

SECTION 15030

COMMISSIONING OF HVAC & R SYSTEMS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes commissioning process requirements for HVAC & R systems, assemblies, and equipment.
- B. Related Sections:
 - 1. Division 01 Section “General Commissioning Requirements” for general commissioning process requirements. The systems included in the commissioning program and the scope of the commissioning program are provided in the Appendices to Section 01 91 13.

1.03 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC & R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean :as-built” systems, subsystems, equipment, and components.

1.04 CONTRACTOR’S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.
- C. Attend testing, adjusting, and balancing review and coordination meeting.

- D. Participate in HVAC & R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.05 CxA'S RESPONSIBILITIES

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC & R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Schedule and direct commissioning testing.
- C. Verify testing, adjusting, and balancing of Work are complete. This will occur through random sample validation testing performed in conjunction with the test, adjust and balance contractor after the completion of balancing activity.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

1.06 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklist and manufacturer's prestart and startup checklist for HVAC & R systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
 - 5. Certificate of readiness for functional performance testing certifying the HVAC & R systems, subsystems, equipment, and associated controls are ready for testing.
 - 6. Test and inspection reports and certificates.
 - 7. Corrective action documents.

8. Verification of testing, adjusting, and balancing reports.

1.07 SUBMITTALS

- A. Certificates of readiness for functional performance testing, as per the commissioning plan.
- B. Certificates of manufacturers start-up and acceptance, as per the commissioning plan.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 TESTING PREPARATION

- A. Certify that HVAC & R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that HVAC & R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklist.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.02 TESTING AND BALANCING VERIFICATION

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklist, and certificates to the CxA.
- B. Notify the CxA at least 10 working days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC & R systems at the direction of CxA.
 - 1. The CxA will notify testing and balancing contractor 10 working days in advance of the date of field verification. Notice will not include data points to be verified.
 - 2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report.
 - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.03 CONTRACTOR'S RESPONSIBILITIES

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC & R testing shall include entire installation, from central equipment through distribution systems to each conditioned space or operated device. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA along with the HVAC & R Contractor, testing and balancing contractor, and Building Automation System and Control Contractor shall prepare detailed testing plans, procedures, and checklist for systems, subsystems, and equipment. In general, the CxA will prepare all installation checklists and functional performance test plans for the commissioned systems.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions. In some cases, weather dependent (seasonal) testing will be deferred if suitable conditions cannot be simulated.

- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the systems, documents the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

END OF SECTION

SECTION 15050

COMMON WORK REQUIREMENTS

PART 1 GENERAL

1.1 SPECIAL NOTICE

- A. Each contractor shall read all relevant documents, become familiar with the job, the scope of work type of general construction architectural, structural, mechanical and electrical drawings and the specifications. Each contractor shall also familiarize himself with the purpose for which these documents have been prepared and shall become cognizant of all the details involved. Each contractor shall coordinate his work with that of others to the end that unnecessary delays be avoided.
- B. The drawings show the general arrangement of piping, equipment and appurtenances and shall be followed as closely as actual building construction and work of other trades permits. Work shall conform to requirements shown on the drawings. Architectural and structural drawings shall take precedence. Because of the scale of the drawings, it is not possible to indicate all offsets, fittings and accessories that may be required. Investigate structural and finish conditions affecting work and arrange work accordingly, providing offsets, fittings and accessories as may be required to meet as constructed conditions.
- C. HVAC equipment and systems, including piping and ductwork shall be installed as high as possible unless otherwise noted on drawings. Equipment and systems shall also be installed to maintain required operation and maintenance clearances.
- D. Mechanical / HVAC Introduction: All HVAC equipment, ductwork, valves, controls, and other items shall be installed for a complete and working HVAC system.
- E. The HVAC system shall incorporate conveniences for maintenance and future remodeling.
- F. The term “contractor” used in this section of the specification shall mean the contractor whose work is covered by this section.
- G. When the term “Engineer” is used in this section of the specification, it shall mean the consulting mechanical engineer.

1.2 CODES AND STANDARDS

- A. All materials and workmanship shall comply with applicable codes, specifications, local ordinances used by the authority having jurisdiction, industry standards and utility

company regulations. In case of differences between building codes, specifications, state laws, local ordinances, industry standards and utility company regulations and contract documents, the most stringent shall govern. Promptly notify A/E in writing of differences.

- B. The HVAC system design and installation shall be based on the principals and data in the current American Society of Heating and Air Conditioning Engineers (ASHRAE) Handbook and Standards.
- C. Comply with the latest published SMACNA, NFPA, NEMA and NEC Standards.
- D. Comply with UL or other tested assemblies to maintain the code required fire ratings of the building, and as indicated in the Drawings.
- E. Comply with code required seismic anchorage and support systems.
- F. Non-compliance
 - 1. If the Contractor installs materials or performs any work that does not comply with above requirements, he shall correct the work and shall bear all costs arising from correcting deficiencies.

1.3 REFERENCE STANDARDS

- A. Abbreviations of standards organizations referenced in other sections are as follows:
 - 1. AABC Associated Air Balance Council
 - 1. ABMA American Boiler Manufacturers Association
 - 1. ADC Air Diffusion Council
 - 1. AGA American Gas Association
 - 1. AMCA Air Movement and Control Association
 - 1. ANSI American National Standards Institute
 - 1. ARI Air-Conditioning and Refrigeration Institute
 - 1. ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers
 - 1. ASME American Society of Mechanical Engineers

1. ASTM American Society for Testing and Materials
1. AWWA American Water Works Association
1. AWS American Welding Society
1. EPA Environmental Protection Agency
1. GAMA Gas Appliance Manufacturers Association
1. IEEE Institute of Electrical and Electronics Engineers
1. ISA Instrument Society of America
1. MCA Mechanical Contractors Association
1. MICA Midwest Insulation Contractors Association
1. MSS Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
1. NBS National Bureau of Standards
1. NEBB National Environmental Balancing Bureau
1. NEC National Electric Code
1. NEMA National Electrical Manufacturers Association
1. NFPA National Fire Protection Association
1. SMACNA Sheet Metal and Air Conditioning Contractors' National Association. Inc.
1. UL Underwriters' Laboratories Inc.

1.5 SPECIFIED MATERIALS AND EQUIPMENT

- A. The design is based on the equipment specified by the manufacturer and model number as specified on the plan schedules. Where certain items are specified by manufacturer or trade name, Contractor's bid shall be based on use of the scheduled equipment. Where one make is described and other makes are listed, comparable models of other named equipment may also be used, provided that they meet all requirements of the specifications.
- B. When equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those on the plan schedules, the

Contractor shall be responsible for all costs involved in integrating the equipment or accessories into the system. This includes any costs incurred by other trades as a result of this change. The Contractor shall also be responsible for obtaining the original design performance from the system into which these items are placed, regardless of whether the manufacturer/model is a specified equivalent or a substitute. This may include changes found necessary during the testing, adjusting, and balancing phase of the project.

- C. If the Contractor wishes to use items other than those named in specifications in his base bid, request for approval of substitution must be made in writing to A/E at least 14 days prior to opening of bids. Including complete technical and descriptive data with the request. If approved, an addendum will be issued notifying all plan holders of the approval.

1.6 EQUIPMENT INSTALLATION

- A. The drawings show the general arrangement and location of equipment and appurtenances. It is the Contractor's responsibility to install equipment in a location and manner that allows for proper service and maintenance access to equipment. Work shall generally conform to requirements shown on the drawings. However, the location of equipment may require field adjustments to obtain the required service space. **DO NOT SCALE OFF PLANS** to determine proper location of equipment. Also, because of the scale of the drawings, it is not possible to indicate the exact routing of ductwork and piping, and offsets, fittings and accessories that may be required to provide proper service access to equipment. The Contractor shall route and install ductwork and piping to provide required service access to equipment.
- B. If during the construction phase of the project the contractor feels that inadequate space exists, or that equipment locations must be substantially modified to provide the proper service and maintenance access, prior to installing the equipment the contractor shall notify the engineer in writing, outlining the general concerns and the proposed modifications. Equipment installed without providing the manufacturer's required maintenance and service clearance shall be considered defective. The Contractor shall remove and relocate piping, ductwork and equipment, to provide the required service clearances at the Contractor's expense.

1.7 CERTIFICATES AND INSPECTIONS

- A. Obtain and pay for required Federal, State and local installation inspections, certificates and permits required, except those provided by the Architect/Engineer in accordance with State and local Codes. Deliver originals of these certificates to the Architect or Construction Manager.

1.8 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Refer to Division 01 of the Project Manual.
- B. Provide HVAC systems and equipment operation and maintenance manuals in accordance with the requirements of the project specification.
- C. Assemble material in three-ring or post binders, using an index at the front of each volume and tabs for each system or type of equipment. In addition to the data indicated in the General Requirements, include the following information:
 - 1. Copies of all approved shop drawings.
 - 2. Manufacturer's instructions for installation, operation, and maintenance.
 - 3. Manufacturer's wiring diagrams for electrically powered equipment.
 - 4. Records of tests performed to indicate compliance with system requirements (system start-up reports).
 - 5. Temperature control record drawings and control sequences.
 - 6. Parts lists for manufactured equipment.
 - 7. Valve schedules.
 - 8. Lubrication instructions, including list/frequency of lubrication done during construction.
 - 9. Warranties.
 - 10. Testing, adjusting and balancing data.

1.9 TRAINING OF OWNER PERSONNEL

- A. Instruct Owner personnel in the proper operation and maintenance of systems and equipment provided as part of this project, video record all training sessions. The Operating and Maintenance manuals shall be used during this instruction. Demonstrate startup and shutdown procedures for equipment.
- B. Training shall be during normal working hours.
- C. All recorded training sessions shall be compiled on a single DVD and turned over to the owner for future use.

1.10 RECORD DRAWINGS

- A. Refer to Division 01 of the Project Manual.
- B. Maintain record drawings on a daily basis to be turned over at the completion of the project.
- C. Maintain temperature control record drawings on originals prepared by the installing contractor/subcontractor. Include copies of these record drawings with the Operating and Maintenance manuals

PART 2 PRODUCTS

2.1 PIPE PENETRATIONS

A. FIRE, SMOKE AND FIRE/SMOKE RATED SURFACES

- 1. 3M CP 25N/S or CP 25S/L caulk, 3M FS 195 wrap/strip with restricting collar, 3M CS 195 composite sheet, Pipe Shields Inc. Series F fire barrier kits, Proset Systems fire rated floor and wall penetrations, Insta-Foam Products Insta-Fire Seal Firestop Foam or Dow Corning Fire Stop System.
- 2. UL listed or tested by an independent testing laboratory, approved by the State and Local Code jurisdictions. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Sleeves in concrete to be schedule 40 steel pipe with integral water stop unless the fire stop material used includes a sleeve that is an integral part of the rated assembly.

B. NON-RATED SURFACES

- 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor/ceiling plates for covering openings in occupied spaces.
- 2. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the un-insulated pipe and the cored opening or a water-stop type wall sleeve.
- 3. At interior partitions where pipe penetrations are sealed, use Tremco Dymonic, Sika Corp. Sikaflex 1a, Sonneborn Sonolastic NPI, or Mameco Vulken 116 urethane caulk to effect the seal. Use galvanized sheet metal sleeves in hollow wall penetrations.

2.2 DUCT PENETRATIONS

A. FIRE, SMOKE AND FIRE/SMOKE RATED SURFACES

1. 3M CP 25N/S or CP 25S/L caulk, 3M FS 195 wrap/strip with restricting collar, Insta-Foam Products Insta-Fire Seal Firestop Foam or Dow Corning Fire Stop System.
2. UL listed or tested by an independent testing laboratory, approved by the State and Local Code jurisdictions. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Sleeves in concrete to be minimum 16 gauge galvanized steel sleeves.

B. NON-RATED SURFACES

1. Fiberglass insulation fill at voids with galvanized steel sheet metal bank-off on both side of duct penetration thru walls. Caulking for sealing and sound proofing shall be fire resistant.

2.3 IDENTIFICATION

A. STENCILS

1. Not less than 1 inch high letters/numbers for marking pipe and equipment.

B. ENGRAVED NAME PLATES

1. White letters on a black background, 1/16 inch thick plastic laminate, beveled edges, screw mounting, Setonply ® Style 2060 by Seton Name Plate Company, Emedolite Style EIP by EMED Co., or equal by W. H. Brady.

C. VALVE TAGS

1. Round brass tags with ½ inch numbers, ¼ inch system identification abbreviation, 1¼ inch minimum diameter, with brass jack chains or brass "S" hooks around the valve stem, available from EMED Co., Seton Name Plate Company, or W. H. Brady.

D. PIPE MARKERS

1. At least ¾" high legend for piping under 3" diameter and at least 2" high legend for piping 3" diameter and larger. Include flow arrows. Manufacturers: W.H. Brady Co., EMED Co. or Seton Name Plate Company.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site is ready for ductwork and piping installation.

- B. Elevations and locations of all points of connection as indicated on drawings are approximate and the Contractor shall establish elevations and locations of services in the field.
- C. Any anticipated offsets to avoid obstructions that are not shown on the drawings shall be noted.
- D. The Contractor shall check all measurements of equipment and shall be responsible for connections of his Work with the Work of other contractors (if any) in the building.
- E. Slight modifications (three-inch or less, in any direction) in the size of ductwork, dampers, diffusers, and other air distribution material shall be permitted but may not be of less cross-sectional area than as shown on the plans. Modifications greater than three-inches in any direction shall require review with Engineer.
- F. Confirm location and space availability for access panels, service valves and drain valves.
- G. Confirm location and space availability of chases, joist spaces and beam clearances.
- H. Confirm electrical voltages, phase and other characteristics.

3.2 INSTALLATION

- A. Contractor shall cooperate with the other contractors so that construction may proceed without hindrance. Confer with other contractors regarding any Work that may affect this Work and arrange schedule so that components shall be installed in a natural sequence. Contractor shall be responsible for grading, fitting, joining or adjusting of his Work to all adjacent Work of other contractors.
- B. Sequence, coordinate and integrate installations of mechanical equipment and material for efficient flow of the Work.
- C. Coordinate positioning of large equipment prior to enclosing building or equipment room.
- D. Install Work to conform with reviewed shop drawings to greatest extent possible. Position finish components, such as air outlets and temperature controls, to achieve symmetry in ceiling and wall layouts.
- E. Ducts and piping shown on plan views shall be installed above finished ceilings of rooms shown unless otherwise specified. In mechanical spaces and similar unfinished areas, install ducts and pipes as high as possible unless otherwise specified.

- F. Piping installed at specified pitch shall generally take precedence of ductwork and other piping.
- G. Operation of doors, windows, lighting, Owner's equipment or fixtures shall not be hindered by position of ductwork or piping.
- H. Piping, tubing, and ductwork shall not be permitted above or through elevator equipment rooms, electrical rooms, telephone rooms or computer rooms without the approval of Landmark.
- I. In rated egress enclosures, such as stairways and exit passageways, only piping, tubing, and ductwork related to such spaces shall be permitted within these spaces.

3.3 ACCESS

- A. Installation shall allow access to all portions of equipment requiring routine service including:
 - 1. Service, cleaning, inspection and lubrication as recommended by manufacturer
 - 2. Replacement of renewable components as recommended by manufacturer
 - 3. Visibility of all vents
 - 4. All Dampers
 - 5. Drain Valves
 - 6. Name plate data
 - 7. Automatic Dampers
 - 8. Valves
 - 9. Smoke Detectors
 - 10. Sensors
 - 11. Gauges
 - 12. Motors and Motor Controllers
 - 13. Pumps

3.4 PROTECTION

- A. Protect final installation from damage during construction period.
- B. All open sections of ducts exposed to construction dust and all grilles and diffusers shall be covered with cheesecloth.
- C. Open ends of all piping shall be kept closed during construction.

3.5 LUBRICATING

- A. Before any equipment is energized, it shall be lubricated according to manufacturer's instructions.
- B. Lubrication points that are concealed or are hard to reach shall have extended fittings to a point of easy access and shall be clearly marked.

END OF SECTION

SECTION 15100

MECHANICAL MATERIALS AND METHODS

PART 1- GENERAL

1.01 SPECIAL NOTICE

- A. Each contractor shall read all relevant documents, become familiar with the job, the scope of work type of general construction architectural, structural, mechanical and electrical drawings and the specifications. Each contractor shall also familiarize himself with the purpose for which these documents have been prepared and shall become cognizant of all the details involved. Each contractor shall coordinate his work with that of others to the end that unnecessary delays be avoided.
- B. The term “contractor” used in this section of the specification shall mean the contractor whose work is covered by this section.
- C. When the term “Engineer” is used in this section of the specification, it shall mean the consulting mechanical engineer.

