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SECTION 23 00 00

HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.0 GENERAL PROVISIONS

A. The GENERAL REQUIREMENTS, DIVISION 1, and BIDDING AND CONTRACT REQUIREMENTS, DIVISION 00, are hereby made a part of this Specification Section.

B. Examine all drawings and all sections of the specifications and requirements and provisions affecting the work of this section.

C. The work listed in the following sections shall be made a part of this specification Section

23 20 00 HVAC Piping and Distribution Systems

23 70 00 Central HVAC Equipment

1.1 SCOPE OF WORK

A. This project includes the replacement of one (1) pool dehumidifier unit and circulator pump as outlined in the construction documents.

B. The work under this section shall include the furnishing of all materials, labor, equipment and supplies and the performance of all operations to provide complete working systems, in general, to include the following items:

1. Piping and Fittings (all systems and types) including connecting to existing systems and submitting sizing where called for on the drawings or in these specifications
2. Pipe Hangers and Supports
3. Identification
4. Sleeves, Fire stopping
5. Valves and Accessories (all types)
6. Pressure Gauges, Thermometers, Accessories
7. Electric Motors and Starters
8. Pumps (all types and systems)
9. Equipment Nameplates
10. Air Filters
11. Air Handling Units
12. Factory Painting
13. Insulation
14. Flues
15. Roof Curbs and Adapters
16. Operating and maintenance instructions and manuals
17. Shop drawings
18. Cleaning, Testing, Adjusting, & Balancing of all Ducted and Piped Systems and Equipment
19. Record (as-built) Drawings
20. HVAC Control Systems
21. Training of Owners Personnel on Equipment, Systems, and Controls

C. The work to be done under this section is generally shown on the Mechanical HVAC Drawings.

1.2 RELATED WORK

A. Principal classes of Work related to the Work of this section are listed in the Specification Table of Contents, and are specified to be performed under the indicated sections of the specifications. Refer to the indicated sections for description of the extent and nature of the indicated Work, and for coordination with related trades. This listing may not include all related Work items. It is the responsibility of the Contractor to coordinate and schedule the Work of this section with that of all other trades.

B. The following work is not included in this section and will be provided under other sections, except as specified herein:

1. Starters and variable speed drives that are not integral to equipment, unless specified otherwise.
2. Structural supports necessary to distribute loading from equipment to roof or floor.
3. Temporary light, power, water, heat, gas and sanitary facilities for use during construction and testing. Refer to Division 01, General Conditions.
4. Flashing of roof and wall penetrations.
5. Painting, except as specified herein.

1.3 DEFINITIONS

A. As used in this section, the following terms shall be understood to have the following meaning:

1. "*Contractor*," or "*Subcontractor*," unless otherwise qualified, shall mean the installer of the work specified under this section, and shall be responsible for coordination of this work with the work of the ATC Contractor.
2. "*Furnish*" shall mean purchase and deliver to the project site, complete with every necessary appurtenance and product support.
3. "*Install*" shall mean unload at the delivery point at the site and perform all work necessary to establish secure mounting and proper operation at the proper location in the project.
4. "*Provide*" shall mean furnish and install.
5. "*Work*" shall mean all labor, materials, equipment, apparatus, controls, accessories and all other items required for a proper and complete installation.
6. "*Concealed*" shall mean hidden from sight in chases, furred in spaces, shafts, embedded in construction, in a crawl space, and above hung ceilings.
7. "*Exposed*" shall mean not installed underground or concealed as defined above.
8. "*Furnished by others*" shall mean materials or equipment purchased under other sections of the general contract and installed by this section of the specifications by this trade Contractor.
9. "*Owner's Representative*" shall be the party responsible to make decisions regarding all contractual obligations in reference to the Scope of Work for the Owner.
10. "*Date of Substantial Completion*" shall indicate the date where the work has been formally accepted as evidenced by completed final punchlist or where the work has reached the stage that the Owner obtains beneficial use and commences utilization of the installed systems for business or occupancy purposes. The

General Requirements, Division 01, shall supersede this definition where specifically defined.

11. "*Piping*" shall mean, in addition to pipe or tubing, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.
12. "*ATC*" shall mean Automatic Temperature Controls, and shall be interchangeable with "BAS" (Building Automation System).

1.4 CODES, REFERENCES AND PERMITS

A. Materials, installation of systems and equipment provided under this section shall be done in strict accordance with the latest governing edition of the following standards, codes, specifications, requirements, and regulations, and any other Codes and Regulations having jurisdiction including but not limited to:

1. All Applicable NFPA Standards
2. State and Local Building Mechanical, Electrical, and Energy Codes
3. American Society of Mechanical Engineers (ASME)
4. American Society of Testing and Materials (ASTM)
5. American National Standards Institute (ANSI)
6. Underwriters' Laboratories, Inc. (UL)
7. Occupational Safety and Health Administration (OSHA)
8. Any other local codes or authorities having jurisdiction.

B. Heating, pumping, process piping and refrigeration systems shall be installed by Contractors and personnel appropriately licensed in the State (Installing Contractor).

C. All pressure vessels shall conform to ASME and State codes and regulations.

D. All equipment shall meet the more efficient requirement:

1. As shown on bid documents,
2. Minimum efficiencies state in ASHRAE 90.1-2013, or
3. Minimum efficiencies stated in the governing Energy Code.

E. Unless otherwise specified or indicated, materials, workmanship and equipment performance shall conform with the latest governing edition of the following standards, codes, specifications, requirements, and regulations, except when more rigid requirements are specified or are required by applicable codes but not limited to:

1. Air Conditioning and Refrigeration Institute (ARI)
2. Air Diffusion Council (ADC)
3. Air Movement and Control Association (AMCA)
4. American Boiler Manufacturers Association (ABMA)
5. American National Standards Institute (ANSI)
6. American Petroleum Institute (API)
7. American Society of Heating, Refrigeration and Air Conditioning (ASHRAE)
8. American Society of Mechanical Engineers (ASME)
9. American Society of Testing and Materials (ASTM)
10. American Welding Society, Inc. (AWS)
11. Associated Air Balance Council (AABC)
12. Certified Ballast Manufacturers (CME)
13. Copper Development Association (CDA)
14. Cooling Tower Institute (CTI)
15. Expansion Joint Manufacturers Association, Inc. (EJMA)
16. Factory Mutual System (FM)

17. Illuminating Engineering Society (IES)
18. Institute of Electrical and Electronics Engineers (IEEE)
19. Insulated Cable Engineers Association (ICEA)
20. Manufacturer's Standardization Society of the Valve & Fitting Industry (MSS)
21. National Electrical Contractors Association (NECA)
22. National Electric Manufacturers Association (NEMA)
23. National Environmental Balancing Bureau (NEBB)
24. North American Insulation Manufacturer's Association (NAIMA)
25. Sheet Metal and Air Conditioning Contractor's National Association, Inc. (SMACNA)
26. The Hydronics Institute (HI)
27. Thermal Insulation Manufacturer’s Association (TIMA)

F. Codes, laws and standards provide a basis for the minimum installation criteria acceptable. The drawings and specifications illustrate the scope required for this project, which may exceed minimum codes, laws and standards.

G. The date of the code or standard is that in effect when the permits will be issued.

H. Give all notices, file all plans, obtain all permits and licenses, and obtain all necessary approvals from authorities having jurisdiction. Deliver all certificates of inspection to the authorities having jurisdiction. No work shall be covered before examination and approval by the Owner’s Representative, inspectors, and authorities having jurisdiction. Replace imperfect or condemned work to conform to requirements, satisfactory to Owner’s Representative, and without extra cost to the Owner. If work is covered before inspection and approval, this Contractor shall pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

1.5 GENERAL REQUIREMENTS

A. Nameplates

1. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, type or style, model number, catalog number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

B. Maintenance Information

1. Systems and equipment which require periodic maintenance to maintain efficient operation shall be furnished with complete necessary maintenance information. Required routine maintenance actions, as specified by the manufacturer, shall be stated clearly and incorporated on a readily accessible label on the equipment. Such label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of product.

C. Equipment Guards

1. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto shall be completely enclosed or guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be guarded or covered with insulation of type specified for service.

1.6 MATERIAL AND EQUIPMENT STANDARDS

A. Where equipment or materials are specified with the name of a manufacturer, such specification shall be deemed to be used for the purpose of establishing a standard for that particular item. No equipment or material shall be used unless previously approved by the Owner's Representative.

B. Substitutions (approved equals) may be offered for review provided the material, equipment or process offered for consideration is equal in every respect to that indicated or specified. In order for Requests for substitution to be considered, all must be submitted for pre-approval of manufacturer within thirty (30) days of award of contract. All requests must be accompanied by a list of minimum five (5)-year-old successful installations of similar scope (with Owner contact and phone number), complete specifications together with drawings or samples to properly appraise the materials, equipment or process. Allow thirty (30) days for Owner's Representative's review.

C. If a substitution of materials or equipment in whole or in part is made, this Contractor shall bear the cost of any changes necessitated by any other trade as a result of said substitution.

D. All materials, equipment and accessories provided under this section shall be new and unused products of recognized manufacturers as approved.

