatible to ensure fully functioning system is designed and installed.
- B. Conform to this Specification in its entirety to ensure the installed and programmed Life Safety/Fire Alarm System will accommodate future requirements and operations. Any specified item or operational feature not specifically addressed prior to bid date shall be provided without exception.

2.2 EQUIPMENT AND MATERIAL GENERAL REQUIREMENTS

- A. Equipment shall be new and unused. Components and systems shall be designed for uninterrupted duty. Equipment, materials, accessories, devices, and other facilities specified or indicated on Drawings shall be best suited for intended use and shall be provided by a single manufacturer. Where the equipment provided under this Specification interfaces with equipment provided by a different manufacturer, then that equipment shall be recognized as compatible by both manufacturers, and listed by UL.
- B. System installation and operations shall be verified by the manufacturer's representative and a verification certificate presented upon completion. The manufacturer's representative shall be responsible for on-site demonstration of operation of system and initial owner's staff training. All equipment and components shall be installed in strict compliance with manufacturers' recommendations.
- C. As-Built" riser and wiring diagrams reflecting T-taps and each programmed device characteristic including detector type, base type, address, sensitivity setting, and wire configurations shall be provided to Engineer.
- D. It shall be possible for the contractor, using a Program/Service Tool or laptop PC to change personality/function of Devices to meet changes in building layout or environment.
- E. System shall be designed with the capability of expanding the entire system by adding 30% more detection and/or initiating devices without adding any additional equipment to the fire alarm control panel or power supplies. This shall include any additional equipment such as panels, expansion cards, SLC loops, etc. Provide a complete and fully operational system capable of having 30% additional detection and/or initiating devices above what shall be required by applicable codes, regulations, standards and the authority having jurisdiction. Provide written documentation specifically identifying system is designed with these provisions for expansion.

2.3 ACCEPTABLE MANUFACTURERS

- A. EST
- B. Notifier
- C. Silent Knight
- D. Simplex

2.4 EQUIPMENT

- A. Life Safety/Fire Alarm System shall be designed specifically for fire-protection signaling system.
- B. Fire Alarm System shall include required hardware and system programming to provide complete and operational system, capable of providing protected premises with following functions and operations:
 - 1. System operational software shall be stored in non-volatile memory. Control panel disassembly and replacement of electronic components of any kind shall not be required in order to upgrade operations of installed system to conform to future application code and operating system changes.
 - 2. System response to any alarm condition must occur within 3 seconds, regardless of size and complexity of installed system.
 - 3. System Common Control Functions shall be automatically routed to any node of system as function of time of day and date.
 - 4. Smoke detectors within the Inmate cells and dayrooms shall be capable of providing detection of smoke within 60 seconds, per TCJS requirement.
 - 5. The control panel shall be capable of providing a specific cell location in which smoke is detected for all the smoke zones, per TCJS requirement.

2.5 MAIN FIRE ALARM CONTROL PANEL

- A. The fire alarm control panel (FACP) shall have the following:
 - 1. The FACP shall have a power supply as required and be capable of expansion to a maximum of 4.5 total amps via bus connected expander modules that supervise low battery, loss of AC and loss of communication.
 - 2. The FACP shall have Day/Night sensitivity capabilities on detectors and be capable of supporting 250 analog addressable points and expandable to a maximum of 500 analog addressable points. This shall be accomplished via three signaling line circuits (SLC) capable of supporting a minimum of 125 devices each. The communications protocol on the SLC loop must be digital.
 - 3. The FACP shall have a built in UL approved digital communicator. The communicator must allow local and remote up/downloading of system operating options, event history, and detector sensitivity data.
 - 4. The FACP shall automatically test the smoke detectors in compliance with NFPA standards to ensure that they are within listed sensitivity parameters and be listed with Underwriters Laboratories for this purpose.
 - 5. The FACP shall compensate for the accumulation of contaminants that affect detector sensitivity. The FACP shall have day/night sensitivity adjustments, maintenance alert feature (differentiated from trouble condition), detector sensitivity selections, auto-programming mode (Jumpstart) and the ability to upgrade the core operating software on site or over the telephone.
 - 6. The main communication bus shall be capable of class A or class B configuration with a total Bus length of 3,000 feet between panels.