1.02 FLAME SPREAD PROPERTIES OF MATERIALS

- A. All materials and adhesives used for acoustical linings, jackets and insulation shall comply with requirements of NFPA 90A and 90B and UL guide no. 40 V.8.15. Products exceeding a flame spread rating of 25, or a smoke developed rating of 50, as determined by ASTM Test Method E-84 are prohibited. Adhesives and sealers shall be fire retardant and fire resistant when dry. Flame proofing treatments which are subject to decomposition, deterioration, or the effects of moisture are prohibited.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

- A. All horizontal runs of piping shall be suspended from the structural members above by means of approved hangers spaced as scheduled. Supports and hangers shall be installed to permit free expansion and contraction. The piping shall be guided and firmly anchored. No piping shall be self-supporting nor shall it be supported from the equipment connections or the suspension system furnished for suspended ceilings.
- B. All hangers shall be properly sized to fit the pipe or the insulation around the pipe which they are supporting. All hangers shall bear the name of the manufacturer by whom they are made. Pipe hangers shall be formed steel clevis type hanger with adjustable attachment to hanger rod. Hangers shall be properly sized to support weight of piping under operating conditions as recommended in the manufacturers’ published literature. For uninsulated copper or brass piping, use hangers as specified above except that they shall be copper plated or plastic sheathed wherever they will be in contact with the copper pipe.
- C. Hangers shall be fastened to the construction by the use of malleable iron adjustable clamps, properly designed and sized for steel encountered and installed with lock nuts or bolts securely tightened. Hangers, rollers, inserts, beam clamps and riser clamps shall be standard products of the same recognized manufacturer.

- D. All miscellaneous steel necessary for supporting the pipe systems from pipe hangers shall be included as part of this section of the work. Necessary trapeze, rods, bolts and accessories, clamps, weld clips, angle iron brackets or other approved means shall be used for attaching supporting steel to the building construction. Where additional steel members are required for hanging the lines in areas with special conditions, the steel work shall be provided as part of this contract.
- E. Each fitting and length of cast iron pipe shall be separately supported by installing the pipe hanger immediately behind the hub. Generally hangers shall be on 5 foot centers, but if 10 foot length of cast iron pipe is used, hangers may be spaced 10 foot on centers
- F. All plastic piping systems such PVC, polypropylene and fiberglass reinforced epoxy unless otherwise specified or detailed shall be supported in full accordance with the manufacturer's published instructions. Installation bulletins shall be submitted with shop drawings.

2.02 FLOOR AND CEILING PLATES

- A. 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 shall fit snugly against the finished surface. Furnish a galvanized or aluminum collar and flange on all ducts passing through floors, walls or ceilings.

2.03 ACCESS DOORS

- A. Each subcontractor, under the mechanical sections of the work, shall furnish and turn over to the General Contractor for installation access doors as required to operate and service all equipment and valves furnished and installed by him. Access doors shall be of the size indicated on the drawings or required for proper access to equipment. See Section 09280 – Gypsum Board Assemblies for details.
- B. Approved Manufacturers: Milcor, Zurn, Wade, and Josam.

2.04 VALVES AND COCKS

- A. Valves and cocks shall be furnished and installed in all branches serving more than one piece of equipment such as pumps, tanks, coils, etc. for shut-off branch mains, eliminating the necessity of interrupting service to the entire building structure for maintenance purposes and where indicated. Valves shall be installed with the best workmanship and appearance and grouping so that all parts are easily accessible. Manufacturer's figure numbers are specified to indicate type and quality and construction and products of approved manufacturers may be substituted for those specific numbers shown. Valves for similar service shall be of the same manufacturer. Pressure rating specified for valves are steam working pressure regardless of the services for which used except where noted as WWP.
- B. All materials herein shall comply with ANSI 61, Drinking Water System Components.
- C. Domestic water valves for 1/2" to 2" size shall be full port two-piece ball valves with bronze hard chrome plate ball, thread or soldered ends, Milwaukee Model BA-155, Watts Model B-6080, Nibco 585-70.
- D. Swing check valves 2" and under, bronze, Y pattern horizontal swing type, Nibco T-413-B or Milwaukee Valve #1509.
- E. Drain Valves: Nibco T or S-585-70-HC two-piece ball drain valve with 3/4" hose thread connection, brass cap and attached brass beaded cap chain.
- F. PVC valves to be true union ball valves.

- G. Sizes:
2 1/2" and Smaller

Gate 125 # Crane Co. #428
Valve BB, Screwed

Globe 300# Crane Co. #7
Valves BB, Union Bonnet

Check 125# Crane Co. #34
Valves BB, Screwed

- H. Valves for PEX piping systems shall be 2-piece, full port, lead free brass with PEX ends for use in PEX piping systems with forged lead free brass body and adapter as manufactured per the ASTM F1807 standard.

Sizes:
1" and Smaller
Watts LFFBV-PEX

- I. Hose Bibs
Screw End Solder End

Hose Bibs Nibco #760 Nibco #70

- J. Approved Manufacturers: Crane, Homestead, Jenkins, Kennedy, Rockwell, Stockham, Walworth, Nibco, Watts, Wolverine and Hammond.

2.05 COMBINATION TEMPERATURE AND PRESSURE RELIEF VALVES

- A. Combination temperature and pressure relief valves shall be furnished and installed on all hot water tanks and heaters. Valves shall be constructed and rated in accordance with ASME standards. Valves shall have cast iron bodies, shall be of the diaphragm type, constructed with stainless steel spring. All units shall be field adjustable set to relieve above the operating pressure of the system, but not higher than the design pressure of the tank. Relief connections shall be piped to the nearest floor drain.
- B. Approved Manufacturers: Bell & Gossett, Taco, Thrust, Watts, Spence, McDonnell and Miller.

2.06 UNIONS

- A. Unions shall be installed on each side of each piece of equipment and each automatic control valve in locations that will permit easy removal of equipment or valve for service. Unions shall not be located in concealed spaces. Unions for copper piping systems shall be similar to Walworth Figure No. 3677 and unions for steel piping shall be similar to Walworth Figure No. 771B malleable iron union with bronze to iron seat.
- B. Approved Manufacturers: Crane, Jenkins, Rockwell and Walworth.
- C. Connection of pipes of different metallic construction shall utilize the proper dielectric union to prevent electrolytic corrosion.

2.07 STRAINERS

- A. Strainers shall be of the basket or wye type in sizes as indicated on the drawings and shall be provided with 1/2 inch valved drain and unless the strainer design is devoid of air pockets, a 1/4 inch air vent cock.

- B. All strainers shall have cast iron or bronze bodies of ample strength for the pressure to which they shall be subjected, removable cylindrical or conical screens of nickel, copper or brass and suitable flanges or tappings to connect with the piping they serve. Strainers 2 1/2 inches and larger shall be provided with flanged covers.
- C. The free area of each screen shall not be less than three times the area of the strainer inlet and the mesh size shall be suitable for the service intended.
- D. Approved Manufacturers: Armstrong, Cash, Crane, Keckley, McAlear, Mueller, and Sarco.

2.08 WATER HAMMER ARRESTORS

- A. Water hammer arrestors shall be installed in this project at the discretion of the project engineer. Install one water hammer arrestor on each hot water and each cold water pipe to each plumbing fixture or behind each group of plumbing fixtures. Water hammer arrestors shall be constructed from copper or stainless steel and installed in accordance with manufacturer's specifications. Arrestors shall be installed as close as possible to quick-acting valves and conform to ASSE 1010.
- B. Approved Manufacturers: Watts.

2.09 IDENTIFICATION AND LABELING

- A. General: Make it possible for the personnel operating and maintaining the equipment and systems in this project to readily be able to identify the various pieces of equipment, valves, piping, etc., by marking them. All items of equipment such as fans, pumps, etc., shall be clearly, marked using engraved nameplates as here-in-after specified.
- B. Equipment Nameplates: All items of mechanical and electrical equipment shall be identified by the attachment of engraved nameplates constructed from laminated phenolic plastic, at least 1/16" thick, 3-ply, with black surfaces and white core. Engraving shall be condensed gothic, at least 1/2" high, appropriately spaced. Nomenclature on the label shall include the name of the item, its mark number, area, space, or equipment served, and other pertinent information.
- C. Valve Tags: Provide and install identification tags sequentially numbered. These tags are to be affixed to only those valves of which the functions are not obvious. For example, it would not be expected that valves at a pump in a machine room would be tagged. These tags shall be 1/8" thick brass discs, 1-1/2" in diameter. Each tag shall be attached to its valve with copper clad annealed iron wire or other approved material. Valves above the ceilings shall have a red, 1/2" round or square, press tape marking on the ceiling access panel or the tee bar at lift-out ceiling panel access.
- D. Pipe Identification Markers: In addition, pipe runs throughout the building including those lift-out ceilings, under floor, and those exposed to view when access doors or access panels are opened, shall be identified by means of Brady Markers. Concealed areas, for purposes of this identification section, are those areas which cannot be seen except by demolition of the building elements. Markers shall be made of laminated plastics and shall have acrylic plastic over coating to shed dirt, grease, and, moisture. In addition to the pipe markers, arrow markers shall be used to indicate the direction of flow. The following specific instruction shall apply to the application of these markers.
 - 1. Provide a pipe marker at each valve to indicate proper identification of pipe contents. Where several valves exist on one header, it is necessary to mark only the header.
 - 2. Provide an arrow marker with each pipe marker pointing away from the pipe marker to indicate direction of flow.
 - 3. Provide a double-ended arrow marker when flow can be in either or both directions.
 - 4. Provide a pipe marker and arrow marker at every point of pipe entry or exit where the lines go through a wall or service column.

5. Provide pipe markers and arrow markers at intervals not exceeding 5 feet.
6. Markers shall be located on the two lower quarters of the pipe where view is unobstructed.
7. Use Brady Marker with 2" letter height on pipes with outside diameters (including insulation) of 3" or more. Use 1" letter height on all pipes with outside diameters less than 3".
8. Brady Markers shall conform to ASA A-13 "Scheme for the Identification of Piping Systems". Arrow markers must have the same ASA background colors as their companion pipe markers.
9. Brady Markers shall have a 3/4" pressure sensitive adhesive strip on the inside edge of each marker to seal the marker to itself.

PART 3 - EXECUTION

3.01 EQUIPMENT FOUNDATIONS

- A. All concrete equipment foundations and bases required for the installation of mechanical work hereinafter specified will be furnished and installed by the General Contractor. Each subcontractor shall be responsible for the proper coordination of his equipment with these bases. He shall furnish all anchor bolts and other accessories required for casting bases and setting of all sleeves and/or anchor bolts.
- B. After equipment is set on concrete bases, the equipment shall be fully grouted to the base filling all void spaces with a non-shrinking grout.
- C. All roof top equipment shall be properly bolted or fastened to the structural steel framework to prevent movement under high wind and adverse weather conditions.
- D. Curbs shall be installed around the perimeter of roof top equipment.

3.02 SCAFFOLDING, RIGGING AND HOISTING

- A. Each contractor shall furnish all scaffolding as required for the installation of his work. He shall either arrange with the General Contractor for servicing in connection with any rigging and hoisting required to provide his own equipment to hoist apparatus to be installed by him into place. Each contractor shall see that any equipment too large to permit passage through normal doorways and access ways is brought to the job and set in place before the mechanical spaces are enclosed. All apparatus not delivered in this manner shall be disassembled and reassembled in the proper location. Equipment specified to be factory assembled and tested prior to shipment not be disassembled for shipment to an installation into the building.

3.03 JOINING OF PIPING SYSTEMS

- A. Cast iron piping systems shall be joined with lead and oakum, pre-formed neoprene joints or no-hub connectors at the subcontractor's option, as allowed by code. If caulked joints are used, spigots shall be placed in the bell and properly centered and lined in piping before packing starts. Joints shall then be properly packed with dry oakum and then caulked with not less than one pound of lead for each one inch pipe diameter. Lead shall be poured and caulked in layers and then faced flush with hub. Piping shall be carefully handled after joint is made to insure that jointing and material are not damaged.
- B. Copper piping systems shall be joined with solder joints except that water distribution systems buried below building slabs shall be joined with compression type fittings. For solder type joints, the tubing shall be cut smooth and square and all burrs removed with a reamer and when necessary, tubing shall be rounded out with a sizing tool. All surfaces shall be properly cleaned by polishing both cup of fitting and the tube end with steel wool or fine sand

cloth. After cleaning, flux shall be applied evenly to male end of tubing and shall be inserted into the fitting, revolving the fitting once or twice on the tubing end to spread the flux evenly. After inserting tubing in cup of fitting, apply flame to outside of cup only. Do not apply solder until after the fitting and pipe have reached proper heat. After connection is made, remove excess solder with brush and wipe clean. Solder shall be recommended by the manufacturer for the pressures involved, but shall generally be 95 - 5 hard solder. Refrigerant piping shall be joined as hereinafter specified for that particular application.

- C. Threaded and coupled piping systems shall be joined with properly lubricated screwed joints. Pipe shall be cut smooth and square and all burrs shall be removed with a reamer. Tapered threads shall be properly cut on the male end of the pipe and shall be a sufficient number so that when the pipe is pulled up tight in the coupling, at least three full threads remain exposed. Joints shall be made tight with graphite and oil applied to the pipe threads only and not to the fittings. No pipe thread caulking compound shall be used. Where chromium plated piping and fittings are involved, they shall be made tight using strap wrench. Completed chromium plated piping shall not show any wrench marks on piping or fittings. All piping so marred shall be removed and replaced before acceptance of the job. On galvanized piping systems after the piping has been fully assembled and tested, all exposed threads shall be painted with a heavy coat of red lead or other rust inhibitor paint.
- D. All mechanical, no-hub and no-ring type sockets shall be installed in full accordance with manufacturer's published directions, whose instructions shall be submitted to the Engineer for approval before proceeding with the installation. Engineer's approval of this data will not absolve the subcontractor from any guarantees and required tests.
- E. Plastic piping systems, PVC, polyethylene, ABS, or polypropylene shall be joined by the use of socket type plastic fittings of the same material with either solvent cement and/or heat of fusion type joints. All piping shall be cut smooth and square, all burrs removed, and all surfaces properly cleaned. Solvent cement shall be of the type as recommended by the pipe manufacturer and all procedures shall be in accordance with manufacturer's published directions. Pipe shall be used on PVC fittings.
- F. RO water pipe systems shall be pressure tested for leak detection using bottled dry nitrogen. DO NOT use compressed air! The system shall be pressurized to 50 psig and left overnight. Any discernable pressure decay will call for a joint-by-joint leak inspection and repair of any faults detected. The repaired system will then be tested again to assure a leak-proof installation.

3.04 VIBRATION ISOLATION

- A. Transmission of vibration or structural borne noise to occupied areas by equipment installed by the contractor will not be permitted. Contractor shall furnish for approval, data showing disturbing frequency, supported weight, static deflection, efficiency and calculations supporting same for each isolator he proposes to use. Equipment shall be manufactured by Amber-Booth, Korfund, Mason Industries, Vibration Eliminator, Vibration Mounting, or Consolidated Kinetics Corporation.
- B. All isolators shall be selected and certified, using published data, to limit vibration transmission to 10% for equipment located on floors in direct contact with grade and 5% for equipment located other than the above. Should any noise or vibrations be objectionable to the Engineer and/or Owner, field instrumentation tests and measurements shall be made by the isolator manufacturer or his representative to determine the source and cause of such disturbance. Any

non-compliance with these specifications shall be corrected by the contractor in a manner satisfactory to the Engineer at no additional cost to the Architect, Engineer or Owner.

END OF SECTION

SECTION 15200

PIPE SLEEVES, SUPPORTS AND ANCHORS FOR MEDICAL PROCESS PIPING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes materials, equipment, labor and incidentals required for and to provide underground and overhead pipe sleeves, supports and anchors required to install reverse osmosis water treatment process piping and SDS Polyethylene Tubing Systems as shown on the contract documents and as specified herein.
- B. Junction boxes, pull strings and conduit for low voltage wiring
- C. Related Sections:
 - 1. Section 15100: "Mechanical Materials and Methods."
 - 2. Section 15700: "Covering and Insulation."
 - 3. Section 15800: "Testing, Adjusting and Balancing."

1.02 SYSTEM DESCRIPTION

- A. Medical equipment process piping system is intended to supply city water to the R.O. water processing system, and distribute the R.O. water from the storage tank(s) to the patient dialysis machines tech repair, SDS unit, Granuflo Mixer and return back to the storage tank(s).

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with Sections 00700 "General Conditions" and 00800 "Supplementary Conditions" of this specification, and comply with pertinent provisions of Specification Section 01340.
- B. Product data: Within 20 calendar days after the Contractor has received the Owner's Notice of Proceed, submit the following:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
 - 3. Mock-up of 6" Schedule 40 PVC double 45 degree elbow assembly.

