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SECTION 01 0450 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION

A. This Section specifies administrative and procedural requirements for cutting and patching.

B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

Requirements of this Section apply to mechanical and electrical installations. Refer to Division-26 and 27 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

C. Definition:

1. Cutting and Patching includes cutting into new and/or existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original condition.
2. Refer to other sections of these specifications for specific cutting and patching requirements and limitations applicable to individual units of work.

1.3 BUILDING MODIFICATIONS

A. Modifications to the new and/or existing structure, and its mechanical and electrical parts, shall be provided as indicated and as necessary to accomplish the work of these Contract Documents.

B. Modifications shall include the removal of parts, relocation of parts, termination and relocation of utilities, cutting, patching, cleaning, adjusting and refinishing, and all incidental work related to these tasks.

1.4 ACOUSTICAL AND RATED ASSEMBLY PENETRATIONS

A. Where structural members and/or other construction elements penetrate smoke and fire rated assemblies, and sound barriers, including walls around and floor below mechanical equipment rooms; provide acoustical fire rated sealant between such work and barrier to maintain acoustical attenuation, and smoke and fire integrity of the barrier.

B. All penetrations through fire rated construction shall be fire stopped as per NEC 300-21 using a through penetration fire stop system (XHEZ) listed in the Underwriters Laboratory Fire Resistance Directory.

1.5 SUBMITTALS

A. Cutting and Patching Proposal: Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the proposal:

1. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.
2. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
3. List products to be used and firms or entities that will perform Work.
   Indicate dates when cutting and patching is to be performed.
4. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.
5. Where cutting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations to show how reinforcement is integrated with the original structure.
6. Approval by the Architect to proceed with cutting and patching does not waive the Architect's right to later require complete removal and replacement of a part of the Work found to be unsatisfactory.

1.6 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.

1. Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements:
2. Foundation construction.
3. Bearing and retaining walls.
4. Lintels.
5. Structural decking.
6. Miscellaneous structural metals.
7. Equipment supports.
8. Piping, ductwork, vessels and equipment.

B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities,

or result in visual evidence of cutting and patching. Remove and replace Work cut and patched in a visually unsatisfactory manner.

1. If possible retain the original installer or fabricator to cut and patch the following categories of exposed Work, or if it is not possible to engage the original installer or fabricator, engage another recognized experienced and specialized firm:
   a. Processed concrete finishes.
   b. Stucco plaster.
   c. Acoustical ceilings.
   d. HVAC enclosures, cabinets or covers.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

B. All penetrations through fire rated construction shall be fire stopped as per NEC 300-21 using a through penetration fire stop system (XHEZ) listed in the Underwriters Laboratory Fire Resistance Directory.

PART 3 - EXECUTION

3.1 INSPECTION

A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

Before proceeding, met at the site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.

1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
3. Cut through concrete and masonry using a cutting machine such as a carborundum saw or diamond core drill.
4. Comply with requirements of applicable Sections of Division-2 where cutting and patching requires excavating and backfilling.
5. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.
4. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken containing the patch, after the patched area has received primer and second coat.
5. Patch, repair or rehang existing ceilings as necessary to provide an even plan surface of uniform appearance.

3.4 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to it is original condition.

END OF SECTION

SECTION 01 3300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, Approved Products List, and other miscellaneous submittals.

B. Related Sections include the following:

1. Division 01 Section "Closeout Procedures" for submitting warranties, Project Record Documents and operation and maintenance manuals.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Engineer's responsive action.

B. Informational Submittals: Written information that does not require Engineer's approval. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

A. General: Submit submittals in Adobe Portable Document Format (PDF) minimum version 4.0 with Submittal Transmittal to Engineer for review.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    a. Engineer and Contractor reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Submittals Schedule: Comply with contract and request for proposal for time requirements for scheduled performance of related construction activities.

D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows.

Time for review shall commence on Engineer's receipt of submittal.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
2. If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Allow 10 days for processing each resubmittal.
4. Contractor shall keep a submittal log of to track progress of submittals.
5. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, product delivery time or product substitutions.

E. Identification: Place a permanent label or title block on each submittal for identification. Provide in PDF for electronic submittals.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space beside title block to record Contractor's review and approval markings and action taken by Engineer and Contractor.
3. Include the following information on label for processing and recording action taken:
    a. Project name.
    b. Date.
    c. Name and address of Engineer.
    d. Name and address of Contractor.
    e. Name and address of subcontractor.
    f. Name and address of supplier.
    g. Name of manufacturer.
    h. Number and title of appropriate Specification Section.
    i. Drawing number and detail references, as appropriate.
    j. Other necessary identification.

4. Electronic PDF submittal files shall be named utilizing the specification number followed by a sequential number for the submittal made under the given specification number followed by "r#" if it is a resubmittal, and then followed by a brief description of the submitted item.
    a. The description shall indicate the actual item submitted, shall not be general in nature, and does not have to be that of the specification section heading.
    b. Using the example, "15135-4r2 Differential Pressure Gauge"; 15135 - Meters and Gauges is the relevant specification, the " 4 shows it was the fourth submittal for specification section 15135, "1-2" shows it was the second resubmittal, and the description indicates what item is submitted.
    c. Each specification item shall be submitted in a separate PDF file. PDF files with multiple specification items will be returned without review.
    d. Each file shall have sufficient space allowance for the Engineers review stamp(s).
    e. Each file shall have the Contractor's review stamp(s) and indicate information required by specification 01330-1.4.E.3 above.

5. All marks made by the Contractor shall be in green pen the will be visible when copied.

F. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.

G. Additional Copies: Unless additional copies are required for final submittal, and unless Engineer or Contractor observes noncompliance with provisions of the Contract Documents, initial submittal may serve as final submittal.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling.

Transmit each submittal using a transmittal form. Engineer will discard submittals received from sources other than Contractor.

1. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements of the Contract Documents, including minor variations and limitations.
   Include the same label information as the related submittal.
2. Include Contractor's certification stating that information submitted complies with requirements of the Contract Documents.

END OF SECTION

SECTION 01 4200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. “Architect”: Architect, Engineer, Architect/Engineer, and A/E are used interchangeably, and refer to the Prime Professional on the project, Anston-Greenlees, Inc.

C. “A/E”: Architect, Engineer, and A/E can be used interchangeably, and refer to the Prime Professional on the project, Anston-Greenlees, Inc.

D. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

E. “Contractor”: The project contractor directly under contract for the project with the Owner.

F. “Sub-contractor”: A contractor under contract directly with the project Contractor.

G. “Owner”: The Florida Department of Management Services, and specifically the Real Estate and Development Division, is the Owner.

H. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."

I. “Engineer”: Architect, Engineer, and A/E can be used interchangeably, and refer to the Prime Professional on the project, Anston-Greenlees, Inc.

J. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled”, and "specified" have the same meaning as "indicated."

K. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

L. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

M. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

N. "Provide": Furnish and install, complete and ready for the intended use.

O. "Installer": Contractor or another entity engaged by the project Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular and specific construction operation, including installation, erection, application, and similar operations.

1. Using a term such as "carpentry" does not 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 trades people of the corresponding generic name.

P. "Experienced": When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

Q. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless 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 standards in effect as of date of the Contract Documents, unless otherwise indicated.

C. Conflicting Requirements: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

1. 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 requirements. Refer uncertainties to Architect for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source and make them available on request.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc.	(202) 862-5100	www.aluminum.org
AABC	Associated Air Balance Council	(202) 737-0202	www.aabchq.com
AAMA	American Architectural Manufacturers	(847) 303-5664	www.aamanet.org
ACI	American Concrete Institute/ ACI International	(248) 848-3700	www.aci-int.org
ADC	Air Diffusion Council	(312) 201-0101	www.flexibleduct.org
AGC	Associated General Contractor of America	(703) 548-31 18	www.agc.org
AIA	American Institute of Architects	(202) 626-7300	www.e-architect.com
ANSI	American National Standards Institute	(202) 293-8020	www.ansi.org
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers	(800) 527-4723	www.ashrae.org
ASTM	American Society for Testing and Materials	(61 0) 832-9585	www.astm.org
AWI	Architectural Woodwork Institute	(800) 449-8811	www.awinet.org
CLFMI	Chain Link Fence Manufactures Institute	(301) 596-2583	www.chainlinkinfo.org
CRSI	Concrete Reinforcing Steel Institute	(847) 517-1200	www.crsi.org
CSI	Construction Specifications Institute	(800) 689-2900	www.csinet.org
NAAMM	National Association of Architectural Metal Manufacturers	(312) 332-0405	www.naamm.org
NECA	National Electrical Contractors Association	(301) 657-3110	www.necanet.org
NEMA	National Electrical Manufacturers Association	(703) 841-3200	www.nema.org
NFPA	National Fire Protection Association	(800) 344-3555	www.nfpa.org

NHLA	National Hardwood Lumber Association	(800) 933-0218	www.nathardwood.org
NRCA	National Roofing Contractors Association	(800) 323-9545	www.nrca.net
SMACNA	Sheet Metal and Air Conditioning Contractors National Association	(703) 803-2980	www.smacna.org

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

1. FBC: Florida Building Code
   a. Website: http:llwww.floridabuiIding.orglc/default.aspx
   b. Phone: (850) 487-1824

END OF SECTION

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. Related Sections include the following:

1. Division 01 Section "References" for applicable industry standards for products specified.
2. Division 01 Section "Closeout Procedures" for submitting warranties for contract closeout.
3. Divisions 2 through 26 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

A. Products: Item’s purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service

performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.4 SUBMITTALS

A. Product List: Submit a list, in tabular from, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.

1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
2. Form: Tabulate information for each product under the following column headings:
    a. Specification Section number and title.
    b. Generic name used in the Contract Documents.
    c. Proprietary name, model number, and similar designations.
    d. Manufacturer's name and address.
    e. Supplier's name and address.
    f. Installer's name and address.
    g. Projected delivery date or time span of delivery period.
    h. Identification of items that require early submittal approval for scheduled delivery date.
    i. Refer to specific specification sections for more submittal and shop drawing requirements.

3. Submittal: Within 10 days after date of commencement of the Work, submit electronic copies of product list and shop drawings. Include a written explanation for omissions of data and for variations from Contract requirements.
4. Architect's Action: Architect will respond in writing to Contractor within 15 days of receipt of complete submittal. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement that products comply with the Contract Documents.

B. Substitution Requests: Submit three copies of each request for consideration at least 15 days prior to the bid due date. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    a. Statement indicating why specified material or product cannot be provided.
    b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.

c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
I. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 calendar days of receipt of a request for substitution. Architect will notify Contractor of acceptance of proposed substitution by addendum, within the allowable addendum period, prior to bid date. Any substitution request that is not accepted by an official addendum shall be deemed un-acceptable.
   a. Form of Acceptance: Addendum.
   b. Use product specified if Architect does not make a decision on use of a proposed substitution within time allocated.

C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Store products to allow for inspection and measurement of quantity or counting of units.
6. Store materials in a manner that will not endanger Project structure.
7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
9. Protect stored products from damage.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: Forms are included with the Specifications. Prepare a written document using appropriate form properly executed.
3. Refer to Divisions 2 through 26 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures: Procedures for product selection include the following:

1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
   a. Substitutions may be considered, unless otherwise indicated.

2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
   a. Substitutions may be considered, unless otherwise indicated.

3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: Architect will consider requests for substitution if received within 15 days prior to bid date. Requests received after that time may be considered or rejected at discretion of Architect.

B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect may reject requests without action:

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.

3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.
10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
11. Requested substitution specifically identifies any deviations from the requirements of the specifications and how that deviation is addressed, deleted, or modified.

2.3 COMPARABLE PRODUCTS

A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 01 70 00 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.
7. Correction of the Work.

B. Related Sections include the following:

1. Division 01 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.

1.3 SUBMITTALS

A. Certificates: Submit documentation of coordination with any required inspections, testing, and approvals from the authority having jurisdiction, and evidence of the execution of any required easements.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

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

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
   a. Description of the Work.
   b. List of detrimental conditions, including substrates.
   c. List of unacceptable installation tolerances.
   d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

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

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

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

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling. Six feet, 6 inches will be permitted in spaces dedicated to mechanical and electrical systems.

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

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

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

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.

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

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

3.4 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

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

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

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

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

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

G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

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

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

3.5 STARTING AND ADJUSTING

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

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

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

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division I Section "Quality Requirements."

3.6 PROTECTION OF INSTALLED CONSTRUCTION

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

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

3.7 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

1. Comply with requirements in Division 1 Section "Cutting and Patching."
2. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Project Close Out Documents.
3. Operation and maintenance manuals.
4. Warranties.
5. Instruction of Owner's personnel.
6. Final cleaning.
7. Spare parts list summary.
8. Related Sections include the following:
    a. Refer to Contract for requirements for Applications for Payment for Substantial and Final Completion.
    b. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
    c. Divisions 2 through 27 Sections for specific closeout and special cleaning requirements for products of those Sections.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. If applicable, prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
3. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
4. Complete startup testing of systems.
5. Submit test/adjust/balance records.
6. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
7. Complete final cleaning requirements, including floor waxing and touchup painting.

8. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
9. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
    a. Multiple Inspections: The Architect's Agreement with the Owner includes one Substantial Completion Inspection for the entire project.
    aa. If the Contractor wants additional Inspections, they will be conducted at the Contractor's expense. Cost of multiple Substantial Completion Inspections will be billed at the Architect's and Engineers' hourly rates as identified in the Architect Owner Agreement.
    bb. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
    aaa. The Architect's Agreement with the Owner includes one reinspection to determine if the Substantial Completion Punch List has been completed. Cost of more than one re-inspection will be at the Contractor's expense and will be billed at the Architect's and Engineers' hourly rates as identified in the Architect Owner Agreement.
    cc. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Contract requirements.
2. Submit copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed by Contractor. The copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Complete and submit the Owner Training Log in the format provided at the end of this section.
4. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
    a. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
    aa. The Architect's Agreement with the Owner includes one inspection to determine Final Completion. Cost of more than one inspection will be at the Contractor's expense and will be billed at the Architect's and Engineers' hourly rates.

5. Submit Contractor Close Out Documents prior to requesting the final inspection. Close Out Documents are to consist of the documents listed on the attached Checklist, and any additional documents required elsewhere in the specifications.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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

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

1.6 PROJECT RECORD DOCUMENTS

A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

B. Record Drawings: Maintain and submit one set of black-line white prints of Contract Drawings and Shop Drawings.

1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
    a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
    b. Accurately record information in an understandable drawing technique.
    c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
    d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.
    aa. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
    bb. Mark important additional information that was either shown schematically or omitted from original Drawings.
    cc. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
    dd. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

2. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where

installation varies from that indicated in Specifications, addenda, and contract modifications.

a. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
b. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
c. Note related Change Orders, Record Drawings, and Product Data, where applicable.

1.7 EXTRA STOCK - SPARE PARTS LIST

A. Submit a list summarizing all of the spare parts required by each specific section of the specifications, and provide the requested spare parts. Refer to specification section 2 through 27 for spare parts requirements. Obtain a signed receipt indicating the date, time, location, and the person to whom the part were delivered and received.

1.8 WARRANTIES

A. All work shall be warranted for a period of 1 year unless a longer warranty period is stated elsewhere in the specifications. All warranty periods shall start on date of the approved substantial completion of the final phase of work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 DEMONSTRATION AND TRAINING

A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system. Complete a log of activities as indicated in attached Owner Training Log.

1. Provide instructors experienced in operation and maintenance procedures.
2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
3. Schedule training with Owner, with at least seven days' advance notice.
4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.
5. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual

Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:

a. System design and operational philosophy.
b. Review of documentation.
c. Operations.
d. Adjustments.
e. Troubleshooting.
f. Maintenance.
g. Repair.
h. Review spare parts list

3.2 FINAL CLEANING

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

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

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
   a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. Remove tools, construction equipment, machinery, and surplus material from Project site.
   d. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition. Provide floor waxing as specified elsewhere in the construction documents.
   e. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   f. Sweep concrete floors broom clean in unoccupied spaces.
   g. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
   h. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
   i. Remove labels that are not permanent.
   j. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
   aa. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

aaa. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
bbb. Replace parts subject to unusual operating conditions.
ccc. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
ddd. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
eee. Clean ducts, blowers, and coils if units were operated without filters during construction.
fff. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
ggg. Leave Project clean and ready for occupancy.

2. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION

SECTION 02 0700 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Bidding Requirements, Contractual Conditions, and General Requirements of Division One shall apply to all work hereunder.

1.2 WORK INCLUDED

A. Coordinate and verify existing conditions, including utilities, prior to commencement of selective demolition.

B. Remove portions of existing slabs/walks as required and shown.

C. Remove designated building equipment, fixtures, partitions and components. Remove partial items as required.

D. Cap and identify exposed utilities.

E. Provide temporary partitions as necessary to allow continued building occupancy by Owner during phased construction.

F. Maintain approved means of egress from existing building exits as required by code.

G. Other items of demolition as indicated on drawings.

1.3 SUBMITTALS

A. Permits and notices authorizing demolition.

B. Permit for transport and disposal of debris.

C. Schedule: Indicating demolition procedures and operational sequence for review and acceptance by Architect/Engineer prior to start of work. Include coordination for shut-off, capping and continuation of utility services as required.

1.4 JOB CONDITIONS

A. Occupancy: Areas to be demolished will be vacated and discontinued in use prior to start work.

1.5 PROTECTION

A. Do not interfere with use of adjacent existing buildings or parking areas. Maintain free and safe passage to and from.

1. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
2. Do not close or obstruct corridors or passageways within the existing building except as shown on the Demolition Plans.

B. Prevent damage, movement or settlement of structure. Provide and place bracing or shoring and be responsible for safety and support of structure. Assume liability for such movement, settlement, damage or injury.

C. Cease operations and notify the Architect/Engineer and Owner immediately, if safety of structure appears to be endangered. Take precautions to properly support structure. Do not resume operations until safety is restored.

D. Provide, erect and maintain barricades, lighting, and guardrails as required by applicable regulatory advisory to protect occupants of building and workers.

1. Erect temporary covered passageways as required by authorities having jurisdiction.

E. Explosives: Use of explosives will not be permitted.

F. Damages: Promptly repair damages caused to adjacent facilities by demolition operations at no cost to Owner.

G. Refer to drawings for additional protection requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Except where noted otherwise, maintain possession of materials being demolished. Immediately remove from site.

B. Equipment and articles of value remain the property of the Owner. Notify Architect prior to removal and obtain acceptance regarding method of removal.

C. Items of salvageable value only to Contractor may be removed from area as work progresses. Salvaged items must be transported from site as they are removed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Erect weatherproof closures for exterior openings. Maintain exit requirements.

B. Erect and maintain dustproof partitions as required to prevent spread of dust, fumes and smoke to other parts of the building. On completion, remove partitions and repair damaged surfaces to match adjacent surfaces.

C. Coordinate installation and removal of temporary partitions with the Owner to facilitate Owner's use of building.

D. During removal of any existing parapets or roofing, provide proper protection from falling objects entrances which are to be kept open during normal working hours.

E. Carry out demolition work to cause as little inconvenience to adjacent occupied building areas as possible.

3.2 DEMOLITION

A. Demolish in an orderly and careful manner as required to accommodate new work, including that required for connection to the existing building. Protect existing foundations and supporting structural members.

B. Perform demolition in accordance with applicable authorities having jurisdiction.

C. Immediately repair all demolition performed in excess of that required, at no cost to the Owner.

D. Pollution Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level.

E. Comply with governing regulations pertaining to environmental protection.

1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding and pollution. Do not use water at interior of building.
2. Clean adjacent structures and improvements of dust, dirt and debris caused by demolition operations, as directed by Architect or governing authorities. Return adjacent areas to condition existing prior to start of work. Supply and maintain dust mats at all dust partition doors.

3.3 DISPOSAL

A. Burning of materials on site is not permitted.

B. Remove from site any contaminated, vermin infested, or dangerous materials encountered and dispose of by safe means so as not to endanger health of workers and public.

C. Remove demolished materials, debris, tools and equipment from site upon completion of work. Leave site in a condition acceptable to the Architect/Engineer.

D. Transport materials removed from demolished structures and dispose of off site at an approved location.

END OF SECTION

SECTION 23 0000 - MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Work herein shall conform to all applicable laws, ordinances, and to regulations of the local utility companies. The general conditions and all requirements of the contract documents shall apply to all work of this section. Work shall be in accordance with the requirements of:

1. Florida Building Code (FBC) 6th Edition (2017): This code includes the 2017 FBC Building, Mechanical, Plumbing, Energy Conservation, Fuel Gas, Accessibility, and Test Protocols volumes. Further, see "Referenced Standards" in the FBC Building Chapter 35; FBC Mechanical Chapter 15; FBC Plumbing Chapter 14; FBC Energy Conservation Chapter 6; and FBC Fuel Gas Chapter 8) (Effective December 31, 2017).
2. 6th Edition of the Florida Fire Prevention Code (FFPC): This code also includes the Florida versions of NFPA 1 and NFPA 101. (Effective December 31, 2017).
3. 2014 National Electric Code.
4. 2014 State Requirements for Educational Facilities (SREF): – (Effective November 4, 2014)

B. Cooperate with all other trades and install work as fast as the progress of the job will permit.

C. Use only mechanics skilled in the work they are to perform and have a competent representative on the job when any work is being done.

D. No work shall be done unless the Superintendent of the Contractor is on the job site. Work shall be properly protected, all rubbish removed promptly, and exposed work shall be carefully cleaned prior to final acceptance.

E. The term "provide" shall include labor, materials, and equipment necessary to furnish and install, complete and operable, the item or system indicated.

F. In decisions arising from discrepancies, interpretation of Drawings and Specifications, substitutes, and other pertinent matters, the decision of the Owner's representative's approval shall be final.

1.2 SPECIFICATIONS AND DRAWINGS

A. Plans show location of fixtures and equipment and are intended to depict the general intent of the work in scope, layout and quality of workmanship. They are not intended to show in minute detail every or all accessories intended for the purpose of executing the work, but it is understood that such details are a part of this work.

B. Where Drawings and Specifications conflict, it shall be the responsibility of this Contractor to bring such conflict to the attention of the Architect/Engineer for clarification. Refer to Supplementary Conditions, Paragraph 1.2. In general, the Architectural Drawings shall take precedence over the Mechanical Drawings with reference to building construction. All changes

from the Drawings necessary to make the work conform with the building as constructed and to fit the work of other trades or to conform to the rules of authorities having jurisdiction, shall be made by the Contractor at his own expense.

C. Keep a record of the locations of concealed work and of any field changes in Contract Drawings and Specifications for each trade and, upon completion of the job. Refer to Specification Section 017000, "Closeout" for requirements.

1.3 PERMITS, FEES AND INSPECTIONS:

A. The Contractor shall give all necessary notices, obtain all permits and pay all government fees in accordance with the Supplementary Conditions, sales taxes and other costs, including utility connections or extensions, in connection with this work; file all permit applications required by all governmental departments having jurisdiction.

B. Obtain all required certificates of inspection for work and deliver them to the Owner before requesting acceptance and final payment for the work.

C. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and drawings required to comply with all applicable laws, ordinances, rules and regulations.

D. The Contractor shall inform the Owner of any work or materials which conflict with any of the applicable codes, standards, laws and regulations before submitting his bid.

1.4 GENERAL

A. Materials or products specified herein and/or indicated on drawings by trade name, manufacturer's name and/or catalog number shall be provided as specified. Substitutions will not be permitted except as described herein and in the Supplementary and General Conditions.

B. Since manufacturers reserve the right to change their products at any time, contractors shall verify all dimensions, performance data, etc. for each piece of equipment submitted to assure compliance with the intent of the drawings and specifications.

C. All materials shall be new and of quality as specified, and when required, be clearly labeled and/or stamped as manufactured in the United States.

D. Where an accepted substitution or deviation requires different quantity or arrangement of foundations, supports, ductwork, piping, wiring, conduit, and any other equipment or accessories normal to this equipment, contractor shall furnish said changes and additions and pay all costs for all changes and additions to his work and the work of others affected by this substitution or deviation.

E. Deviations mean the use of any listed approved manufacturer other than those on which the drawings are based.

1.5 SHOP AND ERECTION DRAWINGS AND SAMPLES

A. The Architect/Engineer's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site. Submittals shall be made for all equipment and systems as indicated in the respective specification section.

B. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Architect/Engineer to ascertain that the proposed equipment and materials comply with specification and drawing requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.

C. Shop and erection drawing submittals shall conform to the requirements of the General Conditions and Division 00 specifications except as modified herein.

D. Submit required and/or requested shop and erection drawings, for review by Architect/Engineer before ordering or installing any equipment or material. Equipment or material ordered or installed before Architect/Engineer review may not be accepted and may have to be removed from the project if deemed unacceptable.

E. Shop drawings shall consist of manufacturer's scale drawings, cuts or catalogs, including descriptive literature which shall clearly indicate the construction, material, physical dimensions, wiring diagrams and complete operating data clearly marked for each item. Data of general nature will not be accepted.

F. Shop drawings on paper larger than 11”x17” shall be submitted in the form of one set of reproducibles (vellum) and one set of blueprints. The blueprints will be retained by the engineer and the reproducibles will be returned to the contractor.

1. Coordination drawings shall show major elements, components, and systems of mechanical equipment and materials in relationship with other building components. Prepare drawings to an accurate scale of 1/4"=1'-0" or larger. Indicate the locations of all equipment and materials, including clearances for installing, servicing and maintaining equipment, valve stem movement, and similar requirements. Indicate movement and positioning of large equipment into the building during construction.

G. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval. Submittals shall be submitted for all applicable products and materials specified in each individual section of these specifications.

H. Make submittals for the equipment and materials in accordance with the following:

1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. The submittals shall include the following:
    a. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required. Provide

any additional information specifically requested in the individual specification section or on the drawings.

b. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

4. Electronic PDF submittal files shall be named utilizing the specification number followed by a sequential number for the submittal made under the given specification number followed by "r#" if it is a resubmittal, and then followed by a brief description of the submitted item.
   a. The description shall indicate the actual item submitted, shall not be general in nature, and does not have to be that of the specification section heading.
   b. Using the example, "230519-4r2 Differential Pressure Gauge"; 230519 – Meters and Gauges is the relevant specification, the "4" shows it was the fourth submittal for specification section 230519 02,"r2" shows it was the second resubmittal, and the description indicates what item is submitted.
   c. Each specification item shall be submitted in a separate PDF file. PDF files with multiple specification items will be returned without review.
   d. Each file shall have sufficient space allowance for the Architects and Engineer's review stamp(s).
   e. Each file shall have the Construction Manager's review stamp(s) and indicate information required by specification 230000.1.5.K.

I. Shop drawings on paper 11"X17" or smaller in size shall be submitted in a tabbed and indexed three ring binder. The binder shall not exceed 11-5/8" height. Partial submittals are unacceptable. The index shall indicate the related specification section number.

J. A fee will be charged for Engineering review plans that have been rejected two or more times due to non-compliance or incompleteness. The fee will be determined by the Architect/Engineer and the CM will back charge the responsible subcontractor and will reimburse the owner by change order for the additional fees.

K. The Construction manager will certify that all Division 23 shop drawings are in conformance with the plans and specifications. Deviations from the plans and specifications shall be noted, and the specific area of the deviation clouded and in contrasting color (green) with a complete explanation for the reasons for the deviation. Any redesign of the system shall be Certified by a Professional Engineer currently registered in the State of Florida, and will be accompanied by the fees as described in "J" above.

L. Carefully examine all shop drawings and mark-up as necessary before submitting to the Architect/Engineer for review. The consultant will only consider shop drawings bearing the contractor's stamp of approval.

M. The engineer's review shall not relieve the contractor from the responsibility for deviations from drawings and specifications. The engineer's review shall be construed to apply only to general arrangement and shall not relieve the contractor from the responsibility for the correctness of details and dimensions and provision of the correct equipment.

N. The contractor shall retain copies of all reviewed shop drawings on the job site for reference.

O. In addition to the requirement of SUBMITTALS, the Owner reserves the right to request the manufacturer to arrange for the Owner's representative(s) to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.

P. Operation and Maintenance Manuals:

1. Maintenance manuals shall be complete and shall be furnished in a loose leaf binder or in the manufacturer's standard binder. Information shall be sufficient to enable a qualified technician to perform normal first line maintenance and repair. A parts list shall be included which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
2. Operation manuals shall be clear and concise and shall describe, in detail, the information required to properly operate the equipment specified. The manuals shall include complete catalog cuts and as-built wiring diagrams.
3. Operation and maintenance manuals shall be submitted for approval prior to final close-out.

1.6 EXPERIENCE

A. The Contractor performing this work shall be a licensed, reputable firm, regularly performing the type of work incorporated in this project and who also maintains, as part of the firm, a service department with qualified personnel who regularly perform this type of work. The Contractor shall, upon request, show evidence of at least two jobs of similar character and size installed within the preceding two years.

1.7 COORDINATION WITH OTHER TRADES

A. Contractor shall coordinate his work with other trades to avoid interferences and delays. He shall assist in working out space requirements to make a satisfactory installation.

B. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with the work of other trades, he shall make the necessary changes in his work to correct the condition without extra charge.

C. The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

1.8 STORAGE OF MATERIALS

A. All materials stored on site shall be properly protected from injury or deterioration. Materials shall not be stored in contact with ground or floor.

B. Do not remove manufacturer's packing materials until ready to install. Materials showing signs of corrosion, improper handling or storage shall be replaced at no cost to the Owner.

C. Provide continuous protection for all equipment already installed.

1.9 CUTTING, PATCHING, EXCAVATION, BACKFILL, AND LAYOUT

A. Provide openings and excavation required for the installation of the work. Patch work and backfill as required. Finished work shall match the existing adjoining work.

B. Verify all conditions affecting the work to be performed under this contract.

C. Carefully verify measurements at the site, determine the exact location of chases and openings required. Provide sleeves, inserts, and hangers as required. No columns, beams, joists, building foundations or any other structural building component shall be cut, drilled or disturbed in any way. Conflicts shall immediately be brought to the attention of the Architect/Engineer.

D. All excavation on sites containing existing buildings and existing services shall be done with hand shovel to avoid damage to existing services. Any damage incurred by the Contractor shall be repaired by the Contractor in a manner approved by the Architect/Engineer at no cost to the Owner and with no extension of time limitation.

1.10 REMOVAL OF RUBBISH

A. Contractor shall keep premises free from accumulations of waste material or rubbish caused by his employees or work in accordance with Division 00 - Construction Procedures. At completion of work, he shall remove all his tools, scaffolding, surplus materials, and rubbish from building and site. He shall leave premises and his work in a clean orderly condition acceptable to the Architect/Engineer.

1.11 ELECTRICAL WORK FOR MECHANICAL SYSTEMS

A. Factory installed starters, controllers, and control equipment mounted in manufactured mechanical equipment necessary for mechanical equipment operation shall be furnished under Division 23.

B. Power wiring for motors and installation of starters shall be under Division 26 Electrical.

C. Temperature, humidity, pressure and similar controls essential to the operation of mechanical systems, and wiring and conduit thereof, including interlock wiring, shall be under Division 23 of specifications, installed in accordance with requirements of Division 26.