1.7 SUBMITTALS

A. Conform to the requirements of Division 01, General Conditions, for schedule and form of all submittals unless specifically noted otherwise in this section. Coordinate this submittal with submittals for all other finishes. Shop drawings and design layouts shall be prepared by licensed installing Contractors and shall note the name(s), license number(s) and license expiration date(s) of the Contractor(s) installing the heating, pumping, process piping and refrigeration systems.

B. Definitions:

1. Shop Drawings are information prepared by the Contractor to illustrate portions of the work in more detail than indicated in the Contract Documents.
2. Acceptable Manufacturers: The mechanical design for each product is based on the single manufacturer listed in the schedule or shown on the drawings. In Part 2 of the specifications certain Alternate Manufacturers are listed as being acceptable. In addition, the MATERIAL AND EQUIPMENT STANDARDS paragraph potentially allows for substitutions as being acceptable. These are acceptable only if, as a minimum, they:

a. Meet all performance criteria listed in the schedules and outlined in the specifications. For example, to be acceptable, an air handling unit must deliver equal CFM against equal external static pressure (with the allowed pressure drop of dirty filters) using equal or less horsepower as the air handler listed in the schedules.
b. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings, and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean the Engineer has determined that the manufacturer's products will fit within the available space – this determination is solely the

responsibility of the Contractor.

c. For rooftop mounted equipment and equipment mounted in areas where structural matters are a concern, the products must have a weight no greater than the product listed in the schedules or specifications.

d. Products must adhere to all architectural considerations including, but not limited to: being of the same color as the product scheduled or specified, fitting within the architectural enclosures and details.

C. Submittal Procedures, Format and Requirements

1. Review submittal packages for compliance with Contract Documents and then submit to Owner's Representative for review. Submit enough sets of shop drawings such that, after review, two (2) sets will be kept by the reviewer, with only the remaining sets returned with reviewer's marks and comments. Electronic submittals meeting shop drawing requirements may be used.
2. Each Shop Drawing shall indicate in title block, and each Product Data package shall indicate on cover sheet, the following information:

   a. Title.
   b. Equipment number.
   c. Name and location of project.
   d. Names of Owner, Engineer and Seller.
   e. Names of manufacturers, suppliers, vendors, etc.
   f. Date of submittal.
   g. Whether original submittal or resubmitted.

3. Shop drawings showing manufacturer's product data shall contain detailed dimensional drawings (minimum ¼ inch = one (1) foot scale) including plans and sections (where physical clearance could be an issue). Provide larger scale details as necessary. Sheet metal drawings shall show elements of Architect's reflected ceiling plan, exposed ductwork, walls and partitions (highlighting fire walls and smoke partitions), diffusers, registers, grilles, all dampers (fire, smoke, balancing, backdraft, and control dampers), sleeves and other aspects of construction as necessary for coordination.
4. Submit accurate and complete description of materials of construction, manufacturer's published performance characteristics, sizes, weights, capacity ratings (performance data, alone, is not acceptable), electrical requirements, starting characteristics, wiring diagrams, and acoustical performance for complete assemblies. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.
5. Provide shop drawings showing details of piping connections to all equipment. If connection details are not submitted and connections are found to be installed incorrectly, this Contractor shall reinstall them within the original contract price.

   a. Alternate pipe joining methods such as grooved and permanent push-to-connect systems shall be shown on drawings and product submittals, and be specifically identified with the applicable manufacturer's style or series number. Installation shall include any additional hangers required for the alternate system.

6. Provide complete data for all auxiliary services and utilities required by submitted equipment. This shall include power, cooling water and compressed air requirements and points of connection.
7. Provide a complete description of all controls and instrumentation required including electrical power connection drawing for all components and

interconnection wiring to starters, detailed information on starters, control diagrams, termination diagrams, and all control interfaces with a central control system.

8. Provide installation and erection information including; lifting requirements, and any special rigging or installation requirements for all equipment.
9. The Owner's Representative shall approve all materials before commitment for materials is made.

D. Specifications, Schedule, and Control Sequence Compliance Statement

1. The manufacturer shall submit a point by point statement of compliance with each specification criteria listed in each paragraph for those submittals listed in Product Data that are noted with an asterisk (*).
2. The statement of compliance shall consist of a list of all paragraphs (line by line) identified in the all specification sections of Division 23 containing the equipment, including Part 2 and applicable Part 3 of those specification sections as well as unit controls providing all manufacturer's portions of the control sequences shown on the drawings for which the submitted product in the opinion of the manufacturer complies, deviates, or does not meet.
3. Where the proposed submittal complies fully, the word "comply" shall be placed opposite the paragraph number.
4. Where the proposed submittal does not comply, or accomplishes the stated function in a manner different from that described, a full description of the deviation shall be provided.
5. Verify each field of the associated schedule where associated technical data is presented and sequences are shown on the drawings. Where the submitted material does not 'comply" provide the value the submitted equipment will achieve based upon the specified conditions.
6. Where a full description of a deviation is not provided, it shall be assumed that the proposed system does not comply with the paragraph in question and the product will be rejected.
7. Submissions which do not include a point by point statement of compliance as specified shall be disapproved.

E. Product Data: Submit complete manufacturer's product description and technical information including:

1. Piping and Fittings (all services, types, and joining methods)
2. Pipe Hangers and Supports
3. Identification
4. Sleeves, Fire stopping
5. Valves and Accessories (all types)
6. Pressure Gauges, Thermometers, Accessories
7. Electric Motors and Starters
8. Pumps (Water systems)
9. Complete ductwork, equipment layout, and piping shop drawings, construction details and construction standards
10. Rooftop Units (*)
11. Roof Curbs and Adapters
12. Operating and maintenance instructions and manuals
13. Testing, Adjusting, & Balancing Qualifications, Plan, and Reports
14. Identification, labels and tags
15. O&M manual table of contents
16. O&M manual

F. Submit shop drawings and product data grouped to include complete submittals of related

systems, products and accessories in an individual (combined) submittal.

1. Access panel shop drawings shall be submitted to the Construction Supervisor for approval.
2. Do not submit multiple product information in a single bound manual.
3. Three-ring binders shall not be accepted.

G. Deviations

1. Concerning deviations other than substitutions, proposed deviations from Contract Documents shall be requested individually in writing whether deviations result from field conditions, standard shop practice, or other cause. Submit letter with transmittal of Shop Drawings which flags the deviation to the attention of the Owner's Representative.
2. Without letters flagging the deviation to the Owner's Representative, it is possible that the Engineer may not notice such deviation or may not realize its ramifications. Therefore, if such letters are not submitted to the Owner's Representative, the Seller shall hold the Engineers, his consultants and the Owner harmless for any and all adverse consequences resulting from the deviations being implemented. This shall apply regardless of whether the Engineer has reviewed or approved shop drawings containing the deviation, and will be strictly enforced.
3. Approval of proposed deviations, if any, will be made at discretion of Engineer.

H. Schedule: Incorporate shop drawing review period into construction schedule so that Work is not delayed. This Contractor shall assume full responsibility for delays caused by not incorporating the following shop drawing review time requirements into his project schedule: Allow at least ten (10) working days, exclusive of transmittal time, for review each time shop drawing is submitted or resubmitted with the exception that twenty (20) working days, exclusive of transmittal time are required for the following:

1. HVAC temperature control submittals
2. TAB draft and final balancing reports.
3. O&M manuals
4. As built drawings
5. If more than five (5) shop drawings of a single trade are received in one (1) calendar week.

I. Responsibility

1. Intent of Submittal review is to check for capacity, rating, and certain construction features. HVAC Contractor shall ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction; and for coordination of work of this and other sections. Work shall comply with approved submittals to extent that they agree with Contract Documents. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports and access for service, nor the shop drawing errors or deviations from requirements of Contract Documents. The Engineer's noting of some errors while overlooking others will not excuse the HVAC Contractor from proceeding in error and will not absolve the Contractor from meeting the full design intent of the associated system(s). Contract Documents requirements are not limited, waived nor superseded in any way by review.

2. Inform Contractors, manufacturers, suppliers, etc. of scope and limited nature of

review process and enforce compliance with contract documents.

J. In the event that the HVAC Subcontractor fails to provide Shop Drawings for any of the products specified herein:

1. The HVAC Subcontractor shall furnish and install all materials and equipment herein specified in complete accordance with these specifications.
2. If the HVAC Subcontractor furnishes and installs material and/or equipment that is not in complete accordance with these specifications, he shall be responsible for the removal of this material and/or equipment. He shall also be responsible for the replacement of this material and/or equipment with material and/or equipment that is in complete accordance with these specifications, at the direction of the Owner's Representative.
3. Removal and replacement of materials and/or equipment that is not in complete compliance with these specifications shall be done at no extra cost to the Owner.
4. Removal and replacement of materials and/or equipment that is not in complete compliance with these specifications shall not be allowed as a basis for a claim of delay of completion of the Work.

