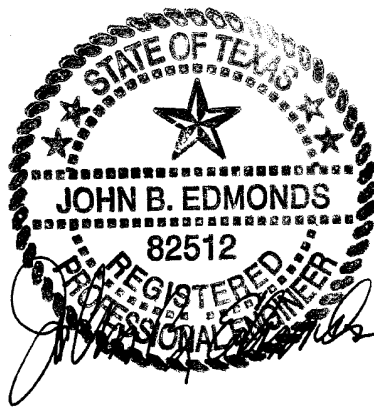


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04/27/18



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DIVISION 15 - MECHANICAL

SECTION 15010 - GENERAL PROVISIONS

PART 1 - GENERAL

1.01 SCOPE:

The scope of the mechanical work in this project shall include all labor, materials, equipment, etc., required for the complete installation of the mechanical systems as shown on the drawings and hereinafter specified under the subsequent sections of Division 15 of these specifications.

1.02 RELATED DOCUMENTS:

All applicable provisions of Division 0 and 1 govern work under this Division. Refer to these articles in the specifications for additional information.

1.03 REFERENCE STANDARDS:

1.03.1 All work shall be performed in strict accordance with the latest editions of the applicable state and national building codes and local ordinances.

1.03.2 Refer to each section for applicable codes and reference standards.

1.04 FEES, PERMITS AND TAXES:

This contractor shall obtain all permits, inspection fees, connection fees, and approvals applicable to his trade as required by local authorities. The contractor shall be responsible for the payment of all such permits, inspection fees, connection fees, and approvals. The contractor shall also pay all taxes levied for labor and materials associated with work under this Division.

1.05 QUALITY ASSURANCE:

1.05.1 This contractor shall use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Division.

1.05.2 In the event of conflict between or among specified requirements and pertinent regulations and/or codes, the more stringent requirement will govern when so directed by the Engineer.

1.06 SUBMITTALS:

1.06.1 Comply with pertinent provisions of Section 01340 and AIA General Conditions.

1.06.2 Product data: Within 35 calendar days after the contractor has received the Owner's Notice to Proceed, submit:

- A. Materials list of items proposed to be provided under this Division;
- B. Manufacturer's specifications, catalog cuts, and other data to prove compliance with the specified requirements;
- C. Shop drawings and other data as required to indicate method of installing and attaching equipment.

1.06.3 These specifications and drawings are intended to indicate a standard of quality for materials and equipment by the listing of manufacturer's names and catalog numbers and/or referenced standards. It is the responsibility of the contractor and/or supplier to prove equality for any substitutions.

1.06.4 Deviations between the plans and specifications and the materials and equipment submitted shall be pointed out to the Engineer in writing.

1.06.5 Provide five (5) copies of all submittal data and shop drawings.

1.06.6 The size of the mechanical equipment shown on the drawings is based on the dimensions of a particular manufacturer. It shall be the responsibility of the contractor to determine if his proposed equipment will fit in the space.

1.06.7 **Minimum one-quarter (1/4) inch = one foot scale reproducible shop drawings shall be prepared and submitted for approval to indicate a suitable arrangement in all mechanical rooms and spaces (including above ceiling spaces and outdoor spaces), to include but not limited to duct work, piping, fittings and valves, equipment and accessories, and electrical components such as disconnects, starters, panels, and transformers. All ductwork shall be drawn double-lined. Coordinate with the electrical contractor and any Owner furnished equipment. In addition to the plan view, a minimum of two (2) elevation views utilizing the Architectural and Structural plans shall be included indicating clearances from obstructions, unless noted otherwise, for each mechanical space as directed by the Engineer. The shop drawings shall be provided for review before equipment and material submittal is approved for installation. The dimensions and requirements for the actual equipment and materials proposed for installation shall be used. Clearances for proper code compliance, operation, servicing, and maintenance shall be indicated. All drafting shall be done by a qualified draftsman. The engineer reserves the right to request resumes of drafting personnel or drafting service.**

1.06.8 The Architect's/Engineer's review of the submittal data and shop drawings shall not relieve the contractor of responsibility for deviations from the contract drawings or specifications or the responsibility to coordinate with all other trades for conflicts.

1.07 OPERATING AND MAINTENANCE INSTRUCTIONS:

1.07.1 The owners representative (s) shall be instructed by the contractor on the operation and maintenance of the mechanical systems, including but not limited to each item of equipment and the temperature controls system(s). Any special tools and/or instruments required shall be turned over to the owner.

1.07.2 For each item of equipment furnish to the owner four (4) complete sets of parts and operating and maintenance instructions. Also, furnish four (4) complete sets of the automatic temperature controls systems diagrams, sequences of control, product information and catalogue sheets, etc. All data shall be bound in heavy duty labeled loose-leaf binders with a table of contents and appropriately tabbed sections. Each of these bound copies shall contain as a minimum the following items along with any other information necessary for instructions in operation and maintenance:

1. Routine maintenance operations
2. Complete operating instructions
3. Service instructions
4. Complete control wiring
5. Emergency procedures
6. Equipment warranties and guarantees
7. Complete parts lists for each equipment item

1.08 WARRANTY:

This contractor shall warrant all workmanship, material, equipment systems, etc., provided by him for a period of one year after substantial completion of the project. This warranty means that this contractor shall make good to the Owner, at no cost, any defects that become apparent during the year following substantial completion. This warranty is in addition to any other guarantees or warranties and is not intended to limit such other guarantees or warranties.

1.09 DEFINITIONS:

The following words and phrases as used herein are hereby defined:

1.09.1 "provide": Furnish and install all material, equipment, and labor required for a complete installation ready for operation in accordance with the intent of the Contract Documents.

1.09.2 "as required": Provide the necessary work, material, and equipment in accordance with manufacturer's installation instructions and applicable codes and regulations with proper industry standard workmanship.

1.09.3 "or equal": Contractor may substitute equipment and materials by another manufacturer if the salient features of the equipment in the judgment of the engineer are adequate. Submittals for approval are required.

1.09.4 "contractor": Contractor engaged to execute the work under this division of the specifications only, even though he may be technically described as a sub-contractor.

1.09.5 "intent of the Contract Documents": The specific intent of these documents is to provide to the Owner, in a thoroughly functional condition, all the various systems, equipment, etc., indicated herein. Final authority over interpretation of the "intent" shall rest with the Engineer.

1.09.6 "shall": Indicates a mandatory requirement.

1.10 INSPECTION OF THE SITE:

The drawings are prepared from the best information available and reflect all conditions commensurate with this information. However, the contractor should visit the site, verify the locations, sizes, depths, pressures, etc., of all existing utilities and become familiar with working conditions, hazards, existing grades, soil conditions, obstructions, local requirements involved, etc. All proposals shall take these existing conditions and any revisions required into consideration. Notify the architect in writing of any existing site conditions that will impair the proper operation of the utilities.

1.11 CONSTRUCTION REQUIREMENTS & COORDINATION OF WORK:

1.11.1 The mechanical drawings show the general arrangement of piping, ductwork, equipment, and appurtenances. The mechanical drawings and specifications shall be compared with the drawings and specifications for other trades and existing conditions. The contractor shall report any discrepancies in writing to the Architect.

1.11.2 The drawings do not give exact details of elevations or exact locations of piping, equipment, fixtures, and ductwork to scale. Elevations shall be handled by giving precedence to that which requires a stated grade for proper operation. Minor relocations necessitated by site conditions or directed by the Owner shall be made without additional cost to the Owner. **The contractor shall be responsible for all work required by his discipline and shall review all construction documents including but not limited to**

Architectural plans and specifications, Civil plans and specifications, Structural plans and specifications, Electrical power and lighting plans and specifications, Mechanical and Plumbing plans and specifications and all Addenda.

1.11.3 The mechanical work shall be installed in cooperation with other trades such that the work of the several trades may progress in the most direct, workmanlike, and harmonious manner.

1.11.4 The contractor shall be responsible for his material and equipment fitting into the building and shall conform to the details of the installation as recommended by the manufacturers of the material and equipment. Provide all necessary pilot lines, control lines, make-up water lines with appropriate backflow device, and other such lines and devices for equipment and fixtures as required whether indicated on the drawings or not. Equipment and fixtures shall be installed in such manner to make oiling devices and parts requiring service and maintenance readily accessible.

1.11.5 The contractor shall be responsible for the proper location and size of slots, holes and openings in the building structure pertaining to his work, and for the correct location of pipe sleeves.

1.11.6 All piping and ductwork in exposed areas and unfinished spaces shall be run as high as possible and shall be installed parallel to the building planes, except where a slope is required for proper pitch. Piping and ductwork in finished areas shall be run concealed unless noted otherwise. Any discrepancies resulting from exposed pipe and/ or ductwork in finished areas shall be reported in writing to the Architect.

1.11.7 All pipe openings shall be kept closed during construction until the final connections are made and the systems are complete and closed.

1.11.8 Equipment and fixtures shall be located and installed to permit convenient and safe maintenance and future replacement, without disassembly.

1.11.9 For new construction, where required, place all inserts to accommodate the ultimate installation of pipe hangers in the forms before concrete is poured and set sleeves in forms before construction. For existing construction, all required inserts shall be "drilled-in" and all openings required through concrete or masonry shall be "saw-cut" or "core drilled" with tools specifically designed for this purpose. Explosive or compression driven inserts shall only be allowed for use as approved by SMACNA and the manufacturer of these devices.

1.11.10 All piping and ductwork shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing.

1.12 SLEEVES:

1.12.1 Refer to AIA General Conditions.

1.12.2 All piping and ductwork, regardless of material, which passes through a concrete slab, (except slab on grade), masonry wall, roof or other portion of the building structure shall be free from the structure and shall pass through a sleeve furnished and installed by the Subcontractor responsible for the work involved.

1.12.3 Sleeves above grade and in dry locations shall be constructed from 20 to 22 gauge galvanized steel and shall be flush on both sides of wall surface penetrated. The sleeves shall be sized to allow free passage of the pipe to be inserted, and when this pipe is to be insulated, the sleeves shall be large enough to pass the insulation. Floor sleeves located in pipe chases shall extend up two inches (2") above the floor slab.

1.12.4 Sleeves passing through walls or floors on or below grade and/or in moist areas shall be constructed of schedule 40 galvanized steel pipe and shall be designed with suitable flange in the center of the floor or wall to form a waterproof passage. After the pipes have been installed in the sleeves, void space around the pipe shall be caulked to insure a waterproof penetration. Fire ratings of rated walls and floors shall be maintained by the use of approved materials.

1.13 ISOLATION:

1.13.1 The contractor shall be responsible for the correction of any and all transmission of perceptible vibration, structure-borne noise, or objectionable air borne noise associated with any system provided under this division at no expense to the owner.

1.13.2 The isolation supplier shall be a firm or individual capable of dealing effectively with vibration and noise characteristics, effects and criteria and have facilities and capabilities for measuring and evaluating such disturbances and the preparation of drawings and installation instructions.

1.14 CONSTRUCTION SAFETY:

This contractor shall assume all responsibility regarding the safety of his personnel on the project during construction. The Contract Documents do not include materials, procedures, components, etc., required to insure construction safety. Refer to General Conditions and Supplementary General Conditions for additional information.

1.15 DAMAGE:

1.15.1 This Contractor shall be responsible for damage to project caused by this Contractor's failure to recognize hazards associated with items such as leaks, scheduling of work, inexperienced workmen, excessive cutting, etc.

1.15.2 This Contractor shall repair, at no expense to the Owner, any such damage.

1.15.3 This Contractor shall familiarize himself with working conditions to the extent that he shall be responsible for damage to concealed piping, wiring and other equipment to remain and shall repair any damage caused by his negligence at no cost to the Owner.

1.16 FLOOR, CEILING AND WALL PLATES:

1.16.1 Refer to AIA General Conditions.

1.16.2 In each finished space furnish a chromium plated sectional escutcheon on each pipe or hanger rod penetrating a wall, floor, or ceiling. Escutcheons shall be sized to fit snugly to all lines and where the lines are insulated, the escutcheons shall be fit snugly over the insulation. Where required, these plates shall be provided with set screws so that they fit snugly against the finished surface. All equipment rooms are classified as finished space.

1.17 IDENTIFICATION:

Each piece of equipment; every valve whose service and/or duty is not readily apparent; each zone duct, outside air duct and return air duct whose duty is not immediately apparent; every piping system except cast iron sewer lines, shall be permanently and clearly identified.

1.18 SAFETY GUARDS:

Contractor shall furnish and install all safety guards required. All belt driven equipment, projecting shafts and other rotating parts shall be enclosed or adequately guarded.

1.19 STORAGE OF MATERIALS:

Each contractor shall provide space for storage of materials, equipment or tools at grade level. Any storage contemplated within the building will be allowed only upon specific approval of the Architect.

1.20 MANUFACTURERS' DIRECTIONS:

The manufacturers' published directions shall be strictly followed in the delivery, storage, protection, installation, piping and wiring of all equipment and material. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the contract documents and the manufacturers' directions and shall obtain the Architect's instructions before proceeding with the work. Any such work performed that does not comply with the manufacturers' directions shall have deficiencies corrected at no cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS:

All materials shall be new and free from defects and shall bear the manufacturer's name, trade name, and the UL label in every case where a standard has been established. Materials or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job site, but shall be replaced with new materials.

2.2 MANUFACTURER'S REQUIREMENTS:

When a manufacturer's name appears in these specifications, it is not to be construed that the manufacturer does not have to meet the full requirements of the specifications or that his standard cataloged item will be acceptable.

2.3 SERVICE AND REPAIR PARTS:

All equipment installed on this project shall have local representation, local factory authorized service, and a local stock of repair parts.

2.4 FLAME SPREAD PROPERTIES OF MATERIALS:

All materials and adhesives used for air conditioning filters, acoustical lining, and insulation shall conform to NFPA and UL life, safety and flame spread properties of materials. The composite classifications shall not exceed 25 for a flame spread rating and 50 for a smoke developed rating for these classifications as listed for the basic materials, the finishes, adhesives, etc., specified for each system and shall be such when completely assembled.

2.5 ACCESS PANELS:

Provide flush mounted metal access panels and frames with concealed hinges and key actuated locks for all concealed and otherwise inaccessible valves, parts, fittings, equipment, filters, etc. and as required for inspection, service, maintenance, or replacement.