D. Motors shall be furnished under Division 23 of capacity required to operate equipment specified, but shall not be less than that specified.

E. Furnish and install all low voltage (120V and under) temperature control wiring for equipment provided under this division.

F. Provide conduit when required for control wiring.

1.12 MOTORS

A. All motors shall be furnished and installed under Division 23 and shall be wired under Division 26 Electrical.

B. All motors shall be built in accordance with the current applicable IEEE, ASA, and NEMA standards. All general purpose motors shall be open drip-proof machines for installation indoors and/or in protected locations. Totally enclosed fan cooled (TEFC) motors shall be used in all areas of exposure to weather or other environmental contamination. Motors shall be rated explosion proof when located in hazardous atmospheres. Type II weather protected motors may be used in lieu of TEFC motors on roof mounted fan units and similar equipment.

C. Unless indicated otherwise, motors shall be NEMA Design B with a service factor of 1.15 with total temperature rise of 90 degrees C. (resistance measured) in 40 degrees C. ambient when powered from the system voltage feeding the motor. TEFC motors shall have a service factor of 1.00 with total temperature rise of 80 degrees C. in the above conditions. Motors located in areas exceeding 40 degrees C. ambient shall be factory rated for the ambient temperature of the motor environment. Single phase motors shall generally be NEMA Design N split phase induction motors with built-in thermal protectors. Single phase motors connected on loads requiring high starting torque shall be capacitor-start induction motors. Single phase motors of 1/10 HP or less may be shaded pole induction motors.

D. If the Contractor proposes to furnish motors varying in horsepower and/or characteristics from those specified, he shall first inform the Architect/Engineer of the change and shall then coordinate the change and shall pay all additional charges in connection with the change.

E. All motors supplied on this project three (3) HP and larger shall have a power factor not less than 85 percent under rated load conditions. Power factor of less than 85 percent shall be corrected to at least 90 percent under rated load conditions. Power factor corrective devices, installed to comply with this Code, shall be switched with the utilization equipment.

F. All motors supplied on this project shall be energy efficient. All efficiency testing and labeling shall be performed in accordance with the NEMA Standard MG 1-12.54 and IEEE 112 Test Standard, Method B. Minimum efficiencies shall conform to the following listing:

Motor HP	Efficiency (%)
3/4	80.0
1	82.5
1-1/2	84.0
2	85.5
3	87.5
5	87.5
7-1/2	89.5
10	89.5
15	91.0
20	91.7

1.13 QUIET OPERATION AND VIBRATION

A. All equipment provided under this section shall operate under all conditions of load free of objectionable sound and vibration. Sound and vibration conditions considered objectionable shall be corrected in an approved manner.

B. Vibration and sound control shall be by means of approved vibration eliminators or sound attenuators in a manner as specified and as recommended by the manufacturer.

1.14 EQUIPMENT IDENTIFICATION

A. Each unit shall be identified by its system number and other appropriate designation by stenciling in letters of approved size and wording. Equipment requiring identification shall include: supply and exhaust fans, air conditioning and heating machinery and apparatus, pumps, piping, control cabinets, and other equipment units as may be directed by the Architect/Engineer.

1.15 CLEANING AND ADJUSTMENTS

A. Upon completion of the work, Contractor shall clean and lubricate fans, motors, and other running equipment and apparatus which he has installed and make certain such apparatus and mechanisms are in proper working order and ready to test.

B. Scratched or damaged painting shall be touched up as necessary to return the painting to "new" condition and appearance.

C. All piping and equipment shall be thoroughly blown out under pressure and cleared of all foreign matter, wasting air, gas or water through temporary connections as long as necessary to thoroughly clean system before system is placed in operation. Use every precaution to prevent pipe compound, scale, dirt, welding and other objectionable matter from getting into the piping system and equipment.

D. During blow out period, baskets from strainers shall be removed, traps and control valves, etc., shall be by-passed.

E. All cleaning shall be done prior to any sterilization, pressure testing, flow balancing or equipment adjustment procedures.

F. During construction protect all piping and equipment from damage and dirt. Cap the open ends of all piping and equipment.

1.16 DEMOLITION

A. Demolition shall be as shown on drawings or specified.

B. Schedule all demolition work with Owner to cause minimum downtime of any building service or function. No extra cost to the contract will be allowed for overtime work unless specifically authorized in advance by representative of Owner in writing.

C. During demolition and construction protect from damage all existing equipment and services that are to remain. Repair or replace any damage to existing facilities at no extra cost to the contract.

D. Remove with care and deliver to a location designated by representative of the Owner all items designated to remain the property of the Owner.

E. Drawings are diagrammatic and shown only major obstructions; coordinate with other trades for removal or relocation of pipes; conduits, hangers, etc. in path of work.

F. No columns, beams, joists, building foundations or any other structural building component shall be cut, drilled or disturbed in any way. Conflicts shall immediately be brought to the attention of

the Architect/Engineer. Contractor shall not proceed until instructed in writing by the Architect/Engineer if conflicts between mechanical work and structural elements occur.

1.17 CONNECTIONS TO EXISTING WORK

A. Plan installation of new work and connections to existing work to insure minimum interference with regular operation of existing facilities.

B. Submit to the Owner for approval, a schedule of necessary temporary shut-downs of existing services. All shutdowns shall be made at such times as will not interfere with regular operating of existing facilities and only after written approval of the Owner.

C. To insure continuous operation, make necessary temporary connections between new and existing work.

D. Connect new work to existing work in neat and approved manner. Restore existing work disturbed to original condition.

1.18 WATERPROOFING

A. Where any work pierces waterproofing including waterproof concrete, the method of installation shall be as approved by the Owner before the work is done.

B. Provide all necessary sleeves, caulking and flashing required to make openings absolutely watertight. Waterproof flashing materials shall be compatible with base materials.

1.19 TESTS

A. Contractor shall make all tests required to establish the adequacy, quality, safety, completed status and satisfactory operation of all systems to the satisfaction of the Architect/Engineer. Provide all instruments, labor and services necessary to conduct tests.

1.20 INSTRUCTIONS

A. Fully instruct Owner's personnel in the care and operation of mechanical systems and furnish a letter to the Architect/Engineer advising the particular person who has received such instruction.

1.21 WARRANTY

A. Equipment shall be started, tested, adjusted, and placed in satisfactory operating condition. Furnish a letter addressed to the Architect/Engineer advising that the completed systems have been installed in accordance with the Plans and Specifications and that they are in proper operating condition. The Owner shall receive a written warranty covering all defects in workmanship and material for a period of one year from date of final acceptance. Any defects appearing within this one year period shall be repaired without additional cost to the Owner.

1.22 ACCEPTANCE

A. Before requesting final inspection:

1. Complete all work required. If any items are held in abeyance as incomplete for final inspection, list such items together with explanation for delay.
2. Submit statement that equipment is properly installed, adjusted, fully lubricated and operation is satisfactory.
3. Certify in writing to the Architect/Engineer that the Owner's representative has been instructed as to the care and operation of the system and that catalog service and maintenance information has been turned over to the Architect/Engineer.
4. Submit copy of written guarantee.
5. Submit copy of other data as may be outlined in these specifications.

B. Copies of the above data shall be submitted to the Architect/Engineer prior to requesting final inspection.

1.23 FACILITY STARTUP BROCHURE

A. At the completion of work, Contractor shall provide startup instruction in accordance with Division 00, “Closeout” and shall submit a bound brochure containing the following:

1. Shop Drawings
2. Maintenance Manuals
3. Control Wiring and Piping Diagrams
4. Operating Instructions
5. Copy of Guarantee
6. Certificate of Instruction of Owner's Representative
7. Certificate of Job Completion
8. Record Documents

B. Where projects are of sufficient size to make a single brochure impractical, several brochures shall be prepared by trade and As-Built Drawings may be submitted as a separate item.

C. Brochure shall be indexed and divided for reasonable clarity.

D. Brochure shall be turned over to the Architect/Engineer for review and approval. The contractor shall make modifications to the brochure as deemed necessary for compliance and clarity, by the Architect/Engineer, and re-submit the final brochure to the Architect/Engineer to be forwarded to the Owner.

END OF SECTION

SECTION 23 0519 - HVAC METERS AND GAGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. This section is Division 23 Basic Mechanical Materials and Methods section, and is part of each Division 23 section making reference to meters and gages specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of meters and gages required by this section is indicated on drawings and/or specified in other Division 23 sections.

B. Types of meters and gages specified in this section include the following:

1. Temperature Gages and Fittings.
   a. Glass Thermometers.
   b. Thermometer Wells.
   c. Temperature Gage Connector Plugs.

2. Pressure Gages and Fittings.
   a. Pressure Gages.
   b. Pressure Gage Cocks.
   c. Pressure Gage Connector Plugs.

3. Flow Measuring Meters.
   a. Wafer-Type Flow Meters.
   b. Calibrated Balance Valves.

C. Meters and gages furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 23 sections.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of meters and gages, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ANSI and ISA Compliance: Comply with applicable portions of ANSI and Instrument Society of American (ISA) standards pertaining to construction and installation of meters and gages.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of meter and gage. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.

B. Maintenance Data: Submit maintenance data and spare parts lists for each type of meter and gage. Include this data and product data in Maintenance Manual; in accordance with requirements of Division 00.

PART 2 - PRODUCTS

2.1 GLASS THERMOMETERS:

A. General: Provide glass thermometers of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.

B. Case: Die cast aluminum finished in baked epoxy enamel, glass front, spring secured, 9" long.

C. Adjustable Joint: Die cast aluminum, finished to match case, 180° adjustment in vertical plane, 360° adjustment in horizontal plane, with locking device.

D. Tube and Capillary: Mercury filled, magnifying lens, 1% scale range accuracy, shock mounted.

E. Scale: Satin faced, non-reflective aluminum, permanently etched markings.

F. Stem: Copper-plated steel, or brass, for separable socket, length to suit installation.

G. Range: Conform to the following:

1. Chilled Water: 30° - 180°F with 2°F scale divisions.
2. Hot Water: 30° - 240°F with 2°F scale divisions.

H. Manufacturer: Subject to compliance with requirements, provide glass thermometers of one of the following or approved equivalent:

1. Ernst Gage Co.
2. Marshalltown Instruments, Inc.
3. Trerice (H.O.) Co.
4. Weiss Instruments, Inc.
5. Miljoco

2.2 THERMOMETER WELLS:

A. General: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2" extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.

B. Manufacturer: Same as thermometers.

2.3 TEMPERATURE GAGE CONNECTOR PLUGS:

A. General: Provide temperature gage connector plugs pressure rated for 500 psi and 200°F (93°C). Construct of brass and finish in nickel-plate, equip with 1/2" NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" O.D. probe assembly from dial type insertion thermometer. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

B. Manufacturer: Subject to compliance with requirements, provide temperature gage connector plugs of one of the following or approved equivalent:

1. Peterson Equipment Co.

2.4 PRESSURE GAGES:

A. General: Provide pressure gages of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.

B. Type: General use, 1% accuracy, ANSI B40.1 grade A, phosphor bronze bourdon type, bottom connection. On coils, chillers and where indicated, provide differential pressure gages with two taps. Refer to details on the drawings for specific requirements.+

C. Case: Drawn steel or brass, glass lens, 4-1/2" diameter.

D. Connector: Brass with 1/4" male NPT.

E. Scale: White coated aluminum, with permanently etched markings.

F. Range: Conform to the following:

1. Pumps: 0 - 100 psi.
2. Coils and chillers: Differential pressures not more than 200% of coil pressure drop.

G. Manufacturer: Subject to compliance with requirements, provide pressure gages of one of the following or approved equivalent:

1. Ametek/U.S. Gauge.
2. Marsh Instrument Co.; Unit of General Signal.
3. Marshalltown Instruments, Inc.
4. Trerice (H.O.) Co.
5. Weiss Instruments, Inc.
6. Miljoco

2.5 PRESSURE GAGE COCKS:

A. General: Provide pressure gage cocks between pressure gages and gage tees on piping systems. Construct gage cock of brass with 1/4" female NPT on each end, and "T" handle brass plug.

B. Siphon: 1/4" straight coil constructed of brass tubing with 1/4" male NPT on each end.

C. Snubber: 1/4" brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.

D. Manufacturer: Same as for pressure gages.

2.6 PRESSURE GAGE CONNECTOR PLUGS:

A. General: Provide pressure gage connector plugs pressure rated for 500 psi and 200°F (93°C). Construct of brass and finish in nickel-plate equip with 1/2" NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" O.D. probe assembly from dial type insertion pressure gage. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

B. Manufacturer: Subject to compliance with requirements, provide pressure gage connector plugs of one of the following or approved equivalent:

1. Peterson Equipment Co.

2.7 WAFER-TYPE FLOW METERS:

A. General: Provide as indicated, cast-iron wafer-type flow meters equipped with readout valves to facilitate connecting of differential pressure meter to flow meter. Equip each readout valve with integral EPT check valve designed to minimize system fluid loss during monitoring process. Provide calibrated nameplate with flow meter detailing its flow range through range of differential head pressures.

B. Manufacturer: Subject to compliance with requirements, provide wafer-type flow meters of one of the following or approved equivalent:

1. Bell & Gossett ITT; Fluid Handling Div.

2.8 CHILLED WATER

A. Provide where indicated a Dual Turbine Flow Meter (ONICON Model F-1210 or equivalent product) complete with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. For bi-directional flow applications, provide ONICON Model FB-1210 or equivalent product. The flow meter shall be hand-insertable up to 400 psi. The flow meter shall have two contra-rotating axial turbines, with electronic impedance-based sensing and an averaging circuit to reduce measurement errors due to swirl and flow profile distortion. Wetted metal components shall be nickel-plated brass. Each flow meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to

NIST. The manufacturer's certificate of calibration shall be provided with each flow meter. Accuracy shall be within ± 0.5% of rate at the calibrated velocity, within ± 1% of rate over a 10:1 turndown (3.0 to 30 ft/s) and within ± 2% of rate over a 50:1 turndown (from 0.4 to 20 ft/s). The flow meter shall include integral analog output(s), 4-20 mA, 0-10V, or 0-5V. Bi-directional meters shall include an isolated contact closure output for direction. The flow meter shall be covered by the manufacturer's two year warranty.

2.9 CALIBRATED BALANCE VALVES:

A. General: Provide as indicated, calibrated globe type balance valves equipped with readout valves to facilitate connecting of differential pressure meter to balance valves. Provide calibrated nameplate to indicated degree of closure of precision machined orifice. Construct balancing valve with internal EPT O-ring seals to prevent leakage around rotating element. Provide balance valves with preformed polyurethane insulation suitable for use on heating and cooling systems, and to protect balance valves during shipment.

B. Manufacturer: Subject to compliance with requirements, provide calibrated balance valves of one of the following or approved equivalent:

1. Armstrong
2. Griswold
3. MACON

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which meters and gages are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF TEMPERATURE GAGES:

A. General: Install temperature gages in vertical upright position, and tilted so as to be easily read by observer standing on floor.

B. Locations: Install as indicated on the drawings.

C. Thermometer Wells: Install in piping tee where indicated, in vertical upright position. Fill well with oil or graphite, secure cap.

D. Temperature Gage Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

3.3 INSTALLATION OF PRESSURE GAGES:

A. General: Install pressure gages in piping tee with pressure gage cock, located on pipe at most readable position.

B. Locations: Install in the following locations, and elsewhere as indicated:

1. At suction and discharge of each pump.
2. At inlet and outlet of each chiller.
3. At discharge of each pressure reducing valve.
4. At coil of each air handler. (Not required on fan coils.)

C. Pressure Gage Cocks: Install in piping tee with snubber. Install siphon for steam pressure gages.

D. Pressure Gage Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

3.4 INSTALLATION OF FLOW MEASURING METERS:

A. General: Install flow measuring meters on piping systems located in accessible locations at most readable position.

B. Locations: Install in the following locations, and elsewhere as indicated.

1. At discharge of each pump.
2. At inlet of each hydronic coil in built-up central systems and fan coils.
3. At inlet of each water chiller.

C. Wafer-Type Flow Meters: Install between 2 Class 125 pipe flanges, ANSI B16.1 (cast-iron) or ANSI B16.24 (cast-bronze). Provide minimum straight lengths of pipe upstream and downstream from meter in accordance with manufacturer's installation instructions.

D. Calibrated Balance Valves: Install on piping with readout valves in vertical upright position. Maintain minimum length of straight unrestricted piping equivalent to 3 pipe diameters upstream of valve.

3.5 ADJUSTING AND CLEANING:

A. Adjusting: Adjust faces of meters and gages to proper angle for best visibility.

B. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 23 0523 - HVAC VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General Conditions and Division 1 Specification sections, apply to work of this section.

B. This section is a Division 23 Basic Mechanical Materials and Methods section, and is part of each Division 23 section making reference to valves specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of valves required by this section is indicated on drawings and/or specified in other Division 23 sections.

B. Types of valves specified in this section include the following:

1. Gate Valves.
2. Drain Valves.
3. Ball Valves.
4. Butterfly Valves.
5. Swing Check Valves.

C. Valves furnished as part of factory-fabricated equipment, are specified as part of equipment in other Division 23 sections.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of valves, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Valve Types: Provide valves of same type by same manufacturer.

C. Valve Identification: Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on valve body.

D. Codes and Standards:

E. MSS Compliance: Mark valves in accordance with MSS-25 "Standard Marking System for Valves, Fittings, Flanges and Unions".

F. ANSI Compliance: For face-to-face and end-to-end dimensions of flanged- or welded-end valve bodies, comply with ANSI B16.10 "Face-to-Face and End-to-End Dimensions of Ferrous Valves".

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of valve. Include pressure drop curve or chart for each type and size of valve. Submit valve schedule showing manufacturer's figure number, size, location, and valve features for each required valve.

B. Shop Drawings: Submit manufacturer's assembly-type (exploded view) shop drawings for each type of valve, indicating dimensions, weights, materials, and methods of assembly of components.

PART 2 - PRODUCTS

2.1 VALVES:

A. General: Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with installation requirements. Provide end connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

B. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.

C. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves, 6" and smaller.

2.2 GATE VALVES:

A. Comply with the following standards:

1. Cast-Iron Valves: MSS SP-70.
2. Bronze Valves: MSS SP-80.
3. Steel Valves: ANSI B16.34.

B. Manufacturer: Subject to compliance with requirements, provide gate valves of one of the following or approved equivalent:

1. Crane Co.
2. Fairbanks Co.
3. Hammond Valve Corp.
4. ITT Grinnell Valve Co., Inc.
5. Jenkins Bros.
6. Lunkenheimer Co.
7. Milwaukee Valve Co., Inc.
8. Nibco, Inc.
9. Powell (Wm) Co.
10. Stockham Valves and Fittings.
11. Walworth Co.

2.3 DRAIN VALVES:

A. Comply with the following standards:

1. Water Heater Drain Valves: ASSE 1005.

B. Manufacturer: Subject to compliance with requirements, provide globe valves of one of the following or approved equivalent:

1. Hammond Valve Corp.
2. Lee Brothers; Div. Phelps Dodge Brass Co.
3. Mansfield Plumbing Products.
4. Nibco Inc.
5. Prier Brass Mfg. Co.
6. Tanner Mfg. Co.

2.4 BALL VALVES:

A. Comply with the following standards:

1. Cast-Iron Valves: MSS SP-72.
2. Steel Valves: ANSI B16.34.

B. Manufacturer: Subject to compliance with requirements, provide ball valves of one of the following or approved equivalent:

1. Conbraco Industries, Inc.
2. Crane Co.
3. Fairbanks Co.
4. Hammond Valve Corp.
5. ITT Grinnell Valve Co., Inc.
6. Jamesbury Corp.
7. Jenkins Bros.
8. Metraflex Co.
9. Nibco, Inc.
10. Powell (The Wm.) Co.
11. Stockham Valves and Fittings, Inc.
12. Walworth Co.
13. Watts Regulator Co.

2.5 BUTTERFLY VALVES:

A. General: Comply with MSS SP-67. Provide lug-body type valves for all applications.

B. Manufacturer: Subject to compliance with requirements, provide butterfly valves of one of the following or approved equivalent:

1. Center Line; Mark Controls Corp.
2. Crane Co.

3. Demco; Div. Cooper Industries, Inc.
4. Fairbanks Co.
5. ITT Grinnell Valve Co., Inc.
6. Jamesbury Corp.
7. Jenkins Bros.
8. Keystone Valve USA.
9. Nibco, Inc.
10. Powell (The Wm.) Co.
11. Stockham Valves and Fittings.

2.6 SWING CHECK VALVES:

A. Comply with the following standards:

1. Cast-Iron Valves: MSS SP-71.
2. Bronze Valves: MSS SP-80
3. Steel Valves: ANSI B16.34.

B. Manufacturer: Subject to compliance with requirements, provide swing check valves of one of the following or approved equivalent:

1. Crane Co.
2. Fairbanks Co.
3. Hammond Valve Corp.
4. Jenkins Bros.
5. Lunkenheimer Co.
6. Milwaukee Valve Co., Inc.
7. Nibco, Inc.
8. Powell (The Wm.) Co.
9. Stockham Valves and Fittings
10. Walworth Co.
11. TITAN

2.7 VALVE FEATURES:

A. General: Provide valves with features indicated and, where not indicated otherwise, provide proper valve features as determined by Installer for installation requirements. Comply with ASME B31.9 for building services piping, and ASME B31.1 for power piping.

B. Flanged: Valve flanges complying with ANSI B16.1 (cast iron), ANSI B16.5, (steel), or ANSI B16.24 (bronze).

C. Threaded: Valve ends complying with ANSI B2.1.

D. Socket-Welding: Valve ends complying with ANSI B16.11.

E. Solder-Joint: Valve ends comply with ANSI B16.18.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Except as otherwise indicated, comply with the following requirements:

1. Install valve where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
2. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.

B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.

C. Mechanical Actuators: Install mechanical actuators with chain operators where indicated. Extend chains to about 5' above floor and hook to clips to clear aisle passage.

D. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends or types of pipe/tube connections:

1. Tube Size 2" and Smaller: Soldered-joint valves.
2. Pipe Size 2" and Smaller: One of the following, at Installer's option:
   a. Threaded valves.
   b. Butt-welding valves
   c. Socket-welding valves.
   d. Flanged valves.

3. Pipe Size 2 1/2" and Larger: One of the following, at Installer's option.
   a. Grooved-end valves.
   b. Butt-welding valves.
   c. Socket-welding valves.
   d. Flanged valves.

E. Valve System: Select and install valves with outside screw and yoke stems, except provide inside screw non-rising stem valves where headroom prevents full opening of OS&Y valves.

F. Non-Metallic Disc: Limit selection and installation of valves with non-metallic discs to locations indicated and where foreign material in piping system can be expected to prevent tight shutoff of metal seated valves.

G. Renewable Seats: Select and install valves with renewable seats, except where otherwise indicated.

H. Fluid Control: Except as otherwise indicated, install gate, ball, and butterfly valves to comply with ANSI B31.9. Where throttling is indicated or recognized as principal reason for valve, install butterfly valves, unless indicated otherwise on the plans.

3.2 INSTALLATION OF CHECK VALCES:

A. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to center line of pipe. Install for proper direction of flow.

3.3 ADJUSTING AND CLEANING:

A. Valve Adjustment: After piping systems have been tested and put into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks, replace valve if leak persists.

B. Valve Identification: Tag each valve in accordance with Division 23 section "Mechanical Identification".

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.4 VALVE SCHEDULE:

A. General: Provide the following valves for various valve types listed in Division 23 piping sections.

3.5 GATE VALVES:

A. 2" and Smaller: Class 125, bronze, screw-in bonnet, rising stem, solid wedge.

	Threaded Ends	Solder Ends
Crane:	428	1334
Fairbanks:	0252	0282
Grinnell:	3010	3010-SJ
Hammond:	IB640	IB635
Jenkins:	47	1242
Lunkenheimer:	2127	2132
Milwaukee:	148	1149
Nibco:	T-111	S-111
Powell:	500-S	1821-S
Stockham:	B-100	B-108
Walworth:	55	55-SJ

C. 2" and Smaller: Class 125, bronze, screw-in bonnet, non-rising stem, solid wedge.

	Threaded Ends	Solder Ends
Crane:	438	1324
Fairbanks:	0250	0280
Grinnell:	3000	3000-SJ
Hammond:	IB645	IB647

Jenkins:	370	1240
Lunkenheimer:	2129	2133
Milwaukee:	105	1145
Nibco:	T-113	S-113
Powell:	507	1822
Stockham:	B-103	B-104
Walworth:	55	4-SJ

D. 2 1/2" and Larger: Flanged ends, class 125, iron body, bolted bonnet, solid wedge, bronze mounted.

	OS&Y	Non-Rising Stem
Crane:	4651/2	461
Fairbanks:	0405	0403
Grinnell:	6020	6060
Hammond:	IR1140	IR1138
Jenkins:	651A	326
Lunkenheimer:	1430	1428
Milwaukee:	F-2885	F-2882
Nibco:	617-O	F-619
Powell:	1793	1787
Stockham:	G0623	G-612
Walworth:	8726-F	8719-F

E. Hose End, 2 1/2": FM, 174 psi, bronze body, solid wedge, inside screw, non-rising stem. Provide cap and chain.

Fairbanks:	0210.
Jenkins:	707.
Lunkenheimer:	366.
Nibco:	T-103-HC.
Walworth:	115.

F. Threaded End; 2" and Smaller: FM, UL-listed, 175 psi, bronze body, solid wedge, outside screw and yoke, rising stem.

Crane:	459.
Fairbanks:	0222.
Hammond:	IB681.
Jenkins:	175U.
Nibco:	T-104-O.
Stockham:	B-133.
Walworth:	904.

G. Flanged End; 2 1/2" and Larger: FM, UL-Listed, 175 psi, iron body bronze mounted, solid wedge, outside screw and yoke, rising stem.

Crane:	467.
Fairbanks:	0412.
Hammond:	IR1154.

Jenkins:	825-A.
Nibco:	F-607-O.
Stockham:	G-634.
Walworth:	8713-F.

3.6 DRAIN VALVES:

A. Class 125: Bronze body, screw-in bonnet, rising stem, composition disc, 3/4" hose outlet.

	Threaded Ends	Solder Ends
Hammond:	712	711
Lee:	717-20	717-12
Mansfield:	526.40	526.41
Nibco:	73	72
Prier:	C-73ST	C-71ST
Tanner:	806	851

3.7 BALL VALVES:

A. 1" and Smaller: 150 psi, bronze body, standard port, bronze trim, 2-piece construction, TFE seats and seals.

	Threaded Ends	Solder Ends
Conbraco:	70	70
Crane:	2182	2182
Grinnell:	3700	3700-SJ
Jamesbury:	21-1100	-
Jenkins:	900T	902T
Metraflex:	IT	IS
Nibco:	T-585	S-585
Powell:	4520R20	421OR
Stockham:	S-216BRRT	S-216BRRS
Watts:	B-6000	B-6001

A. 1 1/4" to 2": 150 psi, bronze body, standard port, 3-piece body, TFE seats with bronze trim.

	Threaded Ends	Solder Ends
Conbraco:	82	82
Fairbanks:	0851	-
Nibco:	T-595-Y	S-959-Y
Powell:	4201-R	4201-R
Watts:	B-6800	B-6801

3.8 BUTTERFLY VALVES:

A. 6" and Smaller: 150 psi, cast-iron body, extended neck, aluminum bronze disc, reinforced resilient EDPM seat, manual lever and lock.

	Lug
CenterLine:	SeriesLT
Crane:	14
Demco:	SeriesCE
Fairbanks:	3502
Grinnell:	WC-LC-8211
Hammond:	33824
Jamesbury:	8815L
Keystone:	10
Nibco:	WL-NL-082-3
Powell:	Series5000
Stockham:	LD-711-BS3E
Grooved Ends:	Victaulic Series 700.

B. 8" and Larger: 150 psi, cast-iron body, extended neck, aluminum bronze disc, reinforced resilient EDPM seat, gear operator.

	Lug
CenterLine:	SeriesLT
Crane:	14
Demco:	SeriesCE
Fairbanks:	602
Grinnell:	LC-8212
Keystone:	122
Nibco:	NL-082-5
Powell:	Series5000
Stockham:	LD-721-BS3E
Grooved Ends:	Victaulic Series 701.

3.9 SWING CHECK VALVES:

A. 2" and Smaller: Class 125, bronze body, horizontal swing, regrinding type, Y-pattern, renewable disc.

	Threaded Ends	Solder Ends
Crane:	37	1342
Fairbanks:	0640	0680
Grinnell:	3300	3300-SJ
Jenkins:	92-A	1222
Lunkenheimer:	2144	2145
Milwaukee:	509	1509
Nibco:	T-413	S-413
Powell:	578	1825
Stockham:	B-319	B-309

Walworth: 340600 3406-SJ

B. 2 1/2" and Larger: Class 125, iron body, bolted bonnet, horizontal swing, renewable seat and disc, flanged ends.

Crane: 373.
Fairbanks: 0702.
Grinnell: 6300.
Hammond: IE1124.
Jenkins: 624.
Lunkenheimer: 1790.
Milwaukee: F2971.
Nibco: F-918.
Powell: 559.
Stockham: G-931.
Walworth: 8928-F.

C. 2 1/2" and Larger; FM: 175 psi, iron body bronze mounted, renewable composition disc and bronze seat ring, bolted cover, flanged ends.

Fairbanks: 0711.
Jenkins: 729.
Nibco: F-908-W.
Stockham: G-940.
Walworth: 8883-LT.

END OF SECTION

SECTION 23 0529 - HVAC SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. This section is Division 23 Basic Mechanical Materials and Methods section, and is part of each Division 23 section making reference to supports and anchors specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of supports and anchors required by this section is indicated on drawings and/or specified in other Division 23 sections.

B. Types of supports and anchors specified in this section include the following:

1. Horizontal-Piping Hangers and Supports.
2. Hanger-Rod Attachments.
3. Building Attachments.
4. Saddles and Shields.
5. Miscellaneous Materials.
6. Anchors.
7. Equipment Supports.

C. Supports and anchors furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 23 sections.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Code Compliance: Comply with Florida Building Code pertaining to product materials and installation of supports and anchors.
2. UL and FM Compliance: Provide products which are UL-listed and FM approved.
3. MSS Standard Compliance:
   a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.
   b. Select and apply pipe hangers and supports, complying with MSS SP-69.
   c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.

d. Terminology used in this section is defined in MSS SP-90.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

PART 2 - PRODUCTS

2.1 HORIZONTAL-PIPING HANGERS AND SUPPORTS:

A. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

B. Adjustable Steel Clevis Hangers: MSS Type 1.

C. Steel Double Bolt Pipe Clamps: MSS Type 3.

D. Steel Pipe Clamps: MSS Type 4.

E. Pipe Hangers: MSS Type 5.

F. Split Pipe Rings: MSS Type 11.

G. Clips: MSS Type 26.

H. Pipe Saddle Supports: MSS Type 36, including steel pipe base-support and cast-iron floor flange.

I. Pipe Stanchion Saddles: MSS Type 37, including steel pipe base-support and cast-iron floor flange.

2.2 HANGER ROD ATTACHMENTS:

A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

B. Steel Turnbuckles: MSS Type 13.

2.3 BUILDING ATTACHMENTS:

A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

B. Concrete Inserts: MSS Type 18.

C. Top Beam C-Clamps: MSS Type 19.

D. Side Beam or Channel Clamps: MSS Type 20.

E. Center Beam Clamps: MSS Type 21.

F. Steel Brackets: One of the following for indicated loading:

1. Light Duty: MSS Type 31.
2. Medium Duty: MSS Type 32.
3. Heavy Duty: MSS Type 33.

2.4 SADDLES AND SHIELDS:

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

B. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.

C. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

D. Thermal Hanger Shields: Constructed of 360° insert of high density, 100 psi, water-proofed calcium silicate, encased in 360° sheet metal shield. Provide assembly of same thickness as adjoining insulation.

E. Manufacturer: Subject to compliance with requirements, provide thermal hanger shields of one of the following or approved equivalent:

1. Elcen Metal Products Co.
2. Pipe Shields, Inc.

2.5 MANUFACTURERS OF HANGERS AND SUPPORTS:

A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following or approved equivalent:

1. B-Line Systems, Inc.
2. Carpenter and Patterson, Inc.
3. Corner & Lada Co., Inc.
4. Elcen Metal Products Co.
5. Fee & Mason Mfg. Co.; Div. Figgie International.
6. ITT Grinnel Corp.

2.6 MISCELLANEOUS MATERIALS:

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes, and Bars: Provide products complying with ASTM A36.

C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION:

A. Proceed with installation of hangers, supports, and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct the inadequacies, including (but not limited to) proper placement of inserts, anchors, and other building structural attachments.

B. Prior to installation of hangers, supports, anchors, and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.3 INSTALLATION OF BUILDING ATTACHMENTS:

A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69.

Install any additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.

3.4 INSTALLATION OF HANGERS AND SUPPORTS:

A. General: Install hangers, supports, clamps, and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

D. Provisions for movement: Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

G. Insulated Piping: Comply with the following installation requirements.

1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields.
3. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

3.5 INSTALLATION OF ANCHORS:

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

C. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.6 EQUIPMENT SUPPORTS:

A. Provide concrete housekeeping bases for all floor-mounted equipment furnished as part of the work of Division 23. Size bases to extend minimum of 4" beyond equipment base in any direction; and 4" above finished floor elevation. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.

B. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands.

3.7 ADJUSTING AND CLEANING:

A. Hanger Adjustments: Adjust hangers so as to distribute loads equally on attachments.

B. Supports Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 23 0593 - TESTING AND BALANCING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, of this specification division, Division 1 specification sections apply to work of this Section.

1.2 TESTING AND BALANCING OF HVAC SYSTEMS

A. Selection: The Construction Manager or Prime Contractor, herein referred to as Contractor, shall procure the services of, and have a contract directly with an independent Test and Balance contractor (Balancer), which specializes in the testing and balancing of heating, ventilating, and air conditioning systems. The Balancer shall test, balance and adjust all water circulating and air moving equipment, air distribution, and exhaust systems, and temperature control equipment and systems as herein specified and shown on the drawings.

B. The Contractor shall award the test and balance contract to the Balancer as soon as possible to allow them to schedule the work in cooperation with other trades and to meet the completion date. The Contractor shall prepare a critical path schedule, coordinated with all subcontractors, so as to accomplish all tasks required of the Balancer as scheduled herein.

C. Refer to specific items of work provided by each installer, and outlined in the paragraph entitled, "CONTRACTOR'S RESPONSIBILITIES." Contractor shall cooperate with the Balancer as required during execution of the work under this section.

D. The Balancer shall inspect all work under the above sections as it relates to work under this section and report in writing to the Contractor and Design Professional any deviations from plans and specifications that will affect the performance of the systems. All correspondence (written, fax, electronic mail, and the like) is to be copied to the Testing and Commissioning Contractor (Commissioner) that is directly contracted by the Owner.

E. Design balance deviation tolerances:

1. All HVAC systems (water and air) shall be balanced to +/-5% of design. Except as follows:
    a. Exhaust and supply fans where the design airflow is less than 100 CFM: Balance to between 100% and 110%.
    b. Air distribution devices: Balance to within +/- 10%.
    c. Set pumps to 100%-105% of design flow.

2. Each form presented in the report shall include a column that shows the amount of deviation from the design values in percent (%).

1.3 BALANCER QUALIFICATIONS

A. The Balancer shall be a member in good standing with The Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) and shall provide a National Project Certification Performance Guaranty to the Owner. The Balancer must be totally independent, having no affiliation with any contractor, Design Professional, or equipment manufacturer/supplier of HVAC related equipment.

B. The Balancer shall have a fully staffed office and have been regularly engaged in the testing and balancing of heating, ventilating, and air conditioning systems.

C. The Balancer shall provide proof that personnel performing work have successfully completed at least five (5) projects of similar size and scope. A complete list of reference projects, including name and phone number of contacts, shall be submitted with the bid.

D. All instruments used shall be accurately calibrated within six months of balancing and maintained in good working order. If requested, the test shall be conducted in the presence of the Design Professional and/or his representative.

1.4 BALANCER SUBMITTALS

A. Provide a testing and balancing plan for review within thirty days upon receipt of contract. The plan review should include comments and recommendations on any discrepancies that may hinder balancing. This plan review shall be transmitted directly to the Contractor.

B. Submit to Contractor, equipment pre-start and start-up forms. After receipt from the contractor of the submittal data, forms will be transmitted by the Balancer to the Mechanical Contractor for use in equipment start-up. The completed forms will be turned over to the Balancer prior to the beginning of the test and balance phase.

C. Submit agenda of test procedures for each system, describing balancing standards for the testing and balancing of the air conditioning, heating, and ventilating systems for the approval of the Design Professional. This agenda shall include all forms for each system and component, with specified data from the project plans and specifications included on the forms.

D. The Final Testing and Balance Report, with the Design Professional’s letter of acceptance, must be received by the Owner’s Project Coordinator prior to substantial completion inspection. Allow no less than 10 days for Design Professional’s review. (See also paragraphs 1.6.B and 3.1.B.)

E. The Final Testing and Balance Report shall indicate any design requirements which were modified after the issuance of the original Construction Documents. Such indication(s) shall include the date on which the requirement was changed and shall reference the particular Contract Document (i.e., Addenda, Change Order, Construction Change Directive, etc.) which effected the change. (Changes made without Owner’s written approval are invalid.)

1.5 BALANCER MEETINGS, INSPECTIONS AND TESTS

A. Make inspections of the systems during construction for proper installation of balancing devices and general construction as related to HVAC testing and balancing work. The number of inspections will vary with size and complexity of the project, but a minimum of two inspections is required: one at 50% completion of ductwork installation, the second at 80% completion of ductwork installation. A written report of each job visit shall promptly be sent to the Contractor for transmittal to the Design Professional, and shall be included in the Final Test and Balance report.

B. Perform Final Test and Balance work associated with the HVAC system as described herein.

C. A minimum of one after-occupancy inspection shall be made within 90 days after the final test and balance. At this time, any minor adjustments shall be made for occupant comfort. Major problems, which will require major readjustments, shall be addressed to the Design Professional prior to any readjustments. Any alterations to the final test and balance report shall be transmitted as a revised report to the Construction Manager for transmittal to the Design Professional.

1.6 BALANCER WARRANTY AND REPORTS

A. Provide National Project Certification Performance Guarantee. This Performance Guarantee is to be either by NEBB or AABC. Depending on which organization is chosen, the report is not to mention, or include reference to the other organization.

B. Submit to the Design Professional (A/E) one (1) printed copies and one (1) electronic PDF copy of tabulated reports in neatly organized typed forms (with numbered pages) with AABC or NEBB approved minimum data, within fifteen working days after completion of test. Report will include start-up reports, equipment test data and drawings to coincide with the test report. In addition, all reports shall incorporate a summary page(s) which shall include:

1. General description of project (building type, system type, equipment description, etc.)
2. A descriptive list of all equipment and test results (sorted building by building) which do NOT meet plans and specifications. All equipment and test data NOT listed on the above-mentioned summary page(s) will be considered to perform within design balance deviation tolerances specified in Paragraph1.2.E.
3. Copies of reduced plan drawings that uniquely identify and cross-reference air devices, VAV boxes, dampers, equipment, etc.
4. Duct pressure test/leakage and Hydrostatic leakage test reports.
5. Building Pressure tables, design and actual.
6. Start-up reports.
7. Inspection reports.

Any report which the Design Professional determines is inaccurate or incomplete shall be returned to for correction, completion, or retesting. Revised reports shall be submitted in their entirety – partial reports will not be accepted. Each revision shall be highlighted and shall indicate the revision date. The cover page shall indicate the date of the first edition and the revision date.

D. The Owner reserves the right to obtain verification of the test and balance reports. Such verification shall be performed by a second independent contractor. Balancer's reports found to be inaccurate will be disallowed and the Balancer will be required to repeat operations under the supervision of the second independent contractor until accurate reports are completed and agreed upon. The cost of the verification will be borne by the Owner, unless the Balancer's initial report is found to be inaccurate. In such case, the costs of the verification test and balance and all subsequent costs of supervision in order to secure acceptable reports will be borne by the Balancer.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONTRACTOR'S RESPONSIBILITIES

A. Final testing and balancing of the HVAC systems shall be performed as specified above. It is the responsibility of the Contractor to be completely familiar with all the provisions and responsibilities of the Balancer, and to provide such certification, cooperation, and support required.

B. The Contractor shall correct or repair all deficiencies noted by the Balancer in a timely manner. The Balancer will notify the Contractor in writing, on a daily basis, of any deficiencies discovered. Contractor will notify the Balancer immediately, in writing, upon completion of the corrections or repairs. If any items certified as having been corrected or repaired are found to remain deficient, the Contractor shall thereafter be responsible for additional costs incurred by the Balancer and the Design Professional, including but not limited to repeated inspections, tests and document reviews, until such items are individually either deemed compliant or accepted in writing by the Owner. The final testing and balancing report will contain no punch list items. All deficiencies will have been corrected prior to submission of the final report. Preliminary reports are not to be submitted to the Owner.

C. The Contractor shall:

1. Allow adequate time in the construction schedule to perform the Testing and Balancing work.
2. Notify the Balancer upon commencement of work related to the HVAC system.
3. Provide required shop drawings and equipment data.
4. Provide test openings as required for testing and balancing HVAC systems.
5. Provide updated job schedule and timely notice prior to scheduled events.
6. Provide test openings and temporary end caps or otherwise seal off ends of ductwork to permit leakage testing prior to installation of diffusers, grilles, and similar devices.
7. Make preliminary tests to establish adequacy, quality, safety, completed status, and satisfactory operation of HVAC systems and components. The systems shall be free of electrical grounds and short circuits.
8. Perform duct leakage tests, in the presence of the Balancer, on all supply, return, outside air make-up, and exhaust air systems.

9. Within the intent of the contract documents, provide, at the request of the Balancer, all equipment, material, supplies, workmen, and supervisions necessary to provide a satisfactory, operating system.
10. During the test and balance period, operate all HVAC equipment as necessary to permit systems to be tested and balanced as fully operating, functional systems.
11. Work harmoniously with the Balancer, providing all courtesies normally extended to professional consultants.
12. Perform all work necessary to make ceiling plenums air-tight and functional.
13. Remove and replace ceilings as necessary to permit test and balance operations.
14. Remove and replace equipment, lights, or other items which obstruct testing and balancing operations. Where equipment, lights, or other items will interfere with future adjustments of the HVAC system, such equipment, lights, or other items shall be relocated by the Contractor, as directed by the Design Professional.
15. Provide completed start-up forms on each piece of equipment.
16. Replace belts and drives as required for proper balancing. Drives shall be adjusted and aligned by the Contractor to prevent abnormal belt wear and vibration.
17. Adjust fan speed as required not to exceed RFLA of motor.
18. Open all manually adjustable dampers and test dampers for smooth, vibration-free operation.
19. Verify that all controls are installed and operating in accordance with the sequence of operation.
20. Before requesting final testing and balancing, submit signed statement that HVAC systems are installed, adjusted, fully lubricated, operating satisfactorily, and are ready for use.

D. Duct Leakage Report: The Contractor shall make all the supply, return, outside air, and exhaust duct systems (limited to 1,500 CFM and greater) operationally air-tight, with no more than 2% leakage for duct systems rated at 2" w.c. pressure class, and 1% leakage for systems exceeding 2" w.c. pressure class. Leakage test to be performed by Contractor with all air device openings and fan connections sealed airtight. Test the systems prior to applying any insulation or concealing in soffits or chases. Use a portable fan capable of producing a static pressure equal or greater than the duct test pressure. This fan to have a flow measuring assembly consisting of a straight section of duct with an orifice plate, pressure taps, and a calibrated performance curve for determining leakage rates.

1. Test each section equal to the external static pressure indicated for that fan or air handler with the portable fan assembly. After the fan achieves that steady state design pressure, record the airflow quantity across the orifice and the percent of design airflow. If the test fails, the Contractor shall reseal and retest at no additional cost to the District.
2. Repair all duct leaks that can be heard or felt, even if the system has passed the leakage test.
3. Submit duct leakage reports to the Balancer and the Design Professional for their review and approval.

3.2 BALANCER'S RESPONSIBILITIES

A. Air Balance: The Balancer shall perform the following tests, and balance system in accordance with the following requirements:

1. Record minimum data required by AABC and NEBB forms.

2. Test and adjust fan rpm to design requirements.
3. Test and record motor full load amperage/voltage and operating amperage/voltage.
4. Make pitot tube traverse of main supply, return, OA and exhaust ducts and obtain design CFM at fans. The air flow in rectangular duct shall be traversed and measured using the log-Tchebycheff method and round duct shall be measured with the log-Linear method (a.k.a. log-Tchebycheff), no exceptions. Refer to the AABC's 1989 National Standards Manual Chapter 8; NEBB's latest Procedural Standards, Section 10; and ASHRAE's 1997 Fundamentals Handbook Chapter 14.
5. Test and adjust system for design CFM recirculated air.
6. Test and adjust system for design CFM outside air.
7. Test and record system static pressure profile.
8. Adjust all main supply and return air ducts to proper design CFM.
9. Adjust all zones to proper design CFM, supply, return, and exhaust.
10. Adjust all VAV terminals to design minimum, maximum and/or heat CFM and record controller setpoint.
11. Provide suggestion/corrective measures pertaining to performance related issues.
12. Test and adjust each air distribution device to operate within tolerances specified in Paragraph 1.2.E.
13. Each grille, diffuser, and register shall be identified as to the location, area, and system.
14. Test and adjust fans to operate within tolerances specified in Paragraph 1.2.E.
15. Test and adjust fume hoods. Traverse exhaust duct. Seal test holes through the duct access panel with flat head bolts inserted from inside of duct.
16. Provide a Table in the report that itemizes all the Outside Air Make-up CFM compared to all the Exhaust Air CFM (specified and actual) that is to demonstrate that the building is experiencing a continual positive pressure. There is to be one Table per building.

B. Size, AK catalog factors of diffusers, grilles, registers, and all tested equipment shall be identified and listed.

C. Readings and test of diffusers, grilles, and registers shall include required fpm velocity and test resultant velocity, required CFM, and test resultant CFM after adjustments. When direct CFM measuring instruments are used, velocities are not required.

D. In cooperation with the controls contractor, set adjustments of automatically operated dampers to operate as specified, indicated, and / or noted.

E. Check all controls for proper calibrations, and list all controls requiring adjustment by control installers.

F. All diffusers, grilles, and registers shall be adjusted to minimize drafts in all areas.

G. Witness and record the testing of the ductwork for leakage to insure proper sealing. The Balancer shall randomly select sections of the completed duct system for testing. The sections selected shall not exceed more than 20% of the measured linear footage of supply, return, exhaust, or plenum duct length. All selected ductwork shall be leak tested in accordance with SMACNA. Maximum allowable leakage at any tested section shall not exceed 2% of the total air. If any of the selected duct sections exceed the specific leakage allowance, those sections shall be repaired by the Contractor and retested by the Balancer. If initial testing exceeds specification allowance, testing of all remaining duct ductwork shall be required at the Contractor's expense. All additional costs for duct leak repair and retesting shall be the responsibility of the Contractor.

H. Advise Contractor in writing of all ductwork that shall be repaired to reduce air leakage. Retest to confirm minimum allowable leakage. The cost of retest of failed systems will be the responsibility of the Contractor.

I. Water Balance: The Balancer shall prepare the water systems for balancing in the following manner:

1. Open all valves to full open position. Close all bypass valves. Set modulating valve to full coil flow.
2. Check all strainers where gauge taps are provided, and if required, direct Contractor to clean same.
3. Examine water in system and determine if the water has been treated and cleaned. If water has mud or other entrained matter, test and balance work shall stop and Contractor shall clean system as specified in other sections of this Division 23 specification.
4. Check pump rotation.
5. Check expansion tanks to determine that they are not air-bout and that the system is completely full of water.
6. Check all air vents at high points of water systems and determine all are installed and operating freely.
7. Check coils for counterflow or parallel flow as called for by design.
8. Set all temperature controls so all coils are calling for full cooling or heating. This should close all automatic bypass valves at coils.
9. Check operation of automatic bypass valves.
10. Check and have control contractor set operating temperatures of chillers to design requirements.
11. Complete air balance must have been accomplished before actual water balance is complete.

J. Chilled Water:

1. Set pumps to 100%-105% of design flow.
2. Adjust flow of water through chillers.
3. Check leaving water temperatures and return water temperature through chillers. Reset to correct design temperatures.
4. Check water temperature at inlet side of coils.
5. Proceed to balance each water coil. Upon completion of flow readings and adjustments at coils, mark all settings and record data.
6. After adjustments to coils are made, recheck settings at the pumps and chillers, and readjust if required.
7. All flow devices to be balanced to within +/-5% of design.
8. Record and check the following items at each cooling / heating element:
    a. Test and record entering air temperature (DB heating and cooling).
    b. Test and record entering air temperatures (WB cooling).
    c. Test and record leaving air temperatures (DB heating and cooling).
    d. Test and record leaving air temperatures (WB cooling).
    e. Entering and leaving chilled water temperature.
    f. Pressure drop of each coil or vessel.
    g. Calculate chilled water GPM.
    h. Calculate total cooling and heating coil capacities.

i. If test conditions are not within design tolerance, then convert the test conditions to design conditions, or re-test when conditions are closer to design (i.e. opposite season test).

K. Chiller Performance Test: Test chiller in accordance with ARI Standard 83-550.

L. Record the Dry Bulb Temperature in each space and in addition, record a wet bulb temperature at each thermostat or sensor.

M. Deficiencies: All deficiencies shall be noted by the Balancer in a field report and submitted to Contractor and the Design Professional on a daily basis. All deficiencies will be uniquely numbered and tracked.

O. Upon correction of deficiencies, the Contractor shall notify the Balancer in writing that the problem is resolved. If any deficiencies are not corrected, the Contractor will be responsible for the cost of additional re-testing.

P. Equipment: All information required as shown, but not limited to, shall be compiled in a neat, orderly, itemized format on 8½" x 11" test forms. The following data shall be submitted to the Contractor, for distribution to the Design Professional and Owner. This data is the minimum required data except where specified standard (i.e. AABC) requires additional data. In addition, any HVAC equipment specified for the project, but not indicated below, is required per AABC form.

Air Handlers:

1. Mark number
2. Unit manufacturers and model number
3. Total supply air CFM and rpm - specified and actual
4. Return air CFM - specified and actual
5. Outside air CFM - specified and actual
6. Unit static pressure profile, including total fan static
7. Specified total and external static pressure
8. Water GPM flow, coil pressure drop, and entering and leaving temps - specified and actual
9. Coil - entering and leaving air DB/ OF and WB/ OF - specified and actual
10. Outside air DBF and WBF at time of test
11. Voltage, phase, and cycle specified load conditions
12. Hand calculations of the BTUH at test conditions of Total cooling, Latent cooling, and Sensible cooling.

Pumps:

1. Mark number
2. Manufacturer and model number
3. GPM flow - specified and actual
4. Shut-off head
5. Pump heat and full load amperage - specified and actual
6. Motor HP - specified and actual
7. Voltage, phase, and cycles - specified and actual

Fans:

1. Mark number
2. Manufacturer and model number
3. Total CFM supply and rpm - specified and actual
4. Static pressure (discharge static - suction static)
5. Full load amperage - specified and actual
6. Voltage, phase, and cycles - specified and actual

Air Devices (grilles, Registers, Diffusers, and Louvers):

1. Mark number
2. Room number
3. CFM - specified and actual
4. Size
5. Effective area
6. Velocity FPM - specified and actual

Chiller:

1. Mark number
2. Unit manufacturer and model number
3. Total chilled water flow (GPM) - specified and actual
4. Chilled water entering and leaving temperature - specified and actual - one hour log
5. Chilled water pressure drop - specified and actual
6. Compressors full load amperage - specified and actual
7. Voltage, phase, and cycle - specified and actual
8. Ambient temperature, DB/WB, time of day, and weather conditions at time of test
9. Cooler tons, condenser tons, and operating kW compared to specified conditions

Variable Air Volume Boxes:

1. Mark number
2. Unit manufacturer and model number
3. Location and room number
4. Air handler number
5. Maximum / minimum and heating supply CFM - specified and actual
6. For DDC controls: measure and record computer readout and calibration factor at design conditions.
7. Electric heat, KW – specified and actual
8. Electric heat, ^{o}F entering and leaving – specified and actual.
9. Voltage, phase and cycles – specified and actual

Air Monitor:

1. Mark number
2. Unit manufacturer and model number
3. Duct size/monitor size factor
4. CFM - specified and actual.
5. Velocity and velocity pressure

Water Flow Stations:

1. Mark number.
2. Unit manufacturer and model number.
3. Size.
4. GPM specified and actual.
5. Pressure drop and setting.

DX Equipment:

1. Mark number
2. Unit manufacturers and model number
3. Total supply air CFM and rpm - specified and actual
4. Return air CFM - specified and actual
5. Outside air CFM - specified and actual
6. Hot Gas Reheat Coil - entering & leaving air DB/ OF and WB/ OF - specified & actual
7. Specified total and external static pressure
8. Cooling Coil - entering and leaving air DB/ OF and WB/ OF - specified and actual
9. Outside air DBF and WBF at time of test
10. Voltage, phase, and cycle specified load conditions
11. Hand calculations of the BTUH at test conditions of Total cooling, Latent cooling and Sensible cooling.

END OF SECTION

SECTION 23 0900 - HVAC CONTROL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions of the Specifications, and Division 01 Specifications sections apply to this work.

B. Division 23 Basic Mechanical Materials and Methods sections apply to work of this section.

C. Division 26 and 27 sections apply to work of this section with respect to raceways, boxes, conductors, and fire alarm, including:

1. Section 26 0500 – Basic Methods and Requirements (Electrical)
2. Section 26 0519 – Wire and Cables
3. Section 26 0526 – Grounding
4. Section 26 0529 – Supporting Devices
5. Section 26 0530 – Electrical Connections for Equipment
6. Section 26 0533 – Electrical Boxes and Fittings
7. Section 26 0553 – Electrical Identification
8. Section 26 2913 – Motor Controllers and Contactors

1.2 GENERAL REQUIREMENTS:

A. Examine other Sections of the Specifications for requirements that affect work of this Division whether or not such work is specifically mentioned in this Division.

B. Coordinate work with that of other trades affecting or affected by work of this Division. Cooperate with those trades to assure steady progress of work under contract. It is this controls contractor's responsibility to neatly "line item" work and responsibilities in their bid, of other subcontractors described in this section that are required for a complete HVAC controls system.

1.3 SCOPE OF WORK

A. This project includes all labor and materials required to integrate the replacement chillers, replacement exhaust fans, and bi-polar ionization units. The controls contractor will report to the General Contractor (GC) and will participate in and abide by all rules, schedules, and meetings required by the GC for completion of the project.

B. The District has standardized its controls system District-wide. The system’s manufacturer for this project shall be seamlessly compatible with the District-wide controls systems, and the District-wide system’s manufacturer shall be Schneider Electric by Advanced Control Corporation. Component / unit pricing has been previously established with the District per MCSD RFP 2016614.

1.4 CONTROLS CONTRACTOR QUALIFICATIONS:

A. Control system shall be Schneider as provided by Advanced Control Corporation per MCSD RFP 2016614.

B. This item shall be a direct purchased by the GC or MCSD managed by the GC.

1.5 RESPONSIBILITIES OF THE CONTROLS CONTRACTOR:

A. Provide to the architect/engineer complete CAD generated point-to-point submittal wiring diagrams and sequences of operation based on the owner's standard. The controls contractor shall include the following information:

1. Location on the drawings of critical control devices such as control panels, auxiliary control panels, static pressure sensors, room temperature sensors, water temperature sensors/wells.
2. Location of all 120/1/60 power sources for the control devices. Note that power is provided by Division 26 as indicated on the electrical drawings. It is the Division 23 contractor's responsibility to advise the electrical contractor of any additional power connections that shall be provided, prior to bid, and they shall be provided at no additional cost to the Owner.
3. Control valve sizing (valve CV and pressure drops). Valve schedules.
4. Complete bill of material.
5. Communication trunk line layout.
6. Lightning protection devices (quantity and location).
7. Surge protection devices (quantity and location).

B. Provided (furnished and installed) and/or performed by the controls contractor, unless otherwise noted:

1. Insertion temperature sensors
2. Differential pressure switches (water)
3. Control valves (installed by mechanical contractor)
4. Valve actuators
5. Name plates (engraved type)
6. Control relays
7. Varistors
8. Electric type flow meters (installed by the mechanical contractor)
9. Terminal strips
10. Control fuse blocks
11. Power supplies
12. Transducers
13. Pressure switches
14. End switches
15. Submittal literature on all control devices provided
16. 120/24VAC transformers
17. Warranty for installed control system
18. Installation of DDC controllers within control cabinets. (Control panel cabinets installed by Division 26.)
19. DDC control cabinets (installed by Division 26)

20. Installation of all electric temperature control devices not in-line
21. Installation of all power supplies
22. Install all system grounding

C. The programmable controllers shall be programmed by controls contractor to be compatible with existing software and point naming conventions in the Monroe School District's Central Energy Management and Control Systems Department. Fully implement the controls sequences indicated on the drawings.

D. Responsibilities regarding field equipment start-up and checkout

1. Provide support to the contractor to insure all control devices are properly interfaced with HVAC equipment.
2. Perform a point-to-point operational check of each analog and digital point.
3. Power up the panels and verify correct power operation.
4. Verify communications line integrity.
5. Write all software programs and database.
6. Install all software and database in the system.
7. Verify operation of all operating software.
8. Calibrate/adjust/setup field devices as necessary in the order to provide a complete and proper operating system.
9. Notify owner/architect/engineer of any problems related to the design within two (2) working days of find.
10. Work with the architect-engineer to validate operation and final completion of the project.
11. Work with the test and balance agency in balancing and adjusting the HVAC system.
12. Work with the commissioning agent and provide all required services, programming, and adjustments for all required testing and verification as needed for commissioning.

E. Sign-off and Acceptance Responsibilities

1. Once the job is installed and the controls contractor has thoroughly checked it, then it will be necessary to prove to the owner that the project specifications have been met. The controls contractor shall prepare technical demonstrations routine to the owner where the owner will require a random test of not less than 20% of the system points.
2. The owner will sign-off on the acceptance form only after the complete system has been certified in writing complete by the engineer and the system has been successfully demonstrated in accordance with the above criteria. Commissioning agent sign-off is also required.

F. Record Drawing As-builts - Any and all changes in the project design package shall be reflected in the owner's record drawings before sign off and acceptance by the owner. As-built changes made in the field shall also be reflected in the record drawings.

1.6 RESPONSIBILITIES OF THE MECHANICAL CONTRACTOR:

A. Provided (furnished and installed) and/or performed by the Mechanical Contractor

1. Installation of all in-line control devices (such as valves, dampers, flow meters, water temperature sensors, air flow control devices, wells, flow switches, differential pressure switches across pumps)
2. Provide all submittal literature of HVAC equipment purchased.
3. Start-up and check-out of all HVAC equipment
4. Copper line connections to in-line devices
5. Work with the commissioning agent and provide all required services and adjustments for all required testing and verification as needed for commissioning.

1.7 RESPONSIBILITIES OF THE ELECTRICAL CONTRACTOR:

A. Provided (furnished and installed) by the Electrical Contractor, unless otherwise noted.

1. Install all control panels (control panels furnished by controls contractor)
2. Provide all wiring, conduit, boxes, and cabling for the control system, excluding internal wiring within the control panels. Refer to the mechanical controls drawings for all field devices and wiring requirements.
3. All wiring shall be coordinated with the controls contractor, mechanical contractor, and the electrical contractor. The controls contractor under this contract shall provide technical support, termination, control panel, internal wiring, labeling, and checkout/startup. All wiring shall conform to the specifications of Division 26 of the project specification manual unless specifically stated otherwise in this control specification.
4. Division 26 to provide all conduit and wiring required for a complete operational control system as described in this specification. Provide all materials and labor required for the installation of this wiring system.
5. Provide surge and lightning protection using Metal Oxide Varistors (surge protection devices) on controller outputs. All cables entering or leaving a building shall be protected by gas discharge diodes tied to a ground bar/rod. All 120 volt power connections to control panels shall be provided with a 120 volt surge protection devices. Surge protection devices shall be by ADT, PQ Protection, EDCO, or DiTEK.
6. All wiring required for the control of the HVAC and kitchen hood system is the responsibility of this contractor unless specifically shown in the project documents as being installed by Division 26. It is the responsibility of this contractor to determine from the project documents all wiring required for a complete and operational system.

1.8 QUALITY ASSURANCE:

A. All control conduit and wiring shall meet the requirements of Division 26 for materials and installation. All electrical system components shall comply with NEMA and UL standards.

B. Electrical Standards: Provide electrical components of systems which comply with NEMA and UL standards.

C. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for control systems.

D. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

1.9 SUBMITTALS:

A. Submit product data in accordance with the requirements of specification 23 000 - HVAC Requirements, and requirements of Division 1.

B. The submittal shall contain product data sheets and control drawings. Product data sheets shall be provided for each control device furnished. Control drawings shall be organized with a system layout sheet and individual controller drawings. The layout page must contain: controller locations, communication bus routing, and electrical power feed location for each controller. Each controller shall have two of its own control drawings. The first shall show terminations at the controller with cable, wire, and terminal numbers and colors. This drawing shall also show other panel mounted devices and their wiring. The second drawing shall show all field wiring and devices pertaining to that controller. All cable numbers, wire colors, and terminals shall be identified. Each drawing shall contain the bill of materials for that drawing. Drawings shall be formatted to print on 11" by 17" paper in black and white to allow for reproduction by photocopier. Print shall not be smaller than 1/8" and must be easily read.

C. Provide the following information for each item and device: Proper system label, indication of coordination with submitted catalog information, proper settings and adjustments of instruments, physical dimensions of devices and accessories, and the normal condition of device, such as normally open or closed dampers, valves, and relays.

D. Maintenance Data: Submit maintenance instructions and spare parts lists for each type of control device. Include product data and shop drawings in maintenance manual; in accordance with requirements of Division 1.