1.04 WATER TREATMENT AND SDS EQUIPMENT DELIVERY, STORAGE, AND HANDLING

- A. Special care shall be taken to protect R.O. water process piping sleeve and components from dirt and debris entering the sleeve prior to underground or overhead installation. FMC's water treatment vendor shall be responsible for unpacking and setting equipment into place.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. **PVC/CPVC pipe and fittings are no longer acceptable for R.O. piping systems in FMC clinics. All R.O. and SDS plumbing and piping systems are now the sole responsibility of FMC's water treatment vendor(s).**

- B. Pipe Sleeves:
 - 1. Piping sleeves (underground and overhead): 6" Schedule 40 PVC pipe and elbows meeting ASTM Specification D-1785.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Pipe sleeve and pipe sleeve fittings:
 - 1. All pipe and tubing shall be cut accurately to measurements established at the job site. All pipes shall be cut with tubing cutters designed for such purpose. Deburr and ream all sections of pipe prior to installation.
 - 2. All pipes shall be installed such that no part of the pipe or pipe system shall contact any surface through its normally installed position.
 - 3. Install pipe so that no undue strain is imposed on any part of the pipe sleeve system.
- B. Pipe supports:
 - 1. Pipe supports and hangers shall be securely fastened to the structure above without overstressing any portion of the supports or the structure itself. No drilling or cutting of building steel shall be permitted. In cases where supplementary steel is required, steel support shall be designed in accordance with AISC specifications. Piping shall not be supported from gratings, fireproofing material, ducts, other pipes, electrical conduit, wires or other non-structural supports.
 - 2. Secure pipe supports to steel by welded brackets or beam clamps. Secure pipe supports to concrete by means of inserts.
 - 3. PVC piping and sleeve supports shall be spaced at a maximum of the lesser of 3 feet 6 inches or the manufacturer's recommendation. Provide hangers at a maximum of 12 inches from each change in pipe direction change. Provide additional pipe supports as required.
- C. Overhead Sleeves for Teflon R.O. Loop:
 - 1. Each vertical sleeve shall have a single entrance point and single exit point at opposite ends of each plumbing chase.
 - 2. All horizontal overhead tubing sleeves are to be handled using sleeve sections of 3" Schedule 40 PVC in a rack assembly supported by U clamps.
 - 3. Provide vertical end wall chase to connect overhead sleeves down to dialysis counter.
 - 4. Contractor shall install pull strings in all sleeves.
 - 5. Items #1 thru #5 must be complete in order for FMC's water treatment contractor to provide installation of tubing loops.
 - 6. Contractor to fire caulk any and all penetrations through fire or smoke walls caused by the installation of overhead sleeves.

3.02 FIELD QUALITY CONTROL

- A. All pipe sleeve and pipe sleeve fittings shall be inspected prior to installation and no piece shall be installed which is determined to be defective. If any defective pipe or fittings are discovered to be defective, they shall be replaced with like pipe of fittings determined to be defect-free.

3.03 CLEANING

- A. All pipe and pipefittings shall be wiped clean prior to installation.

END OF SECTION

SECTION 15300

PLUMBING PIPING SYSTEMS

PART 1 - GENERAL

1.01 SPECIAL NOTICE

- A. Each contractor shall read all relevant documents, become familiar with the job, the scope of work, type of general construction, architectural, structural, mechanical and electrical drawings and the specifications. Each contractor shall also familiarize himself with the purpose for which these documents have been prepared and shall become cognizant of all the details involved. Each contractor shall coordinate his work with that of others to the end that unnecessary delays be avoided.
- B. The term "contractor" used in this section of the specification shall mean the contractor whose work is covered by this section.
- C. When the term "Engineer" is used in this section of the specification, it shall mean the facility engineer.

1.02 SERVICES

- A. Extension of services in the building shall be fabricated from the same materials as the utility lines or those materials hereinafter specified for the building service. Where dissimilar metals are used, proper dielectric unions as hereinbefore specified shall be installed. Should points of service or connections vary from that shown on the drawings, the subcontractor shall properly allow for this in the installation.

1.03 RELATED WORK SPECIFICATIONS

- A. Section 15700 Covering and Insulation.
- B. ASTM D-1785-06 Standard Specification for PVC Pipe
- C. ASTM B-88 Specification for Copper Tube
- D. ASTM B-306 Copper Drainage Tube
- E. ASTM B-42 Copper Pipe
- F. ASTM F-876 Standard Specification for Crosslinked Polyethylene (PEX) Tubing
- G. ASTM F-877 Standard Specification for Crosslinked Polyethylene (PEX) Tubing Hot- and Cold-Water Distribution Systems.
- H. ASTM F-1807 Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Crosslinked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing.

PART 2 - PRODUCTS

2.01 SANITARY DRAINS AND VENT PIPING

- A. Above ground: Soil waste and vent pipe and fittings shall be PVC Schedule 40, ASTM D2665, ASTM D1785 where allowed by local plumbing code. Where PVC is not allowed, service weight no-hub cast iron soil waste and vent pipe and fittings ASTM A74. Hub and spigot where no-hub is prohibited by local authority having jurisdiction. Fittings for use in vent systems shall be inverted. Vent lines 2 inches and smaller and waste lines 1 1/2 inch and smaller may be made using galvanized steel pipe and galvanized screwed pattern, malleable iron fittings, or Type "M" hard drawn copper joined with solder type drainage fittings. See Section 07800 Roof Penetrations.
- B. All P-Traps below treatment area sinks, home training sinks, soiled utility sinks, lavatories and similar fixtures to be fabricated from Schedule 40 PVC pipe with screw-type cleanouts, unless otherwise specified by local jurisdiction.
- D. Cast iron pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and shall be listed by NSF International.
- E. All Schedule 40 PVC must be solid core. The use of Schedule 40 Foam Core PVC will not be acceptable for any purpose on an FMC project.

2.02 DOMESTIC WATER PIPING

- A. All domestic water piping, except as hereinafter specified, shall be fabricated from type "L" copper tubing hard drawn, of the size shown. Fittings on copper tubing shall be wrought copper, sweat type fittings and adapters shall be used when tubing connects to brass piping system. Nipples for connection from copper pipe to plumbing brass shall be red brass Grade "A" threaded. Join copper piping systems using 95-5 hard solder. Water piping installed below building slab shall be fabricated from type "K" soft copper arranged so that no joints are made below the floor line. Should this distance be greater than lengths of type "K" soft copper that are available, then the joints shall be made using sil-fos solder.
- B. PVC/CPVC water piping is approved for use in those jurisdictions that will allow it. All Schedule 40 PVC must be solid core. The use of Schedule 40 Foam Core PVC will not be acceptable for any purpose on an FMC project.
- C. Cross-linked polyethylene, PEX water piping is approved for use in those jurisdictions that will allow it. PEX piping 1/2" thru 2" shall be straight length, solid tubing sticks conforming to ASTM F876 and ASTM F877 standards. PEX piping shall comply with NSF 61 and NSF 14 standards as required for use in domestic water systems. PEX fittings shall be in accordance with ASTM F1807 standards. Pipe and fittings shall be by the same manufacturer. PEX tubing sizes 1/2" and 3/4" shall be color coded blue for cold water and red for hot and hot water return.

PART 3 - EXECUTION

3.01 SANITARY DRAINS

- A. The sanitary drains and related piping shall be immediately installed after excavation or cutting for same has been done so as to keep the openings for this pipe open as short a time as possible. However, no piping shall be permanently closed up, furred in or covered before inspection and approval. Street elbows, bushings, close nipples, long screws, bull head tees or crosses shall not be installed in the plumbing lines. Each piece of pipe shall be reamed to make the bore of the pipe at its end the same as the pipe. All exposed polished connections from the fixtures shall be made with special care showing no tool marks or threads. Under no conditions shall any piping be run in the floor except as shown on the plans or written approval has been received. Bushings shall not be used where any changes in pipe size occurs, only reducing fittings (or increasers) shall be used.
- B. Sanitary sewers shall be installed a neat manner and shall be installed to grade 1/4 inch per foot if possible, 1/8 inch per foot minimum. Vent piping shall be graded to free itself quickly of any water and condensations. Drainage piping shall run straight as possible and shall have easy bends with long turns. Offset shall be made at 45 or less.
- C. Install cleanouts as shown on the drawings and at each change in direction of the line, at the end of each run, and at the foot of each riser. Cleanouts shall be installed at not more that 80 foot intervals in horizontal lines, taking care to locate cleanouts where they are easily accessible.
- D. Flash all pipe openings through the roof, using 4# sheet lead or approved equal as dictated by roof type. Construct the flashing with a base of 10 inches beyond the pipe openings in all four directions and extend the vertical tube up the pipe and terminate by turning into the pipe cavity at least 2 inches on vent pipes 2 inches in size and larger and terminating in a specially fabricated flashing fitting on pipe sized 1 1/2 inch and smaller. The Plumbing Subcontractor shall fabricate flashing and turn over to the roofer to install at the roof level and after completion of this installation he shall finish the top of the flashing as hereinbefore specified.

3.02 INSTALLATION OF WATER PIPING

- A. Water piping systems shall generally be run level, free of traps, without any unnecessary bends, as high as possible and to suit the necessity of clearances for other mechanical work. Water piping shall be so graded and valved to provide for the complete drainage and control of the system. Piping shall be installed so as to cause no unusual noise from flow of fluid within the building system.
- B. Hot water supply and return and cold water piping systems shall be separated by at least 6 inches and every precaution shall be taken to see that the pipes do not come in contact. Where piping is paralleled, space shall be provided for the proper thickness of covering.
- C. Piping system shall be designed to use the fewest number of joints possible.

- D. All pipe cuts are to be smooth and set directly against internal shoulder in all fittings.
- E. Follow manufacturer's instructions during application of PVC cleaner and welding compound to assure proper socket weld.
- F. All pipe and tubing shall be cut accurately to measurements established at the job site.
- G. All pipes shall be cut with tubing cutters designed for such purpose. Deburr and ream all sections of pipe prior to installation.
- H. All socket welded connections shall be made as recommended by the pipe and pipe fitting manufacturer. Special care shall be taken so that no dirt, debris or excess adhesive enters the piping system.
- I. PVC piping supports shall be spaced at a maximum of the lesser of 3 feet 6 inches or the manufacturer's recommendation. Provide hangers at a maximum of 12 inches from each change in pipe direction. Provide additional pipe supports as required.
- J. PEX piping supports shall be spaced at a maximum of the lesser of 32 inches or the manufacturer's recommendation. Greater hanger support distances may be used where metallic carrier channels or PVC sleeves are used in conformance with the manufacturer's recommendations and meet all code requirements. Provide hangers at a maximum of 12 inches from each change in pipe direction. Provide additional pipe supports as required. Hangers and supports shall be firm, but loose enough to allow for expansion and contraction of tubing.
- K. Provide anchors, expansion joints, expansion loops and/or expansion arms as recommended by the manufacturer so that the piping may expand and contract without damage to itself, equipment, or building.
- L. PEX tubing installed in walls shall be supported every 4 to 6 feet or as recommended by the manufacturer. Provide protective sleeves or plastic bushings where tubing penetrates metal studs.
- M. Fixture connection stub-out piping shall transition to copper piping within wall, before entry into finished space, and include manufactured rigid support.
- N. Provide sleeves as recommended by the manufacturer where PEX tubing passes through a poured concrete slab.
- O. Vertical PEX tubing passing between floors shall be supported at the floor level and ceiling as recommended by the manufacturer.

3.03 CONNECTIONS TO EQUIPMENT NOT FURNISHED UNDER THIS SECTION OF WORK

- A. Plumbing connections for miscellaneous equipment will be furnished by this contractor. The contractor shall rough-in all soil waste, water and gas piping as required and shall make all final connections. All roughing-in shall be done in accordance with approved shop drawings furnished by the subcontractor furnishing the equipment. All water and gas connections shall be properly valved before connection to the equipment. All supply stops, supply tubes and "P" traps required for connection of this equipment will be furnished under this contract. Supply trim, waste connections and other miscellaneous accessories will be furnished by the equipment supplier, but will be mounted by this contractor unless noted otherwise.

3.05 FINAL CONNECTIONS

- A. This contractor shall make final connections of all water and sanitary drain lines required to serve equipment furnished by him. Contractor shall rough-in and make final connections to all miscellaneous equipment furnished and set in place under other sections of the work. All roughing-in and connections shall be made in accordance with manufacturer's recommendations. All final connections shall be fabricated from the same materials as piping system to which they are connected.

3.07 CLEANING

- A. Clean systems thoroughly before testing. Fixtures, equipment, pipe, valves and fittings shall be free of grease, metal cuttings, dirt and other foreign matter. Remove protective covers. Fixtures (including lavatories, water closets, and urinals) shall be cleaned and ready for use.
- B. After completion of project, clean the exterior surface of equipment included in the section, including concrete residue.
- C. After the completion of the work, all materials and equipment surfaces shall be cleaned and polished in accordance with the finish of the material.
- D. Water system shall be thoroughly flushed and cleansed of any and all deleterious materials at least once before system is placed in operation. At that time, these systems will be carefully checked for leaking and defects as herein specified. An approved cleaning agent will be used in flushing.
- E. At all times, keep the premises clear of undue accumulation of rubbish.
- F. On completion on the work, remove all rubbish and debris resulting from the contract, and dispose of same.
- G. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion.
- H. Before placing orders for pre-cleaned pipe, fittings, valves, etc., the contractor shall submit the manufacturer's cleaning specifications to the Engineer for approval.

3.08 DISINFECTION OF DOMESTIC WATER SYSTEM

- A. Water piping systems shall be thoroughly disinfected with a solution containing no less than 50 parts per million of available chlorine. Chlorinating materials, either liquid chlorine or sodium hypochlorite solution, shall be introduced into the system and drawn to all points in the system. Disinfection solution shall be allowed to remain in system for 24 hours, during this time, valves and faucets shall be opened and closed several times. After disinfection, solution shall be flushed from the system with clear water until residual chlorine content is no greater than 0.2 parts per million.
- B. All disinfection work shall be supervised by Owner. A sample of the potable water shall be provided by the plumbing contractor between 48 to 72 hours after rinsing and submitted to an approved laboratory to verify no bacterial growth. The results shall be transmitted from the lab to the Project Manager and others as directed.

END OF SECTION

SECTION 15400

PLUMBING FIXTURES AND EQUIPMENT

PART 1 - GENERAL

1.01 SPECIAL NOTICE

- A. Each contractor shall read all relevant documents, become familiar with the job, the scope of work, type of general construction, architectural, structural, mechanical and electrical drawings and the specifications. Each contractor shall also familiarize himself with the purpose for which these documents have been prepared and shall become cognizant of all the details involved. Each contractor shall coordinate his work with that of others to the end that unnecessary delays be avoided.
- B. The term "Contractor" used in this section of the specification shall mean the contractor whose work is covered by this section.
- C. When the term "Engineer" is used in this section of the specification, it shall mean the facility engineer.
- D. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Section 06402 - INTERIOR ARCHITECTURAL WOODWORK for solid surface sinks.
- E. References:
 - 1. American Gas Association (AGA)
 - 2. American Society of Mechanical Engineers (ASME)
 - 3. American Society of Heating, Refrigeration and Air Conditioning Engineers(ASHRAE)
 - 4. American National Standards Institute (ANSI)
 - a) ANSI z21.10.0 Gas Water Heaters with Capacity Rating Above 75,000 BTUH

PART 2 - PRODUCTS

2.01 PLUMBING FIXTURE VENDOR

- A. All plumbing fixtures covered in this section shall be provided and installed by the General Contractor, unless noted otherwise on the drawings.
- B. All plumbing fixtures covered in this section are to be provided by FMC Sole Source Plumbing Fixture Supplier:

Ferguson Enterprises, Inc.
National Sales Center (NSC)
(855) 324-7899 or
NSCservice@ferguson.com

- C. All Tankless Water Heaters referenced in this section shall be by FMC approved manufacturer Rinnai Commercial Tankless Water Heater.

2.02 PLUMBING FIXTURES

- A. SPECIAL NOTE – All potable water transporting devices shall comply with the intent of the lead free standard as promulgated by California Assembly Bill 1953.

- B. All fixtures as hereinafter specified shall be furnished complete with all working trim at each location and as indicated by symbol and abbreviation on the drawings.
- C. Each unit shall be furnished with the first line chromium plated all brass trim, unless specifically mentioned to the contrary and shall be furnished with chromium plated wheel handle stops and flexible risers, except that service sink fittings have built-in screw driver stops. Connection between wheel handle stops and piping systems shall be chromium plated brass threaded nipple.
- D. "P" traps on all treatment area sinks, home training sinks, soiled utility sinks, lavatories and similar fixtures shall be schedule PVC with screw- type cleanouts, unless otherwise specified by the local jurisdiction.
- E. All fixtures shall be installed so as to meet the requirements of the drawings, specifications and local plumbing codes.
- F. Where handicapped fixtures are designated on architectural drawings, they shall be furnished and installed to comply with applicable ANSI Standards.

(REFER TO PLUMBING FIXTURE SCHEDULE ON PLUMBING DRAWINGS FOR ALL PLUMBING FIXTURES)

2.03 BACKFLOW PREVENTION

- A. Provide dual backflow preventers which operate on the reduced pressure principal.
- B. Approved manufacturers:
 1. Zurn
 2. Watts

2.04 COMMERCIAL GRADE PROCESS & DOMESTIC WATER HEATERS

- A. Tankless Water Heater
 1. Rinnai C199 (i)(e) models.
 2. Roof mounting may be wall or free standing, interior shall be wall mount only. Shall be installed on the manufacturer's approved mounting system.
 3. Thermal efficiency 96% Natural and Propane gas.
 4. Hot water range 0.26 to Max. 9.8 GPM
 5. Amperage: 4 Amps
 6. Depth: 8.7"
 7. Duct Size: 3" Round, 4" Round
 8. Energy Factor: 0.96
 9. Fuel Type: Natural Gas
 10. Height: 25.7"
 11. Ignition Type: Electronic
 12. Max BTU Input: 199000
 13. Temperature (Max): 185°F
 14. Temperature (Min): 98°F
 15. Voltage: 120v
 16. Watts: 75W
 17. Width: 18.3"Width: 18.3"
 18. Venting options
 19. Maintenance alerts

2.05 DOMESTIC USE WATER HEATERS

(If Tankless not feasible a Tank Water Heater maybe used).