PART 3 - EXECUTION

3.1 WORKMANSHIP:

3.1.1 All work shall be done by experienced craftsmen skilled in the applicable trade.

3.1.2 Sloppy work shall be rejected and corrected at no additional expense.

3.2 PROTECTION OF EQUIPMENT:

The Contractor shall continuously maintain adequate protection of stored materials and installed equipment. Fixtures and equipment, whether located inside or outside, shall be tightly covered and protected against dirt, rust, moisture and abuse from other trades. Adequate air circulation shall be provided under any protective sheet to prevent condensate build up. Materials and equipment shall not be stored directly on the ground. Ductwork, piping and equipment shall not be used by other trades as supports for scaffolds or personnel. At the completion of the work, equipment, fixtures, exposed supports and piping shall be cleaned of loose dirt, construction debris, overspray, etc., to the satisfaction of the Architect. Repairs made necessary by damage shall be paid for by the Contractor.

3.3 PROTECTION OF STRUCTURE:

Each Contractor in performing his work shall take particular care not to damage the structure. All finished floors and step treads shall be covered to prevent any damage by workmen or their tools and equipment during the construction of the building. In addition, each Contractor shall protect any materials on the job site whether a part of this contract or the property of another Contractor.

3.4 FOUNDATIONS:

3.4.1 Concrete foundations required by mechanical equipment shall be constructed by this Contractor.

3.4.2 Equipment shall be set in place on the bases, leveled and aligned by means of shims, piped, then grouted in, in that order. After grouting, the forms shall be removed and the surfaces of the foundation shall be hand-rubbed with carborundum. Concrete work shall conform to the requirements of General Specifications, Concrete Work, of this specification.

3.5 CONFLICTS, INTERFERENCES AND COORDINATION BETWEEN TRADES:

3.5.1 The drawings indicate the extent, general location, arrangement, etc., of piping systems, ductwork, and equipment and are not to be construed as shop drawings. This Contractor shall refer to other sections of the specifications and other drawings such as electrical, structural, architectural, etc., in order to eliminate conflicts and undue delays in the progress of the work. Where other Contractors furnish items requiring connections by this Contractor, they will be held responsible for providing roughing-in drawings and assistance upon request.

3.5.2 Each trade shall so harmonize its work with that of the other trades so that the work may be done in the most direct and workmanlike manner without hindering the other

trades. Piping interference shall be handled by giving precedence to pipe lines which require a stated grade for proper operation.

3.5.3 In the event of conflicts between specifications and drawings, drawings shall take precedence over specifications except in matters pertaining to quality, applications, and coordination between trades, which shall be governed by specifications.

3.5.4 In the event of conflict between codes, as interpreted by the authority having jurisdiction and the contract documents, the codes shall govern.

3.5.5 In the event of conflict between manufacturer's installation instructions and the drawings, the manufacturer's installation instructions shall govern.

3.6 CUTTING AND PATCHING:

3.6.1 All cutting incident to the work in this section such as installation of sleeves, piping, equipment, etc., shall be coordinated with the General Contractor. Cutting shall be performed by this Contractor and patching shall be by the General Contractor. This Contractor shall not cut any structural element or any finished work without permission from the Architect.

3.6.2 This Contractor shall cut and patch all paving as required by the installation of buried piping, including utilities.

3.7 CONCRETE WORK:

This Contractor shall provide all forming, reinforcing and concrete as required and/or indicated such as equipment bases, plumbing stack support pads, grease interceptors, catch basin and headwalls. Work shall conform to applicable portion of Division 3 CONCRETE.

3.8 PAINTING:

3.8.1 All painting except "touch-up" shall be provided under the painting sections (Division 9) unless noted otherwise. All exposed piping, equipment, etc., shall be left clean and free from rust or grease and ready for the painter.

3.8.2 Where equipment finishes are damaged, this Contractor shall obtain matching color touch-up paint from the equipment's manufacturer and paint as required.

3.9 EXCAVATION AND BACKFILL:

3.9.1 All excavation and backfill required for the installation of work under this section shall be accomplished by each trade Subcontractor under his phase of the work. All such work shall be included regardless of the type of materials encountered in the excavation.

3.9.2 Trenches for all underground piping shall be excavated to the required depths and cut to required grades. The banks of trenches shall be kept as nearly vertical as practicable and where required shall be properly formed and braced. Trenches shall be at least 12" wider than the outside diameter of the pipe to be laid therein. The bottoms of the trenches shall be thoroughly tamped. For bell and spigot piping, bell holes shall be excavated to a depth 6" below the bottom of the pipe and shall be backfilled to the proper grade with pea gravel or sand thoroughly tamped. Pipe laid in trenches dug in fill shall be supported down to load bearing undisturbed soil. After the pipes have been tested, inspected and approved by inspecting authorities, the trenches shall be backfilled in 12" layers and thoroughly tamped after each layer (95% compaction). Backfill material shall be river sand or other approved material to a depth of six (6) inches above the top of the pipe. The next layer and subsequent layers of backfill may be excavated materials if of earth, loam, sand or gravel free of large clods and with rocks no larger than 1 - 1/2" in diameter. Any additional material required for backfilling shall be furnished and any excess materials and debris shall be removed from the site. Any special backfill material shall be provided as specified or shown on the drawings.

3.9.3 All excavating and backfilling shall be done in a manner so as not to disturb adjacent structures and any shoring required shall be provided.

3.9.4 The contractor shall review the plans and specifications and the existing site conditions for trees, shrubs, and other plants, both new and existing to remain, and avoid excessive disturbance to root structures and harm to these trees, shrubs, and other plants. Report discrepancies and conflicts in writing to the Architect/Engineer before proceeding with any work.

3.10 LUBRICATION:

This Contractor shall provide all lubricants for the operation of all equipment until acceptance. The Contractor shall be required to protect all bearings during the installation and shall thoroughly grease steel shafts to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction. All equipment bearings requiring periodic lubrication shall be provided with proper fittings for this purpose. Where equipment requiring such lubrication is not readily accessible due to location, copper tubing extensions shall be provided in addition to lubrication fittings.

3.11 ELECTRICAL WORK:

3.11.1 All wiring and conduit and mounting of all electrical devices shall be provided under Division 16, except for such items that are completely wired at their point of manufacture and so delivered and unless specifically noted to the contrary herein.

3.11.2 Wiring for all HVAC controls and interlocks shall be done under Division 16. The furnishing of all disconnect switches as required for proper operation as shown on

the drawings and required by code shall be under Division 16, except where specifically designated on the plans. The furnishing of all starters for mechanical equipment shall be done under this section (Mechanical) of these specifications, unless specifically scheduled otherwise on a starter schedule on the drawings.

3.11.3 Furnishing of complete wiring diagrams showing power wiring and interlock wiring shall be work under the trade supplying the equipment. Diagrams shall be based on approved equipment and shall be complete integral drawings, not a series of manufacturer's individual diagrams. After these diagrams have been approved by the Architect/Engineer, copies shall be furnished to the trades involved and they shall be followed in detail.

3.11.4 The electrical design and drawings are based on the equipment scheduled and shown on the drawings and should any mechanical equipment requiring changes to the electrical design be approved, the required electrical changes shall be made at the expense of the trade furnishing the changed equipment and at no cost to the Owner.

3.12 OPERATION PRIOR TO COMPLETION:

When any piece of mechanical or electrical equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so providing that he properly cleans the equipment, installs clean filter media, properly adjusts and completes all punch list items before final acceptance by the Owner. The date of acceptance and the start of the warranty may not be the same date.

3.13 FLASHING AND WATERPROOFING:

All building penetrations to outside shall be flashed and counter flashed as required to eliminate leaks.

3.14 TESTS:

All tests shall be made by this Contractor and repeated until approved by the Architect. Piping systems shall not be covered or otherwise concealed until tests have been made and approvals obtained. Notify the Architect four days prior to tests to allow for scheduling. Test the piping systems as indicated in applicable articles.

3.15 CLEAN-UP:

3.15.1 It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition. At the end of each day's work, each trade shall properly store all of his tools, equipment, any surplus materials and clean up debris caused by his portion of the work.

3.15.2 When all work has been finally tested, the Contractor shall clean all work installed by him, including all fixtures, equipment, pipes, ducts and all exposed work. All pipes shall be flushed out and left free of all obstructions. All plates, grilles, and other finished products shall be thoroughly cleaned and polished.

3.16 CHANGE ORDERS:

Any change requests shall be accompanied with detailed itemized cost break downs of all material and equipment and labor for all disciplines involved. Material and equipment costs shall be accompanied with vendor quotes specific to the change request. In addition to the material, equipment, and labor breakdowns, each contractor's overhead and profit breakdowns shall be provided.

3.17 FINAL OBSERVATIONS:

3.17.1 It shall be the responsibility of the Contractor to make a careful inspection trip of the entire project, assuring himself that the work on the project is ready for final acceptance, before calling upon the Architect/Engineer to make a final observation.

3.17.2 In order not to delay final acceptance of the work, the Contractor shall have all necessary bonds, guarantees, receipts, affidavits, etc., called for in the various articles of this specification, prepared and signed in advance, and together with a letter of transmittal listing each paper included, and shall deliver the same to the Architect/Engineer at or before the time of the final observations. The Contractor is cautioned to check over each bond, receipt, etc., before preparing same for submission to see that the items check with the requirements of the specification.

3.18 AS-BUILT DRAWINGS:

Each contractor and subcontractor shall maintain one (1) set of prints on the job, indicating any and all changes made during construction. At the completion of the project, this set shall be turned over to the Architect, including revised control and wiring diagrams.

3.19 ASBESTOS POLICY:

3.19.1 It is the intent of the engineer that no asbestos or asbestos containing materials be used on this project. No asbestos material has been knowingly included in the construction requirements.

3.19.2 Should the contractor have reason to believe that asbestos has been encountered, the proper authority should be notified and appropriate instructions received before proceeding with the work.

3.20 FIRE STOPPING:

All penetrations of fire rated ceilings, walls, partitions, or floors shall be firestopped using approved materials to maintain the fire rating of the ceiling, wall, partition, or floor. Methods and materials shall be approved by local code officials.

END OF SECTION

SECTION 15100 - PIPING SYSTEMS

PART 1 - GENERAL

1.1 SCOPE:

Work in this section shall include piping, fittings, accessories etc., to be used in piping systems in accordance with the intent of the Contract Documents and shall include the following principal items:

Piping
Valves
Piping Accessories

1.2 REFERENCED STANDARDS:

National Bureau of Standards (NBS).
Cast Iron Soil Pipe Institute (CISPI).
American Society of Testing & Materials (ASTM).
American Water Works Association (AWWA).
National Fire Protection Association (NFPA).
Factory Mutual Engineering Corporation (FM).
American Society of Mechanical Engineers (ASME).
American National Standards Institute (ANSI).

1.3 SUBMITTALS:

Submittals are required as indicated only. Submittal of pipe and fittings is not required unless a deviation from the specification is proposed.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER PIPING (HOT AND COLD):

2.1.1 Domestic water piping within the building and above ground, shall be type "L" hard drawn commercially pure copper joint fittings per ASTM B-88 and hard solder.

2.1.2 For all copper piping flux shall be a non-corrosive paste type. Cored solder will not be allowed; all solder shall be a solid string or wire type. Where soldered copper piping must be connected to screwed brass pipe, a cast brass adapter shall be used. Piping above ground shall be assembled with 95-5 tin/antimony solder or 95-5 tin/silver solder. No solder containing lead shall be used.

2.1.3 Water piping connections to fixtures or equipment shall be made by use of brass pipe or nipples, chrome plated where exposed to view in finished areas, screwed into copper to IPS adapter fittings. Ferrous piping connections shall not be used in copper piping systems.

2.1.4 Dielectric insulating couplings shall be provided between ferrous and copper piping systems.

2.1.5 On each supply serving urinals and/or water closets, provide a manufactured water hammer protective device, sized as recommended by the manufacturer for the particular application and installed in accordance with Plumbing and Drainage Institute Standard PDI-WH201. On all other hot and cold water supplies provide an air chamber the same size as the supply to the fixture and not less than 24" long, located directly behind the supply connection to the fixture. The air chambers shall be constructed of the same material as the piping system in which they are installed, and shall be insulated in the same manner as the piping system in which they are installed.

2.2 SANITARY DRAINAGE:

2.2.1 All sanitary soil waste and vent lines shall be cast iron service weight soil pipe and fittings per ASTM A74-75, coated inside and out and shall be labeled with the C.I. mark of quality and permanence as illustrated in Commercial Standard CS-188-59. Provide compression type joints equal to Tyler Pipe and Foundry's "Ty-Seal" or approved lead and oakum joint. "No Hub" piping above grade will be acceptable if approved by Plumbing Inspector. Any drain line subject to contamination by oil, gasoline, or any other petroleum product shall have "BUNA-N" gaskets, approved for that service. All cast iron piping shall be furnished and installed in accordance with CISPI.

2.2.2 At the Contractor's option, and where approved by local authority sanitary drainage and vent piping installed above ground or below ground may be type DWV Schedule 40 PVC pipe and fittings per ASTM D-2665-78. PVC piping shall not be permitted in return air plenums. It shall be the contractor's responsibility to obtain approval from local authorities. Submit to the Engineer for approval.

2.2.3 Horizontal waste and soil pipe shall be given a grade of 1/4" per foot where possible and not less than 1/8" per foot. Vent and waste connections to stacks shall be made by the appropriate use of forty-five (45) degree wyes, long sweep quarter bends, sixth, eighth, or sixteenth bends as approved by local codes. Sanitary tees and sanitary crosses shall be used on the connection to vertical stacks.

2.2.4 Vents shall be extended at least 15" above roof and shall be flashed per roofing manufacturer requirements. For metal roofs, use a one-piece flexible E.P.D.M. rubber base with a ductile aluminum alloy reinforcing base ring bonded to a rubber flange on the base of the flashing unit. On other roof types, use 4 lb. lead with the base extending at least 10" in every direction from stack. The vertical portion of the flashing

shall extend upward. The entire length of the vent pipe shall be turned down inside the pipe at least 2" to provide a weather-tight joint.

2.2.5 Vents of 1-1/2" in nominal size or smaller shall be made by the use of Schedule 40 galvanized steel pipe joined with galvanized, screwed, malleable iron fittings per ASTM A-120-55 or type "M" or "DWV" hard drawn copper pipe per ASTM B-88, assembled with cast copper fitting, joined as specified under "Domestic Water Piping".

2.2.6 Cleanouts shall be provided at each change in direction of the soil lines, at the end of each continuous waste line, at the foot of each riser within the building and at 75'-0" intervals in long horizontal lines except as noted. The sizes of cleanouts shall be same size of soil or waste lines in which they are placed, except that cleanouts larger than four inches (4") in diameter will not be required. Cleanouts shall be placed in accessible locations. Exact locations of each shall be approved by the Architect before installation. All cleanouts shall be of the type specifically designed for installation in the type of wall in which they are installed. Cleanouts in finished floors shall be specifically designed for the type of floor in which they are installed. All cleanouts located in exterior locations shall be encased in 14" x 14" x 6" concrete pads unless installed in a walk drive or other paved area. All cleanouts in walls or other painted surfaces shall be of type furnished in prime coat to be painted on the job to match the surface in which they are installed. All cover plates on cleanouts shall be attached with vandal-proof screws.