2.6 SYSTEM WIRING

- A. The Signaling Line Circuit and Data Communication Bus shall be wired with standard NEC 760 compliant wiring, no twisted, shielded or mid capacitance wiring is required for standard installations. All FACP screw terminals shall be capable of accepting 14-18 AWG wire. All system wiring shall be in accordance with the requirements of NFPA 70, the National Electrical Code (NEC) and also comply with article 760 of the NEC.

2.7 SLC LOOP DEVICES

- A. Devices supported must include intelligent, addressable photoelectric smoke detectors, intelligent addressable heat detectors, intelligent addressable input modules, relay output modules or intelligent addressable notification modules. There is to be no limit to the number of any particular device type up to the maximum of 250 that can be connected to the SLC.

2.8 ANAOG DETECTOR FUNCTIONS

- A. The products of combustion detectors must communicate analog values using a digital protocol to the control panel for the following functions:
1. Automatic compliance with NFPA 72 standards for detector sensitivity testing
Drift compensation to assure detector is operating correctly
 2. Maintenance alert when a detector nears the trouble condition Trouble alert when a detector is out of tolerance
 3. Alert control panel of analog values that indicate fire.

2.9 SENSITIVITY FUNCTION

- A. The FACP shall have the ability to set three different sensitivity levels. A zone can be programmed to a day and a night sensitivity value. The day/night schedule shall allow for 16 holiday dates that are user programmable to allow the FACP to respond at the night level on those days.

2.10 SERIAL/PARALLEL INTERFACE

- A. The fire system shall be capable of supporting up to two serial / parallel interfaces that are capable of driving standard computer style printers. The interface shall be programmable as to what information is sent to it and shall include the ability to print out Detector Status, Event History and System Programming.

2.11 DIGITAL COMMUNICATOR

- A. The digital communicator must be an integral part of the control panel and be capable of reporting all zones of alarm, supervisory, and trouble as well as all system status information such as loss of AC, low battery, ground fault, loss of supervision to any remote devices with individual and distinct messages to a central station or remote station. The communicator must be capable of up/downloading of all fire alarm system programming options, Event history and Sensitivity compliance information to a PC on site or at a remote location.

2.12 DRY CONTACTS

- A. The FACP shall have two form "C" dry contacts, one will be dedicated to trouble conditions, the other one will be programmable for alarm, trouble, notification, pre-alarm, waterflow, manual pull, aux. 1 or aux. 2. The trouble contact shall be normal in an electrically energized state so that any total power loss (AC and Backup) will cause a trouble condition. In the event that the Microprocessor on the FACP fails the trouble contacts shall also indicate a trouble condition.

2.13 GROUND FAULT DETECTION

- A. A ground fault detection circuit, to detect grounds on all field wiring. The ground fault detector shall operate the general trouble devices as specified but shall not cause an alarm to be sounded. Ground fault will not interfere with the normal operation, such as alarm, or other trouble conditions.

2.14 OVERCURRENT PROTECTION

- A. All low voltage circuits will be protected by microprocessor controlled circuit breakers or have a self restoring circuit breaker for the following: smoke detector power, main power supply, indicating appliance circuits, battery standby power and auxiliary output.

2.15 TEST FUNCTIONS

- A. A "Lamp Test" mode shall be a standard feature of the fire alarm control panel and shall test all LED's and the LCD display on the main panel and remote annunciators.