K. Mark dimensions and values in units to match those specified.

L. Submit Material Safety Data Sheets (MSD) on each applicable product with submittal.

1.8 OPERATION AND MAINTENANCE DATA

A. Commence preparation of the Operating and Maintenance (O&M) Manuals immediately upon receipt of "Approved" or "Approved as Noted" shop drawings and submit each section within one (1) month. The final submission shall be no later than two (2) months prior to the projected date of Substantial Completion of the Project.

B. Each O&M document shall include the manufacturer's web address for equipment - specific O&M information for Internet access by the Owner.

C. The manual shall consist of (3) sets of manuals and include (3) sets of CDs, which shall contain the scanned content of the entire manual. The manual shall highlight the actual equipment used and not be a master catalog of all similar products of the manufacturer. The manual shall be submitted for review prior to creation of the CDs.

D. The Manual shall contain the following:

1. Operations Manual

a. Systems description including all relevant information needed for day-to-day operations and management including:

1) Start-up requirements and procedures, including Water Treatment systems.
2) Shut-down requirements and procedures, including Water Treatment systems.
3) Trouble-shooting checklist (i.e., common alarms with possible cause & effect, etc.).

b. Wiring diagrams, schematics, logic diagrams and sequence of operations that accurately depict the controls system.

c. Depiction of each interface screen where programmable logic and visual

displays are provided. Descriptors shall be provided to define displayed data, alarms, etc.

d. A single sheet (for ease of removal) of all access codes and passwords necessary to access all levels of control and programming.

2. Maintenance Manual

a. Define all maintenance activities required to ensure system operation within manufacturers specified parameters. Maintenance documentation shall include:

1) Data retrieval sheet
2) Special instructions (i.e., lockout/tag-out, etc.)
3) Special tools (i.e., key, allen wrench, etc.)
4) Tasks
5) Frequency
6) Required materials, lubricants, etc.

b. Provide table of all required activities plotted vs. interval with adequate fill-in-space for “activity completion date” and “comments”. Where multiple instrument readings are required, provide data sheet formatted to accommodate activity.

c. Provide as part of each package, lubricating charts indicating equipment tag number, location, equipment service, greasing and lubricating requirements, lubricants, and intervals.

d. Provide as part of each package, a valve and system chart that corresponds to the valve tags. Provide directions for normal positions and positions for equipment failure modes.

e. The HVAC Subcontractor shall furnish spare-parts data for each different item of equipment furnished. The data shall include a complete list of: parts and supplies, with current unit prices, lead time, and source of supply; a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment, or specified hereinafter to be furnished as part of the contract; and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 366 days at the particular installation. The foregoing shall not relieve the HVAC Subcontractor of any responsibilities under the guarantees specified herein.

f. Provide copy of all warranty information including extended warranties where specified with associated date of substantial completion (commencement of warranty) and end date of coverage. Define all components/subsystems specifically included and excluded.

E. Provide O&M manuals for each of the following as a minimum:

1. Valves and Accessories (all types, including charts for all balancing valves)
2. Electric Motors and Starters
3. Pumps (Water systems)
4. Air Handling Units

1.9 COORDINATION

A. Refer to Division 01, General Conditions, for record drawings and procedures to be provided under this section, unless specifically noted otherwise in this section.

B. Materials and apparatus shall be installed as fast as conditions of the building will permit

and must be installed promptly when and as required.

C. Confer with all other trades relative to location of all apparatus and equipment to be installed and select locations so as not to conflict with work of other sections. Any conflicts shall be referred immediately to the Owner's Representative for decision to prevent delay in installation of work. All work and materials placed in violation of this clause shall be readjusted to the Owner's Representative's satisfaction at no expense to the Owner.

D. Where work of this section will be installed in close proximity to work of other sections or where there is evidence that the work of this section may interfere with work of other sections, assist in working out space conditions to make satisfactory adjustment. Prepare and submit for approval 3/8 inch scale or larger working drawings and sections, clearly showing how the work is to be installed in relation to the work of other sections. If the work of this section is installed before coordinating with other trades or so as to cause interference with work of other trades, make changes necessary to protect conditions without extra charge.

E. Keep fully informed as to the shape, size and position of all openings required for all apparatus, piping, ductwork, etc., and give information in advance to build openings into the work. Furnish all sleeves, pockets, supports and incidentals, and coordinate with the Owner's Representative for the proper setting of same.

F. All distribution systems which require pitch or slope such as condensate drains and water piping shall have the right of way over those which do not.

G. Make reasonable modifications in the work as required by structural interferences, interference with work of other trades, or for proper execution of the work without extra charge.

H. Keep fully informed as to the size, shape and location of all openings required for the work of this section and give full information to all Subcontractors and the Owner's Representative.

1.10 RECORD DRAWINGS

A. Refer to DIVISION 1, General Conditions, for record drawings and procedures to be provided under this section, unless specifically noted otherwise in this section.

B. Record Drawings (red-line drawings) will be updated by this Contractor daily for review with the monthly requisition. The record drawing shall be an accurate depiction of the systems as completed, including dimensions (vertical/horizontal) of concealed components off fixed building elements.

C. The HVAC Foreman shall maintain complete and separate set of prints of Contract Drawings at job site at all times and shall record work completed and all changes from original Contract Drawings clearly and accurately including work installed as a modification or addition to the original design.

D. At completion of work the HVAC Contractor shall prepare a complete set of record drawings on AutoCAD showing all systems as actually installed. The Architectural background AutoCAD files will be made available for the Contractor's copying, at his expense, to serve as backgrounds for the drawings. The HVAC Contractor shall transfer changes from field drawings onto AutoCAD drawings and submit copy of files and three

(3) sets of prints to Owner's Representative for comments as to compliance with this section. CADD layering as established by the A & E design team shall be maintained with any and all changes done by the Contractor.

E. The Architect and Engineer are not granting to the Contractor any Ownership or property interest in the CADD Drawings by the delivery of the CADD Disks to the Contractor. The Contractor's rights to use the CADD disks and the CADD Drawings are limited to use for the sole purpose of assisting in the Contractor's performance of its contractual obligations under its contract with respect to the Project. The Architect and Engineer are granting no further rights. Any reuse or other use by the Contractor will be at the Contractor's sole risk and without liability to the Architect and Engineer. The Contractor hereby waives and releases any losses, claims, damages, liabilities of any nature whatsoever, and costs (including attorney fees) arising out of, resulting from, or otherwise related to the use of the CADD Disks and CADD Drawings by the Contractor. The Contractor, to the maximum extent permitted by law, hereby agrees to indemnify, defend and hold the Architect and Engineer harmless from all loses, claims, damages, liabilities, and costs (including attorney fees) arising out of, resulting from, or otherwise related to the use of the CADD Disks and CADD Drawings by the Contractor.

F. Record Drawings, shall show "as-built" condition of all plans, mechanical room part plans, details, sections, piping diagrams, control diagram and sequence changes and corrections to schedules. Schedules shall show actual manufacturer model numbers and capacities of final installed equipment.

G. The HVAC Contractor shall submit the record set for approval a minimum of three (3) weeks prior to seeking the permanent certificate of occupancy.

1.11 WARRANTIES

A. Submit manufacturer's standard replacement warranties for material and equipment furnished under this section. Such warranties shall be in addition to and not in lieu of all liabilities which the manufacturer and the HVAC Subcontractor may have by law or by provisions of the Contract Documents.

B. All materials, equipment and work furnished under this section shall be guaranteed against all defects in materials and workmanship for a minimum period of one (1) year commencing with the Date of Substantial Completion. Where individual equipment sections specify longer warranties, provide the longer warranty at no additional cost to the owner. Any failure due to defective material, equipment or workmanship which may develop, shall be corrected at no expense to the Owner including all damage to areas, materials and other systems resulting from such failures.

C. Guarantee that all elements of each system meet the specified performance requirements as set forth herein or as indicated on the drawings.

D. Upon receipt of notice from the Owner of the failure of any part of the systems during the guarantee period, the affected parts shall be replaced. Any equipment requiring excessive service shall be considered defective and shall be replaced.

1.12 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

A. It is the intention of the specifications and drawings to call for complete, finished work, tested and ready for continuous operation. Any apparatus, appliance, material or work

not shown on the drawings, but mentioned in the specifications or vice versa, or any incidental accessories necessary to make the work complete in all respects and ready for operation, even if not particularly specified, shall be provided by the HVAC Subcontractor or his/her Sub Subcontractors, without additional expense to the Owner.

B. The drawings are generally diagrammatic. The locations of all items that are not definitely fixed by dimensions are approximate only. The exact locations must be determined at the site and shall have the approval of the Architect before being installed. The HVAC Subcontractor shall follow drawings, including shop drawings, in laying out work and shall check the drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions. Where space conditions appear inadequate, notify the Architect before proceeding with the installation. The HVAC Subcontractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

C. Any requests for information (RFI) for resolving an apparent conflict or unclarity, or a request for additional detail, shall include a sketch or equivalent description of Contractors proposed solution.

D. Sizes of ducts and pipes and routing are shown, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered. To carry out the intent and purpose of the drawings, all necessary parts to make complete approved working systems ready for use, shall be furnished without extra charge.