2.2.7 Provide a trap for every fixture and piece of equipment requiring connection to the sanitary drainage system, except fixtures with integral traps. Each trap shall be placed as near to the fixture as possible and no fixture shall be double trapped unless permitted by governing codes.

2.2.8 Hub drains and floor drains connected to the sanitary drainage system shall be provided with deep seal P-traps.

2.3 CONDENSATE DRAIN PIPING AND WATER HEATER RELIEF PIPING:

Condensate drain piping and water heater relief piping shall be type "M" hard drawn copper piping with cast and/or wrought copper fittings per ASTM B-88, 95/5 solder.

2.4 REFRIGERATION PIPING:

2.4.1 All refrigeration piping from the air cooled condensers to the refrigerant coil shall be Type "L" hard drawn copper per ASTM B-88. All fittings and joints shall be made with silver-fos solder. Provide strainer-dryer combination and liquid solenoid valves at refrigerant coil. Thermostatic expansion valves and all accessories shall be equal to Alco, Inc., or approved equal. Provide and install distributors equal to Alco, Inc., suitable for modulating flow rates.

2.4.2 Provide specialties such as solenoid valves, sight glasses, and filter/dryers as indicated and required for proper system operation. Components shall be specifically designed for refrigeration service.

2.5 VALVES: (SUBMITTAL REQUIRED)

A. Acceptable Manufacturers: Jenkins, Crane, Demco, Nibco-Scott, Nordstrom, Stockham, Walworth.

B. General:

1. Valves of the same type and for the same service shall all be of one manufacturer.
2. Valves 2" and smaller shall be bronze body, screwed or solder connections.
3. Valves 2-1/2" and larger to be iron body, bronze trim and flanged connections.
4. Valve connections shall be compatible with adjoining pipe.
5. Valves shall have manufacturer's name and working pressure of valve cast in valve body.

C. GATE VALVES: 2" and smaller shall be Nibco-Scott T-113 screwed or S-115 solder joints; 2-1/2" and larger Nibco-Scott F619 flanged, brass trim. Valves shall have non-rising stem, wedge disc, and bronze seats and working pressure rating shall be 125 psi saturated steam.

D. GLOBE VALVES: 2" and smaller Nibco-Scott T-211 screwed or S-211W solder joints. Valves to have rising stem, resilient seat for water, oil or gas and working pressure shall be 200 psi W.O.G.

E. CHECK VALVES: 2" and smaller Nibco-Scott T413 screwed or S-413 solder joint; 2-1/2" and larger Williams-Hager Fig. 329, 125 lb. silent action, no-slam. Working pressure shall be 125 psi saturated steam.

F. GAUGE COCKS: Gauge cocks shall be W.H. Bolton Co., No. B250OFF brass valve, threaded connections. Valves shall be of bar stock construction, integral stem and disc, with stuffing box, packing, and gland nut.

G. T & P RELIEF VALVES: Shall be suitable for intended service and conform to ASME codes and shall be sized for 150% capacity of served equipment. Valves as manufactured by Watts, Bell & Gossett or Keckley are acceptable.

Acceptable manufacturers: Taco No. 360, Thrush, Bell & Gossett.

2.6 PIPING ACCESSORIES GENERAL:

2.6.1 Flanges shall be slip-on or butt welding standard weight 1/16" raised face type with gaskets.

2.6.2 Unions shall be all bronze for copper systems and malleable iron with ground joint for steel piping systems. Provide dielectric unions for joining dissimilar metallic piping systems.

2.6.3 Escutcheons shall be single piece, set screw type, chrome plated and shall cover the opening and sleeve.

2.6.4 Strainers shall be "Y" type with bronze body for sizes 2" and smaller and steel body with blowdown gate valve for sizes 2-1/2" and larger. Screens shall be 1/16" perforated monel metal. Strainers by Mueller, Kiely or Crane are acceptable.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION:

3.1.1 Arrange and install piping systems sizes as shown approximately as indicated, straight, properly supported and run as directly as possible forming right angles or running parallel with building lines. Locate piping as high as practical and in parallel groups as close together as practical. Unless otherwise noted, conceal all piping.

3.1.2 All piping shall be run in the most direct manner, avoiding unnecessary joints. All changes necessary to make the piping conform to the building construction shall be made without extra charge.

3.1.3 All pipe sizes shown on the plans are nominal except refrigerant piping where O.D. sizes are indicated.

3.1.4 Pipe shall be cut accurately to measurements established at the site and worked into place without springing or forcing.

3.1.5 Provide clearance for installation of insulation and for access to valves, air vents, drains and unions.

3.1.6 Install piping to allow for expansion and contraction without undue stress to pipe or equipment connected.

3.1.7 Provide escutcheon plates at each wall and ceiling penetration in finished areas.

3.1.8 Slope piping as indicated and provide automatic air vents at high points of system. Extend 1/4" soft copper extensions where manual air vents are in inaccessible locations.

- 3.1.9 Provide 18 gauge sheetmetal sleeves for all piping penetrations of above grade floors and walls. Sleeves shall be sized to allow for insulation. Pack annulus between pipe and sleeve with fiberglass batts neatly secured in place with duct tape.
- 3.1.10 Provide a 1/2" thick foam plastic insulating sleeve-protector over all copper and plastic piping penetrations of concrete slab-on-grade prior to pouring of concrete.
- 3.1.11 Locate and suspend piping in such a manner so as to minimize transmission of vibration and noise.
- 3.1.12 Install piping markers on all exposed piping in mechanical rooms.
- 3.1.13 Test, clean and disinfect piping systems as indicated in the appropriate piping system specification.
- 3.1.14 All domestic piping systems shall be installed level and the low points of all risers shall have gate valves 1/2" in size installed with hose ends in order to adequately drain the system.
- 3.1.15 At each group of plumbing fixtures and at each piece of equipment, gate valves shall be furnished and installed by this Contractor so that these groups of fixtures or pieces of equipment may be isolated from accessible locations. Provide General Contractor with locations of all access doors. Access doors required for these valves shall be furnished by this Contractor.
- 3.1.16 Install thrust blocks and anchorage at fittings and changes of direction for all underground domestic piping systems. Blocking shall be sized according to pressure, pipe size, kind of soil and type of fittings, following pipe manufacturer's recommendations.
- 3.1.17 Each of the piping systems shall be concealed in chases and above ceilings and in walls in all finished areas and shall be run exposed only as specifically specified or as shown on the drawings in machinery spaces or unfinished areas.
- 3.1.18 Exposed piping shall be held close to the walls and ceilings and necessary fittings shall be provided and installed to allow for offsets to hold the piping close to wall and ceilings. Where these lines run exposed a clearance shall be obtained from the Architect in writing before making the installation.
- 3.1.19 All piping penetrations through fire rated ceilings, walls or floors shall be fire stopped using approved materials to maintain the fire rating of the ceiling, wall or floor structure.
- 3.1.20 All piping connections to equipment and fixtures shall contain flanges or unions to allow easy removal whether or not shown on the plans.

3.1.21 Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe installed underground. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.22 All under ground piping shall be installed with the proper bedding, and backfill as required according to best practices for the pipe material being used and in accordance with Section 15010 General Provisions Paragraph 3.9 Excavation and Backfill, or as shown on the plans, whichever is more stringent.

3.2 PIPING JOINTS:

3.2.1 Screwed joints shall have full cut pipe threads, assembled with an approved compound applied to only the male threads. A minimum of three pipe threads shall remain exposed when the joint is assembled.

3.2.2 Solder and braze joints shall be assembled with square cut pipe using a pipe cutter. Hack saw cut pipe ends shall be reamed to full size. Both the pipe and fittings shall be furnished absolutely clean. Brazing flux shall be applied to both the pipe and the fittings. The use of corrosive acid flux will not be permitted. During the brazing, the pipe and fittings must be charged with nitrogen gas.

3.2.3 PVC Plastic pipe joints shall be assembled by applying Oatey all purpose purple primer and all purpose clear solvent or approved equal. PVC primer and solvent cement shall be applied to both the pipe and fittings in accordance with the manufacturer's recommendations. Join the pipe and fittings to completely set the pipe within the fitting and rotate the pipe within the fitting one-half revolution to evenly distribute the solvent cement.

3.3 SECURING AND SUPPORTING OF PIPE:

3.3.1 All pipe shall be supported from the building structure by means of approved hangers and supports. Piping shall be supported to maintain required grade and pitch, prevent vibration and provide for expansion/contraction.

3.3.2 All hangers shall be secured to approved inserts wherever possible and practicable. Hanger inserts shall be set in place before concrete is poured. Where hangers attach to the structural steel framing, approved beam clamps shall be employed. Where required, the Mechanical Subcontractor shall install channels to span between framing members. In no case shall spacing of hangers be greater than indicated on the following schedule:

COPPER (WATER TUBE) PIPING

NOMINAL PIPE SIZE **(MAXIMUM)**

HANGER SPACE

Up to 3/4"

6'-0"

1" to 1-1/2"

8'-0"

1-1/2" to 2"

10'-0"

Larger than 2"

12'-0"

PLASTIC PVC PIPING

NOMINAL PIPE SIZE (MAXIMUM)

HANGER SPACE

Up to 1-1/4"
1-1/2" to 2-1/2"
3" to 4"
6" to 8"

5'-0"
6'-0"
7'-0"
8'-0"

CAST IRON PIPING

NOMINAL PIPE SIZE (MAXIMUM)

HANGER SPACING

All pipe sizes

one hanger per length
of pipe and not ex-
ceeding 5'-0" O/C

3.3.3 Vertical lines shall be adequately supported at their bases, either by a suitable hanger placed in the horizontal line near the riser, or by a base fitting set on a pedestal or foundation and from each floor slab by means of approved clamp type support bearing on the slab or beam.

3.3.4 Hangers for piping 2" and smaller shall be of the split cast ring type with fastening device. Hangers for piping larger than 2" shall be of the adjustable clevis hanger type. For piping requiring expansion and contraction, provide approved roller type hangers. Hanger rods shall be minimum 3/8" diameter and shall have machine threads. Brackets of approved type may be used along walls. Hanger rods for individually suspended horizontal pipes shall be steel rods of size indicated on the following table:

NOMINAL PIPE SIZE (MAXIMUM)

ROD SIZE

1/2" to 2"
2-1/2" to 3"
4"
5" to 6"

3/8"
1/2"
5/8"
3/4"

3.3.5 Hangers for use with copper piping shall be copper plated ferrous sizes for copper tubing.

3.3.6 Hangers shall be installed within 2'-0" of each change in direction, either vertical or horizontal, or pipe tee and on each side of valves, strainers, etc.

3.3.7 Multiple horizontal pipes, smaller than 8" diameter pipe, may be supported on trapeze hangers. Trapeze spacing shall be in accordance with the schedule for pipe

spacing based upon the smallest pipe and shall be properly sized for the piping load they are to support.

3.3.8 Hangers shall be oversized to accommodate the outside diameter of the insulation, and half-round 16 gauge galvanized steel shields, not less than 14" long, rolled to fit the insulation diameter, shall be provided between the insulation and the hanger.

3.3.9 Pipe supports shall be as manufactured by Fee and Mason, Grinnel, Elcen or F&S Manufacturing.

3.3.10 Provide pipe positioning systems consisting of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixture and equipment installation equal to Holdrite Corp. Install support devices to make rigid supply and waste piping connections to each plumbing fixture and piece of equipment.

3.3.11 Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

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

3.4 SCHEDULE OF PLUMBING BRANCHES:

The size of branches or runouts to each fixture shall be as indicated on the drawings. Where no size of connection is indicated, connection shall be not less than in accordance with the following schedule or local plumbing code.

<u>FIXTURE</u>	<u>WASTE</u>	<u>VENT</u>	<u>C. W.</u>	<u>H. W.</u>
Water Closet	4"	2"	1"	---
Lavatories	1-1/2"	1-1/2"	1/2"	1/2"
Urinals (Wall Mtd)	2"	1-1/2"	3/4"	---
Sinks	1-1/2"	1-1/2"	1/2"	1/2"
Mop and Service				
Sinks	3"	2"	3/4"	3/4"
Floor Drains	3"	2"	---	---
Hose Bibbs	---	---	3/4"	---
Drinking				
Fountains	1-1/2"	1-1/2"	1/2"	---

3.5 EQUIPMENT PLUMBING CONNECTIONS:

3.5.1 The Plumbing Subcontractor shall rough-in and make final connections to all miscellaneous equipment noted on the drawings.

3.5.2 The Plumbing Subcontractor shall make final connections to all pieces of equipment furnished under this section and other sections of the specifications and/or drawings that require natural gas, water, drain, waste or vent connections, furnishing all required shutoff cocks, valves, drain valves, closet flanges, traps, etc.

3.6 REFRIGERANT PIPING TESTS:

3.6.1 Piping system shall be tested for four (4) hours with 250 psig on high side and 150 psig on low side, using nitrogen and anhydrous carbon dioxide.

3.6.2 Refrigerant charge shall be provided as required after the piping system has been pressure tested and then drawn down to a vacuum of 50 microns for 12 hours. Halide torch test each joint after charging.

3.7 VALVES

Provide all valves as indicated on the drawings and specified.

3.7.1 Provide all valves for the complete control of all risers, branches, groups of plumbing fixtures, as shown on the plans. All valves shall be located behind access panels and arranged within easy reach or access.

3.7.2 Do not install valves with stems below horizontal.

3.7.3 Provide drain valves at main shut-off valves and at low points of piping and apparatus.

3.7.4 Relief valves shall be furnished for all water heaters, boilers, converters, refrigerant receivers or other equipment as required by ASME codes. Pipe valve discharge full size of valve outlet to 6" above drain unless noted otherwise.

3.8 TESTING REQUIREMENTS:

Refer to sections 15800 for further testing requirements.

END OF SECTION

SECTION 15150 - SHEETMETAL WORK AND ACCESSORIES

PART 1 - GENERAL

1.1 GENERAL:

1.1.1 Provide all "sheet metal work" or "ductwork" referenced in this section of the specifications, on the drawings, and as may be required to provide a complete system for the air conditioning, heating, and ventilating systems.