- B. A "Walk Test" mode shall be a standard feature of the fire alarm control panel. The walk test feature shall function so that each alarm input tested will operate the associated notification appliance for two seconds. The FACP will then automatically perform a reset and confirm normal device operation. The event memory shall contain the information on the point tested. The zone tripped, the zone restore and the individual points return to normal.
 - C. A "Fire Drill" mode shall allow the manual testing of the fire alarm system notification circuits. The "Fire Drill" shall be capable of being controlled at the main annunciator, remote annunciators and via a remote contact input.
 - D. A "Bypass Mode" shall allow for any point or nac circuit to be bypassed without effecting the operation of the total fire system.
- 2.16 REMOTE INPUT CAPABILITIES
- A. The control panel shall have provisions for supervised switch inputs for the purpose of Alarm reset and Alarm and trouble restore.
- 2.17 MOUNTING
- A. The system cabinet shall be grey and flush mounted. The cabinet door shall be easily removable to facilitate installation and service.
- 2.18 AUDIBLE SYSTEM TROUBLE SOUNDER
- A. An audible system trouble sounder shall be an integral part of the control unit. Provisions shall also be provided for an optional supervised remote trouble signal.
- 2.19 POWER SUPPLY AND CHARGER
- A. The entire system shall operate on 24 VDC, filtered switch mode power supply with the rated current available of 5 Amps. The FACP must have a battery charging circuit capable of complying with the following requirements:
 - B. Twenty Four (24) hours of battery standby with five (5) minutes of alarm signaling at the end of this Twenty Four (24) hour period (as required per NFPA 72 remote station signaling requirements) using rechargeable batteries with automatic charger to maintain standby gel-cell batteries in a fully charged condition.
 - C. The power supply shall comply with UL Standard 864 for power limiting.
 - D. The FACP will indicate a trouble condition if there is a loss of AC power or if the batteries are missing or have insufficient capacity to support proper system operation in the event of AC failure. A "Battery Test" will be performed automatically every minute to check the integrity of the batteries. The test must disconnect the batteries from the charging circuit and place a load on the battery to verify the battery condition. In the event that it is necessary to provide additional power one or more 3-BPS Power Supply modules can be provided.
- 2.20 CONNECTIONS AND CIRCUITS
- A. Connections to the light and power service shall be on a dedicated branch circuit in accordance with the National Fire Alarm Code NFPA 72, National Electrical Code (NEC) NFPA 70, and the local authority having jurisdiction (AHJ). The circuit and connections shall be mechanically protected. A circuit disconnecting means shall be accessible only to authorized personnel and shall be clearly marked "FIRE ALARM CIRCUIT CONTROL".
- 2.21 NOTIFICATION DEVICES
- A. The visible and audible/visible signal be listed by Underwriters Laboratories Inc. per UL.
 - B. The visible signaling appliance shall maintain a minimum flash rate of 1Hz or greater regardless of power input voltage.

2.22 SMOKE DETECTORS

- A. Smoke detectors shall be ceiling mounted, intelligent, addressable photoelectric smoke detectors. The combination detector head and twist lock base shall be UL listed.
- B. The base shall permit direct interchange with the ionization smoke detector or the heat detector. The Smoke detector shall have a flashing status LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady at full brilliance. The detector may be reset by actuating the control panel's reset switch. The sensitivity of the detector shall be capable of being selected and measured by the control panel without the need for external test equipment.
- C. The vandal security-locking feature shall be used in detention areas. The locking feature shall be field selectable when required. It shall be possible to perform a sensitivity test of the detector without the need of generating smoke. The test method shall simulate the effects of products of combustion in the chamber to ensure testing of the detector circuits. Detectors shall have completely closed back to restrict entry of dust and air turbulence and have a 30 mesh insect screen. Electronics of the unit shall be shielded to protect against false alarms from E.M.I. and R.F.I. The detector shall be a double EE-prom technology and be programmed using the internal programming loop located on the FACP.

2.23 HEAT DETECTORS

- A. Furnish and install intelligent, addressable heat detectors where indicated on drawings. The combination heat detector and twist lock base shall be UL listed compatible with the fire alarm control panel. The base shall permit direct interchange with the Ionization smoke detector and the photoelectric smoke detector. The base shall be appropriate twist lock base. The heat detector shall have a flashing status LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady at full brilliance. The detector may be reset by actuating the control panel's reset switch. Electronics of the unit shall be shielded to protect against false alarms from E.M.I. and R.F.I.