1.13 INSPECTION OF SITE CONDITIONS

A. Prior to submission of bid, visit the site and review the related construction documents to determine the conditions under which the Work has to be performed. Send a report, in writing, to the Owner’s Representative, noting any conditions which might adversely affect the Work of this section of the specifications.

1.14 SURVEY AND MEASUREMENTS

A. Base all required measurements, horizontal and vertical, from referenced points established with the Owner’s Representative and be responsible for correctly laying out the Work required under this section of the specification.

B. In the event of discrepancy between actual measurements and those indicated, notify the Owner’s Representative in writing and do not proceed with the related work until instructions have been issued.

1.15 DELIVERY, STORAGE AND HANDLING

A. No materials shall be delivered or stored on site until Shop Drawings have been approved.

B. All manufactured materials shall delivered to the site in original packages or containers bearing the manufacturer's labels and product identification.

C. Protect materials against dampness. Store off floors, under cover, and adequately protected from damage.

D. Inspect all equipment and materials, upon receipt at the job site, for damage and conformance to approved shop drawings.

1.16 PROTECTION OF WORK AND PROPERTY

A. This Contractor shall be responsible for the care and protection of all work included under this section until the completion and final acceptance of this Contract.

B. Protect all equipment and materials from damage from all causes including, but not limited to, fire, vandalism and theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment at no additional cost to the Owner.

C. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen under this section and make good damage thus caused.

D. Damaged materials are to be removed from the site; no site storage of damaged materials will be allowed.

1.17 SUPERVISION

A. Provide a competent Supervisor with a minimum of 5 years of experience in HVAC Construction Supervision who shall be in charge of the HVAC work at the site.

1.18 SAFETY PRECAUTIONS

A. Life safety and accident prevention shall be a primary consideration. Comply with all of the safety requirements of the Owner and OSHA throughout the entire construction period of the project.

B. Furnish, place and maintain proper guards and any other necessary construction required to secure safety of life and property.

1.19 SCHEDULE

A. Construct work in sequence under provisions of Division 01 and as coordinated with the Owner’s Representative.

1.20 HOISTING, SCAFFOLDING AND PLANKING

A. The work to be done under this section of the specifications shall include the furnishing, set-up and maintenance of all derricks, hoisting machinery, cranes, helicopters, scaffolds, staging and planking as required for the work.

1.21 CUTTING AND PATCHING

A. Include all coring, cutting, patching, and fireproofing necessary for the execution of the

work of this section. Structural elements shall not be cut without written approval of the Architect. This Contractor shall be responsible for taking all precautions required to identify hidden piping, conduits, etc. before any core drilling and/or cutting of slabs commences, including X-raying the affected slabs. Provide fire stopping to maintain the fire rating of the fire resistance-rated assembly. All penetrations and associated fire stopping shall be installed in accordance with the fire stopping manufacturer's listed installation details and be listed by UL or FM.

B. All work shall be fully coordinated with all phases of construction, in order to minimize the requirements for cutting and patching.

C. Form all chases or openings for the installation of the work of this section of the specifications, or cut the same in existing work and see that all sleeves or forms are in the work and properly set in ample time to prevent delays. Be responsible that all such chases, openings, and sleeves are located accurately and are of the proper size and shape and consult with the Owner's Representative and all trades concerned in reference to this work. Confine the cutting to the smallest extent possible consistent with the work to be done. In no case shall piers or structural members be cut without the approval of the Owner's Representative.

D. Fit around, close up, repair, patch, and point around the work specified herein to match the existing adjacent surfaces and to the satisfaction of the Owner's Representative.

E. Fill and patch all openings or holes left in the existing structures by the removal of existing equipment that is part of this section of the specifications.

F. All of this work shall be carefully done by workmen qualified to do such work and with the proper and smallest tools applicable.

G. Any cost caused by defective or ill-timed work required by this section of the specifications shall be borne by the Subcontractor.

H. When, in order to accommodate the work required under this section of the specifications, finished materials of other trades must be cut or fitted, furnish the necessary drawings and information to the trades whose materials must be cut or fitted.

1.22 SLEEVES, INSERTS AND ANCHOR BOLTS

A. Coordinate with other trades the location of and maintaining in proper positions, sleeves, inserts and anchor bolts to be supplied and/or set in place under this section of the specifications. In the event of incorrectly located preset sleeves, inserts and anchor bolts, etc., all required cutting and patching of finished work shall be done under this section of the specifications.

B. All pipes passing through floors, walls, ceilings or partitions shall be provided with fire stopping to maintain the fire rating of the structure. All penetrations and associated fire stopping shall be installed in accordance with the fire stopping manufacturer's listed installation details. Provide sleeves for all penetrations where required by the listed detail, for the penetration of all mechanical room floors and where specifically required on the drawings.

C. Field drilling (core drilling), when required, shall be performed under this section of the specifications, after receipt of approval by the Owner's Representative.

1. When coring cannot be avoided, provide ¼ inch pilot hole prior to coring. When coring through floor or slab, verify location of core on floor below and protect and piping, ductwork, wiring, furniture, personnel, etc., below the location of the core.

1.23 SUPPLEMENTARY STEEL, CHANNELS AND SUPPORTS

A. Provide all supplementary steel, factory fabricated channels and supports required for proper installation, mounting and support of all equipment and systems provided under this section of the specification.

B. Supplementary steel and factory fabricated channels shall be firmly connected to building construction in a manner approved by the Owner's Representative, as shown on the drawings, or hereinafter specified.

C. The type and size of the supporting channels and supplementary steel provided under this section of the specifications shall be determined by the Subcontractor and shall be of sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.

D. All supplementary steel and factory fabricated channels shall be installed in a neat and workmanlike manner parallel to the walls, floors and ceiling construction. All turns shall be made with 90 degree and 45 degree fittings, as required to suit the construction and installation conditions.

E. All supplementary steel including factory fabricated channels, supports and fittings shall be galvanized steel, aluminum, or stainless steel where exposed or subject to rust producing atmosphere and shall be manufactured by Unistrut, H-strut, Powerstrut, ERICO or approved equal.

1.24 HAZARDOUS MATERIALS

A. Dispose of all hazardous materials in accordance with Federal and State laws. All handling shall conform to EPA requirements. A uniform hazardous waste manifest shall be prepared for all disposals and returned with all applicable signoffs prior to application for final payment. Provide breakout cost for this scope.

B. Recovered refrigerant shall be recycled by a licensed facility approved by the Owner's Representative.

C. Removed equipment or fluids containing any hazardous materials such as ethylene glycol, oil, mercury or chromate shall be recycled by a licensed facility approved by the Owner's Representative.

D. Where it has been identified that asbestos-containing material exists within the scope limits, refer to the Asbestos Abatement specification section for requirements. Where insulation is removed, provide new insulation (types and thicknesses as specified in this section). Where scope is not defined, provide unit prices with bid for all pipe and duct sizes involved.

1.25 ACCESSIBILITY

A. All work provided under this section of the specification shall be installed so that parts requiring periodic inspection, maintenance and repair are readily accessible. Work of this trade shall not infringe upon clearances required by equipment of other trades, especially code required clearances to electrical gear. Minor deviations from the drawings may be made to accomplish this, but changes of substantial magnitude shall not be made prior to written approval from the Owner's Representative.

1.26 ELECTRICAL WORK

A. All electrical apparatus and controls furnished, and the installation thereof, as a part of the HVAC work, equipment, and controls shall conform to applicable.

1.27 COMMISSIONING

A. The HVAC systems shall be provided with system commissioning by the contractor in accordance with section C408 of the 2015 (for reference – other years may have a different section number) International Energy Conservation Code. The contractor shall provide commissioning and commissioning plans including preliminary commissioning reports developed by a registered design professional or an approved agency in accordance with the commissioning section referenced above in the International Energy Conservation Code. The same registered design professional or approved agency shall provide evidence of mechanical systems commissioning and completion to the professional engineer stamping the HVAC drawings in accordance with the provisions of the code sections.

1.28 PROJECT CLOSEOUT

A. Certificates Of Approval

1. Upon completion of all work, provide certificates of inspections from the following equipment manufacturers stating that the authorized factory representatives have inspected and tested the operation of their respective equipment and found the equipment to be in satisfactory operating condition and installed per the manufacturers installation instructions and requirements.

   a. Rooftop HVAC Units
   b. Air Handling Units

B. Construction Observations By The Engineer

1. The engineer shall make progress site visits during construction and one (1) substantial completion (punch list) site visit for determining substantial completion.
2. The Trade Contractors and the General Contractor are required to inspect their own work and make any corrections to the work to comply with the specifications and the contract documents. It is not the responsibility of the engineer to develop lists of incomplete work items.
3. Progress Site Visits

   a. The purpose of the progress site visit by the engineer is to observe if the work is proceeding in accordance with the contract documents.

   b. The engineer will prepare a field report which will note in general the work

completed since the last observation visit, work found not to be in accordance with the contract documents and work not corrected since the previous observation visit.