1.1.2 Before doing any work, the Contractor shall coordinate with approved reflected ceiling plan and other trades for location of air outlets, lights, tile patterns, etc.

1.2 SCOPE OF WORK:

Provide all labor, materials, equipment, tools and services and perform all operations necessary for and reasonably incidental to the construction of complete ductwork and accessories systems as indicated on the drawings, reasonably implied therefrom or as specified herein unless specifically excluded.

1.3 SHOP DRAWINGS:

Shop drawings shall be submitted on all items of sheet metal work only as specified hereinafter.

1.4 REFERENCE STANDARDS:

ASHRAE - Guide and Data Books.

SMACNA - HVAC Duct Systems Design, Latest Edition.

NFPA - 90A, 90B, 91, 96, 204.

SMACNA - HVAC Duct Construction Standards, Latest Edition.

PART 2 - PRODUCTS

2.1 MATERIAL:

All sheet metal duct, plenum and casing construction, unless otherwise specified herein, shall be constructed of new, prime grade, continuous hot dip mill galvanized, lock forming quality steel sheets, per ASTM A 525-75 and shall have a galvanized coating in accordance W/G90 per ASTM 525 and ASTM 90. Construction shall be in strict accordance with the construction details and installation details in the referenced ASHRAE, SMACNA, and NFPA standards as specified. **All ductwork shall be galvanized sheet metal unless specifically noted otherwise.**

2.2 LABELING AND GAUGE:

Each sheet shall be stenciled with manufacturer's name and gauge. Sheet metal must conform to the tolerances listed in SMACNA HVAC Duct Construction Standards, Latest Edition. All duct systems penetrating 1 hour fire walls shall be of minimum 24 ga. construction.

2.3 LOW PRESSURE DUCTWORK CONSTRUCTION:

2.3.1 Rectangular low pressure ducts shall be constructed and reinforced in accordance with tables 1-1 through 1-9 and applicable figures of SMACNA HVAC Duct Construction Standards, Latest Edition, and NFPA 90A and 90B.

2.3.2 Round low pressure ducts shall be constructed in accordance with Table 3-2 and 3-3 2" W.G. "Round Duct Gauge Selection" and Figure 3-2 "Transverse Joints-Round Duct" of SMACNA HVAC Duct Construction Standards, Latest Edition, and NFPA 90A and 90B. **All round duct work exposed to view shall be factory fabricated spiral round, double wall, with 1" thick insulation liner.**

Elbows shall be smooth elbows; 5 piece 90 degree elbows or 3 piece 45 degree elbows all with centerline radius 1-1/2 times the duct diameter.

2.3.3 Low pressure flexible ducts shall be in accordance with SMACNA HVAC Duct Construction Standards, Latest Edition, NFPA 90A and 90B. Flexible duct shall be equal to Flexmaster Type-8 acoustical insulated, with couplings and end connections as required for proper installation and compatibility with ductwork system in which they are installed. Submit to Engineer for approval. All flexible ducts shall have positive interior air seal permanently bounded to a zinc coated high carbon spring steel helix all sheathed in a Class 1 vapor barrier factory sealed at both ends and shall have minimum R-6 insulation value. The composite assembly including vapor barrier shall meet the Class 1 requirements of NFPA for use in a return air plenum, and be labeled by Underwriters Laboratories, Inc. 181 with a flame spread rating of 25 or less and a smoke developed rating of 50 or under. Flexible duct taps into sheetmetal ducts shall be made with factory fabricated 45" side take-off and rigid round duct with damper, Young or equal bearings, Young or equal operators, and raised bead for tight, positive flex duct connection. Use insulation guard for internally lined ductwork. **Flexible ducts shall be limited to maximum 6'-0" in length unless specifically noted otherwise.**

2.4 JOINTS:

2.4.1 All joints shall be sealed airtight with duct sealer equal to United duct sealer in a manner compatible with type joint being sealed as recommended in the SMACNA HVAC Duct Construction Standards, Latest Edition.

2.4.2 All sealed ducts shall be pressure tested at a developed and maintained system pressure. Leaks that whistle or are excessive shall be repaired and the test repeated. See Part 3 Execution.

2.4.3 As a Contractor option, transverse duct joints may be made with Ductmate System or approved equal with the following stipulation: "Ductmate or equal system may be employed only after Contractor personnel have been properly instructed by a manufacturer's representative in the application and installation of said system." Duct gauges shall be in strict accordance with Ductmate instructions.

2.5 DUCT HANGERS AND SUPPORTS:

2.5.1 All horizontal and vertical ducts shall be supported in accordance with SMACNA HVAC Duct Construction Standards, First Edition, 1985.

2.5.2 Flexible ducts shall be free of sags and kinks and supported on minimum of 36" centers with 3/4" wide flat banding material. Perforated strap will not be acceptable.

2.5.3 Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
4. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

2.5.4 Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.6 DUCT LINER: (LOW PRESSURE DUCTS ONLY)

2.6.1 All supply, return, [exhaust] and outside air ductwork as noted on the plans or with dashed lines indicating the extent of liner, and all ductwork exposed in mechanical rooms shall have integral lining in accordance with SMACNA HVAC Duct Construction Standards, Latest Edition, and NFPA 90A and 90B. Liner shall be 1-1/2 pound per cubic foot, 1" thick. For low pressure ductwork, duct liner may be substituted for ductwrap if approved by the Engineer. See section 15600. **Ductwork with internal liner shall be double wall duct with perforated inner wall with Mylar liner between insulation and air stream or prior approved equivalent system.**

2.6.2 The ductwork from air conditioning units, terminal units, etc. shall be internally lined for distance of 10 lineal feet downstream of the box/unit and 10 lineal feet of return duct.

2.6.3 Where ducts are lined, exterior insulation will not be needed except as otherwise specified. Dimensions given on the drawings are inside the insulation, sheet metal sizes shall be increased to allow for the thickness of liner called for. Refer to Section 15010 for Flame Spread Properties.

2.7 FIRE DAMPERS: (SUBMITTAL REQUIRED)

2.7.1 Furnish and install UL labeled fire dampers of the static type with fusible links where indicated and/or required by local codes in accordance with NFPA 90A and 90B.

2.7.2 Fire dampers shall be 95% minimum free area Ruskin series D-IBD Classified UL-555.

2.7.3 Where dampers are installed in a horizontal position, provide stainless steel closure springs and cam type blade locks to insure complete damper shut-off.

2.7.4 Fire dampers shall be equipped with suitable frame style for round, oval or rectangular ducts.

2.7.5 Acceptable manufacturers: Advanced Air, Ruskin, Air Balance, Airstream Products.

2.8 WALL LOUVERS: (SUBMITTAL REQUIRED)

2.8.1 Provide 6" thick stationary extruded aluminum louvers with drainable blades. Units shall exactly fit opening and be flashed completely weathertight. Finish shall be mill standard unless otherwise indicated.

2.8.2 Maximum free area velocity for intake louvers shall not exceed 1000 ft. per minute with a maximum pressure drop of 0.15 inches wg.

2.8.3 Louver blades shall be a minimum 0.125 inch thick and rigidly bracketed for 20 pounds per square foot wind loading.

2.8.4 Provide accessories as follows:

Birdscreen in removable frames.

2.9 AIR DISTRIBUTION DEVICES: (SUBMITTAL REQUIRED)

2.9.1 Grilles, registers and ceiling outlets shall be as scheduled on the plans and shall be provided with sponge rubber or soft felt gaskets. Sizes shown on the drawings shall be

checked for performance, noise level, face velocity, throw, pressure drop, etc., before the submittal is made. The throw shall be such that the velocity at the end of the throw in the five foot occupancy zone will not be more than 50 FPM or less than 25 FPM. Manufacturer shall be prepared to demonstrate compliance with noise criteria on request to Architect's satisfaction. All devices shall be tested per Air Diffuser Council and labeled as such.

2.9.2 Each air distribution device located in an unconditioned space such as an attic shall be provided with a 3" thick, 3/4 lb. density insulation blanket for condensation control.

2.9.3 Locations of outlets on drawings are approximate and shall be coordinated with other trades to make symmetrical patterns and shall be governed by the established pattern of the lighting fixtures or Architectural reflected ceiling plan. Where called for on the schedules, the grilles, registers and ceiling outlets shall be provided with deflecting devices and manual dampers. These shall be the standard product of the manufacturer, subject to review by the Architect and equal to brand scheduled. All ceiling devices shall be furnished to be compatible with the type ceiling in which they are installed.

2.9.4 Air distribution devices shall be as manufactured by Titus, Price, Krueger, Metalaire only and shall be as scheduled on the drawings.

2.10 INSTRUMENT PORTS:

Instrument ports shall be a 2-5/8" diameter base, neoprene gasket 2" deep neck, screwed cover operated with No. 024 spanner wrench, mounting screws, equal to Young 1101.

2.11 DUCT ACCESS DOORS:

Duct access doors shall be gasketed frame with wing nut fasteners, (1" thick insulation bonded to interior face), 8" x 8" size (duct opening) on ductwork up to 14" and 12" x 12" size on larger ductwork, equal to Young 1310.

PART 3 - EXECUTION

3.1 WORKMANSHIP, QUALITY AND REQUIREMENTS:

3.1.1 All ductwork shall be installed in a first-class workmanlike manner in accordance with SMACNA recommendations. This work shall be warranted for a period of one year from the date of acceptance of the job against noise or vibrations and free from pulsation under all conditions of operation. All defects shall either be removed and replaced or reinforced as directed by the Architect.

3.1.2 Before fabricating any ductwork, the Contractor shall check the conditions at the job site and shall make all necessary changes in cross sections, offsets, etc., whether they are specifically indicated or not.

3.1.3 Provide manually operated volume control dampers in all branches, splits and taps for proper balancing of air distribution whether indicated on the drawings or not. Dampers to be either single blade or multi-blade as indicated or required. They shall have an indicating device with lock to hold damper in position for proper setting. Round dampers and dampers 36" x 12" or less may be single blade, 22 gauge minimum. Larger dampers shall be multi-blade dampers with opposed blade action, 16 gauge minimum. All manual balancing dampers shall be rated for 1,500 FPM minimum. Dampers shall be provided with bearings and manual quadrants. Dampers located in externally insulated ducts shall include operating regulator with a 2" elevated dial similar to VentFabric's 629/639 elevated dial regulator or Young 404B with 2" high base. Dampers may be as scheduled:

	<u>Greenheck</u>	<u>Ruskin</u>	<u>NCA</u>	<u>Air Balance</u>
Round	MBDR-50	MDRS25	PBD-20RS	AC-112
Single	MDB-10M	MD-15	PBD-20	AC-111
Opposed	MBD-15	MD-35	SCD-57	AB-2

3.1.4 Damper operators in all unfinished areas shall be Young Series 400 of the exact style, type and size as required. All other operators shall be Young #315 and/or #895 as required. All dampers shall have Young end bearings on the rod at the opposite end from the operator. Where dampers are installed in ducts located above accessible type ceiling, damper operators shall not be extended through the finished ceiling. Damper operators above inaccessible ceilings shall be furnished with extension rods operable through diffuser and grille faces or from remote locations using concealed damper regulators, field verify locations with the Architect/Engineer. A 90 degree miter gear shall also be provided for use with this damper. The contractor shall provide and cut square rods as necessary to complete the installation.

3.1.5 Provide turning vanes in all square elbows per SMACNA requirements.

3.1.6 Provide hinged access doors for access to all dampers, automatic dampers, fusible links, cleaning operations, etc. Where the ducts are insulated, the access doors shall be double skin doors with one inch (1") of insulation in the door. Factory fabricated doors as manufactured by Milcor or equal meeting these specifications will be acceptable.

3.1.7 Where ducts connect to fans, including roof exhausters, flexible connections shall be made using "Ventglas" fabric that is fire-resistant, waterproof, mildew-resistant and practically air tight and shall weigh approximately thirty ounces (30 oz.) per square yard. There shall be a minimum of one-half inch (1/2") slack in the connections and a minimum of two and one half inches (2 1/2") distance between the edges of the duct except that there shall also be a minimum of one inch (1") of slack for each inch of static pressure on the fan system.

3.1.8 Furnish and install screens on all ducts, fans, etc., and openings furnished by this Contractor which lead to, or are, outdoors. Screens shall be 16 gauge, one half inch (1/2") mesh in removable galvanized steel frames.

3.1.9 Furnish test openings with covers in each zone duct for taking readings of air velocities or pressures in ducts. See the SMACNA manual for cover construction.

3.1.10 All holes in ducts for damper rods and other necessary devices, shall be either drilled or machine punched, (not pin punched), and shall not be any larger than necessary. All duct openings shall be provided with sheet metal caps if the openings are to be left unconnected for any length of time. In general, sheet metal screws shall not be used in duct construction unless the head (not the point) of the screw is in the airstream. Transformations shall have a ratio of not more than one inch (1") in transformation to every seven inches (7") of length unless specifically shown otherwise on the drawings.

3.1.11 Where outside air is ducted into the building and is not connected to a filtered air conditioning unit or fan, it shall be filtered separately with 2" throwaway filters equal to Farr 30/30. Provide a minimum 20 gage galvanized sheet metal filter housing with hinged access door and provide necessary duct transitions to and from the filter housing to the duct work.

3.1.12 Leakage Testing of Installed System:

A. The installed new [and existing duct systems] shall be tested to the designed operating pressure.

B. The air leakage at the test pressure shall be measured by a calibrated orifice type of flow meter. Total allowable leakage of the system shall not exceed 2% of the air handling capacity of the system.

C. If the system is tested in sections, the leakage rates shall be added to give the performance of the whole system.

D. Leakage concentrated at one point may result in objectionable noise even if the system passes the leakage rate criteria. This noise source must be corrected to the satisfaction of the Engineer.

E. The orifice flow measurement device must have been individually calibrated against a primary standard, and this calibrated curve permanently attached to the orifice tube assembly.

F. Testing must be in accordance with a printed procedure submitted to the Engineer for approval.

3.13 Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Reference Architectural plans for fire walls, barriers, and partitions.

3.2 FLASHING:

3.2.1 Provide a flashing and counter-flashing for all ducts penetrating roofs or exterior walls. The flashing shall be not less than No. 24 gauge galvanized steel, and shall be water tight.

3.2.2 Where ducts exposed to view pass through walls, floors or ceilings, furnish and install sheet metal collars to cover the voids around the duct.

3.3 AUXILIARY DRAIN PANS

3.3.1 Provide 18 gauge galvanized sheet metal auxiliary drain pan under all horizontal units mounted above ceiling. Pan shall overhang equipment served by 6" in all dimensions.