A. Gas-Fired Water Heater:

1. Unit shall be commercial grade, high recovery rate, AGA approved glass lined, steel tank, gas fired units as scheduled.
2. Units shall be complete with fiberglass insulation, protective sheet metal jacket with baked enamel finish, cast iron or stainless steel gas burner for use with natural gas, 100% safety pilot, adjustable thermostat control, automatic main gas valve, manual main and pilot gas valves, pressure regulator, backdraft diverter and magnesium anode.
3. Heater tank shall be fabricated so that the water will not come in contact with any ferrous metals.
4. Tank shall have a minimum guarantee of 100% replacement for the first two years. Reference drawing for sizing.
5. The unit shall be factory equipped with independent combustion air flue and exhaust air flue.

B. Electric Water Heater:

1. Unit shall be commercial grade, high recovery rate; UL listed and have an AGA/ASME rated temperature and pressure relief valve.
2. The tank interior shall be coated with a high temperature porcelain enamel and equipped with resitored magnesium anode rod.
3. Unit must meet or exceed the energy factor requirements of ASHRAE. Tanks shall have a working pressure rating of 150 psi and shall be completely assembled.
4. Tank shall be insulated with 2 inches of rigid polyurethane foam insulation.
5. Unit must have surface mounted thermostats each with an integral, manual reset, high limit control.

C. Approved Manufacturers: Per Plumbing Fixture Schedule. Expansion tank shall be diaphragm type, shell construction, with a heavy duty butyl seamless diaphragm, separate non-corrosive water reservoir, mechanical seals, copper lined acceptance fitting, floor stand, polypropylene liner and two-part polyurethane finish. Liner shall be tested and listed by NSF. Tank shall be as manufactured by Amtrol, Inc.

2.06 GAS VENTING SYSTEM

- A. Gas vent system shall include roof flashing, storm collars and vertically louvered non-directional, bird-proof, rainproof galvanized steel or aluminum flue caps and shall be listed by National Fire Protection Association. Install to comply with minimum clearances to combustible materials in accordance with UL listings and local building codes. Gas venting system(s) and equipment shall be approved for use by the water heater manufacturer for the specified equipment to meet all applicable codes and regulations.
- B. Where roofs are bonded, roof flashing shall conform to bonding company's requirements. A square curb base shall be furnished for flat tar and gravel roofs or roofs where curbed openings are provided by the General Contractor.
- C. See Division 7 Sections for roof materials and penetrations.

2.07 EXPANSION TANKS

- A. Expansion tank shall be diaphragm type, shell construction, with a heavy duty butyl seamless diaphragm, separate non-corrosive water reservoir, mechanical seals, copper lined acceptance fitting, floor stand, polypropylene liner and two-part polyurethane finish. Liner shall be tested and listed by NSF. Tank shall be as manufactured by Amtrol, Inc.

2.08 DRAINS AND CLEANOUTS

- A. All drains and cleanouts shall be provided and installed as required and as shown on the drawings. Drains shall have cast iron bodies with screwed or caulked connections of the sized and types shown and specified. Provide deep seal cast iron "P" traps and trap primer connection on all floor drains connected to the sanitary sewer.
- B. Trap Primers: Preferred, in jurisdictions that allow mechanical trap seals, shall be RecterSeal SureSeal. In jurisdictions where mechanical trap seals are not allowed, ZURN ZZ1022-XL-12-IP low-lead Sani-Guard, installed at all floor drains to compensate for evaporation providing a water seal in the trap at all times.
- C. Manufacturer's figure numbers are specified to indicate type, quality and construction. Similar and equal products of approved manufacturers may be substituted for those specified numbers shown.

(REFER TO PLUMBING FIXTURE SCHEDULE ON ALL PLUMBING DRAWINGS FOR ALL PLUMBING FIXTURES)

- D. Approved Manufacturers: Refer Plumbing Fixture Schedule.

PART 3 - EXECUTION

3.01 INSTALLATION OF EQUIPMENT

- A. All plumbing equipment shall be set in place, leveled and connected as indicated on the drawings. All equipment shall be properly protected from damage during storage and construction, and shall be thoroughly cleaned and factory-applied paint touched up where scratched or otherwise damaged, prior to final acceptance.
- B. Installation procedures shall be in strict accordance with manufacturer's published instructions and the contract documents as herein before specified. Contractor shall furnish all required valves, unions, supports, and other required miscellaneous devices.

END OF SECTION

SECTION 15500

SINGLE PACKAGE AIR CONDITIONING AND HEAT PUMPS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes Single Package Air-Cooled Air Conditioners and Heat Pumps
- B. Related Sections:
 - 1. Section 00700 "General Conditions."
 - 2. Section 00800 "Supplementary Conditions."
 - 3. Section 07800 "Roof Penetrations."
 - 4. Section 15100 "Mechanical Materials & Methods."
 - 5. Section 15600 "Ductwork."
 - 6. Section 15610 "Ductwork Accessories."
 - 7. Division 16000 "Electrical."

1.02 REFERENCES

- A. Single Package Air Conditioners Shall Comply With The Following Standards:
 - 1. American Gas Association (AGA)
 - 2. American Society of Heating , refrigeration and Air Conditioning Engineers (ASHRAE)
 - 3. American Refrigeration Institute (ARI)
 - 4. American National Standards Institute (ANZI)
 - 5. Underwriters Laboratories (UL)
 - 6. American Society of Testing and Materials (ASTM)
 - 7. ARI 210/240-89 "Unitary Air Conditioning and Air Source Heat Pump Equipment.
 - 8. ANSI/UL1995 "Heating and Cooling Equipment"

9. UL 1042 Electric Baseboard Heating Equipment
10. ARI 270-84 "Sound Rating of Outdoor Unitary Equipment."
11. UL 1996 Duct Heaters
12. ASTM B-117 Salt Spray Testing
13. UL 378 Draft Equipment
14. UL 441 Gas Vents

1.03 SYSTEM DESCRIPTION

A. Performance Requirements

1. Single package air conditioners shall conform to the performance requirements as scheduled on the contract documents.
2. Units shall be certified in accordance with ARI Standard 210.

1.04 SUBMITTALS

A. Product Data:

1. Roof top/outdoor single package air conditioners.

B. Shop Drawings:

1. Single Package air conditioners.

1.05 DELIVERY STORAGE AND HANDLING

A. Packing and Shipping:

1. Maintain the manufacturer's packing and crating until the unit is on-site ready to be permanently installed.

B. Acceptance at Site:

1. Inspect the unit for damage as a result of shipping. Do not accept the unit if damaged and report the damage to the equipment manufacturer immediately.

C. Storage and Protection:

1. If the unit is not going to be installed for more than two weeks from the time of delivery, store the unit indoors, in the original packing and crating in an area safe from potential damaging acts to the unit. The contractor shall be responsible for

any and all damage to the unit from the time of delivery until the project is accepted as complete by the owner.

1.06 WARRANTY:

- A. Provide manufacturer's warranty for the following components:
 - 1. Compressors - 5 years
 - 2. Heat Exchangers - 10 years
 - 3. Electric Heaters - 5 years
 - 4. Parts - 1 year
 - 5. Labor – 1 year

- B. Warranty term shall commence from date of beneficial use of as agreed upon by the owner and contractor.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. York International Corporation
 - 1. Special Note about York Equipment:
 - a. Contractor may purchase York Equipment through Fresenius Medical Care's national account. Contact Geoffrey Illian at 405-419-6766 for information.
 - b. Contractors shall be responsible for ordering, storage, delivery, installation, payment, etc. of equipment purchased through FMC's national accounts.

- B. Carrier Corporation

- C. The Trane Company

2.02 EQUIPMENT:

- A. General Description:
 - 1. Units shall be factory-assembled, single packaged, designed for outdoor installation. They shall have built-in field convertible duct connections for down discharge supply/return or horizontal discharge supply/return, and be available with factory-installed options or field-installed accessories.

 - 2. The units shall be factory wired, piped, charged with refrigerant and factory tested prior to shipment. All unit wiring shall be both numbered and color coded. Enclosed in each unit shall be a factory test log sheet consisting of the unit tested pressures, temperatures and amps, as tested prior to shipment.

 - 3. All units shall be manufactured in a facility certified to ISO 9001 standards, and the cooling performance shall be rated in accordance with DOE and ARI test

procedures. Units shall be UL listed and classified to ANSIZ21.47 standard and UL1995/CAN/CSA No. 236-M90 conditions.

4. Fans and compressors shall have spring type vibration isolators.
5. Hot gas reheat shall be installed in units specifically located in climate zones #3 and #4 areas.
6. Units shall utilize R-410A refrigerant.
7. Engraved Name Plates
 - a. White letters on a black background, 24 gauge aluminum construction, screw mounting, Seton Name Plate Company, EMED Co., or equal by W. H. Brady.

B. Unit Cabinet:

1. Unit cabinet shall be constructed of G 60 and G90 galvanized steel, with exterior surfaces coated with a non-chalking, powder-coated finish and certified at 1000 hours salt spray test per ASTM-B117 standards.
2. Indoor blower section shall be insulated with minimum 1/2" thick, 1 ½ lb density fiberglass insulation on the air side. Aluminum foil faced insulation shall be used in the furnace compartment and be fastened with rigid fasteners to prevent insulation from entering the air stream. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
3. Full perimeter bases rails shall be provided to assure reliable transit of equipment, overhead rigging for truck access and proper sealing on roof curb applications.
4. Disposable 2" filters (MERV 7) shall be furnished and be accessible through a removable access door, sealed air tight. Units filter track shall be designed to accommodate either 1" or 2" filters.
5. Fan performance measuring ports shall be provided on the outside of the cabinet to allow accurate air measurements of evaporator fan performance without removing panels or creating air by-pass of the coils.
6. Condensate pan shall be internally sloped and conform to ASHARE 62-89 self-draining standards.
7. Unit shall incorporate a outdoor air damper with an outdoor air intake opening covered with a bird screen and a rain hood painted to match the exterior of the unit.

C. Evaporator Fan Assembly:

1. Fan shall be a belt drive assembly and include an adjustable-pitch motor pulley.

2. Fan wheel shall be double-inlet type with forward-curved blades, dynamically balanced to operate smoothly throughout the entire range of operation.
3. Bearings shall be sealed and permanently lubricated for long life and no maintenance.
4. Fan wheel shall be constructed from steel with a corrosion resistant finish.

D. Condenser Fan Assembly:

1. The outdoor fans shall be of the direct-driven propeller type, discharge air vertically, have aluminum blades riveted to corrosion resistant steel spider brackets and shall be dynamically balanced for smooth operation.
2. The outdoor fan motor(s) shall be totally enclosed with permanently lubricated bearings protected against overload conditions and staged independently.

E. Refrigerant Components:

1. Compressors:

- a. Shall be fully hermetic type, direct drive, internally protected with internal high-pressure relief and over temperature protection. The hermetic motor shall be suction-gas cooled and have a voltage range of plus or minus 10% of the unit nameplate voltage.
- b. Shall have internal spring isolation and sound muffling to minimize vibration and noise, and be externally isolated on a dedicated, independent mounting.
- c. All non scroll compressors shall have crankcase heaters.

2. Coils:

- a. Evaporator and condenser coils shall have aluminum plate fins mechanically bonded to seamless internally-enhanced copper tubes with all joints brazed.
- b. Evaporator and condenser coils shall be of the direct expansion, draw-through design.
- c. Evaporator coils shall be leak tested to 150 psig, pressure tested to 450 psig.
- d. Condenser coils shall be leak tested to 150 psig, pressure tested to 600 psig.

3. Refrigerant Circuit and Refrigerant Safety Components shall include:

- a. Metering device:
 - i. 3 through 5 ton models: balanced port thermostatic expansion valve with independent circuit feed system.

- ii. 7 1/2 through 12 1/2 ton models: independent fixed orifice expansion device.
 - iii. 15 and 20 ton models: balanced port thermostatic expansion valve with independent circuit feed system.
 - b. Filter drier/strainer.
 - c. Accessible service gage connections on both suction and discharge lines to charge, evacuate, and measure refrigerant pressure during any necessary servicing or troubleshooting, without losing charge.
 - d. The refrigeration system shall provide at least 15° F of liquid sub-cooling at design conditions.
 - e. The unit shall have two independent refrigerant circuits, equally split on 50% capacity increments. (7 1/2 tons and over).
 - f. The unit shall come with a full factory charge of R-410A refrigerant.
- 4. Unit Controls:
 - a. Unit shall be complete with self contained low-voltage control circuit protected by circuit breaker on the 24 volt transformer side with reset capability.
 - b. Unit shall incorporate a lock-out circuit which provides reset capability at the space thermostat or base unit, should any of the following standard safety devices trip and shut off compressor:
 - i. Loss-of-charge/Low-pressure switch.
 - ii. High-pressure switch
 - iii. Evaporator coil, Freeze-protection thermostat.
 - c. Unit shall incorporate an automatic resetting compressor control for over temperature and over current protection.
 - d. Unit shall operate with conventional thermostat designs and have a low voltage terminal strip.
 - e. Anti-Recycle Timer with 5-minute off-time between compressor cycles.
 - f. Controls on units that possess the dehumidification feature shall incorporate a thermostat, humidistat and internal unit control circuit that provides the full functional logic for the system.

F. Gas Heating Section (Gas Heat Models Only)

- 1. Shall be designed with induced draft combustion with post purge logic, energy saving direct spark ignition, and redundant main gas valve.

2. Venter wheel shall be constructed of stainless steel for corrosion resistance.
3. The heat exchanger shall be of the tubular type, constructed of T1-40 aluminized steel for corrosion resistance.
4. Burners shall be constructed of aluminum coated steel and contain air mixture adjustments.
5. All gas piping shall enter the unit cabinet at a single location, through either the side or bottom, without any field modifications.
6. An integrated control board shall provide timed control of evaporator fan functioning and burner ignition.
7. Heating section shall be provided with the following minimum protection:
 - a. Primary and auxiliary high-temperature limit switches.
 - b. Induced draft motor speed sensor.
 - c. Flame roll out switch (automatic reset).
 - d. Flame proving controls.
8. Unit shall have two independent stages of heating capacity.

G. Electric Heating Section (Electric Heat Models Only):

1. An electric heating section, with heavy duty nickel chromium elements, shall be provided as scheduled on the contract documents.
2. The heating section shall have a primary limit control and automatic reset to prevent the heating element system from operating at an excessive temperature.
3. Units with Electric Heating Sections shall be wired for a single point power supply with branch circuit fusing.
4. Electric heat modules shall be UL listed or CSA certified.

H. Unit Operating Characteristics:

1. Unit shall be capable of starting and running at 125° F outdoor temperature, exceeding maximum load criteria of ARI Standard 210/240.
2. The compressor, with standard controls, shall be capable of operation down to 45° F outdoor temperature. Accessory low ambient kit shall be provided for operation to 0° F on units serving patient care areas.
3. Unit shall be provided with fan time delay to prevent cold air delivery before heat exchanger warms up. (Gas heat only)

I. Electrical Requirements:

2. All unit power wiring shall enter unit cabinet at a single factory provided location and be capable of side or bottom entry. Separate side and bottom openings shall be provided for the control wiring.
3. Provide a weatherproof fusible electrical disconnect switch with fuses to disconnect all power to unit.
4. Unit power shall be as scheduled.

J. Outdoor Air Shall Be Made Available (by either/or as scheduled on the contract documents):

1. Electronic Enthalpy Automatic Economizer - Outdoor and return air dampers that are interlocked and positioned by a fully-modulating, spring-return damper actuator. The maximum leakage rate for the outdoor air intake dampers shall not exceed 2% when dampers are fully closed and operating against a pressure differential of 0.5" WG. A unit-mounted potentiometer shall be provided to adjust the outdoor and return air damper assembly to take in outdoor air to meet the minimum ventilation requirement of the conditioned space during normal operation. During economizer operation, a mixed-air temperature control shall modulate the outdoor and return air damper assembly to prevent the supply air temperature from dropping below 55° F. Changeover from compressor to economizer operation shall be provided by an integral electronic enthalpy control that feeds input into the basic module. The outdoor intake opening shall be covered with a rain hood that matches the exterior of the unit. Water eliminator/filter shall be provided. Dampers shall fully close on power loss.
2. Motorized Outdoor Air Dampers - Outdoor and return air dampers that are interlocked and positioned by a 2-position, spring-return damper actuator, and the maximum leakage rate for the outdoor air intake dampers shall not exceed 2% when dampers are fully closed and operating against a pressure differential of 0.5" WG. A unit-mounted potentiometer shall be provided to adjust the outdoor and return air damper assembly to take outdoor air to meet the ventilation requirements of the conditioned space during normal operation. Whenever the indoor fan motor is energized, the dampers open up to a pre-selected position - regardless of the outdoor air enthalpy. Dampers return to the fully closed position when the indoor fan motor is de-energized. Dampers shall fully close on power loss.