C. Substantial Completion

1. When the Contractor considers the Work under this section is substantially complete, the Contractor shall submit written notice, through the General Contractor, with a detailed list of items remaining to be completed or corrected and a schedule of when each remaining work item will be completed. Should the engineer determine the list of remaining work does not constitute substantial completion the engineer will notify the Architect and/or Owner and he will not make a substantial completion site visit.
2. The following items shall be completed prior to the written request for substantial completion site visit:
    a. Certification of successful operation of all systems.
    b. Training of the Owner's personnel in the operation of the systems.
    c. Record Drawings in accordance with the contract specifications.
    d. Operation and Maintenance manuals.
    e. Testing reports.
    f. Balancing reports.
    g. Manufacturers certificates of approvals.
    h. Emergency contact list for reporting of malfunctioning equipment during the warranty period.
    i. Contractors Project Completion certificate in accordance with the building code requirements.
3. Should the Engineer, during the substantial completion visit, observe that the Work is substantially complete, s/he will provide a written listing of the observed deficiencies referred herein as the Punch List. The Punchlist will provide for a place for the Contractor and General Contractor to sign off and date each item individually indicating that the observed deficiency item has been corrected.
4. Should the Engineer, during the substantial completion site visit, observe that the Work is not substantially complete, s/he will provide, a written list of the major deficiencies and a reason for the work not being considered substantially complete.
5. If the work is found not to be substantially complete then the engineer shall be reimbursed for his time to reobserve the work. A re-observation fee shall be charged to the Contractor through the contractual agreement for any further observations by the engineer.
6. The Contractor shall remedy all deficiencies listed in the punchlist within the time frame required by the contract.

D. Engineers Construction Completion Certification

1. Where required by the applicable code, the Engineers Construction Completion Certification will be issued by NV5 when all life safety and health related issues are complete, all required functional tests are complete and all reports are complete. The following is a minimum listing of the required systems to be tested with reports generated indicating they are complete and ready for use:
    a. Air and Water Balancing
    b. Duct Pressure/Leakage Tests
    c. Pipe Pressure Tests
2. There shall be NO outstanding items identified on the punchlist for scope within

any of these categories.

E. Final Completion

1. The following items shall be submitted prior to the written request for Final completion:
   a. Revised Substantial Completion items to be resubmitted in accordance with the review process comments.
   b. Warranties commencing the date of Substantial completion
   c. Individual Signed and dated Punchlist acknowledging completion of all punchlist items
2. When the Contractor considers all of the punchlist work items complete, the Contractor shall submit written notice through the General Contractor that all Punchlist items are complete and resolved and the work is ready for final observation site visit. The signature lines for completion of each punchlist item shall be signed by the Contractor indicating the work is complete and signed by the General Contractor indicating s/he has inspected the work and found it to be complete. Should the Engineer find the work to be finally complete and all Punchlist items are complete the Engineer will make a recommendation to the Architect or Owner. If the Engineer has found the punchlist work to be incomplete during final inspection a written listing of the observed deficiencies will be prepared by the Engineer.
3. If the work is not fully complete then the engineer shall be reimbursed for his time to re-observe the work. A re-observation fee shall be charged to the Contractor through the contractual agreement for any re-observations by the engineer.

F. Re-observation Fees

1. The re-observation fee shall be $1200.00 per visit.

G. Contractor's Project Completion Certificate

1. Upon completion of work and prior to request for Certificate of Occupancy, each Trade Contractor and the General Contractor shall issue a certificate stating that work has been installed generally consistent with construction documents and all applicable codes. NV5 can furnish a blank Contractor's certificate form upon request. The certificate shall certify:
   a. Execution of all work has been installed in accordance with the approved construction documents.
   b. Execution and control of all methods of construction was in a safe and satisfactory manner in accordance with all applicable local, state and federal statutes and regulations.
2. The certificate shall include the following information:
   a. Project.
   b. Permit Number.
   c. Location.
   d. Construction Documents.
   e. Date on Plans and specifications submitted for approval and issuance of the Building Permit.
   f. Addendum(a) and Revision Dates.

3. The certificate shall be signed by the Contractor and include the following:

   a. Signature.
   b. Date.
   c. Company.
   d. License Number.
   e. License Expiration Date.

PART 2 - PRODUCTS

2.0 SLEEVES

A. Size sleeves to provide a minimum of one (1) inch clearance around piping and ductwork, and to allow continuous runs of insulation where specified. Ensure that insulated piping and ductwork do not touch sleeves.

B. Pack clearance spaces with Thermafibre Fire stopping. Caulk with fire-resistant, resilient waterproof compound, RectorSeal Biostop 500+ or equal. Ensure that fire ratings of floors and walls are maintained.

C. Piping sleeves shall be according to the following:

1. Through interior non-masonry walls, use 18 gauge rolled and tack welded galvanized steel sleeves, set flush with finished surfaces on both sides.
2. Through interior masonry walls, exterior walls above grade and roofs, use machine cut and reamed standard weight steel piping, set flush with finished surfaces on inside and to suit flashing on outside.
3. For floors in mechanical equipment rooms, and similar areas where a water dam is required, use machine cut and reamed standard weight steel piping set flush to underside of structure and extending six (6) inches above finished floor.
4. For other floors, use 18 gauge rolled and tack welded galvanized steel, or machine cut and reamed plastic pipe or standard weight steel piping set flush to both finished surfaces. Refer to Room Finish Schedule.
5. Cover pipe sleeves in walls and ceilings of finished areas other than equipment rooms with satin finish stainless steel, or satin finish chrome or nickel plated brass escutcheons, with non-ferrous set screws. Do not use stamped steel split plates. Split cast plates with screw locks may be used.
6. In non-rated walls, escutcheon plates shall be of adequate size to allow for piping with full insulation to pass through the wall uninterrupted. The interior diameter of the plate shall fit snugly around the outside diameter of the insulation.

D. Duct sleeves shall be minimum 18 gauge galvanized steel. Provide adequate bracing for support of sleeves during concrete and masonry work. For fire rated floors and walls, build fire dampers into structure to attain fire rated construction, in a manner acceptable to the local and state authorities.

E. Cover exposed duct sleeves in finished areas with 18 gauge galvanized steel plates in the form of duct collars. Fix in position with non-ferrous metal screws.

2.1 FIRE STOPPING

A. Provide asbestos-free fire stopping material capable of maintaining an effective barrier

against flame, gases, and temperature. Provide noncombustible fire stopping that is nontoxic to human beings during installation or during fire conditions. Devices and equipment for fire stopping service shall be UL FRD listed or FM P7825 approved for use with applicable construction, and penetrating items.

1. Fire Hazard Classification: Material shall have a flame spread of 25 or less, a smoke developed rating of 50 or less when tested in accordance with UL 723 or UL listed and accepted.
2. Fire stopping Rating: Fire stopping materials shall be UL FRD listed or FM P7825 approved for "F" and "T" ratings at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected, except that "F" and "T" ratings may be three (3) hours for fire stopping in through-penetrations of 4-hour fire rated wall or floor.

2.2 PIPING, DUCTWORK, EQUIPMENT, PANEL AND VALVE IDENTIFICATION

A. All piping, ductwork, equipment, panels and valves furnished and/or installed under this section of the specifications including automatic temperature controls shall be identified with pipe markers, valve tags, ductwork markers, and equipment name plates. Refer to Part 3 – Identification for materials and methods of installation.

2.3 MOTORS, DRIVES AND STARTERS

A. All equipment shall be provided complete with motors and drives, unless otherwise indicated.

B. Motors shall be Premium Efficiency (as available by size/speed/horsepower) and shall conform to NEMA Standards and shall be suitable for load, duty service and location. Motors shall have nameplates giving manufacturer's name, serial number, horsepower, efficiency, speed and current characteristics. Motors shall be Century “E+3”, General Electric “Energy Saver Premium”, Reliance “Premium Energy Efficient” Series, Baldor “Super Premium Efficiency”, or approved equal. Motors shall have a minimum manufacturer’s warranty of 3 years.

C. Motors shall be tested in accordance with the standards of ANSI C50 and conform therewith for insulation resistance and electric strength. Minimum efficiency levels shall be as listed in latest edition of ANSI/ASHRAE Standard 90.1 or the state’s energy code, whichever is higher. All motors shall be tested in accordance with IEEE Standard 112, Test Method B. Provide on nameplate the type of bearing grease to use.

D. Motors for use with variable frequency drives (VFD) shall be inverter duty rated and labeled, meet NEMA MG-1 Part 31, and have a minimum Class F or H insulation. All VFD motors shall have AEGIS™ or approved equal Shaft Ground Rings to prevent electrical bearing damage from capacitively coupled shaft voltages. For motors up to 100 HP, ring shall be installed on either the drive end or non-drive end. Motors over 100 HP shall have ring installed on the drive end of the motor with an insulated bearing on the non-drive end to prevent circulating currents. If rings are not factory installed, Contractor shall install them in the field following manufacturer’s requirements and, to start factory warranty, shall register them with AEGIS™ in the Owner’s name. Failure to install or register the rings will require Contractor to take on the responsibility of providing a 15 year warranty and to replace any failed motor bearings during the 15 year period.