3.3.2 Provide 1" auxiliary drain piping and a soldered in bushing at the drain pan.

3.4 FIRE DAMPERS:

3.4.1 Fire dampers shall be installed in accordance with the SMACNA recommendations and as detailed on the drawings.

3.4.2 Provide a duct access panel for each fire damper.

END OF SECTION

SECTION 15200 - AIR CONDITIONING EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL:

Refer to Section 15010 for General Requirements for Mechanical Work.

1.2 SCOPE OF WORK:

Furnish and install all labor, materials, equipment, tools and services and perform all operations required in connection with, or properly incidental to, the construction of complete air conditioning equipment systems as indicated on the drawings, reasonably implied therefrom or as specified herein unless specifically excluded.

1.3 SCHEDULES ON DRAWINGS:

In General, all capacities of equipment and motor and starter characteristics are shown on schedules on the drawings. Reference shall be made to the schedules for such information. The capacities shown are minimum capacities. Variations in the characteristics will be permitted only on written approval of the Architect. Insofar as is possible, all items of the same type (i.e., pumps, fans, etc.) shall be by the same manufacturer. Where instructions on installation are not included on these specifications or on the plans, the manufacturer's instructions shall be followed. Equipment shall be labeled and provided with installation and operating instructions in accordance with Standard Mechanical Code, Section 302.

1.4 EQUIPMENT INSTALLATION AND WARRANTY SCHEDULE:

This Subcontractor shall refer to the architectural specifications for the required time schedule for the installation of equipment furnished as a part of this contract. The required time schedule will necessitate the setting-in-place of some items before the normal period of occupancy of the space and before the acceptance of substantial completion and subsequent approval by the Owner and Architect. The Subcontractor is advised that the warranty for each item of equipment will not begin until the documented time of beneficial use as defined in the architectural specifications, and the Subcontractor will, therefore, make the necessary arrangements with the equipment manufacturers for extended warranties as may be required.

1.5 REFERENCE STANDARDS:

ASHRAE Handbook – 2009 Fundamentals

ASHRAE Handbook - 2010 Refrigeration

ASHRAE Handbook-2011 HVAC Applications

ASHRAE Handbook-2012 HVAC Systems and Equipment

American National Standard for Mechanical Refrigeration Systems - ANSI B9.1

Standard for Installation of Residence Type Warm Air Heating & Air Conditioning Systems - NFPA 90B

Standard For Installation of Air-Conditioning & Ventilating Systems - NFPA 90A

International Mechanical Code – IMC, latest edition

Reference SECTION 15010 for additional information

PART 2 - PRODUCTS (SUBMITTALS REQUIRED)

2.1 FILTERS:

2.1.1 To protect the equipment during construction and for the purpose of testing and balancing, this Contractor shall furnish and install a complete set of temporary filters. These temporary filters shall be of glass fiber in heavy cardboard frame with suitable retainers to hold the media in place.

2.1.2 All permanent filters for the air conditioning unit shall be equal to 2" thick Farr 30/30 throw-away filters.

2.2 VARIABLE REFRIGERANT VOLUME SYSTEMS:

2.2.1 SYSTEM DESCRIPTION

The system specified shall be as schedule on the contract documents. Systems shown or scheduled as heat recovery shall have the capability to simultaneously heat and cool and shall be three (3) pipe systems. Systems shown or scheduled as heat pump systems shall utilize a two pipe system and be in either heating or cooling. The basis of design shall be Daikin Variable Refrigerant Volume (VRV) series, and the contractor shall base their bid on this system. The system shall consist of multiple evaporators, branch selector boxes, REFNET™ joints and headers, a three pipe (heat recovery) and/or two (2) pipe heat pump refrigeration distribution system using PID control and variable speed condensing unit. The condenser shall be a direct expansion (DX), air-cooled heat recovery, multi-zone air-conditioning system with variable speed inverter driven compressors using R-410A refrigerant. The condensing unit may connect an indoor evaporator capacity up to 200% of the condensing unit capacity. All zones are each capable of operating separately with individual temperature control. On heat recovery systems, a dedicated hot gas pipe shall be required to ensure optimum heating operation performance. Two-pipe,

heat recovery systems utilizing a lower temperature mixed liquid/gas refrigerant to perform heat recovery are not acceptable.

The condensing unit shall be interconnected to indoor unit models that have been specifically engineered to operate with the outdoor units. The indoor units shall be connected to the condensing unit utilizing REFNET™ specified piping joints and headers to ensure correct refrigerant flow and balancing. T style joints are not acceptable for a variable refrigerant system.

On heat recovery systems, operation of the system shall permit either individual cooling or heating of each indoor unit simultaneously or all of the indoor units associated with each branch of the cool/heat selector box. On heat pump systems, operation of the system shall permit either cooling or heating of all of the indoor units simultaneously. Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, a building level controller or from a separate building management system, via BacNet, as described herein.

On heat recovery systems, a branch selector box shall determine the heating or cooling mode of operation. Branch selector boxes shall be located as shown on the drawing or as directed by the engineer. Each branch of the branch selector box shall consist of three electronic expansion valves, refrigerant control piping and electronics to facilitate communications between the box and main processor and between the box and indoor units. The branch selector box shall control the operational mode of the subordinate indoor units. The use of three EEV's ensures continuous heating during defrost (multiple condenser systems), no heating impact during changeover and reduced sound levels. The use of solenoid valves for changeover and pressure equalization shall not be acceptable due to refrigerant noise.

The manufacturer shall provide condensing units of the sizes scheduled. A contractor not providing equipment with the same capacity, physical size and electrical requirements shall be responsible for all cost associated with remedying the situation to the satisfaction of the architect, engineer and owner.

Outdoor Air Processing Units:

The variable capacity, heat pump air conditioning system shall be a Variable Refrigerant Volume Series (heat/cool model) split system. The outdoor units shall be direct expansion (DX), air-cooled heat pump air-conditioning system, inverter driven variable speed compressor, multi-zone split system, using R-410A refrigerant. The outdoor unit may connect an indoor evaporator capacity up to 100% to that of the outdoor condensing unit capacity. All indoor units are each capable of operating separately with individual temperature control.

The outdoor unit shall be interconnected to indoor units as shown on the contract documents. The indoor units shall be connected to the condensing unit utilizing REFNET™ specified piping joints and headers to ensure correct refrigerant flow and balancing. T style joints are not acceptable.

Operation of the system shall permit either cooling or heating of all of the indoor units. Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller and/or through the Intelligent Touch Controller.

Bipolar Ionization:

All indoor units shall be provided with Global Plasma Solutions, bipolar ionization units (BPI). The BPI shall be field installed by the mechanical contractor. The BPI supplier shall provide, WITH THE SUBMITTAL DATA, complete ASHRAE 62 – IAQ Procedure calculations. Any manufacturer desiring to furnish BPI for this project shall submit complete submittal data AND sample calculation data from the proposed manufacturer showing compliance with the procedure.

2.2.2 FEATURES AND BENEFITS

- A. Voltage Platform – Heat recovery condensing and Heat pump condensing units shall be available with the voltage shown on the ELECTRICAL prints.
- B. VFD Inverter Control and Variable Refrigerant Temperature – Each condensing unit shall use high efficiency, variable speed all “inverter” compressor(s) coupled with inverter fan motors to optimize part load performance. The system capacity and refrigerant temperatures shall be modulated automatically to set suction and condensing pressures while varying the refrigerant volume for the needs of the cooling or heating loads. The control will be automatic and customizable depending on load and weather conditions.
- C. Configurator software – Each system shall be available with configurator software package to allow for remote configuration of operational settings and also for assessment of operational data and error codes. If this software is not provided by an alternate manufacturer, for each individual outdoor unit the contractor shall do the settings manually and provide detailed records of all settings submitted with the closeout documents.
- D. Defrost Heating – Multiple condenser VRV systems shall maintain continuous heating during defrost operation. Reverse cycle (cooling mode) defrost operation shall not be permitted due to the potential reduction in space temperature.
- E. Oil Return Heating – Multiple condenser VRV systems shall maintain continuous heating during oil return operation. Reverse cycle (cooling mode)

oil return during heating operation shall not be permitted due to the potential reduction in space temperature.

- F. Oil Return – Each system shall be furnished with a centrifugal oil separator and active oil recovery cycle
- G. Each condensing unit shall incorporate contacts for electrical demand shedding with optional 3 stage demand control with 12 customizable demand settings.

2.2.3 QUALITY ASSURANCE

- A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.
- B. All wiring shall be in accordance with the National Electric Code (NEC).
- C. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
- D. Mechanical equipment for wind-born debris regions shall be designed in accordance with ASCE 7-2010 and installed to resist the wind pressures on the equipment and the supports.
- E. The condensing unit will be factory charged with R-410A.

2.2.4 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendations.

2.2.5 WARRANTY

- A. The equipment manufacturer shall warrant original owner of the building in which the equipment is installed that under normal use and maintenance for comfort cooling and conditioning applications such products (the "Products") will be free from defects in material and workmanship. This warranty applies to compressor and all parts and is limited in duration to ten (10) years starting from the "installation date" which is one of the two dates below:
 - a. The installation date is the date that the unit is originally commissioned, but no later than 18 months after the manufacture date noted on the unit's rating plate.
 - b. If the date the unit is originally commissioned cannot be verified, the installation date is three months after the manufacture date.

2.2.6 PERFORMANCE

- A. The equipment shall perform in capacity and efficiency as indicated on the

contract documents. In the event that the performance is not scheduled, the contractor shall provide equipment that will provide the capacity and efficiency of the scheduled equipment, by model. The scheduled capacity and efficiency are minimums. The ratings shall be cooling capacity, heat capacity, cooling full load and part load efficiency and heating full load and part load efficiency.

2.2.7. OPERATING RANGE

- A. The operating range in cooling or cooling dominant simultaneous cooling/heating will be 0°F DB ~ 122°F DB. If an alternate equipment manufacturer is selected, the mechanical contractor shall provide, at their own risk and cost, all additional material and labor to meet low ambient operating condition and performance.

2.2.8 REFRIGERANT PIPING

- A. The system shall be capable of refrigerant piping up to 540 actual feet or 623 equivalent feet from the condensing unit to the furthest indoor unit, a total combined liquid line length of 3,280 feet of piping between the condensing and indoor units with 295 feet maximum vertical difference, without any oil traps. REFNET™ piping joints and headers shall be used to ensure proper refrigerant balance and flow for optimum system capacity and performance. T style joints shall not be acceptable as this will negatively impact proper refrigerant balance and flow for optimum system capacity and performance.

2.2.9 DESIGN BASIS

- A. The HVAC equipment basis of design is Daikin North America. All bidders shall base their pricing on this equipment. In any event, the contractor shall be responsible for all specified items and intents of this document without further compensation.

2.2.10 CONDENSING UNIT

- A. General: The condensing unit is designed specifically for use with the following components.
 - 1. The condensing unit shall be factory assembled in the USA and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of inverter scroll compressors (digital scroll compressors are not allowed), motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receiver and suction accumulator.

All refrigerant piping lines must be individually insulated between the condensing and indoor units with a minimum of ¾" thick insulation.

2. The condensing unit can be wired and piped with access from the left, right, rear or bottom.
3. The connection ratio of indoor units to condensing unit shall be permitted up to 200%.
4. Each condensing system shall be able to support the connection of up to 64 indoor units dependent on the model of the condensing unit.
5. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
6. The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
7. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
8. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation. Each system shall maintain continuous heating during oil return operation.
9. The condensing unit shall be capable of heating operation at 0 F dry bulb ambient temperature without additional low ambient controls or an auxiliary heat source.
10. The multiple condenser VRV systems shall continue to provide heat to the indoor units in heating operation while in the defrost mode.

B. Unit Cabinet:

1. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.
2. The condensing unit shall be provided with hail guards to match the unit casing.

C. Fan:

1. The condensing unit shall consist of one or more propeller type, direct-drive fan motors that have multiple speed operation via a DC (digitally commutating) inverter.
2. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type, and be of high external static pressure and shall be factory set as standard at 0.12 in. WG. A field setting switch to a maximum 0.32 in. WG pressure is available to accommodate field applied duct for indoor mounting of condensing units.

3. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
4. The fan motor shall be provided with a fan guard to prevent contact with moving parts.
5. Night setback control of the fan motor for low noise operation by way of automatically limiting the maximum speed shall be a standard feature. Operation sound level shall be selectable from 3 steps as shown below.

Operation Sound dB(A)	Night Mode Sound Pressure Level dB(A)
Step 1 max.	55
Step 2 max.	50
Step 3 max.	45

D. Condenser Coil:

1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The heat exchanger on the condensing units shall be manufactured from seamless copper tube with internal grooves mechanically bonded on to aluminum fins.
3. The fins are to be covered with an anti-corrosion Ultra Gold coating as standard with a salt spray test rating of 1000hr (ASTM B117 & Blister Rating:10), Acetic acid salt spray test: 500hr (ASTM G85 & Blister Rating:10)
4. The pipe plates shall be treated with powdered polyester resin for corrosion prevention. The thickness of the coating must be between 2.0 to 3.0 microns.
5. The outdoor coil shall have three-circuit heat exchanger design eliminating the need for bottom plate heater. The lower part of the coil shall be used for inverter cooling and be on or off during heating operation enhancing the defrost operation.

E. Compressor:

1. The inverter scroll compressors shall be variable speed (PVM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit. Non inverter-driven compressors, which may cause starting motor current to exceed the nominal motor current (RLA) and require larger wire sizing, shall not be allowed.
2. The capacity control range shall be as low as 3% to 100%.
3. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
4. Oil separators shall be included with the equipment together with an intelligent oil management system.

5. The compressor shall be spring mounted to avoid the transmission of vibration eliminating the standard need for spring insulation.
 6. In the event of compressor failure the remaining compressors shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be designed to specifically address this condition.
 7. In the case of multiple condenser modules, conjoined operation hours of the compressors shall be balanced by means of the Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or every 8 hours and extending the operating life of the system. When connected to a central control system, sequential start shall be activated for all system on system.
- F. Electrical:
1. The power supply to the condensing unit shall be as shown on the electrical prints +/- 10%.
 2. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded, stranded 2 conductor cable.
 3. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one condensing unit with one 2-cable wire.