K. EQUIPMENT ROOF CURBS

1. Manufacturers: Custom Curb, Pate, Roof Products and Systems, ThyCurb, Vent Products
2. Equipment manufacturer's curbs that match their equipment are also acceptable.
3. Prefabricated Metal Curb

- a. Minimum 12 inch clear height from above roof insulation thickness. Roof curbs shall be constructed of not less than 18 gauge galvanized steel reinforced so it is structurally capable of supporting the intended load with no penetrations through the curb flashing, inside and outside corner sections that are mitered and continuously welded, filled with 3 pound density rigid insulation, integral deck mounting flange, nominal two inch wood nailer, and galvanized steel counterflashing. Do not use built-in metal base flashings or cants. Cant strips shall be provided for the application when required.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Unit must be installed where condenser coil has an unlimited supply of air.
2. For ground level applications, install on a minimum 6" thick concrete pad, 6" larger than unit base rails on every side of the unit.
3. All filters must be replaced with new prior to turning building over to owner.
4. Unit must be set level to within 1/2 inch across the entire dimension of the unit.
5. Rig the unit into place only by the lifting holes in the base rails. Use spreaders longer than the width and/or length of the unit.
6. Install all field-installed parts and accessories in accordance with the manufacturer's instructions.
7. For roof mounted units, power wiring shall be run through the curb.
8. Follow manufacturer's instructions to place the unit into service. Special attention shall be given to energizing crankcase heaters prior to starting compressors.
9. All piping (gas, electric, condensate) associated with this equipment that penetrates thru a rated assembly shall have the penetration sealed to maintain the integrity of the assembly rating.
10. Provide nameplates on all units. Nameplates shall be installed so they are north facing.
11. Where air handling equipment is to be used for temporary heating or ventilation of a facility, do not operate the equipment until specified filter media has been installed. Contractor shall be responsible for maintaining the cleanliness of air handling apparatus and air distribution systems during construction through regular inspection and changing of filter media throughout the construction period.

12. Where air handling apparatus is used during the construction period, install new filter media prior to start of air balancing. Additionally, deliver one new set of media to the owner prior to substantial completion.

3.02 FIELD QUALITY CONTROL

A. Tests

1. Cycle unit through all sequences of operation as recommended by the manufacturer. Check operation of all safety switches, lockouts, etc. and repair or replace any defective parts discovered.

3.03 DEMONSTRATION

A. Training:

1. Owner's representatives on procedures and schedules related to start-up, shutdown, and troubleshooting, servicing, and preventative maintenance of the system. Schedule training with Owner's representative through the Architect.

END OF SECTION

SECTION 15540

FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Centrifugal direct drive roof exhausters
2. Centrifugal belt drive roof exhausters
3. In-line cabinet fans
4. Propeller Fans
 - a. Small Type exhausters
 - b. Large Type exhausters

B. Related Sections:

1. Section 00700 "General Conditions"
2. Section 00800 "Supplementary Conditions"
3. Section 07800 "Roof Penetrations"
4. Section 15000 "Mechanical Materials & Methods"
5. Section 15600 "Ductwork"
6. Section 15610 "Ductwork Accessories"
7. Section 15800 "Testing, Adjusting and Balancing"

1.2 REFERENCES

A. Comply with the following standards:

1. Air Movement and Control Association (AMCA)
2. ANSI/UL 705 "Power Ventilators"

3. AMCA Publications 210 & 300

1.3 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Powered ventilators shall be listed in the current edition of AMCA 261 and shall bear the AMCA performance seal.

1.4 SUBMITTALS

A. Product Data:

1. Roof exhausters
2. Cabinet fans
3. Sidewall exhausters

B. Shop Drawings:

1. Roof exhausters
2. Cabinet fans
3. Sidewall exhausters

1.5 DELIVERY STORAGE AND HANDLING

A. Packing and Shipping:

1. Maintain the manufacturer's original packing and crating until the unit is on-site, ready to be permanently installed.

B. Acceptance at Site:

1. Inspect the unit for damage as a result of shipping. Do not accept the unit if damaged. Report the damage to the equipment manufacturer immediately.

C. Storage and Protection:

1. If the units are not going to be installed for more than two (2) weeks from the time of delivery, store the units indoors, in the original packaging and crating in an area safe from potential damaging acts to the units. The contractor shall be responsible for any and all damage to the units from the time of delivery, until the project is accepted as complete by the Owner.

1.6 WARRANTY

- A. Provide manufacturer's warranty for one (1) year on all power ventilators.
- B. Warranty term shall commence from the date of beneficial use as agreed upon by the Owner and Contractor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Greenheck Fan Corporation
- B. Penn Ventilator Company
- C. Carnes Company, Inc.
- D. Loren Cook Company

2.2 ENGRAVED NAME PLATES

- A. White letters on a black background, 24 gauge aluminum construction, screw mounting, Seton Name Plate Company, EMED Co., or equal by W. H. Brady.

2.3 EXHAUST AIR FANS

- A. Direct Drive Roof Mounted Type:
 - 1. Fan shall be of the direct drive centrifugal type. Construction of fan housing shall be heavy gauge spun aluminum mounted upon a rigid support with a bird screen network of poly-vinyl-chloride coated steel. The fan inlet shall have a spun venture throat overlapped by a backward curved centrifugal wheel with spun cone for maximum performance.
 - 2. The motor and drive housing shall be mounted on vibration isolators and shall be completely sealed from the exhaust air.
 - 3. The motor and wheel shall be removable through the support structure without dismantling the fan housing.
 - 4. Capacity and characteristics shall be as indicated on Contract Drawings. The fan shall bear the AMCA. Seal for rated sound and capacity.
 - 5. Units shall include a factory mounted and prewired NEMA 1 fan motor disconnect switch where switch is protected from the weather. A NEMA 3 fan

motor disconnect switch shall be provided where switch is exposed to the weather.

6. Units shall include a solid state, variable speed controller for each fan. Speed controller to be used for final air balancing of the fan.
7. Unless otherwise indicated, units shall include a motor operated, corrosion resistant, multi-bladed, backdraft damper for mounting in the fan roof curb. Backdraft damper blade edges and end stops shall be gasketed. [The damper shall be low leak type, leak tested and certified not to exceed 3 CFM per square foot area at 1" water column differential static pressure.] Damper motor shall be an electric type, totally enclosed, oil submerged with operating linkage. Damper motor shall be rated for operation at 120 VAC or 24 VAC. Furnish fan with a step down transformer.
8. Units as specified on the plan schedule shall include a gravity operated, corrosion resistant, multi-bladed, backdraft damper for mounting in the fan roof curb. Backdraft damper blade edges and end stops shall be gasketed.

B. Belt Drive Roof Mounted Type;

1. Fan shall be of the belt-driven centrifugal type. Construction of fan housing shall be heavy gauge spun aluminum, mounted upon a rigid support and bird screen network of poly-vinyl-chloride coated steel. The fan inlet shall have a spun venture throat overlapped by a backward curved centrifugal wheel with spun cone for maximum performance.
2. The motor and drive housing shall be mounted on vibration isolators and shall be completely sealed from the exhaust air.
3. The entire drive assembly and wheel shall be removable through the support structure without dismantling the fan housing.
4. The wheel shaft shall be mounted in heavy-duty ball bearing pillow blocks, equipped with grease fittings. Both pulleys shall be fully machined cast iron type, keyed to the wheel and motor shafts.
5. Capacity and characteristics shall be indicated on Contract Drawings. The fan shall bear the AMCA Seal for rated sound and capacity.
6. Units shall include a factory mounted and prewired NEMA 1 fan motor disconnect switch where switch is protected from the weather. A NEMA 3 fan motor disconnect switch shall be provided where switch is exposed to the weather.
7. Unless otherwise indicated, units shall include a motor operated, corrosion resistant, multi-bladed, backdraft damper for mounting in the fan roof curb.

Backdraft damper blade edges and end stops shall be gasketed. [The damper shall be low leak type, leak tested and certified not to exceed 3 CFM per square foot area at 1" water column differential static pressure.] Damper motor shall be an electric type, totally enclosed, oil submerged with operating linkage. Damper motor shall be rated for operation at 120 VAC or 24 VAC. Furnish fan with a step down transformer.

8. Units as specified on the plan schedule shall include a gravity operated, corrosion resistant, multi-bladed, backdraft damper for mounting in the fan roof curb. Backdraft damper blade edges and end stops shall be gasketed.

C. In-line Direct Drive Above Ceiling Type:

1. Fan shall be mounted above ceiling and vent routed as indicated. Fan shall have forward curved wheel constructed of aluminum. Fan motor shall be of the shaded pole type. Housing shall be of the steel construction with baked enamel finish. Grille mounted in ceiling shall be of extruded aluminum.
2. Capacity and characteristics shall be as indicated on Contract Drawings.
3. Units shall include a solid state, variable speed controller for each fan. Speed controller to be used for final air balancing of the fan.
4. Unit shall include a factory mounted and prewired NEMA 1 fan motor disconnect switch.
5. Provide ½ inch square galvanized wire mesh inlet screens for fans without inlet ductwork.
6. Provide each fan with neoprene isolation hangers.

D. In-line, Belt-Drive Above Ceiling Type:

1. Fan shall be belt-driven in-line type. The square shaped fan housing shall be of heavy gauge formed steel. One of the sides shall be of heavy gauge formed steel. One of the sides shall be hinged and shall support the entire drive assembly and wheel, allowing the assembly to swing out for cleaning, inspection or service without dismantling the unit in any way. The motor shall be mounted on the hinged side exterior isolated from the air stream. The belt and pillow block ball bearings shall be protected from the air stream by an enclosure. The shaft shall be keyed to both the wheel and pulley.
2. The fan inlet shall be a spun venture throat overlapped by a backward curved centrifugal wheel with spun cone for maximum performance.
3. Each in-line type fan shall be furnished with hanging isolators and factory mounted and wired disconnect switch. Fan housing shall be an acoustically lined

motor and belt protection/guard shall be provided with minimum ½” thick fiberglass coated to prevent erosion. Motor and belt protection/guard shall be provided.

4. Single phase motors shall have built-in thermal overload protection.
5. Capacity and characteristics shall be as indicated on Contract Drawings.
6. Unit shall include a factory mounted and prewired NEMA 1 fan motor disconnect switch.
7. Provide ½ inch square galvanized wire mesh inlet screens for fans without inlet ductwork.

E. Propeller Fans:

1. General
 - a. Square steel panel, deep drawn venturi, arc welded to support arms and fan/motor support brackets, baked enamel finish. Provide wall collar and low leakage back draft damper for thru-wall installations.
 - b. Wire safety guards. Provide on exposed inlet and outlet.
 - c. Units shall include a factory mounted and prewired NEMA 1 fan motor disconnect switch.
 - d. For direct drive units, furnish a solid state, variable speed controller for each fan. Speed controller to be used for final air balancing of the fan.
 - e. Units as specified shall include a galvanized steel construction wall collar for fan mounting.
 - f. Units as specified shall include a gravity operated, corrosion resistant, multi-bladed, backdraft damper for mounting at the fan inlet/outlet. Backdraft damper blade edges and end stops shall be gasketed.
2. Propeller fan and Louver (Small Type):
 - a. Fan shall have panel constructed of steel with permanent finish. Fan shall have guard of heavy gauge wire finished with Zinc plated surface. Fan shall have neoprene rubber mounts to isolate motor noise. Propeller blades shall be of steel construction.
 - b. Size and capacity shall be as indicated on Contract Drawings. Fans shall be AMCA certified.

- c. Fan shall be complete with louver housing blades, which close when fan is not in operation. Louver blades shall be of aluminum or galvanized steel painted.
3. Propeller Fan and Louver (Large Type):
 - a. Propeller fan shall be if the belt-driven type. Fan panel shall be of steel construction with spun venturi. Propeller blades shall be die formed and welded to steel hub assembly. Fan drive system shall be attached to fan panel to provide a rigid support system. Fan shall be complete with guard. Fan shall have coating for protection against salt air.
 - b. Size and capacity shall be as indicated on Contract Drawings, and shall be AMCA certified.
 - c. Fan shall be complete with heavy-duty low leakage louver cooling thermostat when temperature in space becomes excessive.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Centrifugal Roof Exhausters:

1. Roof exhausters shall be installed on 12 inch high roof curbs one and one half (1 ½) inches smaller than the unit curb cap. Curbs shall be set level and flashed as recommended by the roof manufacturer. Power wiring shall be run through the curb. Comply with the manufacturer's installation instructions. Exhausters shall be securely anchored to their roof mounting curb/rail by installing corrosion resistant lag screws around the side of the curb cap into the nailor.
2. Fan drive sheaves on belt driven units shall be adjusted or replaced by the contractor to provide design air volumes.
3. Furnish wall and roof opening locations and dimensions to other sections of work requiring opening information.

B. In-line Cabinet Fans:

1. Cabinet fans shall be supported by threaded rod, sized as recommended by the manufacturer. Support fan threaded rods by rubber-type vibration isolators. Install double hex-nut tensioned on the threaded rod to prevent loosening.
2. Fan drive sheaves on belt driven units shall be adjusted or replaced by the contractor to provide design air volumes.

3. Furnish wall and roof opening locations and dimensions to other sections of work requiring opening information.

C. Sidewall Exhausters:

1. Install sidewall exhausters in accordance with the manufacturer's recommendations. Fastening and flashing shall be compatible with the siding construction.
2. Install discharge shutter, backdraft dampers and other accessories requiring field installation. Wire wall shutter and backdraft damper motors to fan power supply and install required transformers. Shutter and dampers shall be interlocked to fan power supply so that shutter or damper opens when fan is energized.

3.2 NAME PLATES

- A. Provide nameplates on all units. Nameplates shall be installed so they are north facing.

3.3 FIELD QUALITY CONTROL

- A. Run-test the power ventilator and check for proper motor rotation, excessive noise or vibration and rated airflow. Repair or replace any parts found to be defective.

3.4 DEMONSTRATION

A. Training

1. Train Owner's representatives on procedures and schedules related to start-up, shutdown, and troubleshooting, servicing, and preventative maintenance of the system.
2. Schedule training with Owner's representative through the Architect.
3. All training sessions shall be video recorded and compiled on a single DVD. Turn over DVD to owner for inclusion in O&M.

END OF SECTION

SECTION 15540

FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Centrifugal direct drive roof exhausters
2. Centrifugal belt drive roof exhausters
3. In-line cabinet fans
4. Propeller Fans
 - a. Small Type exhausters
 - b. Large Type exhausters

B. Related Sections:

1. Section 00700 "General Conditions"
2. Section 00800 "Supplementary Conditions"
3. Section 07800 "Roof Penetrations"
4. Section 15000 "Mechanical Materials & Methods"
5. Section 15600 "Ductwork"
6. Section 15610 "Ductwork Accessories"
7. Section 15800 "Testing, Adjusting and Balancing"

1.2 REFERENCES

A. Comply with the following standards:

1. Air Movement and Control Association (AMCA)
2. ANSI/UL 705 "Power Ventilators"

3. AMCA Publications 210 & 300

1.3 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Powered ventilators shall be listed in the current edition of AMCA 261 and shall bear the AMCA performance seal.

1.4 SUBMITTALS

A. Product Data:

1. Roof exhausters
2. Cabinet fans
3. Sidewall exhausters

B. Shop Drawings:

1. Roof exhausters
2. Cabinet fans
3. Sidewall exhausters

1.5 DELIVERY STORAGE AND HANDLING

A. Packing and Shipping:

1. Maintain the manufacturer's original packing and crating until the unit is on-site, ready to be permanently installed.

B. Acceptance at Site:

1. Inspect the unit for damage as a result of shipping. Do not accept the unit if damaged. Report the damage to the equipment manufacturer immediately.

C. Storage and Protection:

1. If the units are not going to be installed for more than two (2) weeks from the time of delivery, store the units indoors, in the original packaging and crating in an area safe from potential damaging acts to the units. The contractor shall be responsible for any and all damage to the units from the time of delivery, until the project is accepted as complete by the Owner.

1.6 WARRANTY

- A. Provide manufacturer's warranty for one (1) year on all power ventilators.
- B. Warranty term shall commence from the date of beneficial use as agreed upon by the Owner and Contractor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Greenheck Fan Corporation
- B. Penn Ventilator Company
- C. Carnes Company, Inc.
- D. Loren Cook Company

2.2 ENGRAVED NAME PLATES

- A. White letters on a black background, 24 gauge aluminum construction, screw mounting, Seton Name Plate Company, EMED Co., or equal by W. H. Brady.

2.3 EXHAUST AIR FANS

- A. Direct Drive Roof Mounted Type:
 - 1. Fan shall be of the direct drive centrifugal type. Construction of fan housing shall be heavy gauge spun aluminum mounted upon a rigid support with a bird screen network of poly-vinyl-chloride coated steel. The fan inlet shall have a spun venture throat overlapped by a backward curved centrifugal wheel with spun cone for maximum performance.
 - 2. The motor and drive housing shall be mounted on vibration isolators and shall be completely sealed from the exhaust air.
 - 3. The motor and wheel shall be removable through the support structure without dismantling the fan housing.
 - 4. Capacity and characteristics shall be as indicated on Contract Drawings. The fan shall bear the AMCA. Seal for rated sound and capacity.
 - 5. Units shall include a factory mounted and prewired NEMA 1 fan motor disconnect switch where switch is protected from the weather. A NEMA 3 fan

motor disconnect switch shall be provided where switch is exposed to the weather.

6. Units shall include a solid state, variable speed controller for each fan. Speed controller to be used for final air balancing of the fan.
7. Unless otherwise indicated, units shall include a motor operated, corrosion resistant, multi-bladed, backdraft damper for mounting in the fan roof curb. Backdraft damper blade edges and end stops shall be gasketed. [The damper shall be low leak type, leak tested and certified not to exceed 3 CFM per square foot area at 1" water column differential static pressure.] Damper motor shall be an electric type, totally enclosed, oil submerged with operating linkage. Damper motor shall be rated for operation at 120 VAC or 24 VAC. Furnish fan with a step down transformer.
8. Units as specified on the plan schedule shall include a gravity operated, corrosion resistant, multi-bladed, backdraft damper for mounting in the fan roof curb. Backdraft damper blade edges and end stops shall be gasketed.