E. One copy of the submittals shall be submitted directly to Monroe County Schools Energy Management Department for supplemental advisory review.

1.10 WARRANTY:

A. All components, equipment, system software, and control interlocks shall be warranted against defects in materials and workmanship for 12 months from the date of substantial completion. Labor, equipment, and services necessary to repair, replace, or reprogram the system under this warranty, shall be provided at no charge to the owner.

PART 2 - PRODUCTS

2.1 CENTRAL WORK STATIONS AND CONTROLLER PANELS

A. No additional workstations are to be provided in this contract. The DDC system is web based and can be accessed by the District's internal network (IP).

2.2 SOFTWARE

A. Providing all software and upgrades necessary to interface the new controls with the District-wide control system.

1. Application programming shall be by the contractor. The contractor is responsible for naming the points following the standard set for the other buildings. The contractor shall verify each point and calibrate each point before notifying the owner that the system is ready for acceptance.
2. Graphics pages shall be created for the new controls. These shall include a floor plan with associated temperatures and humidity readings. The new controls shall also be added to the summary pages existing for the other buildings. A diagrammatic graphic of the mechanical system shall be provided with live data to aid in system trouble shooting. Graphics pages shall be done in the same style as the existing graphics. Graphics pages shall be updated at each of the owner's three offices. These are located at Key West Maintenance shop, Marathon Maintenance shop, and the Coral Shores maintenance shop.

2.3 MICRO REGULATOR CONTROLLERS

A. Control of field equipment will be accomplished via Schneider Electric native BACnet controllers. Controllers shall have appropriate number of I/O based on the control drawings. Controllers shall function as standalone for local loop functions of the field equipment. Complete PID algorithms shall reside and execute at the local controller level.

2.4 CONTROL DEVICES

A. Provide control devices conforming to the manufacturer's standard materials and components as published in their product information and cut sheets.

1. Temperature Sensors shall be thermistor type equivalent to PreCon Surface Mount Zone Thermistor Sensor, with mounting arrangement for wall, duct, or immersion well service as required by the application.
2. Humidity sensors shall be equivalent to Veris to cover 0-100% RH with a 4-20mA output.
3. Electronic damper actuators shall be provided as required by this specification, the project drawings, and the sequence of operation. Operators shall be selected to provide sufficient torque for smooth operation and proper shutoff. Operators shall be Belimo series.
4. Control panels shall be provided for all controllers. These panels will be mounted in accessible locations near to the controlled equipment. Inside panels shall have a NEMA 1 rating. Outside panels shall have a NEMA 4X rating. The tops of inside panels shall not be mounted higher than 6'6" above finished floor.

2.5 RACEWAY SYSTEMS AND WIRING

A. Wiring above 50 volts or exposed to view, including in mechanical rooms, shall be run in EMT conduit. Any wiring installed in a location prone to physical damage shall be run in EMT conduit. Minimum conduit size is 3/4".

B. Low voltage power wiring (less than 50 volts), I/O wiring for controllers, communication wiring within the building, may be run in plenum rated cable in concealed accessible areas, such as drop ceilings. Free-wired cabling shall be

C. All raceways and wiring shall be installed in a neat and workmanship like manner, and parallel to the lines of the building. All conduits and cables shall be adequately fastened and supported to prevent sagging.

D. All wiring shall be labeled with tape or shrink wrap type wire markers similar to 3M or Panduit. Wire markers shall be specifically designed for that purpose. Wire labels shall be noted on the control drawings.

E. Conduits in mechanical rooms shall use minimum 3/4" EMT conduit with compression fittings.

F. Outside above ground shall be a minimum of 3/4" IMC with compression fittings. Conduit shall be hot dip galvanized and painted for corrosion protection. Paint shall be white in mechanical yards and shall match the building color when attached to the building, painting to be provided by that contractor. NOTE: Exposed exterior raceways or wiring is not permitted unless specifically prior approved by the Owner and Architect/Engineer.

G. Above drop ceiling, plenum rated cable shall be used. Cable shall neatly be bundled and attached to building steel. Loose cable laying on the drop ceiling system will not be accepted.

H. Outside underground connections shall be PVC electrical conduit. All new communication trunks that go outside shall be fiber optic.

I. All boxes used outside shall be rated for outside use and shall be corrosion resistant.

J. All fasteners used outside shall be stainless steel or hot dipped galvanized.

2.6 SYSTEM FEATURES

A. The system shall be non-proprietary with both regards to hardware and software. The District will have the right to install on work stations as needed. The system must be capable of working with other systems via BACnet.

B. The system shall be completely BACnet compatible.

C. All system features shall be accessible by District owned computers via internet.

D. The system shall be backwards compatible with the system in the existing buildings on campus. The end product shall yield seamless integration of all existing campus-wide controls.

E. Set points and schedules be capable of change via smart phone interface.

F. The system must be capable of operating within the District's internal network.

G. The system must be capable of sending email or text based on alarm condition.

H. All components of the new system shall be inherently robust with their resistance to lighting strike induced EMF and power inconsistency. Include protective devices like gas discharge diodes and fiber optics that are inherently resistive to lightening damage.

I. The system must be able of interfacing with School Dude Maintenance Direct and Facility Scheduler. When a facility is leased the appropriate area's HVAC system shall be temporarily overridden on.

J. The system must be able to interface with existing chillers via BACnet data communication. The system must be able to view data and alter its changeable values.

K. Scheduling

1. The new system must be capable of scheduling on multiple units to serve one area.
2. Each zone or area must be capable of individual optimized starting.
3. In most cases large decoupled Outside Air units are shut down at the end of the work day. Return Air units will continue to run until the end of the work day.
4. Twist timer style override switches shall bring the units back on during unoccupied times or when the control system is not operating.
5. System must have a way to schedule holidays and non-work days as "OFF" days. The units will operate only via override on these days. These shall be pre programmable one year in advance. Entry of these dates should be one time by the District or by school. This should not require entry unit by unit.

L. Points: Physical hardware type points shall be the same as the current system as documented in the database print outs for each school.

1. All suction line temperature sensor points shall be deleted. Sensor may be left in place. Leaving wiring coiled, capped, and disconnected in the control panel. Label wiring.
2. Devices reading out of range on incorrectly per the database printout shall be troubleshot and repaired as part of this contract.

2.7 USER INTERFACE FEATURES

A. The primary interface with the new system shall be via District owned computers and network system.

B. If hand held interface devices are required to communicate or configure controllers, then these shall be provided by the contractor. One device will be needed. All staff shall be trained in the use of the handheld interface device.

C. The primary interface shall be graphical. Graphics shall give the owner the ability to change set points and schedules from the graphics screen. The graphics shall support "manual override" of hardware points.

D. Graphics will be linked in a method to allow the operator to penetrate down. The minimum views will include a District summary page, campus summary page, building floor plan summary, floorplans divided by HVAC system, each HVAC system. The operator shall be able to penetrate into and out of each successive layer.

1. Each icon to move to the next screen shall have a list or range of room numbers that the graphic serves.

2. The District Summary Page shall have a section for the campus. This section will have an icon to take you to that school's graphic page summary. It shall also have the chiller plant status if the site has a chiller.
3. The School Summary page shall be a graphical representation of the all floors and all building. Major mechanical equipment icons and status shall be located as appropriate. Indicate room ranges for units. Provide high temp for each major system. Provide Icons to go back to the District Summary or Down into each building and floor.
4. School Summary Data page shall be accessed from school summary or floorplans.
5. Floor plan pages shall be accessible from School summary pages and HVAC system pages. Links shall be provided to adjacent floors even if they are in another building. They shall graphically show rooms and all temperature and humidity readings.
6. HVAC system page shall be provided for each air handling unit, roof top unit, chiller system, condenser water plant, or other major controlled system. These systems shall be accessible from the School Summary or Floorplan pages.

E. Graphics shall be at the industry standard for high resolution. All text shall be easily legible by the average user.

F. The system shall allow online programming by District personnel.

2.8 CONTROLLER FEATURES

A. Controllers shall be capable of using 10k ohm thermistors for temperature sensing.

B. Controllers must be capable of accepting universal industry standard input signals including pulses, 0-5 Vdc, 1-5 Vdc, and 4-20mA.

C. Controllers shall be capable of dry contact type output.

D. Controllers must be available with models or software to allow for 0-100% analog outputs in standard control system configurations including tri state floating, pulse width modulation, 420mA, 0-5 or 1-5 Volts.

PART 3 - EXECUTION

3.1 SYSTEM TESTING AND APPROVAL

A. Upon completion of the work, submit a report stating that final calibration and adjustments to the system have been made. All connections at panels must be complete, all circuits must be operational, and all electronic controls must be in final operating order.

B. Upon receipt of this report the Engineer of Record, District, and the contractor shall set a mutually agreeable time and date for an operational demonstration. This demonstration is to verify the correct operation of all of the points in the system and to familiarize the owner's staff with the new control system. In addition to the point verification the contractor shall show location of all controllers, location of power sources for control devices, location of remote dampers, and a brief description of the sequence of operation.

C. Provide required services, including testing, adjustments, demonstrations of programming, etc., to assist with the commissioning process, led by the commissioning agent.

3.2 TRAINING

A. Provide a comprehensive training program. Classes shall be taught by factory trained representatives who are competent in teaching technical material. Training shall be scheduled with the District's personnel through the General Contractor. The training program shall be as follows:

1. Prior to the completion of the first project. One 4-hour session of training on the basics of system operation and programming.
2. At substantial completion, One 6-hour session of training on site concerning specifics to the project.
3. Two months after final completion, One 4-hour follow up training session on site.
4. Provide one 6-hour session of programming training for District staff to allow modification to the system's programing. This shall be done during the first year at a time convenient to the District.

3.3 SPARES

A. Provide one master controller and two spare local controllers, one spare humidity sensor, and five spare temperature sensors. These devices are to be turned over to the District prior to the owner demonstration. The spare components may be used during construction to ease project construction phasing however, this must be documented.

3.4 CLOSE-OUT DOCUMENTS – RECORD DRAWING AS-BUILTS

A. At the end of the project, provide "as-built" corrections made to the drawings via a CAD type program.

B. Place as-built constructed drawings in the following locations.

1. Each of the three District maintenance offices.
2. One copy to the District Building Official
3. Each panel shall have a copy of the drawings that pertain to that panel.

C. Close-out binder

1. Provide written warranty.
2. DVD with as-built files in CAD and PDF formats.
3. Training sign-in log for each training session.

END OF SECTION

SECTION 23 1060 – HVAC PIPES AND PIPE FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. This section is a Division 23 Basic Mechanical Materials and Methods section, and is part of each Division 23 section making reference to pipes and pipe fittings specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of pipes and pipe fittings required by this section is indicated on drawings and/or specified in other Division 23 sections.

B. Type of pipes and pipe fittings specified in this section include the following:

1. Steel Pipes.
2. Copper Tube.
3. Cast-Iron Soil Pipes.
4. Plastic Pipes.
5. Miscellaneous Piping Materials/Products.

C. Pipes and pipe fittings furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 23 sections.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.4 CODES AND STANDARDS:

A. Welding: Qualify welding procedures, welders and operators in accordance with ASME B31.1, or ASME B31.9, as applicable, for shop and project site welding of piping work.

1. Certify welding of piping work using Standard Procedure Specifications by, and welders tested under supervision of, National Certified Pipe Welding Bureau (NCPWB).

B. Brazing: Certify brazing procedures, brazers, and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job-site brazing of piping work.

1.5 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.

B. Welding Certifications: Submit reports as required for piping work.

C. Brazing Certifications: Submit reports as required for piping work.

D. Maintenance Data: Submit maintenance data and parts lists for each type of mechanical fitting. Include this data, product data, and certifications in maintenance manual; in accordance with requirements of Division 00.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.

B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.

C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Piping Materials: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

B. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

2.2 STEEL PIPES AND PIPE FITTINGS:

A. Black Steel Pipe: ASTM A53, A106 or A120; except comply with ASTM A53 or A106 where close coiling or bending is required.

B. Malleable-Iron Threaded Fittings: ANSI B16.3.

C. Malleable-Iron Threaded Unions: ANSI B16.39; selected by Installer for proper piping fabrication and service requirements, including style, end connections, and metal-to-metal seats (iron, bronze or brass).

D. Threaded Pipe Plugs: ANSI B16.14.

E. Steel Flanges/Fittings: ANSI B16.5, including bolting and gasketing of the following material group, end connection and facing, except as otherwise indicated.

1. Material Group: Group 1.1.
2. End Connections: Buttwelding.
3. Facings: Raised-face.

F. Wrought-Steel Buttwelding Fittings: ANSI B16.9, except ANSI B16.28 for short-radius elbows and returns; rated to match connected pipe.

G. Pipe Nipples: Fabricated from same pipe as used for connected pipe; except do not use less than Schedule 80 pipe where length remaining unthreaded is less than 1-1/2", and where pipe size is less than 1-1/2", and do not thread nipples full length (no close-nipples).

2.3 COPPER TUBE AND FITTINGS:

A. Copper Tube: ASTM B88; type (wall thickness) as indicated for each service; hard-drawn temper, except as otherwise indicated.

B. Cast-Copper Solder-Joint Fittings: ANSI B16.18.

C. Wrought-Copper Solder-Joint Fittings: ANSI B16.22.

D. Copper-Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.

2.4 PLASTIC PIPES AND PIPE FITTINGS:

A. Polyvinyl Chloride Pipe (PVC): ASTM D1785.

B. PVC Fittings:

1. Schedule 40 Socket: ASTM D2466.
2. Schedule 80 Socket: ASTM D2467.
3. Schedule 80 Threaded: ASTM D2464.
4. DWV Socket: ASTM D2665.
5. Sewer Socket: ASTM D2729.
6. Solvent Cement: ASTM D2564.
7. Solvent Cement (To Join PVC to ABS): ASTM D3138.

2.5 GROOVED PIPING PRODUCTS:

A. General: As Installer's option, mechanical grooved pipe couplings and fittings may be used for piping systems in mechanical equipment rooms having operating conditions not exceeding 230° F (110°C), excluding steam piping and any other service not recommended by manufacturer, in lieu of welded, flanged, or threaded methods, and may also be used as unions, seismic joints, flexible connections, expansion joints, expansion compensators, or vibration reducers.

B. Coupling Housings: Malleable iron conforming to ASTM A47 or ductile iron conforming to ASTM A536.

C. Coupling Housings Description: Grooved mechanical type, which engages grooved or shouldered pipe ends, encasing an elastomeric gasket which bridges pipe ends to create seal. Cast in two or more parts, secure together during assembly with nuts and bolts. Permit degree of contraction and expansion as specified in manufacturer's latest published literature.

D. Gaskets: Mechanical grooved coupling design, pressure responsive so that internal pressure serves to increase seal's tightness, constructed of elastomers having properties as designated by ASTM D2000.

E. Bolts and Nuts: Heat-treated carbon steel, ASTM A183, minimum tensile 110,000 psi.

F. Branch Stub-Ins: Upper housing with full locating collar for rigid positioning engaging machine-cut hole in pipe, encasing elastomeric gasket conforming to pipe outside diameter around hole, and lower housing with positioning lugs, secured together during assembly with nuts and bolts.

G. Fittings: Grooved or shouldered end design to accept grooved mechanical couplings.

H. Malleable Iron: ASTM A47.

I. Ductile Iron: ASTM A536.

J. Fabricated Steel: ASTM A53, Type F for 3/4" to 1-1/2"; Type E or S, Grade B for 2" to 20".

K. Steel: ASTM A234.

L. Flanges: Conform to Class 125 cast iron and Class 150 steel bolt hole alignment.

M. Malleable Iron: ASTM A47.

N. Ductile Iron: ASTM A536.

O. Grooves: Conform to the following:

1. Standard Steel: Square cut.

P. Manufacturer: Subject to compliance with requirements, provide grooved piping products of one of the following or approved equivalent:

1. ITT Grinnell Corp.

2. Stockham Valves & Fittings, Inc.
3. Victaulic Co. of America.

2.6 MISCELLANEOUS PIPING MATERIALS/PRODUCTS:

A. Welding Materials: Except as otherwise indicated, provide welding materials as determined by Installer to comply with installation requirements.

B. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.

C. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by Installer to comply with installation requirements.

D. Tin-Antimony Solder: ASTM B32, Grade 95TA.

E. Gaskets for Flanged Joints: ANSI B16.21; full-faces for cast-iron flanges; raised-face for steel flanges, unless otherwise indicated.

F. Piping Connectors for Dissimilar Non-Pressure Pipe: Elastomeric annular ring insert, or elastomeric flexible coupling secured at each end with stainless steel clamps, sized for exact fit to pipe ends and subject to approval by plumbing code.

G. Manufacturer: Subject to compliance with requirements, provide piping connectors of the following or approved equivalent:

1. Fernco, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance.

B. Comply with ANSI B31 Code for Pressure Piping.

C. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other structural and permanent-enclosure elements of building; limit clearance to 1/2" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside

insulation. Wherever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.

D. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures.

3.2 PIPING SYSTEM JOINTS:

A. General: Provide joints of type indicated in each piping system.

B. Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

C. Solder copper tube-and fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

D. Weld pipe joints in accordance with ASME Code for Pressure Piping, B31.

E. Weld pipe joints only when ambient temperature is above 0ºF (-18ºC) where possible.

F. Bevel pipe ends at a 37.5° angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.

G. Use pipe clamps or tack-weld joints with 1" long welds; 4 welds for pipe sizes to 10", 8 welds for pipe sizes l2" to 20".

H. Build up welds with stringer-bead bass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes and non-metallic inclusions.

I. Do not weld-out piping system imperfections by tack-welding procedures; refabricate to comply with requirements.

J. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

K. Plastic Pipe/Tube Joints: Comply with manufacturer's instructions and recommendations, and with applicable industry standards.

L. Making Solvent-Cemented Joints: ASTM D2235, and ASTM F402.

M. Grooved Pipe Joints: Comply with fitting manufacturer's instructions for making grooves in pipe ends. Remove burrs and ream pipe ends. Assemble joints in accordance with manufacturer's instructions.

3.3 CLEANING, FLUSHING, INSPECTING:

A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

B. Inspect pressure piping in accordance with procedures of ASME B31.

3.4 PIPING TESTS:

A. Test pressure piping in accordance with ASME B31.

B. General: Provide temporary equipment for testing, including pump and gages. Test piping system before insulation is installed wherever feasible, and remove control devices before testing. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.

C. Required test period is 48 hours.

D. Test each piping system at 150% of operating pressure indicated, but not less than 25 psi test pressure.

E. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.

F. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

G. Drain test water from piping systems after testing and repair work has been completed.

END OF SECTION

SECTION 23 1119 - HVAC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. This section is a Division 23 Basic Mechanical Materials and Methods section, and is part of each Division 23 section making reference to piping specialties specified herein.

1.2 DESCRIPTION OF WORK

A. Extent of piping specialties work required by this section is indicated on drawings and schedules and by requirements of this section.

B. Types of piping specialties specified in this section include the following:

1. Pipe Escutcheons
2. Pipeline Strainers
3. Dielectric Unions
4. Mechanical Sleeve Seals
5. Fire Barrier Penetration Seals
6. Drip Pans
7. Pipe Sleeves
8. Sleeve Seals

C. Piping specialties furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 23 sections.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of piping specialties of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.4 CODES AND STANDARDS:

A. FCI Compliance: Test and rate "Y" type strainers in accordance with FCI 73-1 "Pressure Rating Standard for "Y" Type Strainers". Test and rate other type strainers in accordance with FCI 78-1 "Pressure Rating Standard for Pipeline Strainers Other than "Y" Type".

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions, and dimensioned drawings for each type of manufactured piping specialty. Include pressure drop curve or chart for each type and size of pipeline strainer. Submit schedule showing manufacturer's figure number, size, location, and features for each required piping specialty.

B. Shop Drawings: Submit for fabricated specialties, indicating details of fabrication, materials, and method of support.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured piping specialty. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 00.

PART 2 - PRODUCTS

2.1 PIPING SPECIALTIES

A. General: Provide factory-fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service, or if not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

2.2 PIPE ESCUTCHEONS

A. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside the pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.

C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

D. Manufacturer: Subject to compliance with requirements, provide pipe escutcheons of one of the following or approved equivalent:

1. Chicago Specialty Mfg. Co.
2. Producers Specialty & Mfg. Corp.
3. Sanitary-Dash Mfg. Co.

2.3 LOW PRESSURE Y-TYPE PIPELINE STRAINERS:

A. General: Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 psi working pressure, with Type 304 stainless steel screens with 3/64" perforations @ 233 per sq.in.

1. Threaded Ends, 2" and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
2. Threaded Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
3. Flanged Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
4. Butt Welded Ends, 2-1/2" and Larger: Schedule 40 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.
5. Grooved Ends, 2-1/2" and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EDPM gasket.

B. Manufacturer: Subject to compliance with requirements, provide low pressure Y-type strainers of one of the following or approved equivalent:

1. Armstrong Machine Works.
2. Hoffman Specialty ITT; Fluid Handling Div.
3. Metraflex Co.
4. R-P&C Valve; Div. White Consolidated Industries, Inc.
5. Spirax Sarco.
6. Trane Co.
7. Victaulic Co. of America.
8. Watts Regulator Co.

2.4 DIELECTRIC UNIONS

A. General: Provide standard products recommended by manufacturer for use in service indicated, which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion.

B. Manufacturer: Subject to compliance with requirements, provide dielectric unions of one of the following or approved equivalent:

1. B & K Industries, Inc.
2. Capital Mfg. Co.; Div. of Harsco Corp.
3. Eclipse, Inc.
4. Epco Sales, Inc.
5. Perfection Corp.
6. Rockford-Eclipse Div.

2.5 MECHANICAL SLEEVE SEALS

A. General: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates

which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

B. Manufacturer: Subject to compliance with requirements, provide mechanical sleeve seals of one of the following or approved equivalent:

1. Thunderline Corp.

2.6 FIRE BARRIER PENETRATION SEALS

A. Provide seals for any opening through fire-rated walls, floors, or ceilings used as passage for mechanical components such as piping or duct work.

B. Cracks, Voids, or Holes Up to 4" Diameter: Use putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 time when exposed to flame or heat, UL-listed.

C. Openings 4" or Greater: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E-814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350oF (121 to 177oC), UL-listed.

D. Manufacturer: Subject to compliance with requirements, provide fire barrier penetration seals of one of the following or approved equivalent:

1. Electro Products Div./3M.
2. Nelson; Unit of General Signal.

2.7 FABRICATED PIPING SPECIALTIES:

A. Drip Pans: Provide drip pans fabricated from corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2". Reinforce top, either by structural angles or by rolling top over 1/4" steel rod. Provide hole, gasket, and flange at low point for watertight joint and 1" drain line connection.

B. Pipe Sleeves: 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. Fabricated from the following gages: 3" and smaller, 20 gage; 4" to 6" 16 gage; over 6", 14 gage.
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.

C. Sleeve Seals: Provide sleeve seals for sleeves located in foundation walls below grade, or in exterior walls, of one of the following:

1. Lead and Oakum: Caulked between sleeve and pipe.
2. Mechanical Sleeve Seals: Installed between sleeve and pipe.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration thru floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surface.

B. Y-Type Strainers: Install Y-type strainers full size of pipeline, in accordance with manufacturer's installation instructions. Install pipe nipple and shutoff valve in strainer blow down connection, full size of connection, except for strainers 2" and smaller installed ahead of control valves feeding individual terminals. Where indicated, provide drain line from shutoff valve to plumbing drain, full size of blow down connection.

1. Locate Y-type strainers in supply line ahead of the following equipment, and elsewhere as indicated, if integral strainer is not included in equipment:
   a. Pumps
   b. Temperature control valves
   c. Pressure reducing valves
   d. Temperature or pressure regulating valves

C. Dielectric Unions: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.

D. Mechanical Sleeve Seals: Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

E. Fire Barrier Penetration Seals: Fill entire opening with sealing compound. Adhere to manufacturer's installation instructions.

3.2 INSTALLATION OF FABRICATED PIPING SPECIALTIES:

A. Drip Pans: Locate drip pans under piping passing over or within 3' horizontally of electrical equipment, and elsewhere as indicated. Hang from structure with rods and building attachments, weld rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1" drain line to drain connection, and run to nearest plumbing drain or elsewhere as indicated.

B. Pipe Sleeves: Install pipe sleeves of types indicated where piping passes through walls, floors, ceilings, and roofs. Do not install sleeves through structural members of work, except as detailed on drawings, or as reviewed by Architect/Engineer. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than 2 pipe sizes larger than piping run. Where insulation includes vapor-barrier jacket, provide sleeve with sufficient clearance for installation. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves. Extend floor sleeves 1/4" above level floor finish, and 3/4" above floor finish sloped to drain. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves.

1. Install sheet-metal sleeves at interior partitions and ceilings other than suspended ceilings.
2. Install iron-pipe sleeves at exterior penetrations; both above and below grade.
3. Install steel-pipe or plastic-pipe sleeves except as otherwise indicated.

C. Sleeve Seals: Install in accordance with the following:

1. Lead and Oakum: Fill and pack annular space between sleeve and pipe with oakum, caulk with lead, on both sides.

END OF SECTION

SECTION 23 2113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK:

A. Extent of hydronic piping work is indicated on drawings and schedules, and by requirements of this section.

B. Refer to other Division 23 sections for insulation of hydronic piping; not work of this section.

C. Refer to other Division 23 sections for hydronic specialties; not work of this section.

D. Refer to other Division 23 sections for HVAC pumps; not work of this section.

E. Refer to other Division 23 sections for testing, adjusting, and balancing of hydronic piping systems; not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of hydronic piping products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with hydronic piping work similar to that required for project.

C. Codes and Standards:

1. ASME Compliance: Fabricate and install hydronic piping in accordance with ASME B31.9 "Building Services Piping".
2. Florida Building Code Compliance: Fabricate and install hydronic piping in accordance with the Florida Building Code - Mechanical.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for hydronic piping materials and products.

B. Record Drawings: At project closeout, submit record drawings of installed hydronic piping and piping products, in accordance with requirements of Division 00.

C. Maintenance Data: Submit maintenance data and parts lists for hydronic piping materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division 00.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS:

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ASME B31.9 Code for Building Services Piping where applicable, base pressure rating on hydronic piping systems maximum design pressures. Provide sizes and type matching piping and equipment connections; provide fittings of materials which match pipe materials used in hydronic piping systems. Where more than one type of materials or products are indicated, selection is Installer's option.

2.2 BASIC IDENTIFICATION:

A. General: Provide identification complying with Division 23 Basic Mechanical Materials and Methods section "Mechanical Identification", in accordance with the following listing:

1. Hydronic Piping: Plastic pipe markers.
2. Hydronic Valves: Brass valve tags.

2.3 BASIC PIPES AND PIPE FITTINGS:

A. General: Provide pipes and pipe fittings complying with Division 23 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings", in accordance with the following listing:

B. Hydronic Piping:

1. Pipe Size 2" and Smaller: Black steel pipe; Schedule 40; Class 125 cast-iron fittings with threaded joints.
2. Pipe Size 2-1/2" and Larger: Black steel pipe; Schedule 40; wrought-steel buttwelding fittings with welded joints.
3. Pipe Size 2-1/2" and Larger: Black steel pipe; Schedule 40; grooved fittings with mechanical grooved couplings in mechanical rooms only.

2.4 BASIC PIPING SPECIALTIES:

A. General: Provide piping specialties complying with Division 23 Basic Mechanical Materials and Methods section "Piping Specialties", in accordance with the following listing:

1. Pipe escutcheons.
2. Pipeline strainers.
3. Dielectric unions.
4. Sleeves.
5. Sleeve seals.

2.5 BASIC SUPPORTS AND ANCHORS:

A. General: Provide supports and anchors complying with Division 23 Basic Mechanical Materials and Methods section "Supports and Anchors", in accordance with the following listing:

1. Adjustable steel clevises, adjustable pipe saddle supports, single pipe rolls, and adjustable roller hangers, for horizontal piping hangers and supports.
2. Two-bolt riser clamps for vertical-piping clamps.
3. Steel turnbuckles, for hanger-rod attachments.
4. Concrete inserts, C-clamps, malleable beam clamps, and steel brackets, for building attachments.
5. Protection saddles, for saddles and shields.

2.6 BASIC VALVES:

A. General: Provide valves complying with Division 23 Basic Mechanical Materials and Methods section "Valves", in accordance with the following listing:

B. Sectional Valves:

1. 2" and Smaller: Ball valves.
2. 2-1/2" and Larger: Butterfly valves.

C. Shutoff Valves:

1. 2" and Smaller: Gate valves.
2. 2" and Smaller: Ball valves.
3. 2-1/2" and Larger: Gate valves.

D. Heating/Cooling Terminal Outlet Valves:

1. 2" and Smaller: Ball valves and balance cocks.
2. 2" and Smaller: Balance valves.
3. 2-1/2" and Larger: Gate valves and balance cocks.

E. Drain Valves:

1. 2" and Smaller: Ball valves.

F. Check Valves:

1. All Sizes: Swing check valves.

2.7 BASIC METERS AND GAGES:

A. General: Provide meters and gages complying with Division 23 Basic Mechanical Materials and Methods section "Meters and Gages", in accordance with the following listing:

1. Thermometers and fittings.
2. Pressure gages and fittings.
3. Flow measuring meters.

2.8 BASIC VIBRATION CONTROL:

A. General: Provide vibration control products complying with Division 23 Basic Mechanical Materials and Methods section "Mechanical Requirements", in accordance with the following listing:

1. Flexible pipe connectors.

2.9 PRE-INSULATED WELDED STEEL PIPING SYSTEM

A. Piping: Provide steel pre-insulated pipe for underground chilled water service. The pipe sections shall be welded. Unless otherwise specified, all pipe, fittings, valves, and accessories shall conform to the requirements of ANSI B31.1 and shall be of the proper type for the pressure and temperature of the service.

B. Steel Carrier Pipe and Fittings:

1. Carrier pipe shall be black steel pipe conforming to ASTM A53 ERW Schedule 40 Grade B. The spigot ends shall be beveled for welding.
2. Fittings: Black steel pipe with field insulated with “sticks and kits” by the same manufacturer of the preinsulated pipe consisting of polyurethane foam, fitting covers, and heat shrink tape.

C. Casing Pipe: Extruded black high-density polyethylene (HDPE), manufactured in accordance with

ASTM D-3350 having a minimum wall thickness of 140 mils.

D. End Seals: End seals for pre-insulated steel pipe shall be certified to resist infiltration of water at 20 feet of head at the intended operating temperature. Mastic end seals which may meet the requirements of the 20 ft test shall not be allowed.

E. Insulation: Polyurethane, conforming to ASTM C591, 90-95% closed cell content, 2.0 to 3.0

pcf, K = .14 @ 75ºF, operating temperature not to exceed 250ºF.

1. Carrier Pipe Size — Insulation Thickness

Carrier Pipe Size	Insulation Thickness
1.5”	1.7”
2”	1.4”
2.5”	1.8”
3”	1.5”
4”	1.5”
5”	1.5”
6”	1.5”
8”	1.5”
10”	1.6”
12”	1.6”
14”	1.5”

2. Insulation concentricity: Carrier pipe shall be concentric to casing pipe. The allowable maximum deviation from center line of carrier pipe shall be plus or minus 1/4 inch at the casing center point and plus or minus 1/16 inch at the end seals.