2.2.11 BRANCH SELECTOR BOX FOR HEAT RECOVERY SYSTEM

- A. General: The branch selector boxes are designed specifically for use with heat recovery system components.
1. These selector boxes shall be factory assembled, wired, and piped.
 2. These selector boxes must be mounted indoors.
 3. The manufacturer may utilize multiple port branch selector boxes.
 4. When simultaneously heating and cooling, the units in heating mode shall energize their subcooling electronic expansion valve.
- B. Unit Cabinet:
1. These units shall have a galvanized steel plate casing.
 2. Each cabinet shall house 3 electronic expansion valves for refrigerant control per branch.
 3. The cabinet shall contain one subcooling heat exchanger per branch.
 4. The unit shall have sound absorption thermal insulation material made of flame and heat resistant foamed polyethylene.
 5. Maximum sound pressure level shall be 50 dB(A).
- C. Refrigerant Valves:
1. The unit shall be furnished with 3 electronic expansion valves per branch to control the direction of refrigerant flow. The use of solenoid valves for

changeover and pressure equalization shall not be acceptable due to refrigerant noise.

2. Each inlet to the branch selector box shall be provided with full port isolation valves with hose port.

3. The refrigerant connections must be of the braze type.
4. In multi-port units, each port shall have its own electronic expansion valves. If common expansion/solenoid valves are used, 100% redundancy must be provided.
5. Multiple indoor units may be connected to a branch selector box with the use of a REFNET™ joint provided they are within the capacity range of the branch selector.

D. Condensate Removal:

1. The unit shall not require provisions for condensate removal. In the event that branch selector device (name varies by mfg.) does potentially produce condensate, a secondary drain pan shall be installed by the mechanical contractor. The drain from the secondary drain pan shall be piped properly piped to the sewer system per all local and national codes.

E. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
2. The unit shall be capable of operation within the limits of 187 volts to 255 volts.
3. The minimum circuit amps (MCA) shall be 0.1 and the maximum overcurrent protection amps (MOP) shall be 15.
4. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded 2 conductor cable.

2.2.12 The configuration of the indoor units shall be as scheduled. In the event there is a conflict between the model number of the scheduled unit and the unit shown on the plans, the contractor shall notify the engineer immediately for clarification.

Following is a description of the various models of indoor units. Some or all of these units are utilized. The descriptions listed are minimum construction and performance standards.

2.2.13 CONCEALED CEILING DUCTED UNIT (Med. Static)

- A. General: Daikin indoor unit shall be a built-in ceiling concealed fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, direct-drive DC (ECM) type fan with auto CFM adjustment at commissioning, for installation into the ceiling cavity. It is constructed of a galvanized steel casing. It shall be available in capacities from 7,500 Btu/h to 48,000 Btu/h. It shall be a

horizontal discharge air with horizontal return air configuration. All models feature a low height cabinet making them applicable to ceiling pockets that tend to be shallow. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control. Included as standard equipment, a condensate drain pan and drain pump kit that pumps to 18-3/8" from the drain pipe opening. The indoor units sound pressure shall range from 29 dB(A) to 40 dB(A) at low speed measured 5 feet below the ducted unit.

- B. Performance: Each unit's performance shall be as scheduled on the contract documents.
- C. Indoor Unit:
 - 1. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall be equipped with automatically adjusting external static pressure logic that is selectable during commissioning. This adjusts the airflow based on the installed external static pressure.
 - 2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
 - 3. Both refrigerant lines shall be insulated from the outdoor unit.
 - 4. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 18-3/8" of lift from the center of the drain outlet and has a built in safety shutoff and alarm.
 - 5. The indoor units shall be equipped with a return air thermistor.
 - 6. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
 - 7. The voltage range will be 253 volts maximum and 187 volts minimum.
- D. Unit Cabinet:
 - 1. The cabinet shall be located into the ceiling and ducted to the supply and return openings.
 - 2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
 - 3. The unit shall be furnished with filter rack to accept two (2) inch thick MERV 8 filters. Two (2) sets shall be provided with the system. In no case shall the equipment be operated without filters in place.

E. Fan:

1. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
2. The unit shall be equipped with automatically adjusting external static pressure logic selectable during commissioning.
3. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range of 0.12 to 0.47 HP respectively.
4. The airflow rate shall be available in three settings.
5. The fan motor shall be thermally protected.
6. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
7. Fan motor external static pressure range for nominal airflow:

Model Number	Fan ESP (in. WG)
FXMQ07PVJU	0.40 – 0.12
FXMQ09PVJU	0.40 – 0.12
FXMQ12PVJU	0.40 – 0.12
FXMQ18PVJU	0.80 – 0.20
FXMQ24PVJU	0.80 – 0.20
FXMQ30PVJU	0.80 – 0.20
FXMQ36PVJU	0.80 – 0.20
FXMQ48PVJU	0.80 – 0.20

F. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 3 row cross fin copper evaporator coil with 13 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1-1/4" outside diameter PVC.
5. A condensate pan shall be located under the coil.
6. A condensate pump with an 18-3/8" lift shall be located below the coil in the condensate pan with a built in safety alarm.
7. A thermistor will be located on the liquid and gas line.

G. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

H. Control:

1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be integrated to the Daikin intelligent Touch advanced multi-zone control system.

2.2.14 4 WAY CEILING CASSETTE UNIT (2'x2')

- A. General: Indoor unit model shall be a ceiling cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity equipped with an air panel grill. It shall be available in capacities from 7,500 Btu/h to 18,000 Btu/h. It shall be a four-way air distribution type, white, impact resistant with a washable decoration panel. The supply air is distributed via motorized louvers which can be horizontally and vertically adjusted from 0° to 90°. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with wall mounted remote control. The indoor units sound pressure shall range from 29 dB(A) to 34 dB(A) at low speed measured at 5 feet below the unit.
- B. Indoor Unit:
1. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
 2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
 3. Both refrigerant lines shall be insulated from the outdoor unit.
 4. The 4-way supply air flow can be field modified to 3-way and 2-way airflow to accommodate various installation configurations including corner installations.
 5. Return air shall be through the concentric panel, which includes a resin net mold resistant filter.
 6. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 21" of lift and has a built in safety shutoff and alarm.
 7. The indoor units shall be equipped with a return air thermistor to allow operation through the building management system or through return air sensing.

8. All electrical components are reached through the decoration panel, which reduces the required side service access.
 9. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
 10. The voltage range will be 253 volts maximum and 187 volts minimum.
- C. Unit Cabinet:
1. The cabinet shall be space saving and shall be located into the ceiling.
 2. Three auto-swing positions shall be available to choose, which include standard, draft prevention and ceiling stain prevention.
 3. The airflow of the unit shall have the ability to shut down one or two sides allowing for simpler corner installation.
 4. Fresh air intake shall be possible by way of direct duct installation to the side of the indoor unit cabinet.
 5. A branch duct knockout shall exist for branch ducting supply air.
 6. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
- D. Fan:
1. The fan shall be direct-drive turbo fan type with statically and dynamically balanced impeller with high and low fan speeds available.
 2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range from 0.06 to 0.12 HP.
 3. The airflow rate shall be available in high and low settings.
 4. The fan motor shall be thermally protected.
- E. Filter:
1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.
- F. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
 2. The refrigerant connections shall be flare connections and the condensate will be 1 -1/32 inch outside diameter PVC.
 3. A condensate pan shall be located under the coil.
 4. A condensate pump with a 21 inch lift shall be located below the coil in the condensate pan with a built in safety alarm.
 5. A thermistor will be located on the liquid and gas line.
- G. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
 2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).

3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.
- H. Control and Isolation:
1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
 2. **Each fan coil unit shall be provided with full port isolation valves with port for hose connection.**

2.2.15 WALL MOUNTED UNIT

- A. General: Indoor unit shall be a wall mounted fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation onto a wall within a conditioned space. This compact design with finished white casing shall be available in capacities from 7,500 Btu/h to 24,000 Btu/h. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with remote control. A mildew-proof, polystyrene condensate drain pan and resin net mold resistant filter shall be included as standard equipment. The indoor units sound pressure shall range from 31 dB(A) to 40 dB(A) at low speed measured at 3.3 feet below and from the unit.
- B. Performance: Each unit's performance is based on nominal operating conditions and the performance scheduled on the contract documents.
- C. Indoor Unit:
1. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops. The remote controller shall be able to set five (5) steps of discharge angle. The front grille shall be easily removed for washing. The discharge angle shall automatically set at the same angle as the previous operation upon restart. The drain pipe can be fitted to from either left or right sides.
 2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
 3. Both refrigerant lines shall be insulated from the outdoor unit.
 4. Return air shall be through a resin net mold resistant filter.
 5. The indoor units shall be equipped with a condensate pan.
 6. The indoor units shall be equipped with a return air thermistor.
 7. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.

8. The voltage range will be 253 volts maximum and 187 volts minimum.
- D. Unit Cabinet:
1. The cabinet shall be affixed to a factory supplied wall mounting template and located in the conditioned space.
 2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
- E. Fan:
1. The fan shall be a direct-drive cross-flow fan, statically and dynamically balanced impeller with high and low fan speeds available.
 2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range 0.054 to 0.058 HP.
 3. The airflow rate shall be available in high and low settings.
 4. The fan motor shall be thermally protected.
- F. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
 2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
 3. The coil shall be a 2-row cross fin copper evaporator coil with 14 fpi design completely factory tested.
 4. The refrigerant connections shall be flare connections and the condensate will be 11/16 inch outside diameter PVC.
 5. A thermistor will be located on the liquid and gas line.
 6. A condensate pan shall be located in the unit.
- G. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
 2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
 3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.
- H. Control:
1. The unit shall have controls provided by the unit manufacturer to perform input functions necessary to operate the system.
 2. The unit shall be compatible with a Intelligent Touch advanced multi-zone controller.
- I. Accessories to be provided:
1. A condensate pump.

2.2.16 OUTSIDE AIR PROCESSING UNIT

- A. General: Daikin indoor unit shall be a built-in ceiling concealed fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation into the ceiling cavity. The unit shall be capable of introducing up to 100% outside air controlled to a fixed discharge air temperature. It is constructed of a galvanized steel casing. It shall be available in capacities from 48,000 Btu/h to 96,000 Btu/h. These units shall be connected to individual heat pump condensing units. It shall be a horizontal discharge air with horizontal return air configuration. All models feature a low height cabinet making them applicable to ceiling pockets that tend to be shallow. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The indoor units sound pressure shall range from 42 dB(A) to 47 dB(A) at low speed measured 5 feet below the ducted unit.
- B. Performance: Each unit's performance shall be as scheduled on the contract documents.
- C. Indoor Unit:
1. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, self-diagnostics, auto-restart function, 3-minute fused time delay and test run switch.
 2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
 3. Both refrigerant lines shall be insulated from the outdoor unit.
 4. The indoor units shall be equipped with a discharge air thermistor.
 5. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
 6. The voltage range will be 253 volts maximum and 187 volts minimum.
- D. Unit Cabinet:
1. The cabinet shall be located into the ceiling and ducted to the supply and return openings.
 2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
- E. Fan:
1. The fan shall be direct-drive Sirocco type fan, statically and dynamically balanced impeller with high and low fan speeds available.
 2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz, with a motor output of 0.51 HP.
 3. The fan motor shall be thermally protected.
 4. Fan motor external static pressure for nominal airflow:

Model Number	Fan ESP (in. WG)
FXMQ48MFVJU	0.88
FXMQ72MFVJU	0.96
FXMQ96MFVJU	1.03

F. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 3 row cross fin copper evaporator coil with 13 fpi design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1-5/16 inch outside diameter PVC.
5. A thermistor will be located on the liquid and gas line.

G. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

H. Control:

1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be integrated to the Daikin intelligent Touch advanced multi-zone control system.
3. Each outside air processing unit shall be provided with motorized low leak dampers, equal to Ruskin CD60 with gasketed edge. The unit shall remain off, with outside air damper closed, until thirty (30) after the start of the main system. Upon start of the outside air processing unit, the outside air damper shall open. The actuator shall be spring return, such that when the unit is powered off, the damper shall close.

2.2.17 The equipment manufacturer shall provide a touch screen interface panel with a plan view of the system, as shown on the mechanical prints. The interface shall provide complete interface to the equipment – setpoints, set-up, alarms and reset of equipment. The interface shall be graphical with a building floor plan included showing location of equipment. The operator shall be able to simply touch equipment icon on the plans to evaluate the specific unit.

The controller shall also have an ethernet connection to the building IT system.

The unit will be provided with an IP address by the owner to allow secure access to the system via the internet.

The contractor shall wire the entire system in per the manufacturer's recommendation. The electrician shall provide a 115 VAC power outlet with surge suppression for connection of the i-Touch Manager. The owner shall provide an ethernet connection to the control panel.

Wiring above the ceiling shall be in plenum rated cable. Wiring in the walls shall be in conduit. All wiring shall be run parallel to building lines and secured via tie wraps.

The equipment manufacturer shall set-up the system with addresses and time schedules. In addition, the manufacturer shall train the operations personnel with two (2) – two (2) hour training events.

2.3 EXHAUST FANS:

2.3.1 Ceiling exhaust fans shall be equal to Greenheck Model SP and as indicated on the drawings. The fan housing shall be constructed of heavy gauge galvanized steel, acoustically lined with 1/2 inch thick insulation. The motor shall be mounted on resilient elastic grommets. The fan shall have a forward curved centrifugal wheel. All fans shall bear the AMCA seal for air and sound performance. Provide expanded aluminum integral grille and wall cap with birdscreen.

2.3.2 Acceptable manufacturers: ACME, Jenn-Air, ILG, Cook, Twin City Fans.

END OF SECTION

SECTION 15250 - TEMPERATURE CONTROLS

PART 1 - GENERAL:

1.1 GENERAL:

Refer to Section 15010 for General Requirements for Mechanical Work. The temperature controls contractor shall submit for approval complete temperature controls shop drawings to include but not limited to wiring diagrams, control diagrams, sequence of operation and interlocks.

1.2 SCOPE OF WORK:

Furnish and install all materials, supplies, labor (except electrical) and services for, required in connection with, or properly incidental to, a complete system of temperature control for heating, ventilating and air conditioning. The temperature controls supplier shall furnish all temperature control equipment as described under this heading and a factory trained employee of the control manufacturer shall provide installation supervision as required for the proper installation of the temperature control system. All wiring in connection with the automatic temperature control system shall be furnished by the Electrical Subcontractor under another section of this specification.

PART 2 - PRODUCTS (SUBMITTAL REQUIRED)

2.1 THERMOSTATS:

Thermostats for air conditioning units shall be provided by the air conditioning unit manufacturer and shall be combination heating/cooling (automatic change over); two stage heating where required and single stage cooling. Provide clear plastic-locking covers for thermostats.

2.2 FIRE-STATS:

Provide in each air moving device such as air conditioning units, ventilation fans, exhaust fans, etc., of 600 CFM capacity and larger, a fire-stat to "stop" each respective air moving device upon an entering air temperature to the fan in excess of 125 degrees Fahrenheit (or in excess of that specified in the local codes or by the authority having jurisdiction). The fire-stat shall be product of the Temperature Control Subcontractor.