E. Motors 1/2 HP and larger shall have ball or roller bearings with pressure grease lubrication, specifically wound for the scheduled voltages. All bearings shall be suitable for radial and thrust loading.

F. Single-Phase Motors

1. Motors 1/20 HP and Smaller: Shaded-pole type.
2. Motors over 1/20 HP and less than 1/12 HP shall be one (1) of the following, to suit starting torque and requirements of specific motor application:

    a. Permanent-split capacitor.
    b. Split phase.
    c. Capacitor start, inductor run.
    d. Capacitor start, capacitor run.

3. Motors not less than 1/12 HP and less than 1 HP shall be electronically commutated (ECM) with a means to adjust motor speed for balancing or modulation or remote speed control (based on the application requirements), OR have a minimum efficiency of 70% (rated in accordance with DOE 10 CFR 431), and be one (1) of the following alternates to ECM (if ECM type is required by being listed in the equipment schedule, no alternate type may be used), to suit starting torque and requirements of specific motor application:

    a. Permanent-split capacitor.
    b. Capacitor start, inductor run.
    c. Capacitor start, capacitor run.

4. Bearings: Prelubricated, antifriction ball bearings for motors 1/12 HP and larger or, for motors under 1/12 HP, ball or sleeve bearings. All bearings shall be suitable for radial and thrust loading.
5. Fractional horsepower motors, integral to equipment intended for installation in finished public spaces, shall be provided with an overload device responsive to motor current. The device shall be integral to the motor and include a wired, concealed, NEMA rated disconnect switch.

G. Electronically Commutated Motors (ECM): Motors shall be equal to General Electric ECM, variable-speed, DC, brushless motors specifically designed for use with single phase, 277 V (or 120 V), 60 Hz electrical input. For motors 1 HP and larger efficiency shall meet or exceed the minimum efficiencies listed in the governing energy code, or the efficiencies listed above, whichever is higher. Motors shall be complete with and operated by a single-phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commutate the stator. All motors shall be designed for synchronous rotation. Motor rotor shall be permanent magnet type with near zero rotor losses. Motor shall have built-in soft start and soft speed change ramps. Motor shall be able to be mounted with shaft in horizontal or vertical orientation. Motors shall maintain a minimum of 70% efficiency over their entire operating range. Provide motor speed control, either integral to the motor or by remote input by the control system (0-10 VDC signal), as indicated on the drawings and by the control sequences) for field adjustment between 20% and 100% of motor speed. Inductors shall be provided to minimize harmonic distortion and line noise. Motors shall be designed to overcome reverse rotation and not affect life expectancy. Motors shall have a minimum manufacturer's warranty of 3 years.

H. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

I. All motors over 5 HP for variable flow air and water systems shall be variable speed. In addition, the drawings may require variable speed motors for smaller motors or for motors with constant flow systems. Coordinate motors with VFD or starter type used.

J. Motors shall be furnished complete with conduit terminal box of size adequate to accommodate conduits and wires as sized on the Electrical Drawings or specified under this section.

K. Motor capacity shall be sufficient to operate associated driven devices under conditions of operation and load and with overload and at least the horsepower indicated or specified. All motors shall be of the premium efficiency, high power factor, low energy consuming type most suitable for the application and installed environment. Any motor replacement necessary for compliance to the application shall be at no additional cost to the Owner.

L. Motors shall be suitable for continuous duty at rated horsepower with temperature rise not to exceed 40°C for drip proof motors, 50°C for splash proof motors, 55°C for totally enclosed or explosion proof motors. All non-VFD motors shall be capable of 15% overload without overheating and suitable for operation for the ambient conditions of its specific location.

M. Direct connected motors shall be furnished with adjustable base. Motors connected to driven equipment by belt or shaft shall be furnished with adjustable sliding bases, except fractional HP motors, which shall have slotted mounting holes.

N. Drives for belted motors shall be as manufactured by Dodge Manufacturing Company, Browning Manufacturing Company, T.B. Woods Company or equal with adjustable motor sheaves and adjustable slide bases. The drive belts shall be as short as practicable. All fans and fan units shall be furnished with cogged-type triple V-belt drives, each sized for 150% of the design drive capacity. All multiple belt drives shall have matched sets of belts.

O. Where starters or variable speed drives are not integral with packaged equipment specified in this section, the Contractor shall furnish all starters and drives in accordance with the drawings and specifications.

P. For packaged equipment, motor controllers shall be equipped with all poles, auxiliary contacts and other devices necessary to permit the interlocking and control sequences required. Controller operating coils shall be generally designed for 120 V operation, and 3 phase motors shall be provided with thermal overload protection in all phases.

Q. All electrical apparatus furnished under this section shall be approved by UL (or other agencies approved by the authority having jurisdiction) and shall be labeled or listed where such is applicable. Where custom-built equipment is specified and the UL label or listing is not applicable to the completed product, all components used in the construction of such equipment shall be labeled or listed by UL where such is applicable to the component.

2.4 FACTORY PAINTING

A. Units which are not of aluminum, stainless steel, or galvanized construction (according to ASTM A 123 or ASTM A 525) shall be factory painted with a corrosion resisting paint finish. Internal and external ferrous metal surfaces shall be cleaned, phosphatised and coated with a paint finish which has been tested according to ASTM B 117, ASTM D 1654, and ASTM D 3359. Evidence of satisfactory paint performance for a minimum of

one hundred and twenty-five (125) hours for units to be installed indoors and five hundred (500) hours for units to be installed outdoors shall be submitted. Rating of failure at the scribe mark shall be not less than six (6), average creepage not greater than 1/8 inch. Rating of the inscribed area shall not be less than ten (10), no failure. On units constructed of galvanized steel which have been welded, exterior surfaces of welds or welds that have burned through from the interior shall receive a final shop docket of zinc-rich protective paint according to ASTM D 520 Type I.

PART 3 - EXECUTION

3.0 DEMOLITION

A. Refer to the drawings for demolition scope applicable to the project.

3.1 GENERAL REQUIREMENTS

A. Install all items specified under PART 2 - PRODUCTS, according to the manufacturer's requirements and best quality recommendations, shop drawings, the details as shown on the drawings and as specified in this specification section.

B. Earthwork: Excavation and backfilling for underground piping and tanks shall be as specified in the EXCAVATION, TRENCHING AND BACKFILLING section.

C. Install all work so that parts requiring inspection, replacements, maintenance and repair shall be readily accessible. Minor deviations from the drawings may be made to accomplish this, but any substantial change shall not be made without prior written approval from the Owner.

D. Equipment bases mounted on concrete slabs and pads, or mounted on stands, gratings, platforms, or other, shall not be set in any manner, except on the finished and permanent support.

E. Support of equipment on studs or other means, and the placing or building of the supporting slab, pad, pier, stand, grating, or other "to the equipment", is prohibited.

F. Concrete supporting structures shall have been constructed and cured a minimum of fourteen (14) days before equipment is mounted.

G. All welding done under this section shall be performed by experienced welders in a neat and workmanlike manner. All welding done on piping, pressure vessels and structural steel under this section shall be performed only by persons who are currently qualified in accordance with ANSI Code B31.9 and B31.1 for Pressure Piping and certified by the AWS, ASME or an approved independent testing laboratory, and each such welder shall present certificate attesting his/her qualifications to the Architect's representative whenever requested to do so on the job.

H. All pipe welding shall be oxyacetylene or electric arc. High test welding rods suitable for the material to be welded shall be used throughout. All special fittings shall be carefully laid out and joints shall accurately match intersections. Care shall be exercised to prevent the occurrence of protruded weld metal into the pipe. All welds shall be of sound metal free from laps, cold shots, gas pockets, oxide inclusions and similar defects.

I. All necessary precautions shall be taken to prevent fire or damage occurring as the result of welding, soldering, brazing or any other hot work, including fire watches.

J. Care shall be taken when working on the roof. Protect the roof from damage.

3.2 IDENTIFICATION

A. General

1. All piping, ductwork, equipment, panels, life safety dampers, and valves furnished and/or installed under all specification sections of Division 23 shall be marked for ease of identification.
2. Marking shall be done using self-adhering (screw or rivets for equipment) labels applied to clean, smooth surfaces. All lettering shall have sharply contrasting background for ease of identification. Colors shall be in accordance with ANSI A13.1 Standards. Samples of stickers together with color schedules shall be submitted for approval.

B. Pipe Identification

1. Provide color-coded pipe identification markers prominently located on all piping in the building installed under this section. Pipe markers shall be heavy plastic faced cloth labels with heat resistant backing, "Set Mark" by Seton Nameplate Corporation, Zipper Tubing Co., or equal by the W. H. Brady Company or approved equal.
2. Provide each pipe with markers/labels indicating the service, size (in inches), and arrow markers to indicate the direction(s) of flow.
3. Pipe labels shall be spaced at maximum intervals of forty (40) feet along each run. Reduce intervals to twenty (20) feet in areas of congested piping and equipment and above ceilings. In finished occupied spaces without ceilings (exposed piping) labels shall be located just before the piping enters the space and just after the piping exits the space and at intervals of 100 feet within the space. Provide labels near each valve and control device. This work shall be done after finish painting has been completed.
4. The following color coding shall be used with names in black letters on backgrounds indicated:

SCHEDULE OF PIPING IDENTIFICATION		
Service	**Legend**	**Background Color**
Condensate drains	Condensate Water	Green
Process Water Supply	PWS	Yellow (hot) or Green (cold)
Process Water Return	PWR	

5. In general, a two (2) inch high legend shall be used for pipe lines four (4) inch diameter and larger, and a ¾ inch high legend shall be used for pipe lines three (3) inch diameter and smaller.