D. Acceptable Manufacturers or approved equivalent:

1. Energy Task Force, LLC
2 Thermacor
3. Thermal Pipe Systems, Inc.

PART 3 - EXECUTION

3.1 INSPECTION:

A. General: Examine areas and conditions under which hydronic piping systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF BASIC IDENTIFICATION:

A. General: Install mechanical identification in accordance with Division 23 Basic Mechanical Materials and Methods section "Mechanical Identification".

3.3 INSTALLATION OF HYDRONIC PIPING:

A. General: Install hydronic piping in accordance with Division 23 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings".

B. Install eccentric reducers where pipe is reduced in size in direction of flow, with tops of both pipes and reducer flush.

C. Install piping level with no pitch.

D. Connect branch-feed piping to mains at horizontal center line of mains, connect run-out piping to branches at horizontal center line of branches.

E. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

F. Paint all steel hydronic piping, whether insulated or not, with rust inhibitor. Apply paint before insulation is applied for insulated piping. Painting materials and execution shall be in conformance with Division 09 specifications.

3.4 INSTALLATION OF PIPING SPECIALTIES:

A. Install piping specialties in accordance with Division 23 Basic Mechanical Materials and Methods section "Piping Specialties".

3.5 INSTALLATION OF SUPPORTS AND ANCHORS:

A. Install supports and anchors in accordance with Division 23 Basic Mechanical Materials and Methods section "Supports and Anchors".

3.6 INSTALLATION OF VALVES:

A. Install valves in accordance with Division 23 Basic Mechanical Materials and Methods section "Valves".

B. Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves 2 or more hydronic terminals or equipment connections, and elsewhere as indicated.

C. Shutoff Valves: Install on inlet and outlet of each mechanical equipment item, and on inlet of each hydronic terminal, and elsewhere as indicated.

D. Hydronic Terminal Outlet Valves: Install on outlet of each hydronic terminal, and elsewhere as indicated.

E. Drain Valves: Install on each mechanical equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere where indicated or required to completely drain hydronic piping system.

F. Check Valves: Install on discharge side of each pump, and elsewhere as indicated.

3.7 INSTALLATION OF METERS AND GAGES:

A. Install meters and gages in accordance with Division 23 Basic Mechanical Materials and Methods section "Meters and Gages".

3.8 EQUIPMENT CONNECTIONS:

A. General: Connect hydronic piping system to mechanical equipment as indicated, and comply with equipment manufacturer's instructions where not otherwise indicated. Install shutoff valve and union on supply and return, drain valve on drain connection.

B. Hydronic Terminals: Install hydronic terminals with hydronic terminal outlet valve and union on outlet; union, shutoff valve on inlet. Install manual air vent valve on element in accordance with manufacturer's instructions. Locate valves and balancing cocks behind valve access doors for ease of maintenance. Where indicated, install automatic temperature control valve with unions between gate valve and element on supply line.

3.9 FIELD QUALITY CONTROL:

A. Piping Tests: Test hydronic piping in accordance with testing requirements of Division 23 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings".

3.10 ADJUSTING AND CLEANING:

A. Cleaning, Flushing, and Inspecting: Clean, flush, and inspect hydronic piping systems in accordance with requirements of Division 23 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings".

B. Chemical Treatment: Refill hydronic piping systems, adding caustic soda to maintain pH of 8.0 to 8.5 and sodium sulfate in amount of 1/3 caustic soda or to maintain residual of 30- to 40-ppm in system. Add trisodium phosphate to make hardness of 0-ppm and residual of approximately 30-ppm in system. Repeat measurements daily with system under full circulation and apply chemicals to adjust levels until no change is apparent.

END OF SECTION

SECTION 23 2123 - HVAC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 00 Specification sections, apply to work of this section.

B. Division 23 Basic Mechanical Materials and Methods section apply to work of this section.

1.2 DESCRIPTION OF WORK:

A. Extent of HVAC pumps work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of pumps specified in this section include the following:

1. Frame-mounted End Suction Pumps.

C. Pumps furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 23 sections.

D. Refer to other Division 23 sections for insulation of HVAC pump housings; not work of this section.

E. Refer to other Division 23 sections for vibration control of HVAC pumps; not work of this section.

F. Refer for Division 26 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on pumps. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

G. Provide the following electrical work as work of this section, complying with requirements of Division 26 sections:

1. Control wiring and conduit between field-installed controls, indicating devices, and pump control panels.
2. Control wiring and conduit specified as work of Division 23 for Automatic Temperature Controls is work of Section 150900 HVAC Control Systems.
3. Interlock wiring specified as factory-installed is work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of general-use centrifugal pumps with characteristics, sizes and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. HI Compliance: Design, manufacture, and install HVAC pumps in accordance with HI "Hydraulic Institute Standards".
2. UL Compliance: Design, manufacture, and install HVAC pumps in accordance with UL 778 "Motor Operated Water Pumps".
3. UL and NEMA Compliance: Provide electric motors and components which are listed and labeled by Underwriters Laboratories and comply with NEMA standards.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's pump specifications, installation and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to HVAC pumps. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance data and parts lists for each type of pump, control, and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 00.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING:

A. Handle HVAC pumps and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged HVAC pumps or components; replace with new.

B. Store HVAC pumps and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with manufacturer's rigging and installation instructions for unloading HVAC pumps, and moving them to final location.

PART 2 - PRODUCTS

2.1 PUMPS:

A. General: Provide factory-tested pumps, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. Type, size, and capacity of each pump is listed in pump schedule. Provide pumps of same type by same manufacturer.

2.2 FRAME-MOUNTED END SUCTION PUMPS:

A. General: Provide frame-mounted end suction pumps where indicated, and of capacities and having characteristics as scheduled.

B. Type: Horizontal mount, single stage, vertical split case, flexible coupling, base mounted, designed for 175 psi working pressure.

C. Casing: Cast iron, 125 psi ANSI flanges, tappings for gage and drain connections.

D. Shaft: Steel with replaceable shaft sleeve.

E. Bearings: Regreasable ball bearings.

F. Seal: Mechanical, with carbon seal ring and ceramic seat.

G. Motor: Open, drip-proof (ODP) for indoor applications and totally enclosed fan cooled (TEFC) for outdoor applications, with regreasable ball bearings.

H. Impeller: Enclosed type, hydraulically and dynamically balanced, keyed to shaft and secured with locking screw.

I. Baseplate: Structural steel with welded cross members, and open grouting area.

J. Coupling: Flexible, capable of absorbing torsional vibration, equipped with coupling guard.

K. Manufacturer: Subject to compliance with requirements, provide frame-mounted end suction pumps of one of the following or approved equivalent:

1. Armstrong Pumps, Inc.
2. Bell & Gossett ITT; Fluid Handling Div.
3. Weinman Pump LFE Corp.; Fluids Control Div.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which HVAC pumps are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF PUMPS:

A. General: Install HVAC pumps where indicated, in accordance with manufacturer's published installation instructions, complying with recognized industry practices to ensure that HVAC pumps comply with requirements and serve intended purposes.

B. Access: Provide access space around HVAC pumps for service as indicated, but in no case less than that recommended by manufacturer.

C. Support: Refer to Division 23 section "Vibration Control" for support and mounting requirements of HVAC pumps.

D. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

E. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

F. Piping Connections: Refer to Division 23 HVAC piping sections. Provide piping, valves, accessories, gages, supports, and flexible connections as indicated.

3.3 ADJUSTING AND CLEANING:

A. Alignment: Check alignment, and where necessary, realign shafts of motors and pumps within recommended tolerances by manufacturer, and in presence of manufacturer's service representative.

B. Start-Up: Lubricate pumps before start-up. Start-up in accordance with manufacturer's instructions.

C. Refer to Division 23 section "HVAC Testing, Adjusting and Balancing" for pump system balancing; not work of this section.

D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 23 2500 - HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK:

A. Extent of hydronic specialties required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of hydronic specialties specified in this section include the following:

1. Balance Valves.
2. Vent Valves.
3. Pump Discharge Valves.
4. Shot Feeders.
5. Liquid Flow Switches.
6. Pressure Reducing Valves.

C. Hydronic specialties furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 23 sections.

D. Refer to other Division 23 sections for insulation of hydronic specialties; not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of hydronic specialties of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Hydronic Specialty Types: Provide hydronic specialties of same type by same manufacturer.

C. Codes and Standards:

1. ASME Compliance: Manufacture and install hydronic specialties in accordance with ASME B31.9 "Building Services Piping".

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of hydronic specialty. Include pressure drop curve or chart for each type and size of hydronic specialty. Submit schedule indicating manufacturer's figure number, size, location, rated capacities, and features for each required hydronic specialty.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weights, required clearances, and method of assembly of components.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of hydronic specialty. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 00.

PART 2 - PRODUCTS

2.1 HYDRONIC SPECIALTIES:

A. General: Provide factory-fabricated hydronic specialties recommended by manufacturer for use in service indicated. Provide hydronic specialties of types and pressure ratings indicated for each service, or if not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option, but more than one type cannot be used on project.

2.2 BALANCE VALVES:

A. General: Calibrated balance valves are specified in Specification Section 150519 “Meters and Gauges” and are work of this section.

2.3 VENT VALVES:

A. Manual Vent Valves: Provide manual vent valves designed to be operated manually with screwdriver or thumbscrew, 1/8" NPS connection.

B. Automatic Vent Valves: Provide automatic vent valves designed to vent automatically with float principle, stainless steel float and mechanisms, cast-iron body, pressure rated for 125 psi, 1/2" NPS inlet and outlet connections.

C. Manufacturer: Subject to compliance with requirements, provide vent valves of one of the following or approved equivalent:

1. Armstrong Machine Works.
2. Bell & Gossett ITT; Fluid Handling Div.
3. Hoffman Specialty ITT; Fluid Handling Div.
4. Spirax Sarco.

2.4 SHOT FEEDERS:

A. General: Provide shot feeders of minimum 5 gal. capacity or otherwise as indicated, constructed of cast iron or steel, for introducing chemicals in hydronic system. Provide funnel and valve on top for loading, drain valve in bottom, and recirculating valves on side. Construct for pressure rating of 125 psi.

B Manufacturer: Subject to compliance with requirements, provide shot feeders of one of the following or approved equivalent:

1. Culligan USA.
2. Vulcan Laboratories, Subsidiary of Clow Corp.
3. York-Shipley, Inc.

2.5 LIQUID FLOW SWITCHES:

A. General: Provide liquid flow switches as indicated to sense flow and non-flow. Construct of brass for all wetted parts, provide packless construction. Provide paddle with removable segments for pipe size and flow velocity. Provide vapor-proof electrical compartment for switches mounted on cold hydronic piping systems. Furnish switches for 115 volt, 60 cycle, single phase with 7.4 amp. rating; or otherwise as indicated.

B Manufacturer: Subject to compliance with requirements, provide liquid flow switches of one of the following or approved equivalent:

1. McDonald & Miller ITT; Fluid Handling Div.

2.6 PRESSURE REDUCING VALVES:

A. General: Provide pressure reducing valves as indicated, of size and capacity as selected by Installer to maintain operating pressure on boiler system.

B. Construction: Cast-iron or brass body, low inlet pressure check valve, inlet strainer removable without system shut-down, non-corrosive valve seat and stem, factory-set at operating pressure.

C. Manufacturer: Subject to compliance with requirements, provide pressure reducing valves of one of the following or approved equivalent:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett ITT; Fluid Handling Div.
4. Taco, Inc.

PART 3 - EXECUTION

3.1 INSPECTION:

A. General: Examine areas and conditions under which hydronic specialties are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF HYDRONIC SPECIALTIES:

A. Balance Valves: At Installer's option, install balance valves in lieu of terminal outlet valves and balance cocks. Install on each hydronic terminal and elsewhere as indicated. After hydronic system balancing has been completed, mark each balance valve with stripe of yellow lacquer across body and stop plate to permanently mark final balanced position.

3.3 VENT VALVES:

A. Manual Vent Valves: Install manual vent valves on each hydronic terminal at highest point, and on each hydronic piping drop in direction of flow for mains, branches, and runouts, and elsewhere as indicated.

B. Automatic Vent Valves: Install automatic vent valves at top of each hydronic riser and elsewhere as indicated. Install shutoff valve between riser and vent valve, pipe outlet to suitable plumbing drain, or as indicated.

C. Flow Control Valves: Install flow control valves on discharge of each pump serving hydronic heating system or zone, and elsewhere as indicated. Install with check mechanism in upright position, with adequate clearance for service and replacement. Screw check down for automatic operation.

3.4 AUXILIARY DEVICES:

A. Shot Feeders: Install shot feeders on each hydronic system at pump discharge and elsewhere as indicated. Install in upright position with top of funnel not more than 48" above floor. Install globe valve in pump discharge line between recirculating lines. Pipe drain to nearest plumbing drain or as indicated.

B. Liquid Flow Switches: Install liquid flow switches on inlet to water chiller, inlet to water condenser, and elsewhere as indicated. Install in horizontal pipe with switch mounted in tee on top of pipe with minimum of 24" of straight pipe with no fittings both upstream and downstream of switch. Remove segments of paddle to fit pipe in accordance with manufacturer's instructions.

C. Pressure Reducing Valves: Install for chilled water makeup system.

END OF SECTION

SECTION 23 3423 - POWER AND GRAVITY VENTILATORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 00 Specification sections, apply to work of this section.

B. Division 23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK:

A. Extent of power and gravity ventilator work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of power and gravity ventilators specified in this section include the following:

1. Power ventilators.
    a. Centrifugal roof ventilators.

C. Refer to Division-7 sections for installation of prefabricated roof curbs; not work of this section.

D. Refer to Division 23 section "Testing, Adjusting, and Balancing" for balancing of power and gravity ventilators; not work of this section.

E. Refer to Division 23 temperature control systems sections for control work required in conjunction with power and gravity ventilators; not work of this section.

F. Refer to Division 26 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on ventilators. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
2. Interlock wiring between ventilators; and between ventilators and field-installed control devices.
3. Interlock wiring specified as factory-installed is work of this section.

G. Provide the following electrical work as work of this section, complying with requirements of Division 26 sections:

1. Control wiring between field-installed controls, indicating devices, and ventilators.
2. Control wiring specified as work of Division 23 for Automatic Temperature Controls is work of that section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of power and gravity ventilators, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. AMCA Compliance: Provide power ventilators which have been tested and rated in accordance with AMCA standards, and bear AMCA Certified Ratings Seal.
2. UL Compliance: Provide power ventilators which are listed by UL and have UL label affixed.
3. NEMA Compliance: Provide motors and electrical accessories complying with NEMA standards.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical data for power and gravity ventilators, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished, and installation instructions.

B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, construction details, methods of assembly of components, and field connection details.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to power ventilators. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance data and parts list for each type of power and gravity ventilator, accessory, and control. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 00.

1.5 INFORMATIONAL SUBMITTALS

A. Florida Product Approval: Provide products and assemblies at all exterior locations that are approved by the Florida Building Commission for statewide use as prescribed by Rule 9B-72 Florida Administrative Code. Furnish State of Florida Product Approval Number for each product or assembly.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Product Approval: Exterior door and frame systems/products that are incorporated into the Work shall comply with Florida Product Approval Rule 9B-72.

2.2 POWER VENTILATORS:

A. General: Except as otherwise indicated, provide standard preabricated power ventilator units of type and size indicated, modified as necessary to comply with requirements, and as required for complete installation.

B. Centrifugal Roof Ventilators: Provide centrifugal roof type, curb mounted, power ventilators of type, size, and capacity as scheduled, and as specified herein.

C. Type: Centrifugal fan, direct or belt driven as scheduled. Provide aluminum, galvanized steel, or fiberglass weatherproof housings as scheduled. Provide square base to suit roof curb. Provide permanent split-capacitor type motor for direct driven fans; capacitor-start, induction-run type motor for belt driven fans.

1. Housing Design: Hooded dome type.

D. Electrical: Provide factory-wired non-fusible type disconnect switch at motor in fan housing. Provide thermal overload protection in fan motor. Provide conduit chase within unit for electrical connection.

E. Bird Screens: Provide removable bird screens, 1/2" mesh, 16-ga aluminum or brass wire.

F. Dampers: Provide gravity-actuated louvered dampers in curb bases.

G. Refer to Division 23 automatic temperature control sections for damper motor and control sequence; not work of this section.

H. Manufacturer: Subject to compliance with requirements, provide centrifugal roof ventilators of one of the following or approved equivalent:

1. Greenheck Fan Co.
2. Loren Cook Co.
3. PennBarry

PART 3 EXECUTION

3.1 INSPECTION:

A. General: Examine areas and conditions under which power and gravity ventilators are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF POWER AND GRAVITY VENTILATORS:

A. General: Except as otherwise indicated or specified, install ventilators in accordance with manufacturer's installation instructions and recognized industry practices to insure that ventilators serve their intended function.

B. Coordinate ventilator work with work of roofing, walls, and ceilings, as necessary for proper interfacing.

C. Ductwork: Refer to Division 23 section "Ductwork". Connect ducts to ventilators in accordance with manufacturer's installation instructions.

1. Provide access door in duct below ventilator to service damper.

D. Roof Curbs: Furnish roof curbs to roofing Installer for installation.

E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

F. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Verify proper rotation direction of fan wheels. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

G. Remove shipping bolts and temporary supports within ventilators. Adjust dampers for free operation.

3.3 FIELD QUALITY CONTROL:

A. Testing: After installation of ventilators has been completed, test each ventilator to demonstrate proper operation of units at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

3.4 ADJUSTING AND CLEANING:

A. Cleaning: Clean factory-finished surfaces: Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.5 SPARE PARTS:

A. General: Furnish to Owner, with receipt, one spare set of belts for each belt drive power ventilator.

END OF SECTION

SECTION 23 4315 - AIR PURIFICATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 00 Specification sections, apply to work of this section.

B. Division 23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 DESCRIPTION OF WORK

A. This section describes the design, performance and installation of an air purification system intended for use as part of another manufacturer's air handling unit or mounted on the duct as shown on the plans, details and equipment schedules.

1.3 REFERENCED CODES & STANDARDS

A. The following codes and standards are referenced through out. The edition to be used is that currently enforced by the authority having jurisdiction (AHJ) or in absence of such direction that referenced by the current enforceable building code or as indicated by the contract documents, except where specifically referenced by this section of the specifications.

1. ASHRAE Standards 62 & 52
2. UL Standard 867
3. Food & Drug Administration; 21CFR801.415; April 1, 2009
4. National Electric Code NFPA 70, 1990

1.4 RELATED WORK

A. Testing, Adjusting and Balancing

B. Facility Access and Protection

C. Ductwork

D. Filters

E. Water Piping

F. Electrical Wiring

G. Control Wiring

1.5 QUALITY ASSURANCE

A. The Air Purification System shall be a product of an established manufacturer with installations in successful operation for a minimum of 10 years in the USA.

B. A qualified representative from the manufacturer shall be available to inspect the installation of the air purification system to insure installation in accordance with manufacturer's recommendations.

C. The complete Air Purification System shall be a product of single and an established manufacturer with installations in successful operation for a minimum of 10 years in the USA.

D. The complete Air Purification System including the assembled Bi-polar ion generator, with power and control wiring, safety switches, airflow switches and controls shall be listed by either UL or ETL for commercial applications. Products submitted with UL or ETL certification for residential applications shall not be acceptable.

E. Provide Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1 to validate acceptable indoor air quality at the quantity of outside air scheduled. The calculations shall have been independently validated to demonstrate compliance with ASHRAE Standard 62.1.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for ion generators including:

1. Product performance data for filters, gauges, and housings.
2. Product drawings detailing all physical, electrical, duct work, and control requirements.

B. Operating & Maintenance Data: Submit O&M data and recommended spare parts lists.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver in factory fabricated shipping containers. Identify on outside of container type of product and location to be installed. Avoid crushing or bending.

B. Store in original cartons and protect from weather and construction work traffic.

C. Store indoors and in accordance with the manufacturers' recommendation for storage.

1.8 WARRANTY

A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of eighteen months after shipment or twelve months from owner acceptance, whichever occurs first. Labor to replace equipment under warranty shall be provided by the owner or installing contractor.

1.9 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide Bi-polar Ion system of one of the following:

1. Bioclimatic Air Systems
2. Global Plasma Solutions

PART 2 - PRODUCTS

2.1 GENERAL

A. The air purification system(s) shall be of the size, type, arrangement and capacity indicated and required by the unit furnished and shall be of the manufacturer specified.

2.2 BI-POLAR IONIZATION DESIGN & PERFORMANCE CRITERIA

A. Each piece of air handling equipment, so designated on the plans, details and/or equipment schedules shall contain a Bi-polar Ion system capable of:

1. Effectively deactivating (neutralizing) microorganisms. (mold, bacteria, & virus)
2. Reducing odors associated with human occupants to the extent that the minimum ventilation rates under the IAQ procedure may be attained.
3. Capable of reducing static charges.

B. No less than MERV 12 efficiency filters shall be provided in the air handling unit downstream from the Bi-polar Ion Generator to conform to ASHRAE Standard 62.1.

D. Velocity Profile - The air velocity through the plenum or duct approaching the Bi-polar Ion Generator shall not exceed 500 fpm in the Bi-polar Ionization Section.

E. Humidity - Relative humidity from 0 - 99% shall not cause damage, deterioration or dangerous conditions within the air purification system. For Bi-polar Ion Generators installed in the supply duct, the manufacturer shall provide additional BPI capacity to offset the loss caused by high humidity. Provide a safety circuit to interrupt power in the event of an internal system short circuit or arcing condition. The safety circuit must be in addition to the normal unit fuse or circuit breaker.

2.2. EQUIPMENT REQUIREMENTS

A. Electrode Specifications (Bi-polar Ionization): Each Bi-polar Ionization unit shall include the required number of ion generators sized to the air handling equipment capacity. .

B. Air Handler Mounted Units: Where so indicated on the plans and/or schedules Plasma Generator(s) shall be supplied and installed. The mechanical contractor shall mount the Plasma Generator and wire it to the remote mount power supply using the high voltage cables provided by the air purification manufacturer. A 115VAC or 230VAC circuit shall be provided

to the plasma generator power supply panel. Each plasma generator shall be designed with an aluminum casing, liquid tight flexible conduit, and a high voltage quick connector.

2.3 BI-POLAR ION GENERATOR REQUIREMENTS

A. Bi-Polar Ion Generator(s): Bi-polar Ion generator(s), capable of controlling gas phase contaminants shall be provided for all equipment listed in paragraph 2.2.

1. The Bi-polar ionization system shall consist of Ion Generators, internal controls, safety door switches, airflow switches, and other accessories (as required) required for safe and efficient operation. The Ion Generators shall include a BMS interface to indicate Ion Generator operation. The Ion Generators shall be installed where indicated on the plans.

B. Ozone Generation: The operation of the Ion Generator electrodes shall not produce chemically detectable Ozone and shall conform to ASHRAE Standard 62.1 and the US CODE OF FEDERAL REGULATION item CFR 39-75 with respect to ozone generation.

2.4 ELECTRICAL REQUIREMENTS

A. Wiring, conduit, and junction boxes shall be installed within housing plenums in accordance with NEC NFPA 70. Electrical service shall be 24 VAC. No “needles” shall be allowed to be in the air stream.

2.5 CONTROL REQUIREMENTS

A. All Plasma Generators shall have internal short circuit protection, overload protection, and automatic fault reset.

B. The ionization system shall be provided with a stand-alone, independent ion sensor designed for duct mounting to monitor the ion output and report to the BAS system that the ion device is working properly. Ion systems provided without an independent ion sensor, shall not be permitted. The control voltage to power the ion sensor shall be 12VDC or 24VAC to 240VAC and draw no more than 150mA of current. The sensor shall provide at minimum, dry contact status to the BAS and optionally a BacNet or Lonworks interface as specified on the control drawings. Manufacturers not providing a stand-alone ion sensor shall not be acceptable.

C. The installing contractor shall mount and wire the Plasma device within the air-handling unit specified or as shown or the plans. The contractor shall follow all manufacturer IOM instructions during installation.

PART 3 - EXECUTION

3.1 ASSEMBLY AND ERECTION

A. The air purification system manufacturer shall complete all interconnecting control and power wiring located within the roof curb unit.

B. All equipment shall be assembled and installed in a workman like manner to the satisfaction of the owner, architect, and consulting engineer.

C. Any material damaged by handling, water or moisture shall be replaced, by the mechanical contractor, at no cost to the owner.

D. All equipment shall be protected from dust and damage on a daily basis throughout construction.

E. Clean all components prior to start-up.

3.2 TESTING

A. Provide the manufacturers recommended electrical and static pressure tests.

3.3 START-UP & TRAINING

A. A manufacturer's authorized representative shall be available to provide start-up supervision and training of owner's personnel in the proper operation and maintenance of all equipment (as required).

B. Provide 5 copies of Operating and Maintenance Manuals.

END OF SECTION

SECTION 23 6423.21 - AIR-COOLED WATER CHILLERS (PREPURCHASE)

For reference only – This work is being provided under a different contract and is provided for coordination purposes only

PART 1 -

PART 2 - GENERAL

2.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other related Specification sections, apply to this section.

2.2 SUMMARY

A. Section includes design, performance criteria, refrigerants, controls, and installation requirements for air-cooled scroll compressor chillers.

2.3 DEFINITIONS

A. BAS: Building automation system.

B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

C. DDC: Direct digital control.

D. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in Btu/h to the total power input given in watts at any given set of rating conditions.

E. GFI: Ground fault interrupt.

F. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit for a single chiller calculated per the method defined by AHRI 550/590 and referenced to AHRI standard rating conditions.

G. I/O: Input/output.

H. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.

I. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit for a single chiller calculated per the method defined by AHRI 550/590 and intended for operating conditions other than the AHRI standard rating conditions.

J. SCCR: Short-circuit current rating.

K. TEAO: Totally enclosed air over.

L. TENV: Totally enclosed nonventilating.

2.4 ACTION SUBMITTALS

A. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:

1. Dimensioned plan and elevation view drawings, required clearances, and location of all field connections
2. Summary of all auxiliary utility requirements such as electricity, water, etc. Summary shall indicate quality and quantity of each required utility.
3. Single line schematic drawing of the field power hookup requirements, indicating all items that are furnished.
4. Schematic diagram of control system indicating points for field interface/connection.
5. Diagram shall fully delineate field and factory wiring.
6. Installation and operating manuals.

2.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Plans on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   a. Structural supports.
   b. Piping roughing-in requirements.
   c. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
   d. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

2. Coordination drawings showing plan, section and elevation views.
3. Each view to show screened background with the following:
   a. Column grids, beams, columns, and concrete housekeeping pads.
   b. Layout with walls, floors, and roofs, including each room name and number.
   c. Equipment and products of other trades that are located in vicinity of chillers and part of final installation, such as plumbing systems.

B. Certificates: For certification required in “Quality Assurance” Article.

C. Installation instructions.

D. Source quality-control reports.

E. Startup service reports.

F. Sample Warranty: For special warranty.

2.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each water chiller to include in emergency, operation, and maintenance manuals.

B. Spare Parts List: Recommended spare parts list with quantity for each.

C. Touchup Paint Description: Detailed description of paint used in application of finish coat to allow for procurement of a matching paint.

D. Instructional Videos: Including those that are prerecorded and those that are recorded during training by the contractor/installer.

2.7 QUALITY ASSURANCE

A. Comply with applicable Standards/Codes of AHRI 550/590, ANSI/ASHRAE 15, ETL, cETL, NEC, and OSHA as adopted by the State.

B. Units shall meet the efficiency standards of the current version of ASHRAE Standard 90.1, and FEMP standard 2012.

2.8 DELIVERY, STORAGE, AND HANDLING

A. Chiller shall be delivered to the job site completely assembled and charged with refrigerant and oil by the manufacturer.

B. Vendor shall provide manufacturer's instructions for rigging and handling of equipment to the contractor/installer.

C. The Vendor shall oversee offloading of chillers to ensure that the manufacturer's requirements are followed.

2.9 WARRANTY

A. Base Warranty:

1. The Bidders hereby agree to warrant the equipment and services supplied under this Contract to be of good workmanship and of proper materials in accordance with these Bid Documents, free from defects and suitable for the intended use for a minimum period of one (1) year. The warranty shall provide for repair or replacement due to failure by material and workmanship that prove defective within the above period, including parts, labor, and refrigerant. The warranty period shall commence on the date of SUBSTANTIAL COMPLETION OF THE PROJECT, as established by the Owner and Engineer of Record and documented in the project close-out documents. It is the Vendor's responsibility to monitor the progress of the installation and to contact the Engineer of Record to ascertain the Date of Substantial Completion.

2. The Vendor agrees to respond to warranty service requests within 4 hours of notification by the Owner or Owner's representative and to repair or replace warranted equipment within 72 hours of receipt of the request. The Vendor agrees, if directed, to provide temporary equipment as necessary to maintain acceptable conditions at no additional cost to the Owner if the repair cannot be completed within 72 hours. However, if the Vendor does not respond within 4 hours or is unable to complete the repair within 72 hours, the Vendor acknowledges that the Owner has the option to proceed with the repair and agrees to reimburse the Owner for all costs.
3. In addition to the manufacturer's standard warranty, the Vendor shall execute and submit a written Warranty. The required format and details of coverage pertaining to the Vendor's warranty is provided in these Bid Documents.
4. Any coil repairs shall be field coated in the field. Coating shall be compatible and match the original coil's coating performance. Any coil replacements shall be coated in a factory environment.

B. Extended Warranties:

1. **Alternate A - 5-year Parts:** The Vendor shall provide an alternate price to extend the base Warranty. The Alternate A Warranty will begin upon expiration of the base Warranty and will end five years from the base Warranty commencement date. The extended Warranty will provide the same coverage as the base Warranty for parts only. The Vendor agrees to respond to Warranty parts requests within 4 hours of confirmed notification by the Owner or Owner's representative. Parts shall be delivered to the site within 48-hours of confirmed notification.
2. **Alternate B - 10-year Parts:** The Vendor shall provide an alternate price to further extend the base Warranty. The Alternate B Warranty will begin upon expiration of the base Warranty and will end ten years from the base Warranty commencement date. The extended Warranty will provide the same coverage as the base Warranty for parts only. The Vendor agrees to respond to Warranty parts requests within 4 hours of confirmed notification by the Owner or Owner's representative. Parts shall be delivered to the site within 48-hours of confirmed notification.
3. **Alternate C - 5-year Parts, Labor, Refrigerant, and Preventative Maintenance:**
   a. The Vendor shall provide an alternate price to extend the base Warranty. The Alternate C Warranty will begin upon expiration of the base Warranty and will end five years from the base Warranty commencement date. The extended Warranty will provide the same coverage as the base Warranty.
   b. The Vendor shall provide an alternate price for all preventive maintenance services listed herein, for a period commencing on the date of SUBSTANTIAL COMPLETION OF THE PROJECT and ending five years from the date of SUBSTANTIAL COMPLETION OF THE PROJECT.
      1) Required Preventative Maintenance tasks are listed below. It will be the responsibility of the Vendor to schedule service calls with the District's Maintenance Department a minimum of 2 weeks in advance of the scheduled date. The report shall be forwarded via e-mail within seven (7) days of the service call.
      2) Provide a report to the Owner, to include the logs and calculations required below, and a checklist in the below-listed format as well as recommendations for corrective actions.
      3) If purchased, the Vendor shall execute and submit a Preventative Maintenance Agreement. The required format of the agreement is provided elsewhere in these Bid Documents.