2.24 DUCT DETECTORS

- A. Duct Detectors shall be provided, installed and powered with remote test switches on the supply and return for each unit 2000CFM or larger. Addressable intelligent modules to monitor the duct detectors for required supervision are to be provided.

2.25 FIRE/SMOKE DAMPERS

- A. Fire/Smoke Damper shut down shall be achieved by an intelligent addressable control relay on each electrical circuit serving fire/smoke dampers.

2.26 WATER FLOW TAMPER SWITCHES

- A. Water Flow/Tamper switches are to be provided and installed by the sprinkler contractor. Addressable intelligent modules to monitor these switches for required supervision.

2.27 SYSTEM OPERATION

- A. When a device indicates any alarm condition the control panel must respond within 3 seconds. The General Alarm or Supervisory Alarm LED on the annunciator(s) should light and the LCD should prompt the user as to the number of current events. The alarm notification must be stored in event memory for later review. Event memory must be available at the main annunciator.
- B. When the alarmed device is restored to normal, the control panel shall be required to be manually reset to clear the alarm condition, except that the alarms may be silenced as programmed.
- C. An alarm shall be silenced by a code or Firefighter key at the main or remote annunciators. When silenced, this shall not prevent the resounding of subsequent events if another event should occur (subsequent alarm feature). When alarms are silenced the silenced LED on the control panel, and on any remote annunciators shall remain lit, until the alarmed device is returned to normal.

- D. When a device indicates a trouble condition, the control panel System Trouble LED should light and the LCD should prompt the user as to the number of current events. The trouble information must be stored in event memory for later review. Event memory must be available at the main and all remote annunciators.
- E. When the device in trouble is restored to normal, the control panel shall be automatically reset. The trouble restore information must be stored in event memory for later review. Event memory must be available at the main and all remote annunciators. A trouble shall be silenced by a code or Firefighter key at the main or remote annunciators. When silenced, this shall not prevent the resounding of subsequent events if another event should occur.
- F. Each SLC loop shall be electrically supervised for opens and ground faults in the circuit wiring, and shall be so arranged that a fault condition on any loop will not cause an alarm to sound. Additionally, every addressable device connected to the SLC will be supervised and individually identified if in a fault condition. The occurrence of any fault will light a trouble LED and sound the system trouble sounder, but will not interfere with the proper operation of any circuit which does not have a fault condition.
- G. Each indicating appliance circuit shall be electrically supervised for opens, grounds and short circuit faults, on the circuit wiring, and shall be so arranged that a fault condition on any indicating appliance circuit or group of circuits will not cause an alarm to sound. The occurrence of any fault will light the trouble LED and sound the system trouble sounder, but will not interfere with the proper operation of any circuit which does not have a fault condition.
- H. Any alarm, trouble or supervisory signal shall also be communicated to the owner's offsite central monitoring facility.

2.28 SPARE SYSTEM COMPONENTS

- A. Provide 10% spare parts for the following components:
 - 1. Smoke detectors
 - 2. Duct smoke detectors
 - 3. Heat Detectors
 - 4. Horn/Strobe notification devices
 - 5. Strobe only notification devices
- B. The spare system components shall be delivered to the Owner's attic stock, as directed.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. System components shall be installed in accordance with the latest revisions of the appropriate NFPA pamphlets, the requirements contained herein, National Electrical Code, local and state regulations, the requirements of the fire department and other applicable authorities having jurisdiction (AHJ).
- B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.
- C. All wire on the fire alarm system shall be UL Listed as fire alarm protection signaling circuit cable per National Electrical Code, Articles 760. Wiring shall be installed in a conduit raceway system. Paint junction boxes red. Hand label as "FA" with black permanent marker.