B. Belt Drive Roof Mounted Type;

1. Fan shall be of the belt-driven centrifugal type. Construction of fan housing shall be heavy gauge spun aluminum, mounted upon a rigid support and bird screen network of poly-vinyl-chloride coated steel. The fan inlet shall have a spun venture throat overlapped by a backward curved centrifugal wheel with spun cone for maximum performance.
2. The motor and drive housing shall be mounted on vibration isolators and shall be completely sealed from the exhaust air.
3. The entire drive assembly and wheel shall be removable through the support structure without dismantling the fan housing.
4. The wheel shaft shall be mounted in heavy-duty ball bearing pillow blocks, equipped with grease fittings. Both pulleys shall be fully machined cast iron type, keyed to the wheel and motor shafts.
5. Capacity and characteristics shall be indicated on Contract Drawings. The fan shall bear the AMCA Seal for rated sound and capacity.
6. Units shall include a factory mounted and prewired NEMA 1 fan motor disconnect switch where switch is protected from the weather. A NEMA 3 fan motor disconnect switch shall be provided where switch is exposed to the weather.
7. Unless otherwise indicated, units shall include a motor operated, corrosion resistant, multi-bladed, backdraft damper for mounting in the fan roof curb.

Backdraft damper blade edges and end stops shall be gasketed. [The damper shall be low leak type, leak tested and certified not to exceed 3 CFM per square foot area at 1" water column differential static pressure.] Damper motor shall be an electric type, totally enclosed, oil submerged with operating linkage. Damper motor shall be rated for operation at 120 VAC or 24 VAC. Furnish fan with a step down transformer.

8. Units as specified on the plan schedule shall include a gravity operated, corrosion resistant, multi-bladed, backdraft damper for mounting in the fan roof curb. Backdraft damper blade edges and end stops shall be gasketed.

C. In-line Direct Drive Above Ceiling Type:

1. Fan shall be mounted above ceiling and vent routed as indicated. Fan shall have forward curved wheel constructed of aluminum. Fan motor shall be of the shaded pole type. Housing shall be of the steel construction with baked enamel finish. Grille mounted in ceiling shall be of extruded aluminum.
2. Capacity and characteristics shall be as indicated on Contract Drawings.
3. Units shall include a solid state, variable speed controller for each fan. Speed controller to be used for final air balancing of the fan.
4. Unit shall include a factory mounted and prewired NEMA 1 fan motor disconnect switch.
5. Provide ½ inch square galvanized wire mesh inlet screens for fans without inlet ductwork.
6. Provide each fan with neoprene isolation hangers.

D. In-line, Belt-Drive Above Ceiling Type:

1. Fan shall be belt-driven in-line type. The square shaped fan housing shall be of heavy gauge formed steel. One of the sides shall be of heavy gauge formed steel. One of the sides shall be hinged and shall support the entire drive assembly and wheel, allowing the assembly to swing out for cleaning, inspection or service without dismantling the unit in any way. The motor shall be mounted on the hinged side exterior isolated from the air stream. The belt and pillow block ball bearings shall be protected from the air stream by an enclosure. The shaft shall be keyed to both the wheel and pulley.
2. The fan inlet shall be a spun venture throat overlapped by a backward curved centrifugal wheel with spun cone for maximum performance.
3. Each in-line type fan shall be furnished with hanging isolators and factory mounted and wired disconnect switch. Fan housing shall be an acoustically lined

motor and belt protection/guard shall be provided with minimum ½” thick fiberglass coated to prevent erosion. Motor and belt protection/guard shall be provided.

4. Single phase motors shall have built-in thermal overload protection.
5. Capacity and characteristics shall be as indicated on Contract Drawings.
6. Unit shall include a factory mounted and prewired NEMA 1 fan motor disconnect switch.
7. Provide ½ inch square galvanized wire mesh inlet screens for fans without inlet ductwork.

E. Propeller Fans:

1. General
 - a. Square steel panel, deep drawn venturi, arc welded to support arms and fan/motor support brackets, baked enamel finish. Provide wall collar and low leakage back draft damper for thru-wall installations.
 - b. Wire safety guards. Provide on exposed inlet and outlet.
 - c. Units shall include a factory mounted and prewired NEMA 1 fan motor disconnect switch.
 - d. For direct drive units, furnish a solid state, variable speed controller for each fan. Speed controller to be used for final air balancing of the fan.
 - e. Units as specified shall include a galvanized steel construction wall collar for fan mounting.
 - f. Units as specified shall include a gravity operated, corrosion resistant, multi-bladed, backdraft damper for mounting at the fan inlet/outlet. Backdraft damper blade edges and end stops shall be gasketed.
2. Propeller fan and Louver (Small Type):
 - a. Fan shall have panel constructed of steel with permanent finish. Fan shall have guard of heavy gauge wire finished with Zinc plated surface. Fan shall have neoprene rubber mounts to isolate motor noise. Propeller blades shall be of steel construction.
 - b. Size and capacity shall be as indicated on Contract Drawings. Fans shall be AMCA certified.

- c. Fan shall be complete with louver housing blades, which close when fan is not in operation. Louver blades shall be of aluminum or galvanized steel painted.
3. Propeller Fan and Louver (Large Type):
 - a. Propeller fan shall be if the belt-driven type. Fan panel shall be of steel construction with spun venturi. Propeller blades shall be die formed and welded to steel hub assembly. Fan drive system shall be attached to fan panel to provide a rigid support system. Fan shall be complete with guard. Fan shall have coating for protection against salt air.
 - b. Size and capacity shall be as indicated on Contract Drawings, and shall be AMCA certified.
 - c. Fan shall be complete with heavy-duty low leakage louver cooling thermostat when temperature in space becomes excessive.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Centrifugal Roof Exhausters:

1. Roof exhausters shall be installed on 12 inch high roof curbs one and one half (1 ½) inches smaller than the unit curb cap. Curbs shall be set level and flashed as recommended by the roof manufacturer. Power wiring shall be run through the curb. Comply with the manufacturer's installation instructions. Exhausters shall be securely anchored to their roof mounting curb/rail by installing corrosion resistant lag screws around the side of the curb cap into the nailor.
2. Fan drive sheaves on belt driven units shall be adjusted or replaced by the contractor to provide design air volumes.
3. Furnish wall and roof opening locations and dimensions to other sections of work requiring opening information.

B. In-line Cabinet Fans:

1. Cabinet fans shall be supported by threaded rod, sized as recommended by the manufacturer. Support fan threaded rods by rubber-type vibration isolators. Install double hex-nut tensioned on the threaded rod to prevent loosening.
2. Fan drive sheaves on belt driven units shall be adjusted or replaced by the contractor to provide design air volumes.

3. Furnish wall and roof opening locations and dimensions to other sections of work requiring opening information.

C. Sidewall Exhausters:

1. Install sidewall exhausters in accordance with the manufacturer's recommendations. Fastening and flashing shall be compatible with the siding construction.
2. Install discharge shutter, backdraft dampers and other accessories requiring field installation. Wire wall shutter and backdraft damper motors to fan power supply and install required transformers. Shutter and dampers shall be interlocked to fan power supply so that shutter or damper opens when fan is energized.

3.2 NAME PLATES

- A. Provide nameplates on all units. Nameplates shall be installed so they are north facing.

3.3 FIELD QUALITY CONTROL

- A. Run-test the power ventilator and check for proper motor rotation, excessive noise or vibration and rated airflow. Repair or replace any parts found to be defective.

3.4 DEMONSTRATION

- A. Train Owner's representatives on procedures and schedules related to start-up, shut-down, troubleshooting, servicing, and preventative maintenance of the system. Schedule training with Owner's representative through the Architect.

END OF SECTION

SECTION 15550

CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. HVAC Equipment Thermostats
2. Thermostat Guards
3. Exhaust Fan Timeclocks

B. References:

1. UL 353 Limit Controls
2. Section 00700 "General Conditions."
3. Section 00800 "Supplementary General Conditions."
4. Section 15100 "Mechanical Materials & Methods."
5. Section 15540 "Fans."
6. Section 15500 "Single Packaged Air Conditioning and Heat Pumps."
7. Section 15510 "Air Handling Units with Coils."
8. Section 16000 "Electrical."

1.02 SUBMITTALS

A. Product Data:

1. Thermostat
2. Thermostat Guards
3. Timeclock

1.03 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection:

1. Maintain the manufacturer's original packaging until the equipment is on-site ready for installation.

1.04 WARRANTY

- ###### **A. Provide the manufacturer's one-year warranty on each control unit.**

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Thermostats:

1. Honeywell

B. Timeclocks:

1. Paragon
2. Intermatic

2.02 EQUIPMENT

A. Thermostat:

1. General Description:

- a) Thermostat shall be fully programmable, commercial application suitable for operation in temperatures from 40°F to 110°F and 5% to 90% percent non-condensing relative humidity. Thermostat shall be configurable for one or two stages of heating and cooling. Thermostat shall have a battery backup to preserve memory in the event of power failure. Thermostat shall have optional single point and averaging remote temperature sensing capability. Thermostat shall be Honeywell RedLINK VisionPro 8000 series, TH8321 programmable units.
- b) Provide Equipment Interface Module kit (YTHM5421R1010) and discharge and return air temperature sensors for each system.
- c) Thermostat shall have a spare contact that can be used to control dehumidification cycle of associated air handling unit.

2. Programming:

- a) Thermostat shall have separate occupied/unoccupied heating and cooling setpoints, three-hour unoccupied override timer, two-minute minimum heat stage operation timers, four-minute cooling-off stage timer, 45°F to 95°F setpoint ranges and a recovery algorithm that attempts to reach setpoint at the programmed occupied start time.
- b) HVAC system fans shall be programmed be on (run continually) while in the occupied mode.

3. Operation:

- a) Thermostat shall incorporate proportional and integral control algorithms to cycle heating/cooling stages to maintain temperature setpoint.

B. Locking Thermostat Guard

1. All building thermostats must be enclosed within a locking thermostat guard.
2. Thermostat guard shall be the LuxPro BB3001-004 (Large).

C. Time clock:

1. General Description:

- a) Time clock shall be electromechanical type, seven day general purpose time control with 4-pole single-throw switch, 40 ampere contact rating at 277VAC, manual override, and synchronous motor suitable for operation from -40°F to 140°F, housed in a NEMA type 1 enclosure. Terminals shall accommodate up to #8 AWG wire. Minimum time setting shall be three hours, maximum time setting shall be 21 hours. Time clock shall include 14 trippers.

D. Staff Lounge Exhaust Fan Switch:

1. Model no. 277WBOX by Cooper Wiring

E. Motorized Damper Switch – for PD/HH Training Rooms

1. Intermatic Spring Wound Timer - Model FF5M

PART 3 - EXECUTION

3.01 INSTALLATION

A. Thermostats:

1. General:

- a) Install thermostats and guards in locations as specified on the contract documents 48 inches above-finished floor. Thermostats shall be installed level. Mount and wire thermostats in accordance with the manufacturer's instructions. Align thermostats with light switch(s).
- b) Install Equipment Interface Module on duct mains below the roof deck.
- c) Install discharge and return air sensors in duct mains below the roof deck

B. Fan/Damper Switches:

1. General:

- a) Install switches in locations as specified on the contract documents 54 inches above-finished floor. Switches shall be installed level. Mount and wire switches in accordance with the manufacturer's instructions.

C. Time clocks

1. General:

- a) Install time clocks in locations as specified on the contract documents. Install time clocks level. Mount and wire time clocks in accordance with the manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

A. Thermostat

1. Check all functions of thermostat by entering a sample program. Verify operation of all thermostat functions and replace if defective.

B. Switches

1. Check functions of switches and replace or repair if defective.

C. Time clock

1. Verify time clock operation. Replace or repair if defective.

3.03 DEMONSTRATION

- A. Train Owner's representatives on procedures and schedules related to start-up, shutdown, troubleshooting, servicing, and preventative maintenance of the system. Schedule training with Owner's representative through the Architect.

END OF SECTION

SECTION 15580

ELECTRIC TERMINAL HEATING UNITS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Wall Heaters
2. Ceiling Heaters
3. Unit Heaters
4. Baseboard Heaters
5. Duct Heaters

B. Related Sections:

1. Section 00700 "General Conditions."
2. Section 00800 "Supplementary Conditions."
3. Section 15100 "Mechanical Materials & Methods."
4. Section 15600 "Ductwork."
5. Division 16000 "Electrical."

1.02 REFERENCES

A. Comply with the following standards:

1. U.L. 1042 Standard for Electric Baseboard Heating Equipment
2. U.L. 1995 Standard for Heating and Cooling Equipment

1.03 SUBMITTALS

A. Product Data:

1. Wall Heaters

2. Ceiling Heaters
 3. Unit Heaters
 4. Baseboard Heaters
 5. Duct Heaters
- B. Shop Drawings:
1. Wall Heaters
 2. Ceiling Heaters
 3. Unit Heaters
 4. Baseboard Heaters
 5. Duct Heaters

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Wall, Ceiling, Unit and Baseboard heaters
1. Q Mark
 2. Marley
 3. Berko
- B. Duct heaters
1. Brasch
 2. Warren

2.02 EQUIPMENT

- A. Wall Heaters:
1. Architectural wall heater equal to a Q Mark Model AWH4000 series
 2. Capacity and voltage as indicated on drawings
 3. Internal thermal overheat protector that will disconnect power in case of overheating.

4. Built-in power disconnect switch
5. Built-in fan delay switch to prevent the fan from turning off prior to the heating coil cooling off.
6. Units shall be UL listed.
7. Integral tamper resistant thermostat that can be adjusted thru the unit face.
8. Fully recessed or surface mounted as shown on drawings. For surface mounted units, provide surface mounting frame.

B. Ceiling Heaters:

1. Heavy duty ceiling heater equal to a Q Mark Model EFF series
2. Capacity and voltage as indicated on drawings
3. Internal thermal overheat protector that will disconnect power in case of overheating.
4. Built-in power disconnect switch
5. Built-in fan delay switch to prevent the fan from turning off prior to the heating coil cooling off.
6. Units shall be UL listed.
7. Integral tamper resistant thermostat that can be adjusted thru the unit face.
8. Fully recessed or surface mounted as shown on drawings.

C. Unit Heaters:

1. Horizontal Unit heater equal to a Q Mark Model MUH series
2. Capacity and voltage as indicated on drawings
3. Units shall be UL listed.
4. Power disconnect switch
5. Ceiling or wall support brackets
6. Wall or unit mounted thermostat as indicated on drawings

7. Built-in fan delay switch to prevent the fan from turning off prior to the heating coil cooling off.

D. Baseboard Heaters:

1. Commercial Baseboard heater equal to a Q Mark Model QMKC series
2. Capacity, length and voltage as indicated on drawings
3. Units shall be UL listed.
4. Integral tamper resistant thermostat
5. Exposed surfaces to touch shall not exceed 120° F

E. Electric Duct Heaters

1. Electric Duct Heater equal to Markel CHMS series.
2. Elements shall be made of alloy resistor wire, centered and permanently encased within refractory material, surrounded by steel sheath. Helical fins shall be brazed to the sheath to increase heat transfer. Sheath and fins shall be permanently coated with a high temperature ceramic for corrosion resistance.
3. Safety controls shall include primary fail safe type capillary cut-out with automatic reset, secondary over-temperature protection consisting of sufficient number of fail safe, trip free capillary type manual resets controlling back-up contractors.
4. Manual resets shall be resettable without opening cover.
5. Units shall be UL listed.
6. Provide with built-in differential pressure switch, control transformer, staging controller with low voltage thermostat, and other appurtenances as required to make for a complete heating system except for field wiring

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install units in accordance with manufacturer's installation instructions.
- B. Coordinate location of units with other trades for correct recess size for recessed units.

- C. After installation, provide protective covers to prevent accumulation of dirt on units during balance of construction.
- D. Providing required line and low voltage control wiring.
- E. For surface mounted wall heaters, mounting frame/sleeve shall be primed and painted to match the wall color.
- F. Protect finishes from damage during construction.
- G. Install units at locations as specified on the drawings and as detailed

3.02 ELECTRIC DUCT HEATERS

- A. Where heaters are indicated to be installed in ductwork, provide manufacturers recommended upstream and downstream ductwork to prevent overheating problems.
- B. Each heater shall be mounted for easy access to the control panel and clearance space shall be provided for heater removal.
- C. The heater coil section shall be totally enclosed within the duct section and securely mounted in place.
- D. Provide duct access doors upstream and downstream of each heater.

3.01 DEMONSTRATION

- A. Train Owner's representatives on procedures and schedules related to start-up, shutdown, troubleshooting, servicing, and preventative maintenance of the system. Schedule training with Owner's representative through the Architect.

END OF SECTION

SECTION 15590

AIR TERMINAL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fan Powered Variable Air Volume, and Variable Air Volume terminals units.