4) Tasks to be performed four (4) times per year, beginning 3 months after SUBSTANTIAL COMPLETION OF THE PROJECT:
   a) Log all operating conditions and compare data to original design requirements
   b) Check operating and safety controls
   c) Check overall condition of the unit
   d) Inspect starters
   e) Inspect contactors and relays, replace as necessary
   f) Inspect condenser fan motors and blades
   g) Check for proper condenser fan rotation
   h) Clean condenser coils using cleaner/degreaser equivalent to Enviro-coil and salt remover equivalent to CHLOR*RID DTS as directed by the coil coating manufacturer.
   i) Check for unusual noise and vibration
   j) Check compressor crankcase heater operation
   k) Check vibration eliminators
   l) Check condenser coils
   m) Check supply voltage. Voltage to be nominal voltage +10%.
   n) Check amperage draw of motors
   o) Check controller operation and alarm history
   p) Check sensor calibration
   q) Log chiller operating parameters
   r) Check system pressures and temperatures
   s) Check refrigerant charge and check sight glass for presence of moisture
   t) Check compressor oil level(s)
   u) Inspect for refrigerant and oil leaks
   v) Check chilled water flow switch operation
   w) Inspect pump seal
   x) Check accuracy of thermistors, replace if > +2ºF (1.2ºC) variance from calibrated thermometer
   y) Check accuracy of transducers, replace if > +5 psi (34.47kPa) variance
   z) Check that proper concentration of glycol is present in the chilled water loop where applicable
   aa) Check refrigerant filter driers for excessive pressure drop, replace as necessary
   bb) Check chilled water strainers, clean as necessary
5) In addition to the above, perform these tasks at the 4th visit. These tasks are to be performed yearly within 2 weeks of the SUBSTANTIAL COMPLETION OF THE PROJECT date:
   a) Conduct refrigerant leak test and repair minor leaks
   b) Inspect condenser fan mounting hardware
   c) Lubricate the condenser fan bearings
   d) Meg hermetic motors
   e) Check and tighten electrical connections
   f) Check tightness of the motor terminal connections
   g) Check for software upgrades
   h) Calculate refrigerant loss rate
   i) Test the low water temperature control device. Calibrate and record setting
   j) Test the oil pressure safety device(s). Calibrate and record setting
   k) Test oil for acid content and discoloration

l) Clean motor starter and cabinet
m) Check condition of the contacts for wear and pitting
n) Verify the operation of electrical interlocks

4. **Alternate D - 10-year Parts, Labor, Refrigerant, and Preventative Maintenance:**
   a. The Vendor shall provide an alternate price to further extend the base Warranty. The Alternate D Warranty will begin upon expiration of the base Warranty and will end ten years from the original Warranty commencement date. The extended Warranty will provide the same coverage as the base Warranty.
   b. The Vendor shall provide an alternate price for all preventive maintenance services listed herein, for a period commencing on the date of SUBSTANTIAL COMPLETION OF THE PROJECT and ending ten years from the date of SUBSTANTIAL COMPLETION OF THE PROJECT. The required Preventative Maintenance tasks shall be as noted in Alternate C above.

PART 3 - PRODUCTS

3.1 UNIT DESCRIPTION

A. Provide and install as shown on the plans factory-assembled, factory-charged air-cooled scroll compressor packaged chillers in the quantity specified. Each chiller shall consist of hermetic scroll compressor sets (total of 4 to 6 compressors), brazed plate evaporator, air-cooled condenser section, microprocessor-based control system and all components necessary for controlled unit operation.

B. Chiller shall be functionally tested at the factory to ensure trouble free field operation

3.2 DESIGN REQUIREMENTS

A. Flow Range: The chiller shall have the ability to support variable flow range down to 45% of nominal design (based on AHRI conditions).

B. Operating Range: The chiller shall have the ability to control leaving chilled fluid temperature from 40F to 60F.

C. General: Provide a complete scroll compressor packaged chiller as specified herein and as shown on the drawings. The unit shall be in accordance with the standards referenced in section 1.02 and any local codes in effect.

D. Performance: Refer to the schedule of performance on the drawings. The chiller shall be capable of stable operation to a minimum percentage of full load (without hot gas bypass) of 25%. Performance shall be in accordance with AHRI Standard 550/590.

E. Acoustics: Sound pressure levels for the unit shall not exceed the specified levels, see chiller equipment schedule. All manufacturers shall provide the necessary sound treatment (parts and labor) to meet these levels if required. Sound data shall be provided with the quotation. Test shall be in accordance with AHRI Standard 370.

3.3 CHILLER COMPONENTS

A. Compressor

1. The compressors shall be sealed hermetic, scroll type with crankcase oil heater and suction strainer. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, two-pole, with inherent thermal protection on all three phases and shall be mounted on RIS vibration isolator pads. The compressors shall be equipped with an internal module providing compressor protection and communication capability.

B. Evaporator

1. The evaporator shall be a compact, high efficiency, dual circuit, barrel & tube, or brazed plate-to-plate type heat exchanger consisting of parallel stainless-steel plates. The water-side working pressure shall be a minimum of 653 psig (4502 kPa). Vent and drain connections shall be provided in the inlet and outlet chilled water piping by the installing contractor. Evaporators shall be designed and constructed according to, and listed by, Underwriters Laboratories (UL).
2. The water-side maximum design pressure shall be rated at a minimum of 653 psig (4502 kPa). Evaporators shall be designed and constructed according to, and listed by Underwriters Laboratories (UL).

C. Condenser

1. Condenser fans shall be propeller type arranged for vertical air discharge and individually driven by direct-drive fan motors. The fans shall be equipped with a heavy-gauge vinyl-coated fan guard. Fan motors shall be TEAO type with permanently lubricated ball bearings, inherent overload protection, three-phase, direct-drive, 1140 rpm. Each fan section shall be partitioned to avoid cross circulation.
2. Coil shall be microchannel design and shall have a series of flat tubes containing multiple, parallel flow microchannels layered between the refrigerant manifolds. Tubes shall be 9153 aluminum alloy. Tubes made of 3102 alloy or other alloys of lower corrosion resistance shall not be accepted. Coils shall consist of a two-pass arrangement. Each condenser coil shall be factory leak tested with high-pressure air under water.
3. Condenser coils shall include baked epoxy coating providing 6000+ hour salt spray resistance (ASTM B117-90) applied to both the coil and the coil frames.
4. **Alternate E – Copper Tube / Aluminum Fin Condenser Coil:** The Vendor shall provide an alternate price for a condenser coil constructed of a copper tube with aluminum fins. The alternate coil shall be factory coated per 23 6423.21-2.C.3 above.

D. Refrigerant Circuit

1. Each of the two refrigerant circuits shall include a replaceable-core refrigerant filter-drier, sight glass with moisture indicator, liquid line solenoid valve (no exceptions), expansion valve, and insulated suction line.

E. Construction

1. Unit casing and all structural members and rails shall be fabricated of pre-painted or galvanized steel. Painted parts shall be able to meet ASTM B117, 6,000-hour salt spray test.
2. Upper condenser coil section of unit shall have protective, 12 GA, PVC-coated, wire grille guards.
3. All chilled surfaces shall be factory insulated.

F. Control System

1. A centrally located weatherproof control panel shall contain the field power connection points, control interlock terminals, and control system. Box shall be designed in accordance with NEMA 3R rating. Power and starting components shall include factory circuit breaker for fan motors and control circuit, individual contactors for each fan motor, solid-state compressor three-phase motor overload protection, inherent fan motor overload protection and two power blocks (one per circuit) for connection to remote, contractor supplied disconnect switches. Hinged access doors shall be lockable. Barrier panels or separate enclosures are required to protect against accidental contact with line voltage when accessing the control system.
2. Shall include high short circuit current rating of 65,000 amps (25,000 amps at 575Volt) with single-point disconnect switch

G. Unit Controller

1. An advanced DDC microprocessor unit controller with a liquid crystal display provides the operating and protection functions. The controller shall take preemptive limiting action in case of high discharge pressure or low evaporator pressure. The controller shall contain the following features as a minimum:
2. The unit shall be protected in two ways: (1) by alarms that shut the unit down and require manual reset to restore unit operation and (2) by limit alarms that reduce unit operation in response to some out-of-limit condition. Shut down alarms shall activate an alarm signal.
3. Shutdown Alarms
   a. No evaporator water flow (auto-restart)
   b. Sensor failures
   c. Low evaporator pressure
   d. Evaporator freeze protection
   e. High condenser pressure
   f. Outside ambient temperature (auto-restart)
   g. Motor protection system
   h. Phase voltage protection

4. Limit Alarms
   a. Condenser pressure stage down, unloads unit at high discharge pressures.
   b. Low evaporator pressure hold, holds stage #1 until pressure rises.
   c. Low evaporator pressure unload, shuts off one compressor.

5. Unit Enable Section
   a. Enables unit operation from either local keypad, digital input, or BAS

6. Unit Mode Selection
   a. Selects standard cooling or test operation mode

7. Analog Inputs:
   a. Reset of leaving water temperature, 4-20 mA\
   b. Current Limit

8. Digital Inputs
   a. Unit off switch
   b. Remote start/stop
   c. Flow switch
   d. Motor protection

9. Digital Outputs
   a. Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared
   b. Evaporator pump; field wired, starts pump when unit is set to start

10. Condenser fan control - The unit controller shall provide control of condenser fans based on compressor discharge pressure.
11. Building Automation System (BAS) Interface
    a. Factory mounted DDC controller(s) shall support operation on a Schneider Controls BAS network via BACnet®.
    b. The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.
    c. All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.

3.4 OPTIONS AND ACCESSORIES

A. The following options are to be included:

1. Hot Gas Bypass: allows unit operation to 10 percent of full load. Includes factory-mounted hot gas bypass valve, solenoid valve, and manual shutoff valve for each circuit.
2. Phase loss with under/over voltage protection and with LED indication of the fault type to guard against compressor motor burnout.
3. BAS interface module to provide interface with the BACnet MSTP protocol.
4. The following accessories, if selected, are to be included:
   a. Rubber-in-shear vibration isolators for field installation
   b. Factory-mounted thermal dispersion type flow switch
   c. Field provided Wye strainer, to be installed at the evaporator inlet and sized for the design flow rate, with perforation diameter of 0.063" with blowdown valve and Victaulic couplings

3.5 MANUFACTURER

A. Subject to compliance with requirements, provide air handling units of one the following:

1. Daikin Applied (Basis of Design)
2. Carrier Corporation
3. Other prior approved scroll chiller manufacturers will be considered. Requests for prior approval shall be made before the end of the question and answer period.

B. All bidders shall include unit performance data and physical unit dimensions with their bid. Any performance degradation with respect to the chiller placement within the chiller yard and its containment walls shall be noted in the bid submittal.

PART 4 - EXECUTION

4.1 EXAMINATION

A. The Chillers must operate on the existing electrical feed.

3.2 INSTALLATION

A. Refer to Specification 23 6423.22 - Installation of Installation of Air-Cooled Water Chillers for installation by the Contractor.

B. The Vendor shall assist with BACnet to Schneider Controls integration in the field as required at no additional cost to the Owner.

4.2 STARTUP SERVICE

A. The installing Contractor (Installer) shall be responsible for the installation of the equipment and any associated piping and wiring in accordance with the manufacturer's recommendations. Contractor (Installer) shall be responsible for coordinating control and electrical control work. Installer shall notify the manufacturer's representative 10 days prior to start-up procedure and shall complete a chiller pre-start checklist and forward it to the manufacturer's representative 5 working days prior to requested start-up date. The Contractor (Installer) shall also be responsible for placing the pumps and system in proper operation so that a load is available for the start-up of the machines.

B. Factory Start-up

1. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.
2. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
    a. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
    b. Verify that pumps are installed and functional.
    c. Verify that thermometers and gages are installed.
    d. Operate water chiller for run-in period.
    e. Check bearing lubrication and oil levels.
    f. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.

g. Verify proper motor rotation.
h. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
i. Verify and record performance of water chiller protection devices.
j. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

3. Visually inspect chiller for damage before starting. Repair or replace damaged components, including insulation. Do not start chiller until damage that is detrimental to operation has been corrected.
4. Prepare a written startup report that records results of tests and inspections.

4.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers.

1. Instructor shall be factory trained and certified.
2. Provide not less than eight hours of training.
3. Train personnel in operation and maintenance and to obtain maximum efficiency in plant operation.
4. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
5. Obtain Owner sign-off that training is complete.
6. Owner training shall be held at Project site.

END OF SECTION

SECTION 23 6423.22 – INSTALLATION OF AIR-COOLED WATER CHILLERS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division – 1 specification sections, apply to work of this section.

B. Division 23 Basic Mechanical Materials and Methods section apply to work of this section.

C. This information pertains to equipment indicated as Owner-furnished ("prepurchased") equipment on the bid documents. The term "Installer" in these notes refers to the awarded General Contractor for the Chiller Replacement Project. All costs associated with the requirements assigned to the Installer herein are to be included in the Bid amount.

D. "Vendor" refers to the firm who is awarded the prepurchased equipment contract. The names of the Vendors and product information for prepurchased equipment will be communicated to the installation bidders prior to receipt of bids.

E. Should any information provided herein conflict with other information in the Chiller Replacement Project plans and specifications, the requirements listed herein shall govern.

1.2 SCOPE:

A. The air-cooled water chiller equipment will be purchased directly by the Owner. The work under this section shall include furnishing of all labor and performing all operations necessary for the complete installation of the prepurchased chiller equipment and all related equipment as shown, detailed, and/or scheduled on the drawings, and/or specified in this section of the specifications. Certain other responsibilities, including delivery, pre start up checkout, Owner's training, manufacturer's warranty, etc. are to be performed by the Vendor under direct contract with the Owner. All work indicated to be performed by the Vendor, Manufacturer, or Manufacturer's Representative is not a part of the Installer's work.

B. Refer for Division 26 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on chiller contactor enclosure. Include disconnects and starters as a part of Division 23 where specified as furnished, or factory-installed, by manufacturer.
2. Control power circuit from power source to chiller control panel in chiller.

C. Provide the following electrical work as work of this section, complying with requirements of Division 26 sections:

1. Control wiring and conduit between field-installed controls, indicating devices, and pump control panels.

2. Control wiring and conduit specified as indicated in Section 23 0900 - HVAC Control Systems.
3. Interlock wiring specified as factory-installed is work of this section.

1.3 PRE-PURCHASED EQUIPMENT DELIVERY

A. Vendors are required to deliver the equipment to the job site within a specific delivery window. The Installer may, with a minimum of 4 weeks prior notice to the Vendor, shift the delivery window to start later and/or change the delivery location to the Installer's storage facility.

B. Delivery will occur between **June 1 and June 15, 2020**, for all equipment.

C. Vendors are required to deliver the equipment between the hours of 8:00 a.m. and 3:00 pm Monday through Friday, excluding holidays. The Vendor is required to contact the Installer a minimum of 48 hours prior to the start of the delivery window to confirm the delivery date and location. In addition, the Vendor is required to contact the Installer a minimum of 24 hours prior to delivery to coordinate the exact time within a 2-hour window.

D. The Vendor will make arrangements with the Installer for offloading. Offloading shall be performed by the Installer at the Installer's expense. Damages occurring during offloading shall be the responsibility of the Installer, unless the damage occurs as a result of insufficient or defective packing by the Vendor, or inadequate instructions or supervision by the Vendor.

E. The Vendor's contract includes the requirement to oversee offloading of chillers to ensure that the manufacturer's requirements are followed. The Installer shall coordinate with the Vendor to ensure that the manufacturer’s requirements are followed.

1.4 PREPURCHASED EQUIPMENT START-UP SUPPORT

A. The Vendor is required to provide a complete checkout of the finished installation and to perform pre-startup inspections by a manufacturer's representative. Installer shall notify the manufacturer’s representative 10 days prior to start-up procedure. The installer shall complete a chiller pre-start checklist and forward it to the manufacturer’s representative 5 working days prior to requested start-up date.

B. The initial startup of the chillers shall be performed by the Installer under the supervision of the manufacturer's representative (Vendor).

1.5 PREPURCHASED EQUIPMENT OWNER TRAINING AND CLOSE OUT REQUIREMENTS

A. The Vendor is required to provide Owner Training in the operation and maintenance of the equipment, and is required to obtain a sign-in sheet for the session, to be submitted with the Vendor’s Close Out Documents. The Installer shall be responsible for coordinating, scheduling and overseeing the Owner Training immediately upon receiving a written request from the Vendor.

B. The Vendor is required to respond to the Installer's e-mailed or written request for Owner Training and to provide training no later than 2 weeks after substantial completion.

C. The Vendor is required to submit close out documents directly to the Owner for the Owner-furnished equipment not more than two weeks after substantial completion of the project or phase.

1.6. PREPURCHASED EQUIPMENT WARRANTY RESPONSIBILITIES

A. The Vendor is required to provide a minimum one-year warranty on all prepurchased equipment, commencing on the date of substantial completion of the project or phase in which the equipment was accepted. This parts, labor, and refrigerant warranty covers all costs associated with the repair or replacement of defective parts, as well as the removal and replacement of incidental materials, provided the defect was deemed to be a manufacturer's defect.

B. During the initial one-year warranty period, the Owner shall contact the Installer for diagnosis of potential warranty issues. Issues deemed to be the responsibility of the Vendor shall be referred to the Vendor, in writing, by the Installer, with a copy to the Owner. Upon completion of the repair, the Installer is required to confirm that the repairs are acceptable and to notify the Owner. The Installer shall not be entitled to additional compensation for the coordination of warranty repairs during the one-year warranty period.

C. The Vendor is required to respond to warranty claims within 4 hours of notification by the Installer and to repair or replace the covered equipment within 72 hours of confirmed notification, or provide temporary replacement equipment when required to maintain acceptable conditions in an occupied facility.

PART 2 - PRODUCTS

2.1 GENERAL:

A. The Installer shall install as shown on the plans factory assembled, factory charged, and factory run tested air-cooled chillers in the quantity specified. Refer to Specification Section 23 6423.21 - Air-Cooled Water Chillers (which is included for information purposes only) for a description of the chillers. A copy of the submittal for the actual prepurchased chiller will be issued in an addendum.

2.2 START-UP SERVICE:

A. The installing Contractor (Installer) shall be responsible for the installation of the equipment and any associated piping and wiring in accordance with the manufacturer's recommendations. Contractor (Installer) shall be responsible for coordinating control and electrical control work. Installer shall notify the manufacturer 10 days prior to start-up procedure. The Contractor (Installer) shall also be responsible for placing the pumps and system in proper operation so that a load is available for the start-up of the machines.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, controls, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.

1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping, controls, and electrical connections.
2. Must operate on the existing electrical feed.

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

3.2 EQUIPMENT

A. Each piece of equipment shall be installed in accordance with the approved recommendations of the manufacturer to conform to the contract documents. The installation shall be accomplished by personnel skilled in this type of work.

B. Each piece of equipment shall be installed to be free of noise and vibration. Provide vibration isolators as per manufacturer's recommendations and/or as herein specified.

C. The prepurchased chiller equipment will be delivered to the site as part of the direct purchase agreement in manufacturer's original packaging. Clearly mark each item with the proper identification number. Store the equipment in accordance with the requirements of Section 23 0000.

3.3 CHILLER INSTALLATION

A. Coordinate sizes and locations of bases with actual equipment provided.

B. Equipment Mounting:

1. The chillers will be placed on the existing chiller pads.

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Maintain clearances required by governing code.

E. Chiller shall be factory charged with refrigerant and oil.

3.4 PIPING CONNECTIONS

F. Comply with requirements in Section 23 2113 "Hydronic Piping" and Section 23 2116 "Hydronic Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

G. Where installing piping adjacent to chillers, allow space for service and maintenance.

H. Evaporator Fluid Connections:

1. Connect directly to evaporator inlet, a field provided 0.063" perforation Wye strainer. Provide with shutoff valve, flexible connector, thermometer, and plugged tee with pressure gage.
2. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve.
3. Make connections to water chiller with a flange or mechanical coupling.

I. Connect each drain connection with a drain valve, full size of drain connection.

J. Connect each chiller vent connection with a manual vent, full size of vent connection.

3.5 ELECTRICAL POWER CONNECTIONS

K. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

L. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

M. Provide nameplate for each electrical connection indicating electrical equipment designation and circuit number feeding connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch high. Locate nameplate where easily visible.

3.6 CONTROLS CONNECTIONS

N. Install control and electrical power wiring to field-mounted control devices.

O. Connect control wiring between chillers and other equipment to interlock operation as required to provide a complete and functioning system.

P. Connect control wiring between chiller control interface and DDC system for remote monitoring and control of chillers. Comply with requirements in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC." Controls shall utilize chiller pump start/stop output signal when available to operate pumps.

Q. Provide nameplate on face of chiller control panel indicating control equipment designation serving chiller and the I/O point designation for each control connection. Nameplate shall be laminated phenolic layers of black with engraved white letters at least 1/2 inch high.

3.7 STARTUP SERVICE

A. Refer to Specification 23 6423.21 – "Air-Cooled Water Chillers" for start-up service by the equipment vendor.

3.8 DEMONSTRATION

A. Refer to Specification 23 6423.21 – "Air-Cooled Water Chillers" for equipment demonstration by the equipment vendor.

3.9 WARRANTY

A. Each chiller shall be provided with a one-year warranty for installing labor including system and equipment trouble-shooting and diagnostics by the contractor (Installer). The installing contractor shall contact the vendor(s) as needed for in-warranty work.

END OF SECTION

SECTION 26 0500 - BASIC METHODS AND REQUIREMENTS (ELECTRICAL)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. Furnish and install all electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, cable, panelboards, etc., and arrangement for specified items in general are shown on drawings.

C. All ampacities herein specified or indicated on the drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are not permitted.

1.2 MINIMUM REQUIREMENTS

A. References to the National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), the Florida Building Code, and National Fire Protection Association (NFPA) are a minimum installation requirement standard. Design drawings and other specification sections shall govern in those instances where requirements are greater than those specified in NEC.

B. The rules and regulations of the Federal, State, local, civil authorities and utility companies in force at the time of execution of the contract shall become a part of this specification. In addition, the following codes and standards shall apply:

1. National Electrical Code - 2014
2. 6th Edition of the Florida Fire Prevention Code (2017), including NFPA-101 – Florida Specific Edition
3. Florida Building Code – (FBC) 6th Edition (2017)
4. Monroe County Public Schools – Design Guidelines and Standards, Current Issue.

C. No work shall be done unless the Superintendent of the Contractor is on the job site. Work shall be properly protected, all rubbish removed promptly, and exposed work shall be carefully cleaned prior to final acceptance.

D. The term "provide" shall include labor, materials, and equipment necessary to furnish and install, complete and operable, the item or system indicated.

E. In decisions arising from discrepancies, interpretation of Drawings and Specifications, substitutes, and other pertinent matters, the decision of the Owner's representative's approval shall be final.

1.3 SPECIFICATIONS AND DRAWINGS

A. Plans show location of fixtures and equipment and are intended to depict the general intent of the work in scope, layout and quality of workmanship. They are not intended to show in minute detail every or all accessories intended for the purpose of executing the work, but it is understood that such details are a part of this work.

B. Where Drawings and Specifications conflict, it shall be the responsibility of this Contractor to bring such conflict to the attention of the Architect/Engineer for clarification. In general, the Architectural Drawings shall take precedence over the Mechanical Drawings with reference to building construction. All changes from the Drawings necessary to make the work conform with the building as constructed and to fit the work of other trades or to conform to the rules of authorities having jurisdiction, shall be made by the Contractor at his own expense.

C. Keep a record of the locations of concealed work and of any field changes in Contract Drawings and Specifications for each trade and, upon completion of the job, supply "As-Built" Drawings and Specifications showing in pencil on sepia reproducibles, any deviations from the original Drawings, indicating in the Specifications each manufacturer's name underlined or inserted whose product was used on the job. These Drawings shall indicate dimensions of buried utility lines from building walls. One set of sepia reproducibles of the original tracings will be furnished upon request for this purpose.

1.4 STANDARDS

A. All material and equipment shall be listed, labeled or certified by Underwriters Laboratories, Inc., where such standards have been established. Equipment and material which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Listed: Equipment is "listed" if of a kind mentioned in a list which:
   a. Is published by a nationally recognized laboratory which makes periodic inspection of production of such equipment.
   b. States that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.

2. Labeled: Equipment is labeled if:
   a. It embodies a valid label, symbol, or other identifying mark of a nationally recognized testing laboratory such as Underwriters Laboratories, Inc.
   b. The laboratory makes periodic inspections of the production of such equipment.
   c. The labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.

3. Certified: Equipment is "certified" if:

a. Equipment has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
b. Production is periodically inspected by a nationally recognized testing laboratory.
c. It bears a label, tag, or other record of certification.

4. Nationally recognized Testing Laboratory: A testing laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.
5. Contractor: Any reference to Contractor shall mean the Construction Manager.

1.5 QUALIFICATIONS (PRODUCTS AND SERVICES)

A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least five years, unless otherwise noted elsewhere in the specifications or on the drawings.

B. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation on three installations of similar size and type, as this project, for approximately three years.
2. The Owner reserves the right to require the contractor to submit a list of installations where the products have been in operation before approval of said products.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.6 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts should be available. Items not meeting this requirement, but which otherwise meet technical specifications, and merits of which can be established through reliable test reports or physical examination of representative samples, will be considered.

B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. All components of an assembled unit need not be products of the same manufacturer, however, the assembled unit shall be the responsibility of a single manufacturer and warranted as such.
2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.

D. All factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

1.7 EQUIPMENT REQUIREMENTS

A. Equipment voltage ratings shall be in accordance with the requirements indicated on the drawings or as specified.

B. Prior to bid, written approval shall be obtained by the Contractor for any equipment that differs from those specified on the drawings and specifications. The Contractor shall be prepared to submit samples of the equipment when requested at no cost to the Architect/Engineer.

1. The Contractor shall furnish drawings showing all installation details, shop drawings, technical data and other pertinent information as required to determine that the equipment is equivalent in quality and function to the equipment specified.
2. Approval by the Architect/Engineer of the equal equipment does not relieve the Contractor of the responsibility of furnishing and installing the equipment at no additional cost to the Owner.
3. Any other items required for the satisfactory installation of the equal equipment shall be furnished and installed at no additional cost to the Owner. This includes but shall not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and correlation with other work, subject to the jurisdiction and approval of the Architect/Engineer.

C. Catalogue numbers, where given, are intended to give a basis for design, quality and function. Any other incidental equipment needed for a complete and functional installation shall be provided at no additional cost.

D. EQUIPMENT PROTECTION: Equipment and material shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain.

E. During installation, equipment, controls, controllers, circuit protective devices, etc., shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing, operating and painting.

F. Damaged equipment shall be, as determined by the Architect/Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.

G. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.

H. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.8 WORK PERFORMANCE

A. Arrange, phase and perform work to assure electrical service for other buildings at all times.

B. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions.

C. Coordinate location of equipment and conduit with other trades to minimize interferences.

D. Obtain and pay for all required installation inspections and deliver certificates approving installations to the Owner unless directed otherwise.

1.9 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Equipment location shall be as close as practical to locations shown on the drawings. Where architectural features govern location of work, refer to architectural drawings.

B. Working spaces shall not be less than specified in the National Electrical Code for all voltages specified.

C. Inaccessible Equipment:

1. Where the Owner/Architect/Engineer determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled as directed at no additional cost to the Owner.
2. "Conveniently accessibility" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping, and duct work.

D. Equipment and Material:

1. New equipment and material shall be installed, unless otherwise specified.
2. Equipment and material shall be designed to assure satisfactory operation and operating life for environmental conditions where being installed. NEC and other code requirements shall apply to the installation in areas requiring special protection such as explosion-proof, watertight and weatherproof construction.

E. Utility Services:

1. Contact KEYS Energy and determine utility connection requirements and include in the base bid all costs to the Owner for utility service, including primary raceways, concrete encasement, concrete pads, and final connections.
2. Include all costs for temporary service, temporary routing of service or any other requirements of a temporary nature associated with the utility service.

F. Continuity of Service:

1. No electrical service and no telecommunications service (voice/data, paging, fire alarm, security, TV) shall be interrupted or changed without prior permission from the Architect and the Owner. A minimum of a two week notice shall be provided and written permission shall be obtained before any work is started.
2. When interruption of services is required, all persons concerned shall be notified and a prearranged time agreed upon.

G. Concrete Work:

1. Provide all cast-in-place concrete shown on the documents unless noted otherwise. Concrete work shall conform to all applicable Division 02 and 03 specification sections.
2. Provide all anchor bolts, metal shapes and templates required to be cast in concrete or used to form concrete for support of electrical equipment.

1.10 EQUIPMENT IDENTIFICATION

A. In addition to the requirements of the National Electrical Code, install an identification nameplate which will clearly indicate information required for use and maintenance of items such as switchboard, panelboards, cabinets, safety switches, separately enclosed circuit breakers, motor starters, communications systems cabinets, control devices and other significant equipment. Refer to details on drawings for nameplates and section 26 05 53.

B. Nameplates shall be laminated white phenolic resin with a black core with engraved lettering, a minimum of 3/16-inch high. Nameplates that are furnished by manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions. Hand written marker is not acceptable. Nameplates shall be permanently attached with rivets or tamperproof screws.

1.11 SUBMITTALS

A. The Architect/Engineer's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site. Submittals shall be made for all equipment and systems as indicated in the respective specification section.

B. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Architect/Engineer to ascertain that the proposed equipment and materials comply with specification and drawing requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.

C. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval. Submittals shall be submitted for all applicable products and materials specified in each individual section of these specifications.

D. Make submittals for the equipment and materials in accordance with the following:

1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
3. The submittals shall include the following:
    a. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required. Provide any additional information specifically requested in the individual specification section or on the drawings.

b. Elementary and interconnection wiring diagrams for fire alarm, sound system, TV system and other communication systems and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
c. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

E. Operation and Maintenance Manuals:

1. Maintenance manuals shall be complete and shall be furnished in a loose leaf binder or in the manufacturer's standard binder. Information shall be sufficient to enable a qualified technician to perform normal first line maintenance and repair. A parts list shall be included which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
2. Operation manuals shall be clear and concise and shall describe, in detail, the information required to properly operate the equipment specified. The manuals shall include complete catalog cuts and as-built wiring diagrams.
3. Operation and maintenance manuals shall be submitted for approval prior to final inspection.
4. Refer to Monroe County Schools standards for detailed requirements for the operation and maintenance manuals.

F. In addition to the requirement of SUBMITTALS, the Owner reserves the right to request the manufacturer to arrange for the Owner's representative(s) to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.