C. Equipment Identification (by Unit Manufacturer)

1. Equipment marking shall be prominently located and securely attached with screws or rivets (no adhesives or cements are permitted) on the normally visible side of the equipment.
2. Equipment identification designations shall be taken from equipment callouts as shown on drawings and coordinated with the Owner's facility group to assure designations match up with Owner's maintenance management system identification database.
3. Provide on the label (or on a prominently located second label) all required

routine maintenance action (per manufacturer). Label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of product.

3.3 FIRE STOPPING INSTALLATION

A. Install fire stopping assembly at locations shown and as specified in accordance with UL FRD systems or FM P7825 designs, and as recommended by manufacturer. Do not cover or enclose fire stopped areas until approved by the Owner's Representative.

B. Completely fill openings around penetrating items with fire stopping material to prevent spread of fire in the following locations:

1. Around duct, cable, conduit, piping, and their supports that penetrate fire-rated above grade floor slabs, interior partitions, and exterior walls.
2. Around openings and penetrations through fire-rated ceiling assemblies.
3. Around penetration of vertical fire-rated service shafts.
4. Around openings and penetrations through fire-rated enclosures.
5. Other locations indicated.
6. At all air barrier penetrations as defined in the State's Energy Code.

C. Completely fill voids flush with the surface; the depth of material shall be in accordance with UL FRD or FM P7825. Fire stopping for filling voids in floors in which smallest dimension of a void is four (4) inches or more shall support the floor design load or be protected by a permanent barrier. Damaged, disrupted, or removed fire stoppings shall be replaced with new fire stoppings as specified in this section.

D. Insulated Pipes and Ducts: Cut and remove thermal insulation where pipes or ducts pass through fire stoppings. Replace thermal insulation with a material having equal thermal insulating characteristics and equal fire stopping characteristics.

E. Wall and Floor Penetration by Plastic Drain, Waste, and Vent Pipes: A 2 hour fire resistive chase enclosure shall be maintained by encasing the pipe in an eighteen (18) inch steel sleeve and penetrating the chase at a 45 degree downward angle. Chases shall be fire stopped at each floor.

3.4 FIELD PAINTING AND COATING

A. Except as otherwise specified, ferrous metal shall be cleaned, prepared, and painted as specified in the PAINTING section. Exposed pipe covering shall be painted. Aluminum sheath over insulation shall not be painted unless otherwise noted.

3.5 AIR AND HYDRONIC SYSTEMS BALANCING

A. General Requirements

1. The Contractor shall select AABC MN-1, NEBB-01, SMACNA-07 or ASHRAE 111 as the standard for providing testing, adjusting and balancing (TAB) of air and hydronic systems. The selected standard shall be used throughout the project. Testing, adjusting, and balancing shall be accomplished by a firm certified for testing and balancing by Associated Air Balance Council (AABC), Testing, Adjusting, and Balancing Bureau (TABB), National Environmental Balancing

Bureau (NEBB), or National Balancing Council (NBC).

B. Prior to testing, adjusting, and balancing, the Contractor shall verify that the systems have been installed and are operating as specified. Approved detail drawings and all other data required for each system and/or component to be tested shall be attached to system flow diagram documentation.

C. The Contractor shall verify that all balancing devices required during the field coordination phase and confirm during the construction phase that they are properly installed to permit testing, adjusting and balancing and that all duct leakage tests have been completed prior to testing, adjusting and balancing. The dampers used for balancing shall be remote from the diffusers and registers, unless the registers are directly attached to the mains. The Owner's Representative shall be notified in writing of all equipment, components, or balancing devices, that are damaged, incorrectly installed, or missing, as well as any design deficiencies that will prevent proper testing, adjusting, and balancing. Testing, adjusting, and balancing shall not commence until approved by the Owner's Representative. Instrumentation accuracy shall be in accordance with the standard selected in this paragraph.

1. The HVAC Subcontractor as a part of his contract shall provide all materials, labor and service of all Subcontractors for fulfillment of air and water balancing of all systems. The TAB Sub Subcontractor shall inform the HVAC Subcontractor of all requirements ahead of time.
2. Provide additional sheaves and belts required to reach design CFM levels.
3. In addition to the procedures outlined in this specification section, the procedures used for air, hydronic and temperature balancing shall also be in conformance with the "Procedural Standards for Testing, Adjusting, Balancing of Environmental System", seventh (2005) edition published by the National Environmental Balancing Bureau, the "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems", fifth edition published by the Associated Air Balance Council or the Practical Standards and Procedures published by Testing, Adjusting, and Balancing Bureau or the National Balancing Institute.
4. A copy of the standards must be maintained on site by the Balancing Subcontractor at all times. The test report forms shall comply with the formats listed in these standards.

D. Instrument Accuracy Requirements

1. All instrumentation shall be checked for accuracy before beginning testing, adjusting and balancing procedures. Instrument accuracy shall be in accordance with the standard selected in Paragraph A. General Requirements, immediately above. Checks may be carried out against similar equipment maintained specifically for checking purposes or by the manufacturer or a recognized testing facility. All instrumentation used for testing shall be calibrated within six (6) months of use. Pitot tubes and U-tube manometers do not require checking. In no case shall the instrumentation accuracy be less than specified by the instrument manufacturer. Any instrument falling out of calibration during the process of balancing and testing shall be recalibrated or removed from the site and replaced by a properly calibrated instrument. No instruments shall be allowed to remain on-site that are not in calibration.

E. Integral with the TAB standard followed, the TAB Contractor shall submit in the submittal phase the following documents:

1. Qualification data shall be submitted, sixty (60) days prior to testing and balancing operations. The test and balance firm shall be certified by the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), Testing, Adjusting, and Balancing Bureau (TABB), or the National Balancing Council (NBC). The lead balancing technician shall be qualified by AABC, NEBB or NBC and his qualification data shall include past experience on at least five (5) similar projects. Provide proof of certification
2. TAB Plan and preliminary timeline.
3. Individual system one-line flow diagrams with pertinent data (i.e., static pressure, velocities, CFM, GPM, etc.) indicated on the applicable flow diagram for all components. Diagrams shall be made for each individual air and hydronic system.
4. The preliminary TAB report, thirty (30) days before balancing commences. The report shall be organized by specific systems and shall clearly identify each item of equipment to be tested, adjusted, and balanced. The appropriate test procedures and measurements to be taken for each item of equipment shall be listed. Instrument calibration records shall be provided on forms shown in AABC MN-1 or SMACNA-07. Manufacturer's specified accuracy shall be shown. The report shall include floor plan drawings showing all dimensions of ductwork, piping and their related measurement locations and types of measurements to be made. All related data necessary for testing, balancing, and adjusting, including fan and pump curves, actual and nameplate speeds, voltage and amp draw (each leg) shall be included. A system readiness checklist, similar to that shown in SMACNA-07, shall be included. The report shall contain a listing of the deficiencies of all systems to be tested, adjusted and balanced and the corrective action taken. The report shall contain a schedule for the final testing and balancing.
5. The final TAB report on forms shown in AABC MN-1, SMACNA-07, or equivalent forms from NEBB or NBC, within 2 weeks after completion of the test and balance operation. Data shall be in a hard bound cover identifying the project name, location, date of submittal, name of Contractor, and a general title indicating the specific area and type of work, and shall be signed by a registered professional engineer, employed by the test and balance firm, who has a minimum of two (2) years' experience in testing, adjusting and balancing work. The final report shall include a summary of the preliminary report describing test methods, test results, and major corrective actions taken. The report shall include as-tested floor plans showing all measurement locations and types of measurements made. The air handling unit data shall include a static pressure profile diagram, and pitot tube traverses where possible. The VAV terminal data shall include maximum and minimum air flows, for design and actual conditions, and shall be supported with summaries which show the air outlet totals for each VAV terminal and the VAV terminal totals for each air handling unit. Air distribution data shall include coded drawings which show the exact location of each air outlet. Pump data shall include pump efficiency. Data for chillers, heating and cooling coils, and heat exchangers, shall include heat balance calculations.
6. All instruments that are recalibrated and brought back onto the jobsite after being found to be out of calibration shall have recalibration records submitted on forms shown in AABC MN-1 or SMACNA-07.