1.02 SUBMITTALS FOR REVIEW

- A. Product Data: Provide data on all air terminal units and accessories, including the following: Air pressure drops, water pressure drops, heating capacities, fan and electrical data for fan powered units and units with electric reheat, controls information and sound data. Submittals that do not include pressure drops and sound data will be rejected and returned.
- B. Provide submittals and IOM's in PDF format for integration into the BAS system

1.03 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Operation and Maintenance Data:
 - 1. Include a parts catalog with complete list of equipment replacement parts and identify each entry with equipment description and identifying code.
 - 2. Provide technical information for servicing operating equipment.
 - 3. Include legible schematic of wiring diagrams of installed electrical equipment and changes made in the Work.
- B. Warranty: Submit manufacturer and installer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Installer: Company specializing in performing the work of this section and approved by equipment manufacturer.
- B. Air terminals shall be installed to maintain required clearances for service.
- C. All terminal units shall be by the same manufacturer.
- D. Units shall comply with requirements of NFPA 90A.

1.05 REGULATORY REQUIREMENTS

- A. Conform to applicable building code for manufacture, product, and installation of system.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

1.06 WARRANTY

- A. Correct defective Work within a one year period after Date of Substantial Completion.
- B. Warranty: Include manufacturer's standard warranty coverage for operating equipment and devices.

1.07 MAINTENANCE SERVICE

- A. A maintenance and service contract, for execution by the Owner, shall be provided covering the period of one (1) year following Substantial Completion. The maintenance shall include testing, inspections, adjustments, lubrication, cleaning, supplies, and parts and labor to keep equipment in proper operation.
- B. Perform maintenance work using competent and qualified personnel under the supervision of the manufacturer or original installer.
- C. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

1.08 DEMONSTRATION

- A. Owner personnel shall be instructed in the proper use, operation, and daily maintenance.
- B. Review emergency provisions, including emergency access and procedures to be followed at the time of failure in operation and other building emergencies.
- C. Train normal procedures to be followed in checking for sources of operational failures or malfunctions.

PART 2 PRODUCTS

2.01 TERMINAL UNITS

- A. Manufacturers: Trane, Titus, ETI, Price, Nailor or Johnson Controls
- B. Description:

- 1. Unit casing shall be minimum 22 gauge steel and internally insulated with 1/2" faced 1.5 lb/ft³ fiberglass insulation or 3/8" thick polyolefin closed cell insulation.

Construction to meet UL 181 and NFPA 90A. Casing shall be sealed to limit leakage to a maximum of 15 cfm at 6.0 inches of static pressure. Casing outlet shall have slip and drive joint for connection to discharge ductwork.

2. Inside surface shall have lining material to provide required acoustic performance, thermal insulation, and prevent sweating. Lining shall be secured to supporting surfaces in a manner that it will not delaminate, sag, or settle. Surfaces including edges, shall be faced with perforated metal or coated so that material is not detached by the air stream.
3. Casing shall have removable panels large enough to provide access to moving parts (except neoprene bellows when bellows are the only moving parts) for inspection, adjustment and maintenance without disconnecting ducts. Panels shall be flush, gasketed airtight, and held in place by screwdriver operated latches.
4. Dampers and other integral devices shall be constructed of materials that cannot corrode, and shall not require lubrication or other servicing.
5. Provide round or flat oval inlet connections and slip and drive rectangular discharge air duct connection.
6. The units shall be pressure independent type with integral air volume regulator to regulate air flow to plus or minus 5% and shall provide a variable volume of air to remote air supply diffusers through flexible ductwork as specified on the drawings. The units shall have adjustable minimum and maximum CFM limiting devices. Scheduled maximum air volumes shall not exceed 75% of nominal unit airflow.
7. At 1.0" inlet static pressure, total sound power shall not exceed NC 32db, re 10 -12 watts based on an 8 db room effect, a 10 db ceiling transmission loss and assuming attenuation from 10 feet of lined duct and slot diffuser on discharge.

C. Variable Volume Fan Powered Terminals

1. Units shall include [series] [parallel] type internal supply fan and factory mounted reheat coils.
2. Unit fan shall be direct drive, double inlet, forward curved type with isolated fan motor. Units shall include factory pre-wired fan speed controller.
3. Return air inlet to unit shall include and integral panel filter media track and also have connection for return air ductwork.
- The following paragraph is for hot water coil reheat boxes.**
4. Units shall include factory mounted hot water reheat coils.
5. Coil shall have the capacities and characteristics as specified on the plan schedules.
6. Constructed of copper tubes and aluminum fins in a serpentine arrangement with

piping connections on the same end. Provide galvanized steel casing, end supports, top and bottom channels to allowance for expansion of finned tube section. Factory test coils at 200 psig.

7. Headers may be cast iron with tubes expanded into the header, steel pipe with tubes brazed to the header, or seamless copper with tubes brazed to the header.
8. Frames shall be flanged for a gasketed connection to adjacent ductwork or constructed for slip and drive connection to the ductwork.
9. Units shall include factory mounted electric reheat coils
10. Coil shall be provided with required safety cutout airflow switch, factory mounted disconnect switch, and silent magnetic contactors for each stage.
11. Heating coil shall be U.L. listed electric resistance type with the scheduled number of capacity steps. Refer to plan schedule for voltage, phase and required input kW rating.

D. Variable Air Volume Terminals

1. Units shall include factory mounted hot water reheat coils.
2. Coil shall have the capacities and characteristics as specified on the plan schedules.
3. Constructed of copper tubes and aluminum fins in a serpentine arrangement with piping connections on the same end. Provide galvanized steel casing, end supports, top and bottom channels to allowance for expansion of finned tube section. Factory test coils at 200 psig.
4. Headers may be cast iron with tubes expanded into the header, steel pipe with tubes brazed to the header, or seamless copper with tubes brazed to the header.
5. Frames shall be flanged for a gasketed connection to adjacent ductwork or constructed for slip and drive connection to the ductwork.
6. Units shall include factory mounted electric reheat coils
7. Coil shall be provided with required safety cutout airflow switch, factory mounted disconnect switch, and silent magnetic contactors for each stage.
8. Heating coil shall be U.L. listed electric resistance type with the scheduled number of capacity steps. Refer to plan schedule for voltage, phase and required input kW rating.

2.02 ACCESSORIES

A. Space temperature sensors; shall be zone sensors with external dial temperature setting adjustment and two (2) hour override button.

1. Space temperature sensors installed in public areas shall have concealed adjustment.

PART 3 EXECUTION

3.01 EXAMINATION

B. Verify that area of Work is ready for work of this section.

C. Verify that electrical power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install in accordance with manufacturer recommendations.

B. Locate each unit for ease of access to all internal and external components requiring service operation or visible examination. Provide service clearance for removal of the internal heating coil.

C. Provide required duct transitions per SMACNA Standards for unit air inlet and outlet connections to duct sizes shown.

D. The Electrical Contractor will provide required line voltage power wiring for units provided with electric reheat coils.

E. Adjust the fan speed controller to obtain the optimum fan speed for proper terminal unit operation.

3.03 ADJUSTING AND CLEANING

A. If system is used during construction of the project, it shall be protected from damage.

1. All damaged parts or equipment shall be replaced prior to Substantial Completion and acceptance.

2. All filters shall be replaced with new.

3. System shall be maintained, and left in like new operation prior to Substantial Completion and acceptance.

3.04 DEMONSTRATION

A. Train Owner's representatives on procedures and schedules related to start-up, shutdown, troubleshooting, servicing, and preventative maintenance of the system. Schedule training with Owner's representative through the Architect.

END OF SECTION

SECTION 15600

DUCTWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Ductwork for HVAC systems:
 - a) Metal
 - b) Flexible

B. Related Sections:

1. Section 00700 "General Conditions."
1. Section 01340 "Shop Drawings, Product Data and Samples."
2. Section 15100 "Mechanical Materials & Methods."
3. Section 15700 "Covering and Insulation."
4. Section 15800 "Testing, Adjusting & Balancing."

1.02 REFERENCES

A. Comply with the following codes and standards:

1. International Mechanical Code
2. NFPA 90A
3. ASHRAE 170 & 90.1
4. ASHRAE Handbook HVAC Systems and Equipment
5. NFPA 99-2012 (where required).
6. SMACNA "HVAC Duct Construction Standards," Latest Edition.
7. ASTM A90 Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles

1.03 SUBMITTALS

- A. Product Data:
 - 1. Flexible Ducts

1.04 DESIGN CRITERIA

- A. Construct ductwork to be free from vibration, chatter, objectionable pulsations and leakage under specified operating conditions.
- B. Use material, weight, thickness, gauge, construction and installation methods as outlined in the latest editions of the following SMACNA publications, unless noted otherwise:
 - 1. HVAC Duct Construction Standards, Metal and Flexible
 - 2. HVAC Air Duct Leakage Test Manual,
 - 3. HVAC Systems - Duct Design
 - 4. Rectangular Industrial Duct Construction Standard
 - 5. Round Industrial Duct Construction Standards
 - 6. Thermoplastic Duct (PVC) Construction Manual
- C. Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke developed rating no higher than 50.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All sheet metal used for construction of duct shall be 24 gauge or heavier except for round and spiral ductwork and spiral duct take-offs 12" and below may be 26 gauge where allowed in SMACNA HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005.
- B. Duct sizes indicated on plans are net inside dimensions; where duct liner is specified, dimensions are net, inside of liner.

2.02 MATERIALS

- A. Metal Duct:

Sheet metal shall be lock-forming quality, ASTM A 653, with G 90 galvanized coating. Provide mill phosphatized finish for ducts exposed to view. (All ductwork serving "Patient Treatment Area" and "Water Treatment Storage Areas" to have no

duct liner or interior insulation. No exposed fiberglass insulation or liner in total system.)

B. Flexible Duct:

1. Thermaflex, Anco Products or Flexmaster
2. Factory fabricated, UL 181 listed as a class 1 duct, and having a flame spread of 25 or less and a smoke developed rating of 50 or under in accordance with NFPA 90A.
3. Duct to be composed of polyester film, aluminum laminate or woven and coated fiberglass fabric bonded permanently to corrosion resistant coated steel wire helix. Two-ply, laminated, and corrugated aluminum construction may also be used. (no exposed fiberglass).
4. Where duct is specified to be insulated, provide a minimum 1 inch fiberglass insulation blanket with maximum thermal conductance of 0.23 K (75 degrees F.) and vapor barrier jacket of polyethylene or metalized reinforced film laminate. Maximum perm rating of vapor barrier jacket to be 0.1 perm.

C. Tie Rods:

1. Galvanized steel, 1/4 inch diameter minimum for up to 36 inch lengths, 3/8 inch diameter minimum for lengths over 36 inches.

2.03 FABRICATIONS

1. Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations, except as modified below.
2. Construct so that all interior surfaces are smooth. Use slip and drive or flanged and bolted construction when fabricating rectangular ductwork. Use spiral lock seam construction when fabricating round spiral ductwork. Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if the screw does not extend more than 1/2 inch into the duct.
3. Mitered elbows shall be square throat type with turning vanes. Maximum unsupported vane length shall be 36 inches. Vanes shall be mechanically fastened to the elbow in such a manner that no noise from vibration is produced. Ducts 18 inches in width and smaller shall use small vanes. Ducts larger than 18 inches shall use large vanes.
4. Provide expanded type or super High Efficient Take-Offs (HETO) for branch duct connections or 45-degree entry fittings. **Square edge 90-degree take-off fittings or straight taps are not acceptable.**
5. Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits. When a short radius (less than 1.5 ratio) elbow must be

used due to limited space, install single wall sheet metal turning vanes. Where space does not allow, and the C value of the radius elbow, as given in SMACNA publications, exceeds 0.31, use rectangular elbows with turning vanes as specified in Section 23 33 00. **Square throat-radius heel elbows is not acceptable.**

6. Smooth radius elbows shall be constructed with a centerline radius equal to one and one half times the nominal duct width in the plane of direction change. **Adjustable segmented elbows are not acceptable.**
7. Rectangular transitions shall be constructed with a maximum convergence of 15 degrees on the transition edge.
8. Round ducts may be substituted for rectangular ducts if sized in accordance with ASHRAE table of equivalent rectangular and round ducts. . No variation of duct configuration or sizes permitted except by written permission of the Architect/Engineer.
9. All butt joints shall be of the standing seam type with a continuous application of duct sealant mastic applied along the entire length of the joint.
10. Longitudinal joints shall be "Pittsburgh lock" or grooved seam type with a full continuous mastic seal provided prior to the final closure.
11. Reinforcements shall be as required by SMACNA standards.
12. All ducts not internally lined shall be cross-broken.

2.04 DUCT SEALANT

1. Manufacturer: 3M 800, 3M 900, H.B. Fuller/Foster, Hardcast, Hardcast Peel & Seal, Lockformer cold sealant, Mon-Eco Industries, United Sheet Metal, or approved equal. Silicone sealants are not allowed in any type of ductwork installation.
2. Install sealants in strict accordance with manufacturer's recommendations, paying special attention to temperature limitations. Allow sealant to fully cure before pressure testing of ductwork, or before startup of air handling systems.

2.05 GASKETS

1. 2 INCH PRESSURE CLASS AND LOWER:
 - a. Soft neoprene or butyl gaskets in combination with duct sealant for flanged joints.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that area of Work is ready for work of this section.
- B. Verify dimensions at the site, making field measurements and drawings necessary for fabrication and erection. Check plans showing work of other trades and consult with A/E in the event of any interference.
- C. Make allowances for beams, pipes or other obstructions in building construction and for work of other contractors. Transform, divide or offset ducts as required, in accordance with SMACNA HVAC Duct Construction Standards, except do not reduce duct to less than six inches in any dimension (unless noted otherwise) and do not exceed an 8:1 aspect ratio. Where it is necessary to take pipes or similar obstructions through ducts, construct easement as indicated in SMACNA HVAC Duct Construction Standards. In all cases, seal to prevent air leakage.

3.02 INSTALLATION

A. General:

1. All ducts shall be installed in accordance with the latest edition of SMACNA "HVAC Duct Construction Standards", for the duct pressure class for which they were designed.
2. All supply, exhaust and return ductwork shall be 2" pressure class, all transfer ducts shall be 1/2" pressure class.
3. Ducts shall be installed with the fewest possible joints, fittings, and changes in direction, sizes, shapes and connections as possible.
4. Ducts shall be run vertically, horizontally, parallel and perpendicular to building lines as much as possible except as indicated otherwise. Install ducts and duct systems in the shortest routes that do not obstruct useable space or block access for servicing the building and equipment.
5. Locate ducts with space around equipment to allow normal operating and maintenance activities.
6. Install ducts with sufficient clearance from walls, ceilings, floors and other permanent structures to maintain the full, installed thickness of the duct insulation plus an additional one inch clearance. Install non-insulated ducts with a one inch clearance.
7. Where ducts pass through fire-rated floors, walls or partitions, firestopping shall be provided between duct and structure, in accordance with requirements of ASTM E 48 and UL-1479.
8. Install ducts concealed from view in finished and occupied spaces by locating ducts in mechanical shafts, hollow wall construction or above suspended ceilings.

9. Coordinate diffuser, return grille and exhaust grille layouts with suspended ceiling, lighting and sprinkler heads layouts.
10. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
11. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Protect ductwork against entry of foreign matter during construction.
12. Ductwork located outside the building that is exposed to the weather shall have seams and joints soldered or caulked watertight. Ductwork shall be reinforced additionally by a factor of 50% beyond the reinforcing requirements as specified in the SMACNA duct construction manual. Ductwork shall be externally covered with duct insulation as specified under section 15700.
13. Pitch moisture laden exhaust duct back to exhaust grille.

B. Flexible Ductwork

1. Secure inner jacket of flexible duct to the rigid branch duct with stainless steel draw bands. Secure insulation vapor barrier jacket in place with steel or nylon draw band. When nylon draw bands are used, they shall be tightened with a tensioner. The use of sheet metal screws or duct tape to attached flexible ducts to hard ducts is not acceptable.
2. Flexible duct used to compensate for misalignment of main duct or branch duct will not be accepted.
3. Flexible ductwork used as transfer duct shall be sized for a maximum velocity of 300 fpm.
4. Penetration of any partition, wall, or floor with flexible duct will not be accepted.
5. Individual sections of flexible ductwork shall be of one piece construction. Splicing of short sections will not be accepted.

C. Seam and Joint Sealing:

1. Seal all duct, with the exception of transfer ducts, in accordance with SMACNA seal class "A"; all seams, joints, and penetrations shall be sealed.
2. Externally insulated ducts shall be sealed prior to insulation installation.
3. When appropriate, metallic foil backed duct tape may be used to seal duct seams and joints. Under no circumstances shall "typical" cloth duct tape be used for sealing ductwork, or for any other purpose.

4. Under no conditions is the use of tape acceptable for sealing ducts exposed to the weather.

D. Hanging and Supporting:

1. Ductwork shall be installed prior to installation of external insulation. **Pre-insulated ductwork segments will not be accepted.**
2. Rigid round, rectangular and flat oval metal ducts shall be installed with support systems in accordance with SMACNA "HVAC Duct Construction Standards - Metal and Flexible" unless noted otherwise on the drawings or in the specifications. Additionally, horizontal ducts shall be supported within two feet of each elbow and within four feet of each branch intersection. Vertical ducts shall be supported at each floor and at a maximum interval of sixteen feet.
3. Wire hangers shall only be used for round ducts 12 inches or less in diameter. Rectangular ducts and larger diameter round ducts shall be supported with strap hangers or steel shapes or uni-strut supports in accordance with SMACNA standards.