1.12 CUTTING, PATCHING, EXCAVATION, BACKFILL, AND LAYOUT

A. Provide openings and excavation required for the installation of the electrical work. Patch work and backfill as required. Finished work shall match the existing adjoining work.

B. Verify all conditions affecting the work to be performed under this contract.

C. Carefully verify measurements at the site, determine the exact location of chases and openings required. Provide sleeves, inserts, and hangers as required. No columns, beams, joists, building foundations nor any other structural building component shall be cut, drilled or disturbed in any way. Conflicts shall immediately be brought to the attention of the Architect/Engineer.

D. All excavation on sites containing existing buildings and existing services, shall be done with hand shovel to avoid damage to existing services. Where hand shovel is not practical extreme caution shall be taken when performing excavation. The contractor will be resposible for locating any existing utilities. Any damage incurred by the Contractor shall be repaired by the Contractor in a manner approved by the Architect/Engineer at no cost to the Owner and with no extension of time limitation.

1.13 EXPERIENCE

A. The Contractor performing this work shall be a licensed, reputable firm, regularly performing the type of work incorporated in this project and who also maintains, as part of the firm, a service department with qualified personnel who regularly perform this type of work. The Contractor shall, upon request, show evidence of at least three jobs of similar character and size installed within the preceding two years.

1.14 ELECTRICAL WORK FOR MECHANICAL SYSTEMS

A. Factory installed starters, controllers, and control equipment mounted in manufactured mechanical equipment necessary for mechanical equipment operation shall be furnished under Division 23 Mechanical.

B. Power wiring for motors and installation of starters shall be under Division 26 Electrical.

C. Temperature, humidity, pressure and similar controls essential to the operation of mechanical systems shall be under Division 23 of Specifications, installed in accordance with requirements of Division 26. Refer to specification section HVAC Controls – 23 0900, for controls raceways, boxes and wiring to be provided by Division 26.

D. Motors shall be furnished under Division 23 Mechanical of capacity required to operate equipment specified, but shall not be less than that specified.

E. All low voltage (120V and under) temperature control wiring for Division 23 equipment shall be provided by Division 26, installed in accordance with requirements of Division 26. Refer to specification section HVAC Controls – 23 0900 and HVAC controls specified on the drawings, for controls raceways, boxes and wiring to be provided by Division 26.

F. All HVAC controls conduit shall be furnished and installed by Division 26 in accordance with Division 26 requirements.

G. Phase Failure Relays: All 3 phase motors (air handlers, condensing units, exhaust fans, etc.) shall be provided with a phase failure relay with adjustable voltage range (+/- zero – 25%), adjustable time delay (0 – 5 minutes), and automatic reset. See Specification 26 2913, Division 23 mechanical schedules and Division 23 specifications for more requirements.

1.15 MOTORS

A. All motors shall be furnished and installed under Division 23 Mechanical and shall be wired under Division 26 Electrical.

1.16 REMOVAL OF RUBBISH

A. Contractor shall keep premises free from accumulations of waste material or rubbish caused by his employees or work. At completion of work, he shall remove all his tools, scaffolding, surplus materials, and rubbish from building and site. He shall leave premises and his work in a clean orderly condition acceptable to the Architect/Engineer.

1.17 QUIET OPERATION AND VIBRATION

A. All equipment provided under this section shall operate under all conditions of load free of objectionable sound and vibration. Sound and vibration conditions considered objectionable shall be corrected in an approved manner.

B. Vibration and sound control shall be by means of approved vibration eliminators or sound attenuators in a manner as specified and as recommended by the manufacturer.

1.18 CLEANING AND ADJUSTMENTS

A. Upon completion of the work, Contractor shall clean and re-lamp all light fixtures, clean and identify all equipment, adjust and test all equipment and apparatus which he has installed and make certain such apparatus and mechanisms are in proper working order and ready to test.

B. During construction protect all conduit and equipment from damage and dirt. Cap the open ends of all conduit and equipment.

1.19 STORAGE OF MATERIALS

A. All materials stored on site shall be properly protected from injury or deterioration. Materials shall not be stored in contact with ground or floor.

B. Do not remove manufacturer's packing materials until ready to install. Materials showing signs of corrosion, improper handling or storage shall be replaced at no cost to the Owner.

C. Provide continuous protection for all equipment already installed.

1.20 WATERPROOFING

A. Where any work pierces waterproofing including waterproof concrete, the method of installation shall be as approved by the Owner before the work is done.

B. Provide all necessary sleeves, caulking and flashing required to make openings absolutely watertight. Waterproof flashing materials shall be compatible with base materials.

1.21 TESTS

A. Contractor shall make all tests required to establish the adequacy, quality, safety, completed status and satisfactory operation of all systems to the satisfaction of the Architect/Engineer. Provide all instruments, labor and services necessary to conduct tests.

B. All conductors for the main campus electrical services, all building feeders, plus all conductors 150 amp rated and up, shall be megger tested to test insulation and connection integrity prior to permanent energization.

1. Cables 600 Volts or Less: Cables 600 volts or less in size #1/0 and larger shall be meggered using an industry standard “megger” with 1000V internal generating voltage.

Readings shall be recorded and submitted to the Engineer for acceptance prior to energizing same. Values are less than 200 Mohms shall be automatic failure. Submit 5 copies of tabulated megger test values for all cables identified by the feeder name (Panel or equipment tag). Tester shall be a Megger MIT200 Series tester, or equivalent with auto discharge ensures all circuits are safely discharged after testing. 1000 V insulation test range shall have a high voltage warning prior to test voltage being applied.

1.22 INSTRUCTIONS

A. Fully instruct Owner's personnel in the care and operation of electrical systems, including all communications, sound and fire alarm systems and furnish a letter to the Architect/Engineer advising the particular person(s) who have received such instruction.

1.23 GUARANTEE

A. Equipment shall be started, tested, adjusted, and placed in satisfactory operating condition. Furnish a letter addressed to the Architect/Engineer advising that the completed systems have been installed in accordance with the Plans and Specifications and that they are in proper operating condition. The Owner shall receive a written guarantee covering all defects in workmanship and material for a period of one year from date of final acceptance. Any defects appearing within this year period shall be repaired without additional cost to the Owner.

1.24 ACCEPTANCE

A. Before requesting final inspection:

1. Complete all work required. If any items are held in abeyance as incomplete for final inspection, list such items together with explanation for delay.
2. Submit statement that equipment is properly installed, adjusted, tested and operation is satisfactory.
3. Certify in writing to the Architect/Engineer that the Owner's representative has been instructed as to the care and operation of the system and that catalog service and maintenance information has been turned over to the Architect/Engineer.
4. Submit copy of written guarantees for all equipment.
5. Submit copy of other data as may be outlined in these specifications, including all test data and certifications.
6. See all other project specification sections for close-out and final inspection requirements.

B. Copies of the above data shall be submitted to the Architect/Engineer prior to requesting final inspection.

1.25 SINGULAR NUMBER

A. Where any device or part of equipment is referred to in these specifications in the singular number (such as "the switch"), such reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.26 PHASING AND SEQUENCE OF THE WORK

A. The contractor shall review all of the contract documents, review all phasing requirements, and visit the site to gain first hand knowledge of the existing conditions and include any work necessary to accomplish the required phasing and sequencing of the work and phasing of the systems.

1.27 DEMOLITION

A. The existing chiller and associated pumps will be demolished in this project. Remove any and all obsolete or demolished raceways, boxes, circuits, equipment, buildings, including all site electrical, etc. All demolition shall be carefully coordinated with the new work.

END OF SECTION

SECTION 26 0519 - WIRES AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Electrical Materials and Methods section, and is part of each Division-23 and -26 section making reference to electrical wires and cables specified herein.

1.2 DESCRIPTION OF WORK

A. Extent of electrical wire and cable work is indicated by drawings and schedules.

B. Types of electrical wire, cable, and connectors specified in this section include the following:

1. Copper conductors.
2. Fixture wires.
3. Flexible cords and cables.
4. Wirenut connectors.

C. Applications of electrical wire, cable, and connectors required for project are as follows:

1. For motor-branch circuits.
2. For power distribution circuits
3. For lighting circuits
4. For appliance and equipment circuits

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical wire and cable products of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project.

C. NEC Compliance: Comply with NEC requirements as applicable to construction, installation and color coding of electrical wires and cables.

D. UL Compliance: Comply with applicable requirements of UL Std 83, "Thermoplastic-Insulated Wires and Cables", and Std 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors".

E. UL Compliance: Provide wiring/cabling and connector products which are UL-listed and labeled.

F NEMA/ICEA Compliance: Comply with NEMA/ICEA Std Pub/ No.'s WC 5, "Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy", and WC-30, "Color Coding of Wires and Cables", pertaining to electrical power type wires and cables.

G. IEEE Compliance: Comply with applicable requirements of IEEE Stds 82, "Test Procedures for Impulse Voltage Tests on Insulated Conductors", and Std 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to wiring systems.

H. ASTM Compliance: Comply with applicable requirements of ASTM B1, 2, 3, 8, and D-753. Provide copper conductors with conductivity of not less than 98% at 20oC (68oF).

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. Wire and Cable:
   a. American Wire and Cable Co.
   b. Anaconda-Ericsson Inc; Wire and Cable Div.
   c. Belden Div; Cooper Industries

2. Connectors:
   a. AMP, Inc.
   b. Appleton Electric Co.
   c. Burndy Corporation
   d. Thomas and Betts Corp.

2.2 WIRES, CABLES, AND CONNECTORS

A. General: Provide electrical wires, cables, and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for application indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 20oC (68oF).

B. Building Wires: Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards. Select from the following UL types, those wires with construction features which fulfill project requirements:

1. Type THWN, THHW, XHHW, THHN/THWN: Unless otherwise indicated, all conductors for wet or dry locations requiring a conductor temperature rating of 75oC (167oF) or less. Insulation shall be flame retardant, moisture and heat resistant thermoplastic. Conductor shall be annealed copper.

2. Type THHN, THHW, XHHW: Unless otherwise indicated, all conductors for dry locations requiring a conductor temperature rating of 90oC (194oF) or less. Insulation shall be flame retardant, moisture and heat resistant thermoplastic. Conductor shall be annealed copper.
3. Type XHHW-2: Unless otherwise indicated, all conductors for wet locations requiring a conductor temperature rating of 90oC (194oF) or less. Insulation shall be flame retardant, moisture and heat resistant thermoplastic. Conductor shall be annealed copper.
4. Conductors for use at 600 volts or below shall be 600 volt rated. Conductors shall be stranded copper only. Stranded conductors shall terminate in crimp type lugs.
5. Motor circuit branch wiring and associated control wiring: Provide type THHN insulation in dry and damp locations. Provide type THHW insulation in wet locations. All motor wiring to be stranded copper.
6. Wiring for HVAC controls shall be provided in accordance with the control system manufacturer/supplier requirements. Refer to HVAC controls drawings and specifications.

C. Cables: Provide UL-type factory-fabricated cables of sizes, ampacity ratings, and materials and jacketing/sheathing as indicated for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements, NEC and NEMA standards.

D. Connectors:

1. General: Provide UL-type factory-fabricated, metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards. Select from the following, those types, classes, kinds, and styles of connectors to fulfill project requirements:
   a. Type: Pressure.
   b. Class: Insulated.
   c. Kind: Copper (for Cu to Cu connection).
   d. Style: Butt connection.
   e. Style: Elbow connection.
   f. Style: Combined "T" and straight connection.
   g. Style: "T" connection.
   h. Style: Split-bolt parallel connection.
   i. Style: Tap connection.
   j. Style: Pigtail connection.
   k. Style: Wirenut connection.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRES AND CABLES

A. General: Install electrical cables, wires, and wiring connectors as indicated, in compliance with applicable requirements of NEC, NEMA, Ul, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Coordinate wire/cable installation work including electrical raceway and equipment installation work, as necessary to properly interface installation of wires/cables with other work.

C. Pull conductors simultaneously where more than one conductor is being installed in the same raceway.

D. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation.

E. Use pulling means including, fish tape, cable, rope and basket weave or wire/cable grips which will not damage cables or raceway. Any cable damaged during installation shall be completely replaced.

F. Keep conductor splices to minimum. No joints shall be made in conductor except at outlet boxes or splice boxes. Newly installed conductors shall not be spliced unless specifically noted on the drawings. Splices shall not be permitted underground. Splices shall not be permitted in low voltage systems, such as fire alarm, intercom, etc.

G. Install splices and tapes which possess equivalent-or-better mechanical strength and insulation ratings than conductors being spliced. Below grade splices shall be prohibited unless impossible to avoid. Any allowable below grade splice shall be completely watertight and shall utilize a splice method UL listed for wet locations.

H. Use splice and tap connectors which are compatible with conductor material.

I. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A and B.

J. At least eight inches (8") of slack wire shall be left in every outlet box whether it be in use, or left for future use.

K. Color code wiring as follows:

1. 240 volt or 120/208 volt, 3 phase, 4 wire: phase A-black, phase B-red, phase C-blue, neutral-white; ground conductor-green.
2. 277/480 volt, 3 phase, 4 wire: phase A-orange, phase B-brown, phase C-yellow, neutral-white; ground conductor-green.
3. All wire #6 and smaller shall be in the required color. Color coding with tape will not be accepted.
4. 600 volt, 3 phase, 4 wire: phase A-orange, phase B-brown, phase C-yellow, neutral-white; ground conductor-green.
5. Neutral – White.
6. Ground – Green.
7. Switch legs shall be the same color as the circuit supplying the power to the switch.

L. Wire and cable boxes and reels shall bear the date of manufacture and must not bear dates by more than one year preceeding contract date.

M. Minimum conductor sizes, except as specifically identified on the drawings to be larger, shall be as follows:

1. No. 12 - Branch circuits of any kind, except as specified otherwise below.

2. No. 14 - Signal systems, fire alarm system, unless specifically noted otherwise.
3. No. 10 - Exit light circuits, emergency circuits, security lighting, security systems circuits and exterior light circuits.

3.2 FIELD QUALITY CONTROL

A. Prior to energization, test wires and cables for electrical continuity and for short-circuits.

3.3 HVAC CONTROLS

A. Temperature, humidity, pressure and similar controls essential to the operation of mechanical systems shall be under Division 23 of Specifications, installed in accordance with requirements of Division 26. Refer to specification section HVAC Controls – 23 0900, for controls raceways, boxes and wiring to be provided by Division 26.

B. All low voltage (120V and under) temperature control wiring for Division 23 equipment shall be provided under by Division 26, installed in accordance with requirements of Division 26. Refer to specification section HVAC Controls – 23 0900, for controls raceways, boxes and wiring to be provided by Division 26.

C. All HVAC controls conduit shall be furnished and installed by Division 26 in accordance with Division 26 requirements.

END OF SECTION

SECTION 26 0526 - GROUNDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Electrical Materials and Methods section apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of grounding work is indicated by drawings and schedules.

B. Types of grounding specified in this section include the following:

1. Solid grounding

C. Applications of grounding work in this section including the following:

1. Underground metal water piping
2. Metal building frames
3. Grounding electrodes
4. Grounding rods
5. Service equipment
6. Enclosures
7. Equipment
8. Walkway canopies.
9. Metal Fencing
10. Playcourt structure

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors, terminals and fittings, of types and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, ground rods and plate electrodes, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer: Qualified with at least 3 years of successful installation experience on projects with electrical grounding work similar to that required for project.

C. NEC Compliance: Comply with NEC requirements as applicable to materials and installation of electrical grounding systems, associated equipment and wiring. Provide grounding products which are UL-listed and labeled.

D. UL Compliance: Comply with applicable requirements of UL Standards Nos. 467 and 869 pertaining to electrical grounding and bonding.

E. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical grounding.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's data on grounding systems and any accessories.

B. Shop Drawings: Submit layout drawings of grounding systems and accessories including, but not limited to, ground wiring, copper braid and bus, ground rods, and plate electrodes.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering grounding products which may be incorporated in the work include, but not limited to, the following:

1. Burndy Corp.
2. Crouse-Hinds Co.
3. Thomas and Betts Corp.
4. Erico

2.2 GROUNDING SYSTEMS

A. Materials and Components:

1. General: Except as otherwise indicated, provide electrical grounding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, terminals (solderless lugs), grounding rods/electrodes and plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for complete installation. Where more than one type unit meets indicated requirements, selection is Installer's option. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE, and established industry standards for applications indicated.

B. Conductors: Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC.

C. Ground Rods: Copper clad, minimum 3/4" dia. x 10'. Provide longer rods if necessary for required resistivity.

1. All ground rods and grounding conductor connections shall be accessible for inspection. Provide inspections wells (Eritech or equal) for each ground rod where located outside. Interior ground rods shall be located where the connection is visible yet not obstructing

access or pathway. Ground rod connections shall be exothermic weld type only. Provide exothermic weld type at all other locations indicated on the drawings.

D. Electrical Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type services indicated.

E. Ground Bars:

A copper ground bar, CADweld, Eritech or equal, shall be provided in each electrical room and each data communications room (MDF & IDF's). Also see Specification 16650. The ground bar shall be bonded to the building grounding system via the building steel or other engineer approved ground. Bound ground bar with grounding electrode conductor size indicated on the power riser diagram, and grounding details.

All electrical rooms shall be provided with a wall mounted copper ground bar to bond all grounding conductors.

1. Ground bar for Main Electrical Rooms shall be a minimum 20" long x 4" wide x 0.25" thick. Erico Part No. EGBA14420CCSKY or approved equal.
2. Ground bar for any sub-electrical rooms shall be a minimum 12" long x 4" wide x 0.25" thick. Erico Part No. EGBA14412AA or approved equal.

PART 3 - EXECUTION

3.1 INSPECTION

A. Installer must examine areas and conditions under which electrical grounding connections are to be made and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF ELECTRICAL GROUNDING

A. General: Install electrical grounding systems where shown, 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. Coordinate with other electrical work as necessary to interface installation of electrical grounding system work with other work.

C. Install clamp-on connectors only on thoroughly cleaned metal contact surfaces, to ensure electrical conductivity and circuit integrity. Ground rod connections shall be exothermic weld type only. Provide exothermic weld type at all other locations indicated on the drawings.

D. All ground connections to water service entrance shall be installed to be exposed and visible for inspection at all times. Insulation shall not be installed over ground connections. Ground rod

connections shall be exothermic weld type only. Provide exothermic weld type at all other locations indicated on the drawings.

E. A water pipe, by itself, is not an adequate grounding electrode and must be supplemented by dual grounding electrodes, a minimum of 10 feet apart, and effectively bonded together. The supplemental ground shall be per Code with the "Footing type electrode" taking precedence when possible.

F. All ground connections shall be made on surfaces which have been cleaned of all paint, dirt, oil, etc., so that connections are bare metal to bare metal contact. All ground connections shall be tight and shall be made with U.L. listed grounding devices, fittings, bushings, etc.

G. Duplex receptacles of any amperage shall be grounding type and shall have a separate grounding contact. A separate jumper shall be installed between the grounding terminal on the device and the metallic box. The Contractor may provide U.L. listed self-grounding receptacles in lieu of providing the separate jumper.

H. Single and duplex receptacles shall have all grounded metal mechanically bonded together. Pressure bonding only is not acceptable.

I. All receptacles shall be installed with the ground contacts up.

J. In all cases where flexible metallic conduit, nonmetallic rigid conduit or liquid tight flexible conduit is used, a green wire ground conductor shall be used to provide ground continuity between the equipment of device and the conduit raceway system.

K. Provide a separate green wire ground conductor for each branch circuit originating from each panelboard. This ground shall be used to ground the device or load fed, and shall be bonded to components of the raceway system, such as junction boxes, starter or disconnect switch enclosures, equipment cases, etc. The green wire ground conductor shall terminate in the panelboard at the green wire ground bus. Ground conductors for branch circuits shall be of size indicated in NEC, except minimum size ground conductor shall be No. 12 AWG.

L. Each branch feeder originating at the switchboard(s) shall have a green wire ground conductor originating at the ground bus in the switchboard and terminating at the green wire ground bus in the panelboard. This green wire ground conductor shall be of size indicated in NEC except in no instance smaller than No. 8 AWG.

M. The green wire ground conductor is in addition to the neutral conductor and in no case shall the neutral conductor serve as the grounding means.

N. Multiple conductors in a single lug not permitted. Each grounding conductor shall terminate in its own terminal lug.

O. All systems, such as fire alarm, intercom, sound, scoreboard, etc. shall be grounded properly.

P. Metal walkway canopies shall be grounded with a minimum #4 awg copper insulated ground wire in conduit to a ground rod. Bond to the walkway a minimum of every 100 feet.

Q. The playcourt structure shall be grounded with a minimum #4 awg copper insulated ground wire in conduit to a ground rod. Bond to playcourt cover steel at every corner.

R. Each building grounding electrode system shall be tested for resistance to ground. The grounding system resistance shall be 5 ohms or less. Provide written certification of test results. Provide supplemental grounding rods, ground ring or other supplemental grounding to achieve the required results.

1. Grounding Tests: The resistance of electrodes (main service, building feeders, transformers, etc.) shall not exceed 5 ohms and shall be measured by the Contractor before equipment is placed in operation. Testing shall be performed on all grounding electrode installations. Testing shall be 2 point method in accordance with IEEE Standard 81. Submit all ground test readings to the Engineer in tabulated format, indicating each ground test location by main service, panel feeder tag, transformer tag, etc., at substantial completion.

END OF SECTION

SECTION 26 0529 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Electrical Materials and Methods section, and is a part of each Division-26 section making reference to electrical supporting devices specified herein.

1.2 DESCRIPTION OF WORK

A. Extent of supports, anchors, sleeves, and seals is indicated by drawings and schedules and/or specified in other Division-26 sections.

B. Types of supports, anchors, sleeves, and seals specified in this section include the following:

1. Clevis hangers
2. C-clamps
3. I-beam clamps
4. One-hole conduit straps
5. Round steel rods
6. Lead expansion anchors
7. Toggle bolts
8. Wall and floor seals

C. Supports, anchors, sleeves, and seals furnished as part of factory-fabricated equipment, are specified as part of that equipment assembly in other Division-26 sections.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of supporting devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of electrical supporting devices.

PART 2 - PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES

A. General: Provide supporting devices which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is Installer's option.

B. Supports: Provide supporting devices of types, sizes, and materials indicated; and having the following construction features:

1. Clevis Hangers: For supporting 2" rigid metal con duit; galvanized steel; with 1/2" dia. hole for round steel rod; approximately 54 pounds per 100 units.
2. Reducing Couplings: Steel rod reducing coupling, 1/2" x 5/8"; black steel; approximately 16 pounds per 100 units.
3. C-Clamps: Black malleable iron; 1/2" rod size; approximately 70 pounds per 100 units.
4. 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.
5. One-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; approximately 7 pounds per 100 units.
   a. All exterior conduit straps and hardware shall be stainless steel.
6. Hexagon Nuts: For 1/2" rod size; galvanized steel; approximately 4 pounds per 100 units.
7. Round Steel Rod: Black steel; 1/2" dia.; approximately 67 pounds per 100 feet.
8. Offset Conduit Clamps: For supporting 2" rigid metal conduit; black steel; approximately 200 pounds per 100 units.

C. Anchors: Provide anchors of types, sizes, and materials indicated, with 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.

D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering anchors which may be incorporated in the work include, but are not limited to, the following:

1. Abbeon Cal Inc.
2. Ackerman Johnson Fastening Systems, Inc.
3. Elcen Metal Products Co.
4. Ideal Industries, Inc.
5. Joslyn Mfg. and Supply Co.
6. McGraw Edison Co.
7. Rawlplug Co., Inc.
8. Star Expansion Co.
9. Expansion Bolt Co.

E. Sleeves and Seals: Provide sleeves and seals, of types, sizes, and materials indicated, with 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 buting passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.

F. U-Channel Strut Systems: Provide U-channel strut system for supporting electrical equipment, 12-gage hot-dip galvanized steel, of types and sizes indicated; construct with 9/16" dia. holes, 8" o.c. on top surface, with standard finish, and with the following fittings which mate and match U-channel.

1. Fixture hangers
2. Channel hangers
3. Thinwall conduit clamps
4. Rigid conduit clamps
5. Conduit hangers
6. U-bolts

G. Available Manufacturers: Subject to compliance with requirements, manufacturers offering channel systems which may be incorporated in the work include, but are not limited to, the following:

1. Greenfield Mfg. Co.; Inc.
2. Midland-Ross Corp.
3. OZ/Gedney Div.; General Signal Corp.
4. Power-Strut Div.; Van Huffel Tube Corp.
5. Unistrut Div.; GTE Products Corp.

H. Pipe Sleeves: 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 sleeves from the following gage metal: 3" and smaller, 20-gage; 4" to 6", 16-gage; over 6", 14-gage.
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.

I. Sleeve Seals: Provide sleeves for piping which penetrates foundation walls below grade, or exterior walls. Calk between sleeve and pipe with non-toxic, UL-classified calking material to ensure watertight seal.

PART 3 - EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES

A. Install hangers, anchors, sleeves, and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA and NEC for installation of supporting devices. Tie wires shall not be acceptable as a means of securing conduits or boxes in ceilings, drop ceilings, walls or chases.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work. Coordinate support locations with other structural and mechanical trades. Supports shall not be attached to mechanical or electrical piping, conduit, ductwork, ceiling grid system or any other non-structural member.

C. 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 spacings indicated and in compliance with NEC requirements.

END OF SECTION

SECTION 26 0530 - ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Electrical Materials and Methods section, and is part of each Division-23 and 26 section making reference to electrical connections for equipment specified herein.

1.2 DESCRIPTION OF WORK

A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

B. Applications of electrical power connections specified in this section include the following:

1. From electrical source to motor starters.
2. From motor starters to motors.
3. To lighting fixtures.
4. To grounds including earthing connections.
5. To equipment of communication, CCTV and alarm systems.

C. Electrical connections for equipment, not furnished as integral part of equipment, are specified in Division-23 and other Division-26 sections, and are work of this section.

D. Motor starters and controllers, not furnished as integral part of equipment, are specified in applicable Division-26 sections, and are work of this section.

E. Refer to Division-23 specification sections and drawings for motor starters and controllers furnished integrally with equipment; not work of this section. Connections to this equipment is work of this section.

F. Junction boxes and disconnect switches required for connecting motors and other electrical units of equipment are specified in applicable Division-26 sections, and are work of this section.

G. Raceways and wires/cables required for connecting motors and other electrical units of equipment are specified in applicable Division-26 sections, and are work of this section.

H. Refer to other Division-26 and Division-23 sections for low voltage control system wiring; not work of this section.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors and terminals, of types and ratings required, and ancillary connection materials, including electrical insulating tape, soldering fluxes, and cable ties, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 2 years of successful installation experience with projects utilizing electrical connections for equipment similar to that required for this project.

C. NEC Compliance: Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches.

D. IEEE Compliance: Comply with Std 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to connections and terminations.

E. ANSI Compliance: Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.

F. UL Compliance: Comply with UL Std 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors", including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are UL-listed and labeled.

G. ETL Compliance: Provide electrical connection products and materials which are ETL-listed and labeled.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. AMP Incorporated
2. Appleton Electric Co.
3. Arrow-Hart Div., Crouse-Hinds Co.
4. Burndy Corporation
5. General Electric Co.
6. Gould, Inc.
7. Harvey Hubbell Inc.
8. Square D Company
9. Thomas and Betts Corp.

2.2 MATERIALS AND COMPONENTS

A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties, solderless wirenuts, and other items and accessories as needed to complete splices and terminations of types indicated.

B. Metal Conduit, Tubing, and Fittings:

1. General: Provide metal conduit, tubing, and fit tings of types, grades, sizes, and weights (wall thicknesses) indicated for each type service. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements and comply with NEC requirements for raceways. Provide products complying with Division-26 basic electrical materials and methods section "Raceways", and in accordance with the following listing of metal conduit, tubing, and fittings:
   a. Rigid steel conduit.
   b. Rigid metal conduit fittings.
   c. Electrical metallic tubing.
   d. EMT fittings.
   e. Liquid-tight flexible metal conduit.
   f. Liquid-tight flexible metal conduit fittings.
   g. Flexible metal conduit.
   h. Flexible metal conduit fittings.

C. Wires, Cables, and Connectors:

1. General: Provide wires, cables, and connectors complying with Division-26 basic electrical materials and methods section "Wires and Cables".
2. Wires/Cables: Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes and ratings, of wires/cables which are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 20oC (68oF).
3. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC, and NECA's "Standard of Installation", to ensure that products fulfill requirements.

B. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

D. Provide the following electrical work as work of this section, complying with requirements of Division 23 sections:

1. Power supply wiring from power source to power connection on chiller, fans, air handling units, pumps, duct heaters, water heaters, boilers, air compressor, air dryer, and unit control panels. Include starters, disconnects, time clocks, receptacles and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer. Make all final electrical connections.

E. Maintain existing electrical service and feeders to occupied areas and operational facilities, unless otherwise indicated, or when authorized otherwise in writing by Owner, or Architect/Engineer. Provide temporary service during interruptions to existing facilities. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting-over" has been successfully accomplished, remove, relocate, or abandon existing wiring as indicated.

F. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced. No new conductors shall be spliced unless specifically noted on the drawings.

G. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

H. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing, and maintenance.

I. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's 486A.

J. Provide flexible conduit for motor connections, and other electrical equipment connections, where subject to movement and vibration.

K. Provide liquid-tight flexible conduit for connection of motors and other electrical equipment where subject to movement and vibration, and also where connections are subjected to one or more of the following conditions:

1. Exterior location.
2. Moist or humid atmosphere where condensate can be expected to accumulate.
3. Corrosive atmosphere.
4. Water spray.
5. Dripping oil, grease, or water, including kitchen areas.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION

SECTION 26 0533 - RACEWAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. This section is a Division-26 Basic Electrical Materials and Methods section, and is part of each Division-26 section making reference to electrical raceways specified herein.

1.2 DESCRIPTION OF WORK

A. Extent of raceway work is indicated by drawings and schedules. Types of raceways specified in this section include the following:

1. Electrical metallic tubing (EMT).
2. Liquid tight flexible metal conduit.
3. Rigid metal conduit.
4. Flexible metal conduit.
5. Rigid non-metallic conduit.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with electrical raceway work similar to that required for this project.

C. Codes and Standards:

1. NEMA Compliance: Comply with applicable requirements of NEMA Standards Publications pertaining to raceways.
2. UL Compliance and Labeling: Comply with applicable requirements of UL safety standards pertaining to electrical raceway systems. Provide raceway products and components which have been UL-listed and labeled.
3. NEC Compliance: Comply with applicable requirements of NEC pertaining to construction and installation of raceway systems.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of raceway system required. Include data substantiating that materials comply with requirements.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. General: Provide metal conduit, tubing, and fittings of types, grades, sizes, and weights (wall thicknesses) for each service indicated.

B. Rigid Steel Conduit: Provide rigid steel, zinc-coated, threaded type conforming to FS WW-C-581, ANSI C80.1 and UL 6.

C. Rigid Metal Conduit Fittings: Cast malleable iron, galvanized or cadmium plated, conforming to FS W-F-408, ANSI C80.4.

1. Use compression type fittings for raintight connections.
2. Use compression type fittings for other miscellaneous connections.