3.2 WIRING METHODS

- A. Wiring methods shall be suitable for an inaccessible ceiling space. Reference article 370-29, NEC.

3.3 TEST

- A. Before the installation shall be considered completed and acceptable by the code authority, a test of the system shall be performed. Test of system shall require the activation of all detection and initiating devices.

- B. Where application of heat would destroy detector, it may be manually activated.
- C. The communication loops and the indicating appliance circuits shall be opened in at least two (2) locations per circuit to check for the presence of correct supervision circuitry.
- D. Leave the fire alarm system in proper working order, and, without additional expense to the owner, replace any defective materials or equipment provided under this contract within one year from the date of final acceptance by the awarding authority.
- E. Prior to final test the fire department and any other authority having jurisdiction must be notified in accordance with local requirements and any testing and/or final inspection shall be performed. Written approval from the authorities having jurisdiction shall be provided prior to final acceptance of system.
- F. The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7.
- G. Provide testing and written verification that owner's central monitoring system is fully functional and accurately receiving alarm and status information from the system fire alarm control panel and the intrusion detection system.

3.4 FINAL INSPECTION

- A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.5 OPERATION AND MAINTENANCE MANUALS

- A. The intent of this section is to require complete documentation of the FA System for the purpose of system operation and maintenance during and after the warranty period. It is intended that the operation and maintenance manuals be detailed in the coverage of the system to the extent they may be used as the sole guide to the troubleshooting, identification, and repair of defective parts.
- B. Provide six complete drawing books and maintenance and operation manuals on the completed system. These manuals shall include basic wiring diagrams, schematics, and functional details such that any component, wire, or piece of equipment in the system may be easily identified by going to the actual equipment and making reference to this manual. It is required that everything in the system be neatly labeled and easily identifiable. Every terminal, wire, component, or piece of equipment, relay, and other such items shall have a number or letter designation. All of these identification characteristics shall be included in the maintenance and operation manuals.
- C. Reference Section 26 0500 for additional requirements.
 - 1. The maintenance manual requirement is in addition to shop drawing requirements. Maintenance manuals and drawing sets shall be compiled after system fabrication and testing, and shall incorporate any changes made after shop drawing submittal.
 - 2. Provide manufacturer's standard literature, detailing all equipment included in the system. The maintenance manuals shall contain specifications, adjustment procedures, circuit schematics, component location diagrams, and replacement parts identification. All references to equipment not supplied on this project shall be deleted.
- D. All drawings shall be developed specifically for this project and shall be reduced to 11" X 17", folded and bound with hard plastic covers. Provide component identification and cross reference on the drawings for the maintenance department to understand the function of each item (the block diagram), find the room where the FA device is mounted (contract document plans), find its location in the control panel (arrangement drawings), find how it is wired (wiring diagrams), and its detailed specifications (vendor data sheets), and how to repair it (spare part lists). Include the following drawings as a minimum:
 - 1. Functional Block Diagram: Provide overall block diagrams showing the major interconnections between the new and existing subsystems.
 - 2. Arrangement Drawings: Provide drawings showing the physical arrangement of all major system components.

3. Elevation drawings of all equipment panels showing the location of each component in the panel. Components in the racks shall be identified as in the functional block diagrams.
4. Wiring Diagrams: Provide wiring diagrams showing all new and existing field-installed inter-connecting wiring. Wire identification on the diagrams shall agree with the wire markers installed on the equipment.

3.6 TRAINING AND INSTRUCTION

- A. Provide FA system operation and administration/maintenance training for the Owner's personnel. Training materials shall be provided to the Owner 30 days in advance of the training courses. Training sessions and intervals shall be as follows:
 1. Manufacturer's factory certification training shall be provided on site. This training shall be sufficient provision for the Owner's technicians to be permitted to provide service to the system during the warranty period (when required) without voiding the conditions of the warranty.
- B. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components shall be provided.
- C. Provide a typewritten "Sequence of Operation."

END OF SECTION