F. The facility shall be essentially complete with final ceiling, walls, windows, doors and partitions in place. Doors and windows surrounding each area to be balanced shall be closed during testing and balancing operations. Air systems shall be complete and

operable with balancing dampers, ducting, diffusers, returns, flow control boxes and control components in place. Exhaust fans and any hoods shall be operational. Hydronic systems shall be complete and operable with balancing valves, flow meters, coils, pumps, piping and control components in place. All measurements and adjustments shall be made using procedures described in standard selected in paragraph GENERAL REQUIREMENTS. Air motion and distribution from air terminals shall be as shown. All data including deficiencies encountered and corrective action taken shall be recorded. If a system cannot be adjusted to meet the design requirements, the Contractor shall promptly notify the Owner's Representative in writing.

G. Air Systems: Each system shall be adjusted until all flow quantities (supply, return, exhaust/relief, and outdoor air) are within plus 10% and minus 5%. Dampers shall be checked for tight shutoff. Any air leakage around dampers shall be rectified. [Face and bypass dampers shall be set for air flow through coils.] [Multizone dampers shall be set for air flow through cooling coils.] Fire and smoke dampers shall be open. Fans shall be checked for correct direction of rotation and proper speed shall be verified. Fire and smoke dampers shall be tested at system design air flow to ensure proper closure in accordance with NFPA 90A and manufacturer's instructions prior to building occupancy.

1. Filters: Clean filters shall be installed at the beginning of the testing, adjusting, and balancing effort. For constant volume air handling units (no VFD), simulate the filters as ½ dirty by adding pressure drop (by temporarily adding cheese cloth or by other means). If the added P.D. is not listed in the schedules, confirm what to use with the engineer. For variable volume air handling units, simulate the filters as dirty (by temporarily adding cheese cloth or by other means). If the dirty P.D. is not listed in the schedules, confirm what to use with the engineer.
2. General Balancing Methods: In addition to the requirements for specific systems, flows in supply, exhaust and return air systems shall be balanced using the methods in standard selected in paragraph GENERAL REQUIREMENTS. Throttling losses shall be limited. Air flow adjustments shall be made by first adjusting the fan speed to meet the design flow conditions. Fan speed adjustment may not be required for fan motors which are less than 746 W, (one horsepower,) or if throttling results in no greater than an additional 5% of the kw draw above that required if the fan speed were adjusted. If the excess draw causes the motor to enter its service factor, fan speed shall be reduced accordingly. Flows and pressures shall be checked in all main risers and supply ducts at all supply, exhaust and return fan discharges. All flows shall be recorded before and after each adjustment.
3. Specific Systems All special or additional procedures for testing and balancing shall be in accordance with the applicable requirements of the standard selected in paragraph GENERAL REQUIREMENTS.

H. Hydronic Systems: All valves and control components shall be open or set as required for maximum system flow. Each system shall be adjusted until all flow quantities are within plus/minus 10%. Pumps shall be checked for proper speed. Pump activation signal and deactivation signal valves shall be verified. Pump motor current shall be checked at maximum design flow. Variable speed pumping systems shall be tested at a minimum of four (4) separate flow conditions to simulate design diversity.

1. General Balancing Methods: In addition to the requirements for specific systems, flows in piping, coils and other hydronic system components shall be balanced using the flow meter, balancing valve, equipment or pump curve methods in accordance with the applicable provisions of the standard selected in paragraph GENERAL REQUIREMENTS. Flows shall be balanced in all flow bypasses, coils, heat exchangers, boilers, chillers, pump discharges and any locations where flow rate is indicated on drawings. Pressure taps on all pumps shall be

made at factory suction and discharge tappings where available. All flows shall be recorded before and after each adjustment. Balancing is simplified where self-adjusting Pressure Independent Automatic Control Valves (PIACV) or flow limiting valves (Griswold type) are used, as the balancer only needs to set ("dial in") the flow and verify the valve flow setting on the device matches and is adjusted to the design equipment flow. If the PIACV or Griswold type device flow is not set to the equipment's design flow, obtain directions for setting the flow with the BAS contractor (for PIACV's) or mechanical contractor (for Griswold type devices) to make the adjustments required or, if the device can't be set properly to have the device replaced with the a device that will give the required flow. Once the device has been set to the correct flow, verify that the valve pressure drop is within the valve's control range per the manufacturer's procedures. Where PIACV's serve multiple coils, proportionally balance each coil to its percentage flow.

3.6 BASES AND SUPPORTS

A. In addition to supports and hangers as mentioned in the MISCELLANEOUS METALS section, provide all bases and supports not part of the building structure, of required size, type, and strength, as approved by the Architect, for all equipment and materials furnished by him. All equipment, bases and supports shall be adequately anchored to the building structure to prevent shifting of position under operating conditions.

B. All concrete foundations and all concrete supports will be provided by the General Contractor. The HVAC Subcontractor shall furnish shop drawings and templates for all concrete foundations and supports for setting all required hanger and foundation bolts and other appurtenances necessary for the proper installation of his equipment. All concrete work shall be shown in detail on the shop drawings prepared by the HVAC Subcontractor, and be submitted to the Architect, showing the complete details of all foundations, including the necessary concrete and steel work and vibration isolation devices.

C. All floor-mounted equipment shall be erected on concrete pads over the complete floor area of the equipment, unless specified to the contrary herein.

3.7 WATERPROOFING

A. Pipes passing through slabs shall have the sleeve extended ¼ inch above floors of finished spaces and two (2) inches above floors of mechanical equipment rooms. The space between the pipe and sleeve shall be sealed with interlinking seals equal to Link-Seal.

B. Ducts through slabs shall have the sleeve extended ¼ inch above floors of finished spaces and two (2) inches above floors of mechanical equipment rooms. The space between the pipe and sleeve shall be caulked with lead wool. The top shall be sealed with lead and the bottom shall be sealed with monolastic caulking compound.

3.8 MISCELLANEOUS IRON AND STEEL

A. All work shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets, and framework shall be properly sized and firmly constructed.

B. Measurements shall be taken on the job and worked out to suit adjoining and connecting work. All work shall be by experienced metal working mechanics. Members shall be straight and true and accurately fitted. Scale, rust, and burrs shall be removed. Welded joints shall be ground smooth where exposed. Drilling, cutting and fitting shall be done as required to properly install the work and accommodate the work of other trades as directed by them.

C. Members shall be generally welded, except that bolting may be used for field assembly where welding would be impractical.

D. All shop fabricated iron and steel work shall be cleaned and dried and given a shop coat of paint on all surfaces and in all openings and crevices.

3.9 PLACING IN SERVICE

A. At the completion of performance tests and following approval of test result, recheck all equipment to see that each item is adequately lubricated and functioning correctly.

B. Furnish upon completion of all work, certificates of inspections from the manufacturers stating that authorized factory engineers have inspected and tested the operation of their respective equipment and found same to be in satisfactory operating conditions.

3.10 CLEANING AND ADJUSTING

A. During the progress of the work, clean up and remove all oil, grease, and other debris caused by the work performed under this section.

B. At the conclusion of the project, clean and repair all areas and finishes as installed or affected by this installation of work under this section.

C. Pipes shall be cleaned free of scale and thoroughly flushed of all foreign matter. A temporary bypass shall be provided for all water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from all water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented.

D. Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.11 OPERATING AND MAINTENANCE INSTRUCTIONS

A. All operating equipment installed under this section shall be placed in operation and shall function continuously in an operating test for a minimum period of two (2) weeks without

shutdown due to mechanical failure or necessity of adjustment. Prior to scheduling the Project Final Inspection and after completion of all installation and running adjustments, the HVAC Subcontractor shall perform all work required to place the equipment in complete operating condition to meet all requirements under this specification.

B. During this running test period, the HVAC Subcontractor shall deliver to the designated representative of the Owner, through the Architect, one (1) electron set and three (3) complete bond sets of operating, service and replacement data for all equipment which will require operating maintenance or replacement and one (1) additional copy of this literature shall be available during the instruction of the operating personnel while the electronic set is checked for completeness by the Architect.

3.12 COMMISSIONING

A. The contractor shall submit commissioning and commissioning plans including preliminary commissioning reports developed by a registered design professional or an approved agency in accordance with section C408.2 of the adopted edition of the International Energy Conservation Code. The same registered design professional or approved agency shall provide evidence of mechanical systems commissioning and completion to the professional engineer stamping the HVAC drawings in accordance with the provisions of the code sections.

3.13 TRAINING

A. Conduct a training course for the maintenance and operating staff. The training shall start after the system is functionally complete but before the final acceptance tests. The training shall include all of the items contained in the operating and maintenance instructions as well as demonstrations of routine maintenance operations. The Owner’s Representative shall be given at least two (2) weeks advance notice of such training.

B. During all working hours of the one (1) week operating test, the HVAC Subcontractor's instruction personnel shall be available for and provide thorough and detailed training to the Owner's operating and maintenance personnel in operation, maintenance and adjustment of all equipment installed. The instructions shall be video recorded by the Subcontractor. The master DVD and two (2) additional copies shall be turned over to the Owner not more than ten (10) days following the completion of the training.

C. Give sufficient notice to the designated operating personnel of the Owner in advance of this period. Upon completion of instruction, obtain from such representatives written verification on that which the above mentioned instruction has been performed, such verification to be forwarded to the Architect.

D. Provide instruction time of four (4) hours for systems and an additional four (4) hours for ATC.

END OF SECTION 23 00 00