Provide in each recirculating air moving device 2,000 CFM and over capacity, a smoke detector with a supervisory relay and remote test station to sound an alarm horn equal to Simplex #2901-96649 and stop the fan. Smoke detectors shall be equal to Simplex #2098-9649 housing with #2098-9747 power adaptor, #2098-9636 detector head with sampling tube extending full width of duct and #2098-9782 remote test station. Remote test station and alarm horn shall be located in the following areas and in order of precedence according to availability.

1. Mechanical Room or Closet
2. Janitor's Closet
3. Storage Room or Closet

2.3 AUTOMATIC DAMPERS:

Modulating dampers shall be of the opposed blade type and shall have blades not exceeding 6" width. Dampers shall be constructed of #16 gauge galvanized steel, rigidly constructed to prevent distortion. Dampers shall have neoprene edges and shall have 5% leakage maximum at the pressures experienced.

2.4 DAMPER OPERATORS:

Damper motors shall be of the reversing, quiet, oil immersed type, ample in size to handle the load imposed on them and shall conform to the requirements detailed in the sequence descriptions of this specification.

2.5 MISCELLANEOUS:

The control manufacturer shall furnish all two position relays, capacity relays and all other controls necessary to meet the specifications and provide for a properly operating control system as specified herein. All electric switches and relays shall be UL listed and the type to meet current and voltage requirements of the particular application.

2.6 TIME CLOCK:

Digital electronic time clock equal to intermatic shall be a single 7-day time clock with skip-a-day feature with manual override. All toilet and janitor closet exhaust fans and other exhaust fans shall be connected through the time clock to prevent operation during unoccupied periods.

PART 3 - EXECUTION

3.1 REQUIREMENTS FOR WORKMANSHIP AND QUALITY:

3.1.1 All wiring shall be terminated by connecting to the temperature control device or numbered terminal strip as indicated on the drawing furnished by the temperature control manufacturer. All wiring shall be color coded and shall be tagged for further identification. Splices in wiring shall be held in an absolute minimum and when necessary shall be made color to color throughout the entire control system.

3.1.2 All switches, panels, etc., furnished and/or installed by the temperature control manufacturer shall be identified by means of plates made of plastic or black anodized aluminum suitably engraved. Embossed or punched plastic tape will not be acceptable.

3.1.3 The Mechanical Contractor shall provide a complete detailed wiring diagram for the air conditioning units to the Electrical Contractor for installation.

3.1.4 The Mechanical Contractor shall provide for relocation of 25% of thermostats and/or zone sensors (minimum of two if less than eight thermostats and/or sensors) to different locations from those shown on the plans as directed by the Engineer.

3.2 SERVICE AND WARRANTY:

The control system herein specified shall be free from defects in workmanship and material under normal use and service. If within 12 months from date of acceptance by the Owners any of the equipment herein described is proved to be defective in workmanship or material, it shall be replaced or repaired free of any charge to the Owner. Upon completion of the job, the temperature controls shall be thoroughly checked, adjusted and calibrated and placed in operation all devices comprising the entire control system provided under this section of the work to the complete satisfaction of the Engineer and/or Owner. The Subcontractor shall provide the Owner with complete instruction manuals covering the function and operation of all control components on the project. A component technician shall be available for instruction purposes to the Owner.

END OF SECTION

SECTION 15500 - PLUMBING FIXTURES, EQUIPMENT AND DRAINS

PART 1 - GENERAL

1.1 GENERAL:

Refer to Section 15010 for General Requirements for mechanical work.

1.2 SCOPE OF WORK:

1.2.1 Furnish and install all labor, materials, equipment, tools and services and perform all operations required in connection with or properly incidental to the installation of complete plumbing fixtures and plumbing equipment, as indicated on the drawings, reasonably implied therefrom, or as specified herein, unless specifically excluded.

1.2.2 Plumbing fixtures shall be supplied, set and connected as listed herein and as shown on the drawings. Fixtures shall be protected from damage during construction and shall be thoroughly cleaned of all tape and adhesive prior to final acceptance.

1.2.3 Special mounting heights of plumbing fixtures shall be coordinated with architectural details of each toilet area.

1.3 REFERENCE STANDARDS:

Standard Plumbing Code
City of Caldwell Plumbing Code
State of Texas Sanitary Code

PART 2 - PRODUCTS

2.1 FITTINGS AND PIPES:

2.1.1 All exposed piping and fittings connected to plumbing fixtures shall be polished chrome-plated brass. Concealed piping and fittings shall be made of brass. Provide chrome-plated brass escutcheons wherever pipes pass through walls, floors and ceilings.

2.1.2 Provide all required water, waste, soil and vent connections to all plumbing fixtures and equipment, with all fittings, supports, fastening devices, cocks, valves, traps, closet flanges, etc., leaving all in complete working order.

2.2 FIXTURES:

2.2.1 All plumbing fixtures shall be new, first quality, free from marks or chips and shall be furnished with sufficient support in order to adequately hang each and every unit..

2.2.2 All plumbing fixtures shall be complete with all required trim, including stop valves whether specifically shown and/or specified or not, and all such stop valves shall have a metal-to-metal seat.

2.2.3 All trim, supply fittings, closet flanges, etc., shall be furnished whether correctly specified or not in order to securely fit the fixture involved to the particular roughing-in available.

2.3 PLUMBING FIXTURES: (SUBMITTAL REQUIRED)

2.3.1 Water Closet (WC) - Kohler Wellcome K-4350 vitreous china, flush valve, floor mounted, siphon jet, elongated bowl. Provide K-4670-CA open front white seat, less cover. Furnish Sloan Royal #ECOS 111 touchless flush valve with transformer (**hard wired, coordinate with electrical contractor**). Connection sizes: CW = 1", WD = 4".

2.3.2 Water Closet, Handicapped (WCH) - Kohler Highcliff K-4368 vitreous china, flush valve, floor mounted, siphon jet, elongated bowl, ADA compliant. Provide K-4670-CA open front white seat, less cover. Furnish Sloan Royal #ECOS 111 touchless flush valve with transformer (**hard wired, coordinate with electrical contractor**). Connection sizes: CW = 1", WD = 4".

2.3.3 Urinal (UR) - Kohler Bardon K-4904-ET vitreous china, wall hung, washout urinal with integral trap. Furnish Sloan Royal #ECOS 186 touchless flush valve with transformer (**hard wired, coordinate with electrical contractor**) and Wade W-400 AM11 carrier. Connection sizes: CW = 3/4", WD = 2".

2.3.4 Lavatory (LHA) - Kohler Caxton K-2210 19 1/4" x 16 1/4" vitreous china oval undercounter mounted lavatory with basin clamps and offset drain, K-7715 grid drain. Furnish K-7605-P supply, K-8998 CPB P-Trap. Furnish K-13462 touchless faucet with K-13481 power supply (**hard wired, coordinate with electrical contractor**). Connection sizes: CW = 1/2", HW = 1/2", WD = 1 1/4". Handicap height with K-13885 offset drain. Provide insulated supplies and drain with PVC cover. Installation shall be ADA compliant.

2.3.5 Lavatory (LHB) - Kohler Greenwich K-2032, 20-3/4" x 18-1/4" vitreous china wall hung lavatory with K-7715 grid drain. Furnish K-7605-P supply, K-8998 CPB P-Trap, and Wade W-520-07 carrier. Furnish K-13462 touchless faucet with K-13481 power supply (**hard wired, coordinate with electrical contractor**). Connection sizes: CW = 1/2", HW = 1/2", WD = 1 1/4". Handicapped height with K-13885 offset drain. Provide insulated supplies and drain with PVC cover. Installation shall be ADA Compliant.

2.3.6 Service Sink (SS) - Fiat TSB-800 terrazzo mop-service basin, 36" x 24" x 12" deep with precast stainless steel cap, nickel bronze strainer and wall flanges. Furnish #830-AA sink fitting, #832-AA hose/hook, #889-CC mop hanger, and C.I. P-Trap. Connection sizes: CW = 1/2", HW = 1/2", WD = 3".

2.3.7 Counter Sink (SK) - Elkay LRADQ191955 19 1/2" x 19" x 5 1/2" deep type 304 stainless steel, 18 ga. single compartment sink, coated underside, 3-hole drilling. Furnish LKD-24898BHC trim, LK-35 drain, angle stops, flexible risers, C.P.B. P-Trap. Connection sizes: CW = 1/2", HW = 1/2", WD = 1 1/2". Provide insulated supplies and drain with PVC cover. Provide ADA compliant offset drain, Kohler K-13885. Installation shall be ADA compliant.

2.3.8 Electric Water Cooler (EWC/EWCH) - Elkay EZSTLG8SC two-station bi-level wall hung electric water cooler, 8.0 GPH, 115V, 370 watts, rough stop supply, stainless steel finish, C.P.B. P-Trap. Water cooler shall be lead-free. Connection sizes: CW = 3/8", WD = 1 1/4".

2.3.9 Electric Water Heater (WH) - State PCE-40-2ORTA 40 gallon, 4,500 watt, 208V, 1 phase with P&T relief. Connection sizes: CW = 3/4", HW = 3/4".

2.3.10 Freezeless Wall Box Faucet (WF) - Woodford Model B65, freezeless, automatic draining, backflow preventer, flush wall box with keyed door, chrome plated brass, loose key.

2.3.11 Mixing valve (MV) - Holby thermostatic type temperature regulating, 105 degrees -F, 140 degrees- F adjustment, connection size as required.

2.3.12 Hot Water Circulator (HWC) - B & G series 100 centrifugal in-line pump, all bronze, 1/12 HP, 115V, 15 GPM at 7 ft. HD., flanged 3/4" connections.

2.3.13 Floor Drain (FD) - Wade 1100-Standard with cast iron body and satin nickel bronze strainer.

2.3.14 Trap Primer (TP) - Precision Plumbing Products, Inc. "Prime-Rite" trap primer valve, machined brass, 1/2" male NPT inlet, 1/2" female NPT outlet. Provide distribution unit as applicable for multiple floor drains.

Acceptable Manufacturers:

Water closet, urinal, lavatories: Kohler, American Standard, Eljer, Crane.

Carriers - Wade, Josam, Smith, Zurn.

Sinks - Kohler, American Standard, Just, Moen, Elkay.

Electric Water Coolers - Elkay, Halsey-Taylor, Oasis, Sunroc, Haws.

Water Heaters - State, Rheem, Ruud, A.O. Smith, Jackson, National.

Wall Faucets - Woodford, Prier, Acorn, Wade, Josam, Smith

Floor Drains - Wade, Josam, Smith, Zurn.

2.4 CLEANOUTS: (SUBMITTAL REQUIRED)

2.4.1 Cleanouts shall be as follows:

Floor Cleanouts - in finished areas - Wade #W-7000 w/satin nickel bronze top
- in tile floors - Wade #7000-T
- in terrazzo floors - Wade #W-7000-U
- in unfinished utility or storage areas - Wade #W-8550-D

Wall Cleanouts - Wade #W-8450-R Stainless Steel coverplate

Cleanouts in exposed piping - Wade #W-8550-R

Exterior cleanouts - Wade #W-7040-X w/nickel bronze top

2.4.2 Cleanouts in waterproof floor shall have flashing flange and clamping device.

2.4.3 Cleanouts in carpeted areas shall be provided with carpet markers (Wade option No. 72).

2.5 FLOOR DRAINS: (SUBMITTAL REQUIRED)

2.5.1 Provide floor drains where indicated on drawings. Drains shall be cast iron construction, with satin nickel bronze strainers.

2.5.2 Strainer sizes shall be as follows: 5 inches on 2" drain, 7 inches on 3" and 4" drain.

2.5.3 A deep seal, cast iron P-trap shall be installed on each drain connected to the sanitary sewer system.

2.5.4 Drains in waterproof floors shall have flashing flange and clamping device.

2.6 WATER HAMMER CONTROL: (SUBMITTAL REQUIRED)

2.6.1 Arrestors shall be sized and applied in accordance with the Plumbing and Drainage Institute Standard PDI-WH-201. Equipment equal to Wade Shockstop or equal by Amtrol, Zurn, Smith or Josam is acceptable.

2.6.2 Provide access cover in wall to service water hammer arrestors.

2.7 VACUUM BREAKERS: (SUBMITTAL REQUIRED)

2.7.1 For hose bibb, sill cock, yard hydrants, and wall faucets: Woodford #34H or equal.

2.7.2 For turf irrigation systems and water heaters without dip tubes: Watts #288A or equal.

2.8 BACKFLOW PREVENTERS: (SUBMITTAL REQUIRED)

2.8.1 Provide a Watts Regulator Company Number 900 series reduced pressure principal backflow preventer with strainer, test cocks, drain elbow and O S & Y gate valves, line size as indicated. Preventer shall be designed to equal or exceed the requirements of A.S.S.E. Standard 1010, AWWA Standard C-506 and the performance requirements of U.S.C. Foundation for Cross Connection Control Standard for Reduced Pressure Principle Backflow Preventers.

2.8.2 **Provide a backflow preventer and enclosure for the city water connection in strict accordance with the local codes and requirements.**

2.8.3 **Provide freeze protection. Coordinate with electrical contractor.**

2.8.4 **For backflow preventers serving fire sprinkler systems, provide tamper switches for each main valve, extend and connect to fire alarm as required, coordinate with electrical contractor.**

2.9 DOMESTIC WATER HEATERS: (SUBMITTAL REQUIRED)

2.9.1 Electric water heaters shall be UL listed and complete with all standard features, five (5) year tank warranty, glass-lined tank, foam insulation on the tank, anode rod, automatic temperature control, and automatic high-limit safety cutoff.

2.9.2 Provide ASME pressure and temperature relief valve for each unit. Units not installed with vacuum breaker on cold water supply line shall be provided with AGA certified vacuum relief valve per ANSI Z21.22. A gate valve shall be installed on same floor as unit and no further than 3 feet on the cold water supply.

2.9.3 Provide heat trap nipples at domestic cold and hot water connections.

2.10 DOMESTIC HOT WATER CIRCULATOR: (SUBMITTAL REQUIRED)

Hot water circulating pump shall be manufactured by Bell and Cossett, Taco or Thrust and shall have capacities as scheduled herein The pump shall be all bronze construction and shall be furnished complete with a manual motor starter equal to Square "D" Class 2510.

PART 3 - EXECUTION:

3.1 INSTALLATION:

3.1.1 Plumbing fixtures and equipment shall be set in place, leveled and connected as indicated on the drawings. Fixtures shall be protected from damage during construction and shall be thoroughly cleaned of all tape and adhesive prior to final acceptance.