D. Electrical Metallic Tubing (EMT): FS WW-C-563, ANSI C80.3 and UL 797.

E. EMT Fittings: FS W-F-408, ANSI C80.4. Steel or malleable iron.

1. Use compression fittings for raintight connections.
2. Use compression type for concrete type connections.
3. Use compression type fittings for miscellaneous connections and connections in inaccessible locations.
4. Set screw may be used for interior EMT use only.
5. All EMT connectors up to 1” must have insulated throat.
6. No EMT shall be encased in concrete slabs or columns.
7. All installed concealed EMT conduits shall be placed against masonry block or concrete will be wrapped with Scotchrap 3M, 50 all weather corrosion protection tape or equivalent.
8. All EMT and rigid metal conduits passing through masonry walls shall be wrapped with Scotchrap 3M, 50 all weather corrosion protection tape or equivalent.

F. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit; construct of single strip, flexible, continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coat with liquid-tight jacket of flexible polyvinyl chloride (PVC). Shall be Sealtite or equal.

G. Liquid-Tight Flexible Metal Conduit Fittings: FS W-F-406, Type 1, Class 3, Style G. Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated, or non-insulated throat.

H. Flexible Metal Conduit: FS WW-C-566 and UL 1. Formed from continuous length of spiral wound, interlocked zinc-coated strip steel.

I. Flexible Metal Conduit Fittings: Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type.

1. Straight Terminal Connectors: One piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.

2. 45o or 90o Terminal Angle Connectors: Two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.

2.2 NONMETALLIC CONDUIT

A. General: Provide nonmetallic conduit, ducts, and fittings of types, sizes, and weights for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements which comply with provisions of NEC for raceways.

B. Electrical Plastic Conduit:

1. Heavy Wall Conduit: Schedule 40, 90 C, UL-rated, construct of polyvinyl chloride and conforming to NEMA TC-2, for direct burial, or normal above ground use, UL-listed and in conformity with NEC Article 347, ANSI C33.91.

C. PVC Conduit and Tubing Fittings: NEMA TC 3, mate and match to conduit or tubing type and material.

2.3 MANUFACTURERS

A. Subject to compliance with requirements, provide conduit bodies of one of the following:

1. Appleton Electric; Div of Emerson Electric Co.
2. Arrow-Hart Div; Crouse-Hinds Co.
3. Bell Electric Div; Square D Co.
4. Gould, Inc.
5. Killark Electric Mfg. Co.
6. O-Z/Gedney Div; General Signal Co.
7. Spring City Electrical Mfg. Co., or equivalent.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways. Notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF RACEWAYS

A. General: Install raceways as indicated; in accordance with manufacturer's written installation instructions, and in compliance with NEC, and NECA's "Standards of Installation". Install units plumb and level, and maintain manufacturer's recommended clearances.

B. Coordinate with other work including wires/cables, boxes, and panel work, as necessary to interface installation of electrical raceways and components with other work.

C. ENT electrical non-metallic tubing, (i.e. flex, smurf pipe, etc.) will not be allowed or accepted under any conditions.

D. MC Cable will not be allowed or accepted under any conditions.

E. Provide all raceways, boxes and wiring for HVAC controls. Refer to specification section 23 0900, and the HVAC controls drawings for requirements

3.3 INSTALLATION OF CONDUITS

A. General: Install concealed conduits in new construction work, either in walls, slabs, or above hung ceilings. Run conduits concealed in existing work where practical or specifically indicated on the drawings..

1. Mechanically fasten together metal conduits, enclosures, and raceways for conductors to form continuous electrical conductor. Connect to electrical boxes, fittings, and cabinets to provide electrical continuity and firm mechanical assembly.
2. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.
3. Install miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application. Install expansion fittings in raceways every 200' linear run or wherever structural expansion joints are crossed.

B. Conduit Installation: Follow minimum requirements in all areas as follows:

1. Use rigid steel galvanized conduit in crawl spaces, service splines, where exposed to weather or subject to saturation with liquids. Also use rigid steel galvanized conduit for all underground conduit risers from underground, except as allowed for conduits used for communications systems.
2. Steel EMT may be used above hung ceilings in classrooms, offices, corridors, toilets, lab areas and other areas where rigid steel or pvc is not required. EMT shall not be installed encased in concrete slabs or columns. All installed concealed EMT conduits shall be placed against masonry block or concrete will be wrapped with Scotchrap 3M, 50 all weather corrosion protection tape or equivalent.
3. Use galvanized rigid steel conduit or PVC heavy wall (Schedule 40) when raceways run below grade, under floors on grade or in concrete. All risers to cabinets and boxes when conduit is to be exposed shall be rigid steel conduit. Use rigid galvanized steel conduit for utility primary conduit (concrete encased). Provide yellow warning tape with metallic finder 12 inches above conduit for **all** underground conduits.
4. Conduit in walls to recessed panels and boxes shall be in accordance with NEC. PVC up to first point of termination with 4'-0" maximum in wall and EMT above 4'-0".
5. Use flexible conduit in movable partitions and from outlet boxes to lighting fixtures, and final 24" of connection to motors, control items or any equipment subject to movement or vibration, and in cells of precast concrete panels. MC cable is not approved for use. Flexible conduit shall not be routed from lighting fixture to lighting fixture.

6. Use liquid-tight flexible conduit where subjected to one or more of the following conditions:
   a. Exterior location.
   b. Moist or humid atmosphere where condensate can be expected to accumulate.
   c. Corrosive atmosphere.
   d. Subjected to water spray or dripping oil, water, or grease, including kitchen areas.

7. Use hot-dipped galvanized conduit where conduit is routed outdoors or in any way exposed to weather – **no exceptions**. Use stainless steel fasteners and straps.
8. Electrical contractor will be responsible for the following for all underground conduits:
   a. Trenching and Excavation
   b. Backfill
   c. Compaction

C. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean.

D. Field bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.

E. Minimum conduit size shall be 1/2" unless noted otherwise. Homeruns shall be a minimum 3/4".

F. Fasten conduit terminations in sheet metal enclosures by two (2) locknuts, and terminate with bushings. Install locknuts inside and outside enclosure. Provide grounding bushings on all metal raceways.

G. Conduits are not to cross pipe shafts, or ventilating duct openings.

H. Keep conduits a minimum distance of 6" from parallel runs of flues, hot water pipes or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.

I. Use of running threads at conduit joints and terminations is prohibited. Where required, use 3-piece union or split coupling.

J. Complete installation of electrical raceways before starting installation of cables/wires within raceways.

K. Install conduits so as not to damage or run through structural members. Avoid horizontal or cross runs in building partitions or side walls.

L. Exposed Conduits:

1. Install exposed conduits and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls of building.
2. Install exposed conduit work as not to interfere with ceiling inserts, lights or ventilation ducts or outlets.
3. Support all conduits by use of hangers, clamps, or clips. Support conduits on each side of bends and on spacing not to exceed following: up to 1": 6'-0"; 1-1/4" and over: 8'-0". All conduits shall be adequately supported to prevent any noticable deflection, vibration or rattle.
4. Run conduits for outlets on waterproof walls exposed. Set anchors for supporting conduit on waterproof wall in waterproof cement.

5. Exposed pvc conduit is not permitted.
6. Exposed conduit shall not be permitted in occupied spaces.
7. **All exposed exterior fasteners, anchors, supports, and mounting hardware shall be stainless steel.**

M. Conduit Fittings:

1. Construct locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening.
2. Bushings for terminating conduits smaller than 1- 1/4" are to have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation.
3. Install insulated type bushings for terminating conduits 1-1/4" and larger. Bushings are to have flared bottom and ribbed sides. Upper edge to have phenolic insulating ring molded into bushing.
4. All bushings of standard or insulated type to have screw type grounding terminal.
5. Miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs to be specifically designed for their particular application.
6. All locknuts must be steel.
7. Exterior raceway straps and fasteners shall be stainless steel.

N. Concealed Conduits:

1. Metallic raceways installed underground or in floors below grade, or outside are to have conduit threads painted with corrosion inhibiting compound before couplings are assembled. Draw up coupling and conduit sufficiently tight to ensure watertightness.
2. Conduit in concrete slabs: Separate conduits by not less than diameter of largest conduit to ensure proper concrete bond. Conduits must have a minimum of three-quarter inch (3/4") concrete cover.
3. Embedded conduit diameter is not to exceed one-third (1/3) of slab thickness. Conduit shall not be run in slabs less than 3 inches thick.

O. Underground Duct Banks and Underground Conduits: All underground conduits shall be installed per the National Electrical Code, in accordance with standard industry practices and in accordance with other sections of these specifications. Conduits in duct banks shall be neatly and securely installed in straight lines with manufactured elbows used for all turns and bends. Provide all required trenching, excavation, backfill, compaction, supports, manholes, etc. for a complete installation. Trenching, excavation, backfill and compaction shall be performed in accordance with applicable Division 2 and Division 3 sections of these specifications. Provide a yellow warning tape along the full length of all underground primary and secondary conduits. Tape shall be 12 inches above conduit.

1. As-built drawings shall documents the dimension of the actual location of all underground conduits. A minimum of two dimensions from building reference points shall be provided and a bury depth indicated.

P. Low Voltage Control:

1. **Electrical contractor (Division 26) shall provide (furnish and install) all necessary wire, boxes, and raceway (EMT conduit) for low voltage control such as thermostats, timers etc.. Raceways shall be installed in accordance with Division 26 sections. Refer**

to HVAC Controls specification 23 0900, and HVAC controls drawings, for more requirements.

Q. Painting of Conduit & Boxes:

1. Fire Alarm: All new fire alarm conduit, including underground conduit, shall be spot painted red at a minimum of every 4 feet, nominally. Underground conduit shall be spot painted red after it is laid in trench and made up tight. All fire alarm junction boxes shall be painted red.
2. Intercom System: All new junction boxes above ceiling shall be painted blue.
3. Video Surveillance System: All new junction boxes above ceiling shall be painted yellow.
4. 208Y/120 volt Power: All new junction boxes above ceiling shall be painted brown.
5. 480Y/277 volt Power: All new junction boxes above ceiling shall be painted orange.
6. Emergency Power (if applicable): All new junction boxes above ceiling shall be painted pink.

3.4 INSTALLATION OF RACEWAYS AND WIREWAYS

A. General: Mechanically assemble metal enclosures, and raceways for conductors to form continuous electrical conductor, and connect to electrical boxes, fittings and cabinets as to provide effective electrical continuity and rigid mechanical assembly.

1. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.
2. Install expansion fittings in all raceways wherever structural expansion joints are crossed.
3. Make changes in direction of raceway run with proper fittings, supplied by raceway manufacturer. No field bends of raceway sections will be permitted.
4. Properly support and anchor raceways for their entire length by structural materials. Raceways are not to span any space unsupported. Supporting conduits from ceiling grid, other conduits, ductwork or other non-structural members will not be permitted.
5. Use boxes as supplied by raceway manufacturer wherever junction, pull or devices boxes are required. Standard electrical "handy" boxes, etc. shall not be permitted for use with surface raceway installations.

3.5 TELEPHONE/DATA RACEWAY

A. Telephone and data raceways shall be provided for each telephone and/or data outlet indicated on the drawings. Conduit shall be a minimum 1” inch from each outlet to the ceiling space. Provide the end of the conduit with a non-metallic protective bushing. See the voice/data network infrastructure specifications for further requirements.

END OF SECTION

SECTION 26 0535 - ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Electrical Materials and Methods section, and is a part of each Division-26 section making reference to electrical wiring boxes and fittings specified herein.

1.2 DESCRIPTION OF WORK

A. Extent of electrical box and associated fitting work is indicated by drawings and schedules.

B. Types of electrical boxes and fittings specified in this section include the following:

1. Outlet boxes
2. Junction boxes
3. Pull boxes
4. Floor boxes
5. Bushings
6. Locknuts
7. Knockout closures
8. Manholes and handholes

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical boxes and fittings, of types, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects utilizing electrical boxes and fittings similar to those required for this project.

C. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.

D. UL Compliance: Comply with applicable requirements UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings which are UL-listed and labeled.

E. NEMA Compliance: Comply with applicable requirements of NEMA Stds/Pub No.'s OS1, OS2, and Pub 250 pertaining to outlet and device boxes, covers, and box supports.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS

A. Outlet Boxes: Provide galvanized coated flat rolled sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with cable and conduit-size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding. All 1900 boxes, (4" square), junction boxes, and gutters installed against masonry block or concrete shall have corrosion protected material installed on backs of their enclosures.

1. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cableclamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliance option.

B. Device Boxes: Provide galvanized coated flat rolled sheet-steel non-gangable device boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct device boxes for flush mounting with mounting holes, and with cable-size knockout openings in bottom and ends, and with threaded screw holes in end plates for fastening devices. Provide cable clamps and corrosion-resistant screws for fastening cable clamps, and for equipment type grounding.

1. Device Box Accessories: Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster board expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliance option.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering outlet boxes which may be incorporated in the work include, but are not limited to, the following:

1. Appleton Electric;
2. Bell Electric;
3. Eagle Electric Mfg. Co.; Inc.
4. Midland-Ross Corp.
5. OZ/Gedney; General Signal Co.
6. Pass and Seymour, Inc.
7. RACO Div.; Harvey Hubbell Inc.
8. Thomas & Betts Co.

D. Raintight Outlet Boxes: Provide corrosion-resistant cast-metal raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, cast-metal face plates with spring hinged watertight caps suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering raintight outlet boxes which may be incorporated in the work include, but are not limited to, the following:

1. Appleton Electric;
2. Crouse-Hinds Co.
3. Bell Electric;
4. Harvey Hubbell, Inc.
5. OZ/Gedney; General Signal Co.
6. RACO Div.

F. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes; with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws, and washers.

G. Available Manufacturers: Subject to compliance with requirements, manufacturers offering junction and pull boxes which may be incorporated in the work include, but are not limited to, the following:

1. Appleton Electric; Emerson Electric Co.
2. Arrow-Hart Div.; Crouse-Hinds Co.
3. Bell Electric; Square D Company
4. OZ/Gedney; General Signal Co.
5. Spring City Electrical Mfg. Co.

H. Available Manufacturers: Subject to compliance with requirements, manufacturers offering floor boxes which may be incorporated in the work include, but are not limited to, the following:

1. Arrow-Hart Div.; Crouse-Hinds Co.
2. Harvey Hubbell, Inc.
3. Midland-Ross Corp.
4. Spring City Electrical Mfg. Co.

I. Bushings, Knockout Closures, and Locknuts: Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connections, of types and sizes, to suit respective installation requirements and applications.

J. Available Manufacturers: Subject to compliance with requirements, manufacturers offering bushings, knockout closures, locknuts, and connectors which may be incorporated in the work include, but are not limited to, the following:

1. Arrow-Hart Div.; Crouse-Hinds Co.
2. Appleton Electric Co.; Emerson Electric Co.
3. Bell Electric; Square D Co.
4. Midland-Ross Corp.
5. OZ/Gedney Co.; General Signal Co.

K. Manholes and Handholes: Manholes and handholes for exterior use shall be pre-cast concrete with steel traffic rated covers, as manufactured by Brooks or equal. Manholes and handholes shall be the size necessary for the number of conduits and conductors indicated on the drawings which will enter the enclosure, plus the necessary capacity for the spare conduits and the

associated estimated conductor fill. Provide manholes with the appropriate drainage and knockouts for conduits and other necessary access. Traffic covers shall be engraved with the appropriate identification, such as "ELECTRIC".

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.

C. Provide weathertight boxes and fittings for interior and exterior locations exposed to weather or moisture.

D. Provide knockout closures to cap unused knockout holes where blanks have been removed.

E. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.

F. Avoid installing boxes back-to-back in walls. Provide not less than 24" (600 mm) separation.

G. Position recessed outlet boxes accurately to allow for surface finish thickness.

H. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.

I. Each circuit in pull box shall be marked with a tag guide denoting panels which they connect to.

J. Manholes and handholes shall be installed for all underground conduit installations. The minimum number of manholes and handholes shall be as indicated on the drawings. The contractor shall provide any additional handholes or manholes necessary for ease of installation, code compliance or due to voluntary or required re-routing of the underground conduits at no additional cost to the Owner.

END OF SECTION

SECTION 26 0553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Electrical Materials and Methods section apply to work specified in this section.

1.2 DESCRIPTION OF WORK

A. Extent of electrical identification work is indicated by drawings and schedules.

B. Types of electrical identification work specified in this section include the following:

1. Electrical power, control, and communication conductors.
2. Operational instructions and warnings.
3. Equipment/system identification signs.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical identification products of types required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. NEC Compliance: Comply with NEC as applicable to installation of identifying labels and markers for wiring and equipment.

C. UL Compliance: Comply with applicable requirements of UL Std 969, "Marking and Labeling Systems", pertaining to electrical identification systems.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering electrical identification products which may be incorporated in the work include, but are not limited to, the following:

1. Brady, W.H. Co.

2.2 ELECTRICAL IDENTIFICATION MATERIALS

A. General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

2.3 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, black face and white core plies (white letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

1. Thickness: 1/8", except as otherwise indicated.
2. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

2.4 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment.

1. Refer to detail on drawings.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. General Installation Requirements:

1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions and requirements of NEC.
2. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.
3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

3.2 OPERATIONAL IDENTIFICATION AND WARNINGS

A. General: Wherever reasonably required to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel,

install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and doors of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

3.3 EQUIPMENT/SYSTEM IDENTIFICATION

A. General: Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/ control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated on the detail on the drawings, provide single line of text, 1/2" high lettering, on 1-1/2" high sign (2" high where 2 lines are required), black lettering in white field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:

1. Switchboard breakers, panelboards, electrical cabinets, disconnect switches and enclosures
2. Access panel/doors to electrical facilities
3. Transformers
4. Intercom system master station and all intercom terminal cabinets
5. All low voltage system control panels and terminal cabinets
6. Fire alarm main control panel, power expander panels, and all terminal cabinets.
7. Each circuit breaker in main switchboard and distribution panels
8. Communications systems terminal cabinets; sound, CCTV, clock, telephone, etc.
9. HVAC control panels.

B. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate.

END OF SECTION

SECTION 26 2616 - CIRCUIT AND MOTOR DISCONNECTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Electrical Materials and Methods section, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of circuit and motor disconnect switch work is indicated by drawings and schedules.

B. Types of circuit and motor disconnect switches in this section include the following:

1. Equipment disconnects.
2. Appliance disconnects.
3. Motor-circuit disconnects.

C. Wires/cables, raceways, and electrical boxes and fittings required in connection with circuit and motor disconnect work are specified in other Division-26 Basic Electrical Materials and Methods sections.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of circuit and motor disconnect switches of types and capacities required whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing circuit and motor disconnect work similar to that required for this project.

C. NEC Compliance: Comply with NEC requirements pertaining to construction and installation of electrical circuit and motor disconnect devices.

D. UL Compliance: Comply with requirements of UL 98, "Enclosed and Dead-Front Switches". Provide circuit and motor disconnect switches which have been UL-listed and labeled.

E. NEMA Compliance: Comply with applicable requirements of NEMA Stds Pub No. KS 1, "Enclosed Switches" and 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)".

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's data on circuit and motor disconnect switches.

B. Wiring Diagrams: Submit power and control wiring diagrams for circuit and motor disconnects including connections to power and control panels, and feeders.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering circuit and motor disconnects which may be incorporated in the work include the following:

1. General Electric Co.
2. Square D Company
3. Cutler Hammer

2.2 FABRICATED SWITCHES

A. Heavy-Duty Safety Switches: Provide surface-mounted, heavy-duty type, sheet-steel enclosed safety switches, of types, sizes and electrical characteristics indicated; fusible or non-fusible type as indicated, amperes as indicated, 60 Hz, 3-blades, 4-poles, solid neutral; 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 integral part of enclosure base and whose operating position is easily recognizable, and is padlockable 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, where applicable. Provide grounding kit. Provide 240 volt rated switches for 208Y/120 volt systems and 600 volt rated switches for 277Y/480 volt systems.

1. Fuses: Provide fuses for safety switches, sized as recommended by the manufacturer of the equipment to be protected, of classes, types, and ratings needed to fulfill electrical requirements for service indicated. Provide R-clips for all fuse holders.

PART 3 - EXECUTION

3.1 INSTALLATION OF CIRCUIT AND MOTOR DISCONNECT SWITCHES

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.

B. Coordinate circuit and motor disconnect switch installation work with electrical raceway and cable work, as necessary for proper interface.

C. Install disconnect switches for use with motor-driven appliances, and motors and controllers within sight of controller position unless otherwise indicated.

D. Provide a nameplate indicating the equipment served and protected.

3.2 GROUNDING

A. Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground, for electrical disconnect switches where indicated.

3.3 FIELD QUALITY CONTROL

A. Subsequent to completion of installation of electrical disconnect switches, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at project site, then retest to demonstrate compliance; otherwise remove and replace with new units and retest.

B. Painting: repair all scratches to factory painted and primed finish with factory supplied touch-up paint.

END OF SECTION

SECTION 26 2813 - OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Electrical Materials and Methods section, and is part of each Division-26 section making reference to overcurrent protective devices specified herein.

1.2 DESCRIPTION OF WORK

A. Extent of overcurrent protective device work is indicated by drawings and schedules.

B. Types of overcurrent protective devices in this section include the following:

1. Circuit Breakers:
   a. Air, molded-case, for installation in panels.
   b. Air, molded-case, for individual, separately enclosed mounting.
   c. For installation in existing panels.

2. Fuses:
   a. Class RK5, dual-element time-delay.

C. Refer to other Division-26 sections for cable/wire and connector work required in conjunction with overcurrent protective devices; not work of this section.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of overcurrent protective devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for project.

C. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of overcurrent protective devices.

D. UL Compliance: Comply with applicable requirements of UL 489, "Molded-Case Circuit Breakers and Circuit-Breaker Enclosures", and UL 198D, "High-Interrupting-Capacity Class K Fuses". Provide overcurrent protective devices which have been UL-listed and labeled.

E. NEMA Compliance: Comply with applicable requirements of NEMA Std Pub Nos. AB 1, AB 2, and SG 3 pertaining to molded-case and low-voltage power type circuit breakers.

F. FS Compliance: Comply with Federal Specification W-C-375B/GEN pertaining to molded-case circuit breakers.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's data on overcurrent protective devices, including: amperes, voltages and current ratings, interrupting ratings, current limitations, internal inductive and non-inductive loads, time-current trip characteristics curves, and mounting requirements.

B. Maintenance Stock, Fuses: For types and ratings required, furnish additional fuses, amounting to one unit for every 5 installed units, but not less than one unit of each.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include the following:

1. Circuit Breakers:
   a. General Electric Co.
   b. Square D Co.
   c. ITE/Seimens
   d. Cutler Hammer

2. Fuses:
   a. Bussmann Div.; McGraw-Edison Co.
   b. Gould, Inc.
   c. Cefco

2.2 CIRCUIT BREAKERS

A. General: Except as otherwise indicated, provide circuit breakers and ancillary components, of types, sizes, ratings, and electrical characteristics indicated, which comply with manufacturer's standard design, materials, components, and construction in accordance with published product information, and as required for a complete installation.

B. Molded-Case Circuit Breakers: Provide factory assembled, molded-case circuit breakers of frame size indicated; rated 600 volts or 240 volts as required, 60 Hz, 3-poles with interrupting ratings as shown on drawings. Provide breakers with permanent thermal and instantaneous magnetic trips in each pole, and with fault-current limiting protection, ampere ratings as indicated. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Handle ties are not permitted. Provide push-to-trip button on cover for mechanical tripping circuit breakers. Construct breakers for mounting and operating in any physical position and operating in an ambient temperature of 40oC. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated. Circuit breakers

shall have the short circuit interrupting rated indicated on the drawings or as required for the short circuit current available.

C. Molded-Case Circuit Breakers for Installation in Panelboards or Switchboards: Shall meet the same specifications as in Part B above. Shall be manufactured by the same manufacturer as the panelboard or switchboard. When the existing panel or switchboard style is obsolete and the existing circuit breaker type is not available the contractor shall provide a circuit breaker of similar type as existing. The breaker shall be provided with all the required mounting hardware to mount the breaker in the existing space. The breaker shall meet or exceed the ratings of the existing breakers.

D. Provide all accessories indicated on the drawings, including accessories indicated on the panel schedules, such as shunt trips, ground fault protection, undervoltage trips, etc. Accessories shall be manufactured by the same manufacturer as the circuit breaker.

2.3 FUSES

A. General: Except as otherwise indicated, provide fuses of types, sizes, ratings, and average time/current and peak let-through current characteristics indicated, which comply with manufacturer's standard design, materials, and construction in accordance with published product information, and with industry standards and configurations.

B. Class RK5 Dual-Element Time-Delay Fuses: Provide UL Class RK-5 dual element time-delay fuses rated 600 V, 60 Hz, amperes as required by the manufacturer of the equipment being protected, with 200,000 RMS symmetrical interrupting current rating for protecting motors.

C. Class RK1 Dual-Element Time-Delay Fuses: Provide UL Class RK-1 dual element time-delay fuses rated 600 V, 60 Hz, amperes as required by the manufacturer of the equipment being protected, with 200,000 RMS symmetrical interrupting current rating for protecting service entrance or as otherwise noted.

2.4 EXISTING EQUIPMENT

A. Circuit breakers to be installed in existing equipment shall be manufactured by the existing equipment manufacturer and shall have short circuit interrupting ratings equal to or greater than the existing breakers.

PART 3 - EXECUTION

3.1 INSTALLATION OF OVERCURRENT PROTECTIVE DEVICES

A. Install overcurrent protective devices as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA standards for installation of overcurrent protective devices.

B. Coordinate with other work, including electrical wiring work, as necessary to interface installation of overcurrent protective devices with other work.

C. Fasten circuit breakers without causing mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cabling.

D. Set field-adjustable circuit breakers for trip settings as indicated, subsequent to installation of units.

E. Install fuses, if any, in fused circuit breakers.

3.2 ADJUST AND CLEAN

A. Inspect circuit-breaker operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.

3.3 FIELD QUALITY CONTROL

A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

END OF SECTION

SECTION 26 2913 - MOTOR CONTROLLERS AND CONTACTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract including General and Division 1 Specification Sections, apply to work of this section.

1.2 SCOPE

A. The work, apparatus and materials which shall be furnished under these specifications and accompanying drawings shall include all items specified hereinafter and shown on the drawings. All other materials necessary for the complete installation shall be furnished and installed by the Contractor to provide complete electrical systems as indicated on the drawings and as specified herein.

B. Coordinate all required interlocks with Division 23. Motor starters shall contain the necessary auxiliary contacts and control coil voltage to interface with the HVAC temperature control system and fire alarm control system.

1.3 DESCRIPTION OF WORK

A. Extent of motor controller work is indicated by drawings and schedules. Types of motor controllers specified in this section include the following:

1. Manual motor starters.
2. Combination disconnect/FVNR motor starters.

1.4 QUALITY ASSURANCE

A. Manufacturers: General Electric, Square D, Allen Bradley.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with electrical motor controller work similar to that required for this project.

C. Codes and Standards:

1. NEMA Compliance: Comply with applicable requirements of NEMA Standards Publications pertaining to motor controllers.
2. UL Compliance and Labeling: Comply with applicable requirements of UL safety standards pertaining to motor controllers. Provide motor controllers and components which have been UL-listed and labeled.
3. NEC Compliance: Comply with applicable requirements of NEC pertaining to construction and installation of motor controllers.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of motor controller required. Include data substantiating that materials comply with requirements.

PART 2 - PRODUCTS

2.1 INDIVIDUAL MOTOR CONTROLLERS

A. Manual motor starters for 115 volts, single phase motors one horsepower and smaller, shall be single pole, horsepower rated switches with thermal overload units and heaters. Starters shall be Allen-Bradley Bulletin 609, General Electric CR-101 or Square D Class 2510 with stainless steel cover plates.

B. Magnetic full voltage starters for three phase motors shall be three pole, horsepower rated, magnetically operated with three thermal overload units and heaters. Starters shall be Allen-Bradley Bulletin 509, General Electric CR-306 or Square D Class 8536. Provide Hand-Off-Auto selector switch, pilot lights to indicate starter's position (Amber - Red - Green), a minimum of two normally open and two normally closed auxiliary contacts, control power transformer fused on primary and secondary, control coil, and electronic overloads (thermal overload “heaters” are not permitted). Provide control power and coil voltage as required for interlock with the HVAC temperature control system and fire alarm system. Starters shall be the Nema size indicated on the drawings but shall be a minimum size one.

C. Combination magnetic, full voltage starters for three phase motors shall be three pole horsepower rated, magnetically operated contacts, with electronic overloads (thermal overload “heaters” are not permitted). A three pole horsepower rated, fusible disconnect switch shall also be included integral within the enclosure. Provide fuses sized as recommended by the motor manufacturer. Starters shall be Allen-Bradley Bulletin 512, General Electric CR-308 or Square D Class 8538. Provide Hand-Off-Auto selector switch, pilot lights to indicate starter's position (Amber - Red - Green), a minimum of two normally open and two normally closed auxiliary contacts, control power transformer fused on primary and secondary, control coil, and electronic overloads (thermal overload “heaters” are not permitted). Provide control power and coil voltage as required for interlock with the HVAC temperature control system and fire alarm system. Starters shall be the Nema size indicated on the drawings but shall be a minimum size one. Overloads shall be selected and sized for each specific motor supplied in the field.

D. Provide enclosure type suitable for the environment in which it is installed. Enclosure shall be interlocked so the door cannot be opened without turning the unit off. This interlock shall be capable of being defeated by properly trained personnel.

E. Provide phase failure relay for all three phase motors, except where provided with the equipment. Relay shall be fully adjustable to open the contacts when any phase to phase or phase to ground voltage is above or below 20% nominal. The relay drop out point shall be adjustable from 0% to 50%. Relay shall be provided with an adjustable time delay of 0 to 120 seconds before opening to avoid nuisance outages. Relay shall be full automatic to open and fully automatic to reset and shall be fully coordinated with the DDC EMS controls. Coordinate

with Division 23 for any phase failure device(s) provide with equipment. Any and all phase failure device shall be adjustable as stated above.

F. IEC type starters and contactors are not acceptable. Provide NEMA listed and approved starters and contactors.

PART 3 - EXECUTION

3.1 MOTOR CONTROLLERS, CONTACTORS AND ASSOCIATED CONTROLS

A. Unless otherwise indicated, motor controllers shown on the drawings shall be furnished and installed under this section. The full load current and starting characteristics of each motor shall be verified for proper selection of motor over load devices. The Contractor shall furnish and install all steel shapes, etc., necessary for a support of all motor controllers.

B. Unless otherwise indicated, all control devices, such as thermostats, firestats, etc., shall be installed in place and wired under other sections of the specifications. Coordinate required starter auxiliary contacts and coil voltages for a properly operational system.

C. Motor controllers shall be installed in accordance with all applicable NEC installation requirements.

3.2 IDENTIFICATION OF EQUIPMENT

A. Identification shall be provided for all motor controllers installed by the Contractor. Identification shall consist of white laminated plastic plates with black engraved letters.

END OF SECTION