3.1.2 Verify exact location and mounting height of wall hung handicapped fixtures with architectural drawings before roughing-in.

3.1.3 Contractor shall set and connect all fixtures, including fixtures and equipment furnished by others, in strict accordance with the manufacturer's printed instructions and applicable industry standards as indicated.

3.1.4 Caulk around wall mounted fixtures with fine continuous bead of white silicon sealant.

3.1.5 Supplies to each fixture or piece of equipment shall be valved for service.

3.1.6 All drains shall be trapped and vented.

3.1.7 Connection between china and soil pipe flanges shall be made gas and water-tight with one-piece molded gasket.

3.1.8 Do not install aerators on faucets until system has been flushed out and sterilized.

3.1.9 Provide china bolt caps for water closet mounting studs.

3.1.10 Contractor shall coordinate all fixture locations and rough-in with the Architectural drawings. Provide all necessary offsets and adjustments required for fixtures in cabinets.

END OF SECTION

SECTION 15600 - INSULATION

PART 1 - GENERAL

1.1 GENERAL:

Refer to Section 15010 for General Requirements for mechanical work.

1.2 SCOPE OF WORK:

The Contractor shall cover all piping and apparatuses, as specified below, with insulation as manufactured by Johns-Manville, Owens-Corning or equal. All insulation, jacket, facing and adhesive shall have composite ratings not exceeding flame spread of 25 and smoke development of 50.

PART 2 - PRODUCTS (SUBMITTAL REQUIRED)

2.1 DOMESTIC HOT AND COLD WATER PIPING:

2.1.1 All cold water, hot water, and hot water recirculating piping, fittings, and valve bodies above grade shall be insulated with 1/2" thick, molded fiberglass mitered to fit the piping. This insulation material shall be an all purpose white vapor barrier jacket with flap and factory applied. Provide rigid factory fitting covers.

2.2 DUCTWORK:

All supply, return, exhaust, and outside air ductwork in conditioned spaces (such as return air plenums) except internally lined ducts shall be insulated with three quarter pound per cubic foot minimum density fiberglass blanket insulation 2 1/2" thick and having type FRK foil reinforced kraft vapor barrier jacket. Ductwork in unconditioned spaces (such as attics or crawlspaces) including internally lined ducts shall have 3" thick, three quarter pound per cubic foot minimum density fiberglass blanket insulation and have type FRK foil reinforced kraft vapor barrier jacket. Insulation shall be wrapped tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2". Adhere insulation to metal with 4" strips of insulation bonding adhesive at 8" on centers. On longitudinal joints, the overlap shall be secured using 9/16" flared door staples applied 6" on centers and taped with minimum 3" wide foil reinforced kraft tape. All pin penetrations or punctures in facing shall be taped. Tape all circumferential joints with 4" wide foil reinforced kraft tape. Refer to Section 15150 for ductwork with internal lining.

2.3 CONDENSATE DRAIN PIPING:

Condensate drain piping from air conditioning units and plumbing P-trap receptors shall be insulated with 1/2" thick molded fiberglass with an all purpose white vapor barrier jacket with flap. Furnish rigid factory fitting covers.

2.4 REFRIGERANT PIPING:

Refrigerant piping shall be insulated with 3/4" Armaflex (liquid and suction) or as recommended by the air conditioning equipment manufacturer.

2.5 FIRE SPRINKLER PIPING IN UNHEATED AREAS:

All fire sprinkler piping, fittings, and valve bodies above grade and subject to freezing shall be insulated with 1/2" thick, molded fiberglass mitered to fit the piping. This insulation material shall be an all purpose white vapor barrier jacket with flap and factory applied. Provide rigid factory fitting covers.

2.6 ALUMINUM METAL JACKET:

All insulation outside, exposed to weather shall be covered with 0.016 aluminum metal jacket.

PART 3- EXECUTION

3.1 PROCEDURES:

3.1.1 All insulation shall be the product of reputable manufacturers and shall be applied by mechanics skilled in the use of various materials and in the employ of a concern regularly engaged in the insulating business. The materials shall all be applied in accordance with the published standards of the manufacturer of the materials, using any special materials as required by these specifications and by those published standards. Unsightly work shall be just cause for rejection.

3.1.2 All sectional covering shall finish round and smooth, without lumps or depressions and all end joints shall butt evenly and tightly together and to the covered surface. No broken or damaged section shall be used. When covering is formed from blocks, they shall be carefully and evenly applied, securely wired in place and joints shall be closed with cement insulation.

3.1.3 In instances where insulated lines pass into other areas, wherein the line will not be insulated as described herein, the insulation shall not terminate at the wall, but shall extend full size a minimum of 1" beyond the wall.

3.1.4 Engage the services of a qualified insulation applicator to furnish and install all the insulation required for the mechanical equipment, piping, etc., specified herein.

3.1.5 All surfaces to be insulated shall be clean and dry before applying insulation. All sections of molded pipe covering shall be firmly butted together. No insulation shall be applied until the pipe, duct, etc., have been pressure tested and found tight. Piping flexible connections, flanges and unions shall not be covered unless specifically noted. Flexible connections on ducts shall not be covered.

3.1.6 Prior to the installation of any insulating material to ferrous piping systems, the piping surfaces shall be thoroughly cleaned of all mill scale, grease and dirt and shall be given a coat of rust inhabiting primer.

3.1.7 Refer to Section 15010, for flame spread properties of insulating materials.

3.1.8 Where vapor barriers are required, the vapor barrier shall be on the outside. Extreme care shall be taken that the vapor barrier is unbroken. Joints, etc., shall all be sealed. Where insulation with a vapor barrier terminates, it shall be sealed off with the vapor barrier being continuous to the surface being insulated. Ends shall not be left raw.

3.1.9 All Armaflex insulation exposed to the weather shall be coated with a weatherproof finish recommended by the manufacturer.

3.1.10 Armaflex insulation shall be slid on unslit or shall be applied with contact cement. Duct tape, electrical tape, staples, etc., shall not be permitted.

3.1.11 Metal jackets shall have side and end lap at least 2-inches wide with the cut edge of the side lap turned inside one inch to provide a smooth edge. Overlap the jacket not less than 2 inches at longitudinal and circumferential joints and secure with metal bands at not more than 9-inch centers or with screws at not more than 5-inch centers. Overlap longitudinal joints down to shed water. Seal circumferential joints with a coating recommended by the insulation manufacturer for weatherproofing.

END OF SECTION

SECTION 15800 - CLEANING AND TESTING

PART 1 - GENERAL

1.1 GENERAL:

1.1.1 Refer to Section 15010 for General Requirements for Mechanical Work.

1.2 SCOPE OF WORK:

1.2.1 This Contractor shall, at his own expense, make such tests of his work as are herein specified in accordance with all laws, governing authorities, or as are required by Architect or by state or municipal authorities having jurisdiction and under their supervision. Any leaks, defects or deficiencies discovered as a result of the tests shall be immediately repaired or made good and test shall be repeated until the test requirements are fully complied with. No caulking of pipe joints to remedy leaks will be permitted. Any damage caused by testing shall be repaired at this contractor's expense.

1.2.2 No work of any nature shall be covered, enclosed or otherwise concealed until properly inspected, tested and approved.

1.2.3 Each system with its various components shall be operated by this Contractor for a reasonable length of time to demonstrate the performance of all equipment and piping in accordance with the true intent and purpose of the plans and specifications. All necessary adjustments shall be made to the satisfaction of the Architect.

1.2.4 All motor driven equipment shall be demonstrated as operable in accordance with the intent of these specifications.

1.2.5 All electrical power and water for testing shall be provided by the General Contractor.

PART 2 - PRODUCTS

2.1 STERILIZATION MATERIALS:

Domestic water sterilization solutions shall contain not less than 50 parts per million of available chlorine. The chlorinating materials shall be either liquid chlorine, conforming to U. S. Army Specification Number 4-1, or calcium hypochlorite or chlorinated lime conforming to the requirements of Federal Specification O-C-114.

PART 3 - EXECUTION

3.1 TESTING AND ADJUSTING:

3.1.1 Water piping systems shall be properly tested to a hydrostatic pressure of one hundred and fifty pounds per square inch gauge (150 psig) for a period of not less than eight hours. All leaks in pipe, fittings and accessories, and in the particular piping system which is being tested, shall be corrected and the hydrostatic test shall again be applied. This procedure shall be repeated until no leaks can be found.

3.1.2 Sanitary drain piping shall have all outlets temporarily plugged. The pipes shall be filled with water testing the systems in sections such that no section shall be tested with less than 10 feet (10') head of water for twenty-four (24) hours. If the level of the water has been lowered by leakage, the leaks shall be found and corrected and the test repeated until no perceptible lowering of the water level of the system being tested is found.

3.1.3 Heating, Ventilating and Air Conditioning Systems: The new air conditioning, heating and ventilating systems shall be operated separately, or in conjunction with the others for a period of time to demonstrate to the satisfaction of the Architect the ability of the equipment to meet the capacity and performance requirements while maintaining design conditions in accordance with the true intent and purpose of these specifications. Heating and cooling capacities and performance for every system shall be checked in the winter and summer, respectively. Any adjustments and/or startup required shall be done at no additional cost to the Owner. Any adjustments done during one season shall not affect capacities and performance during the other season. The volume of air at each outlet and inlet, air conditioning equipment performance data, etc., shall be tabulated and required balancing performed by engineering personnel skilled, trained and experienced in the performance of these functions (see Section 15850 - System Balancing and Adjusting). Previous to such performance tests, this Contractor shall have set all valves, dampers, motors, controllers, thermostats, etc., and shall have the system operating and maintaining design temperatures, humidity and air circulation throughout all areas of the building. This Contractor shall also at the proper time make such additional adjustments as may be required to obtain consistent temperatures throughout the project.

3.2 STERILIZATION:

3.2.1 After completion of the testing, the entire domestic cold and hot water piping systems with attached equipment shall be thoroughly sterilized with a solution containing not less than 50 parts per million of available chlorine as described above. The chlorinating materials shall be pumped into the system through the connection described below. The sterilization solution shall be allowed to remain in the system for a period of eight (8) hours, during which time all valves and faucets shall be opened and closed several times. After sterilization, the solution shall be flushed from the system with clean water until the residual chlorine content is not greater than 0.2 parts per million. The exact procedure actually used shall meet or exceed local code requirements.

3.2.2 The sterilization solution shall be introduced into the water system through a 3/4" opening to be provided in the water main on the house side of the water meter.

3.2.3 The sterilization process shall be conducted under the direction of the local health department and upon completion of the process, the health department shall test and verify the cleanliness of the water piping system. Provide a certificate of performance.

3.3 NOISE LEVEL:

3.3.1 All items of equipment shown on the plans and specified herein have been selected so that the anticipated noise level in the building from the air conditioning and other systems will not be above 35NC level.

3.3.2 If the contractor wishes to make substitution of equipment from that selected, he must satisfy himself and the Engineer that the noise level in the building will not exceed 35NC.

END OF SECTION

SECTION 15850 - SYSTEM BALANCING AND ADJUSTING

PART 1 - GENERAL

1.1 GENERAL:

1.1.1 Refer to Section 15010 for General Requirements for Mechanical Work.

1.1.2 The work described in this Section shall be performed by the Contractor.

1.2 SCOPE OF WORK:

1.2.1 This section covers the testing, balancing and adjusting of environmental systems including but not limited to: air distribution system, hydronic distribution systems and the equipment and apparatus connected thereto.

1.2.1 The work required herein shall consist of setting volume (flow) and speed adjusting facilities provided or specified for the system, recording data, making tests and preparing reports, all as hereinafter specified. Except as otherwise specified, the HVAC Contractor shall furnish and install pressure and temperature taps (Pete's Plugs by Peterson Equipment Company or equal) on both sides of each refrigeration machine, chilled and condenser water pump, cooling tower, and cooling coil, for temperature and pressure measurement.

1.2.3 Work shall be performed by an independent firm certified by the National Environmental Balancing Bureau (NEBB). Submit the name of the NEBB certified firm he proposes to employ to the Architect for approval within 30 days after contract award.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 PROCEDURES:

3.1.1 Environmental systems including all equipment, apparatus and distribution systems shall be tested and balanced in accordance with the latest edition of NEBB Procedural Standards for Testing - Balancing and Adjusting of Environmental Systems published by NEBB.

3.1.2 All work performed shall be under the direction of qualified personnel.

3.1.3 Instruments used for measurement shall be accurate and calibration histories for each instrumentation shall be available for examination.

3.1.4 Before receiving final approval, Contractor shall clean out all lines, adjust all valves, control items and other equipment, clean all pipe and equipment, and leave his installation complete and in good working order.

3.1.5 The Contractor shall be responsible for inspecting, adjusting, balancing and logging the data on the performance of fans, all dampers in the duct system, and all air distribution devices.

3.1.6 Because of variance in usage of area, number of occupants and other factors, any air quantities shown on plans at air terminal units shall be considered preliminary for use in initial balancing of the system. Final balancing, so that all areas of the building are at the same approximate temperature at the time of balancing, shall be done immediately after occupancy. Heating and cooling capacities and performance for every system shall be checked in the winter and summer, respectively. Any testing and/or adjusting required shall be done at no additional cost to the owner. Any adjustments done during one season shall not affect capacities and performance during the other season. Re-balance shall be done during the guarantee period as required by the Architect.

3.1.7 Final adjustments shall be within $\pm 10\%$ of design values. If this cannot be attained, the Engineer shall be notified in writing with an explanation. Outside air shall be balanced within $+ 10\%$, $- 0\%$.

3.2 REPORTS:

3.2.1 The final report shall be submitted on approved reporting forms for review. Each individual final reporting form submitted must bear the signature of the person who recorded the data and the signature of the Test-Adjust-Balance Supervisor of the performing firm.

3.2.2 Identification of all types of instruments used and their last dates of calibration will be submitted with the final report.

3.2.3 Before final acceptance of the system is made, the balancing agency shall furnish to the Architect reports to include but not limited to the following data in five (5) copies.

- A. A tabulation of simultaneous temperature (Dry bulb and wet bulb) of all spaces on each separately controlled zone for both the cooling and heating seasons.
- B. A listing of measured air quantities at each outlet.
- C. Air quantities at all return and exhaust devices.
- D. Amperage draw of all motors and RPM.

- E. Supply, return, and outside air CFM of each air handling unit.
- F. Discharge and suction static pressure readings of each air handling unit.
- G. Entering and leaving air dry bulb and wet bulb temperatures at each air handling unit.

END OF SECTION