E. Connections:

1. Branch connections shall comply with the figures shown in the latest edition of SMACNA "HVAC Duct Construction Standards - Metal and Flexible".
2. Offsets and transitions shall comply with the figures shown in the latest edition of SMACNA "HVAC Duct Construction Standards - Metal and Flexible".

3.03 FIELD QUALITY CONTROL

- A. Conduct leakage tests, in the presence of the owners authorized representative, at static pressures equal to but not exceeding duct system design pressure. Maximum permissible leakage shall be as described in the ASHRAE Handbook, "HVAC Systems and Equipment" and ASHRAE Handbook, "Fundamentals".
- B. Repair and remake any seams and joints that do not comply with the acceptable leakage class.
- C. Any positively pressured exhaust ductwork serving the Isolation and Medical Waste Storage room shall be sealed 100 percent. No leakage shall be permitted.

3.04 CLEANING

- A. Prior to commissioning duct system, clean all interior surfaces of all dust and debris generated as a result of the construction. Where systems are started in finished space, install filter media over diffusers and outlet terminals to entrain dust dislodged from fan pressure. Remove filter media after running the fan for a minimum of ten minutes.

END OF SECTION

SECTION 15610

DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Accessories for ductwork serving HVAC systems.
 - a) Flexible connectors.
 - b) Duct mounted access doors.
 - c) Volume control dampers.
 - d) Fire dampers.
 - e) Fire/smoke dampers.
 - f) Isolation Dampers
 - g) Turning vanes.
 - h) Grilles, Registers and Diffusers
 - i) Brick Vents

B. Related Sections:

1. Section 00700 "General Conditions."
2. Section 01340 "Shop Drawings, Product Data and Samples."
3. Section 15100 "Mechanical Materials & Methods."
4. Section 15600 "Ductwork."

1.02 REFERENCES

A. Comply with the following standards:

1. SMACNA "HVAC Duct Construction Standards - Metal & Flexible", Current Edition.

2. NFPA 90A “Installation of Air Conditioning & Ventilating Systems”, Current Edition.
3. U.L. Standard 555-1999 “Standard for Fire Dampers”, Current Edition.
4. U.L Standard 555S-1999 “Standard for Fire/Smoke Dampers”, Current Edition.

1.03 SUBMITTALS

- A. Flexible connectors.
- B. Access doors.
- C. Fire dampers.
- D. Fire/smoke dampers.
- E. Turning vanes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Registers, Grilles, Diffusers
 1. Titus
 2. Price Industries
 3. Softaire Diffusers, Inc.
 4. Approved Equal.
- B. Fire Dampers, Fire/Smoke Dampers
 1. Greenheck
 2. Ruskin Manufacturing Co.
 3. Air Balance, Inc.
 4. Nailor Ind.

2.02 EQUIPMENT

A. Flexible Connectors:

1. Flexible connectors shall be constructed of flame-retardant, non combustible fabrics, coatings and adhesives complying with U.L. Standard 181, class 1. Standard metal-edge connectors shall be factory fabricated with a flexible, fabric strip 3 inches wide minimum, 10 inches maximum, attached to two strips of three inch wide 24 gauge galvanized sheet steel or 0.032 gauge sheet aluminum. Select metal that is compatible with the duct system. Edges of metal strips shall be hemmed on the sides that connect to ducts. Fabric shall be fastened to metal similar to SMACNA "HVAC Duct Construction Standards," current edition.
2. Connections to have adequate flexibility and width to allow for thermal expansion/contraction, vibration isolation of connected equipment, and other movement.
3. Stainless steel connectors shall be no more than 48" maximum total length.

B. Duct Mounted Access Doors:

1. General
 - a. Access doors to be designed and constructed for the pressure class of the duct in which the door is to be installed. Doors in exposed areas shall be hinged type with cam sash lock. Hinges shall be aluminum or steel full length continuous piano type. Doors in concealed spaces shall be secured in place with cam sash latches.
2. Frame:
 - a. Frame shall be galvanized sheet steel of the thickness as specified. Frame shall have foam or neoprene gasket to provide an airtight seal.
3. Door:
 - a. Door shall be double-wall, galvanized sheet steel construction, one inch by one inch butt hinges and sash locks as specified. Door shall have a continuous foam or neoprene gasket to prevent leakage.
4. Insulation:
 - a. Insulation shall be one inch thick fiberglass or polystyrene foam board.

5. Installation:

- a. Access door assembly shall be constructed in accordance with the following table:

	Door Size	No. Hinges	No. Locks	Metal Gage		
				Frame	Door	Back
2" w.g. Static and Less	12" x 12"	2	1-S	24	26	26
	16" x 20"	2	2-S	22	24	26
	24" x 24"	3	2-S	22	22	26
3" w.g. Static	12" x 12"	2	1-S	22	22	26
	26" x 20"	2	1-S, 1-T, 1-B	20	20	26
	24" x 24"	3	2-S, 1-T, 1-B	20	20	24
4" w.g. to 10" w.g.	12" x 12"	2	1-S, 1-T, 1-B	20	20	26
	16" x 20"	3	2-S, 1-T, 1-B	20	18	24
	24" x 24"	3	2-S, 2-T, 2-B	18	18	24

S = Side opposite hinges, T = Top, B = Bottom

C. Volume Control Dampers:

1. General

- a. Volume dampers shall have positive locking mechanism and operating handle.
- b. Damper handles shall be lever type. Round knob type handles with incremental adjustment are not acceptable.
- c. **Dampers installed in ductwork that is externally insulated shall be provided with standoffs to allow for full operation of damper without damaging the insulation.**

2. Single-Blade Type:

- a. Dampers up to 12 inches in height and 18 inches in width shall be constructed of 22 gauge minimum galvanized sheet steel. All damper edges shall be hemmed. Damper shall be sized to provide one-eighth inch clearance on all edges as installed in the duct. Damper shall have a three-eighths inch locking quadrant on one end and a three-eighths inch pin on the other end. Stiffen damper as required to prevent deflection and unwanted vibration.
- b. Dampers up to 12 inches in height and 48 inches in width shall be constructed of 18 gauge minimum galvanized sheet steel. All damper edges shall be hemmed. Damper shall be sized to provide one-eighth inch clearance on all sides. Damper shall have one-half inch locking quadrant and a one-half inch diameter continuous rod and end bearing. Damper shall be stiffened as required to prevent deflection and unwanted vibration.

- c. Dampers in round ducts shall be single-blade type, constructed of 24 gauge minimum or two sheet metal gauges larger than the duct it is installed in, whichever is greater. Damper shall have three-eighths inch pins on two opposite quadrants for mounting. Dampers larger than 12 inches diameter shall have a continuous three-eighths inch rod. Damper shall have an adjusting arm and wing nut to permit locking. Damper shall be stiffened as required to prevent deflection and unwanted vibration.
3. Opposed-Blade Type:
 - a. Dampers over 12 inches in height shall be opposed-blade design. Dampers shall incorporate a steel channel frame, angle stops, three-eighths inch diameter shafts, 18-gauge neoprene gasketed blades, nylon or bronze bushings, and connecting linkage. Provide shaft extension on installations where the damper is inaccessible.

D. Fire Dampers:

1. Fire dampers shall be equal to a Greenheck Model DFD-150 dynamic, curtain style with integral frame/sleeve or a Greenheck Model CRD-60 Ceiling Radiation damper where required.
2. Model DFD-150 Fire dampers shall be listed to meet U.L. Standard 555, "Standard for Fire Dampers" current edition and labeled for dynamic applications and meet requirements of NFPA 90A.
3. Model CRD-60 Ceiling Radiation dampers shall be listed to meet U.L. Standard 555C "Standard for Ceiling Dampers" current edition.
4. Damper rating shall be 1½ or 3 hour as required to maintain the associated wall rating. Penetrations through barriers with a fire resistance rating less than 3 hours shall be provided with a 1½ hour damper. Penetrations through barriers with a fire resistance rating of 3 hours or more shall be provided with a 3 hour damper.
5. Fire dampers shall provide 100% free-area of the nominal duct dimensions in which it is installed. Dampers shall be curtain-type with blades constructed of 22 gauge minimum galvanized steel. Frame shall be type "B", one-piece roll formed 22 gauge galvanized steel.
6. Damper shall have a U.L. listed, replaceable fused link with a 165°F rating unless noted otherwise. Damper shall include a factory made and installed sleeve of two sheet metal gauges larger than the duct it is installed in but not less than 20 gauge. Sleeve shall not extend over six inches beyond the rated opening. Dampers installed in the horizontal position shall have a constant force, coiled negator type 301 stainless steel springs.

E. Smoke and Combination Fire/Smoke Dampers:

1. Smoke dampers shall be equal to a Greenheck Model SMD-201.
2. Combination dampers shall be equal to a Greenheck Model FSD-211.
3. Dampers shall be listed to meet U.L. Standard 555 “Standard for Fire Dampers,” current edition and U.L. Standard 555S “Standard for Leakage Rated Dampers for use in Smoke Control Systems” current edition.
4. Damper rating shall be 1½ or 3 hour as required to maintain the associated wall rating. Penetrations through barriers with a fire resistance rating less than 3 hours shall be provided with a 1½ hour damper. Penetrations through barriers with a fire resistance rating of 3 hours or more shall be provided with a 3 hour damper.
5. Dampers shall be constructed as follows:
 - a. Frame: 16 gauge minimum galvanized steel hat channel.
 - b. Blades: 16 gauge minimum galvanized steel, eight inches maximum width, parallel action.
 - c. Axles: one-half inch square solid steel.
 - d. Bearings: oil impregnated bronze.
 - e. Linkage: on-blade fixed type, located within the airstream, galvanized steel angle interconnect with plated steel brackets and pivots.
 - f. Stops: 18 gauge minimum steel.
 - g. Blade Seals: elastomer material.
 - h. Side Jamb Seals: stainless steel.
 - i. Sleeve: 20 gauge minimum or two gauges larger than the duct, whichever is greater.
 - j. Caulking: Hardcast Irongrip 601 or U.L. listed equivalent.
 - k. Finish: mill galvanized steel.
 - l. Actuator: electric with 165°F thermal disc or pneumatic with 165°F fusible link. Select actuator type compatible with building control system.
6. Damper sleeves shall be sized so the sleeve does not extend more than six inches beyond the rationed opening except on the actuator side where the sleeve may extend to a maximum of sixteen inches beyond the rated opening.

7. Minimum smoke damper size allowed is 12" X 12". Air pressure drop of damper shall not exceed 0.15" W.G. at design duct velocity. Damper free area shall be a minimum of 90% of the duct in which it is installed, for all size dampers, taking the damper internal framing into account.
8. Smoke dampers to be leakage rated at no higher than Class II under UL 555S. Leakage shall not exceed 10 CFM/square foot at 1" water gauge, and 20 CFM/square foot at 4" water gauge.
9. Combination fire/smoke dampers to be UL 555 listed, have a fire rating compatible with the rating of the building surface in which the damper is used, and be leakage rated at no higher than Class II under UL 555S. Leakage shall not exceed 10 CFM/square foot at 1" water gauge, and 20 CFM/square foot at 4" water gauge.
10. Combination Fire/Smoke Dampers shall be provided with the following:
 - a. Resettable Link
 - b. Open Closed Indicator
 - c. Factory supplied sleeve and retaining angles. Sleeve shall be minimum 16 gauge.
 - d. Factory mounted actuator, UL listed
 1. 24 Volt power supply
 2. Spring return operation
 3. Closed fail direction
 4. Externally mounted
 5. NEMA 1 enclosure
11. Smoke Dampers: shall be UL labeled and a rating as scheduled on the Drawings, per UL 555S. The minimum free open area of dampers shall be the duct clear area.
 - a. Smoke dampers shall be provided with the following:
 1. Momentary Test Switch
 2. Open Closed Indicator
 3. Factory mounted actuator, UL listed
 - a. 24 Volt power supply
 - b. Spring return operation
 - c. Closed fail direction
 - d. Externally mounted
 - e. NEMA 1 enclosure

F. Isolation Dampers

1. Isolation dampers shall be installed in the supply and/or return ducts serving the CAPD and Home Hemo rooms as shown on the floor plans.
2. Dampers shall be power open/power closed style with a selectable normally open or normally closed setting.
3. Dampers will have a fast open time of no more than 20 seconds.
4. Damper switch to be located on wall near door. Switch should be labeled "A/C Shutoff" to distinguish it from the light switch.
5. Power shall be 110v or 24v as shown on mechanical plans.
6. Acceptable Product: Young Regulator Model 4010-PC

G. Turning Vanes:

1. Turning Vanes shall be single-thickness type, welded to their runners.
 - a. Small Vanes shall have a radius of two inches, one and one half inch spacing and be constructed of 24 gauge minimum galvanized sheet steel where the vane runner length is 18" or greater and air velocity less than 2000 fpm.
 - b. Large vanes shall have a radius of four and one half, three and one quarter inch spacing and be constructed out of 22 gauge minimum galvanized sheet steel where the vane runner is 18" or greater and air velocity 2000 fpm or greater.

H. Grilles, Registers and Diffusers:

1. General: All registers and grilles shall be product of a single manufacturer; shall be provided with factory applied baked enamel finish to match adjacent surfaces, except as otherwise specified.
2. Check ceiling suspension system and coordinate interfacing. All grilles, diffusers and registers shall be mounted with countersunk screws with finish to match respective items.
3. Manufacturer's representative shall verify that grilles, registers and diffusers shall not exceed a NC level of 25 at airflow rate indicated.
4. Provide grilles and diffuser types as scheduled on the drawings.
5. Plenum Slot Diffusers: Price Model TBD4. Units shall be constructed of 24-gauge sheet metal with optional T-bars made from extruded aluminum. Slot diffusers shall have the number slots and slot sizes as shown on the plans. The slot diffuser face

and pattern controllers shall be black and the optional T-bars shall have a white finish. Each supply slot shall have an extruded aluminum pattern controller with a tight sealing gasket edge at the top of the blade, which seats against the plenum wall or slot divider and provides full horizontal flow.

6. Square and Rectangular Ceiling Diffusers: Price APDF Series, Aluminum construction with standard off white finish, designed for one, two, three, and four-way diffusion as indicated on plans. Where lay-in ceilings occur, mount each diffuser in a 2' x 2' lay-in ceiling panels with finish to match diffuser. Where plaster or gypsum board ceiling occur use type 1 border with plaster frame. Provide diffuser with square/rectangular to round adapter where required.
7. Wall/Ceiling Supply Register: Double deflection, 3/4-inch blade spacing, aluminum construction, equal to Price Model 620D. Provide opposed blade damper and white finish.
8. Ceiling Return Grille: Shall be Perforated face style grille no less than 50 percent free area, 1/4 inch aluminum border. Construction shall be aluminum. Provide with standard white enamel finish. Grille shall be to Price Model 10A.
9. Ceiling Exhaust Grille: Same as specified above for ceiling return grille.
10. Ceiling Transfer Grille: Same as specified above for ceiling return grille.
11. Wall Return Register: Wall return registers shall be aluminum construction, 1/2" blade spacing, and 45 degree deflection, equal to Price Model 630. Provide with opposed blade volume damper and white finish. Select such that blades are parallel to floor.
12. Wall Return Grille: Wall return grilles shall be the same as the wall return registers specified above except omit opposed blade damper.
13. Wall Transfer Grille: Same as wall return registers specified above except omit opposed blade damper.
14. Supply Diffuser for all patient areas (including Treatment Floor and Home Training Rooms) required:
 - a. Model CCT-SQ diffuser by Softaire (<http://www.softairediffusers.com>)
 - b. Provide starter collar for each diffuser to allow for duct connection.

I. Brick Vents

1. General: Furnish performance ratings for approval.

2. Brick Vents: Brick vents shall be extruded aluminum construction with blades set at 45 degrees and with built-in continuous drip and water stop to provide maximum protection against water entry. Provide with prime coat. Brick vents shall be equal to Greenheck BVE.
1. Acceptable Manufacturers for brick vents are Greenheck, Titus, Reliable, Ruskin or Industrial Louvers.

PART 3 - EXECUTION

3.01 EXECUTION

A. Flexible Connectors:

1. Install in accordance with the manufacturers instructions.
2. The flexible connector, in the final installed state shall not have any tensile or compressive forces imposed on the connector.

B. Duct Mounted Access Doors:

1. Install access doors where specified, indicated on the drawings, and in locations where maintenance, service, cleaning or inspection is required. Examples include, but are not limited to motorized dampers, fire and smoke dampers, smoke detectors, fan bearings, heating and cooling coils, filters, valves, and control devices needing periodic maintenance.
2. Secure access doors as recommended by the manufacturer.
3. Size and numbers of duct access doors to be sufficient to perform the intended service. Minimum access door size shall be 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, or other size as indicated. Install access doors on both inlet and outlet sides of reheat coils as well as other duct mounted coils.
4. Label fire, smoke and combination fire smoke dampers on the exterior surface of ductwork directly adjacent to access doors using a minimum of 0.5 inch height lettering reading, "SMOKE DAMPER" or "FIRE DAMPER".

A. Volume Control Dampers:

1. Install dampers as close as possible to the branch take-off from the duct main.
2. Install dampers in all supply and exhaust air branch ducts where integral dampers in the grilles/diffusers are not provided. Each diffuser, register, grille or open ended duct shall be served by a manual volume damper regardless of whether or not it is indicated on the plans.

3. Where manual balancing dampers are installed above inaccessible ceilings without access panels, provide a remote operator similar to the Bowden Cable Control System as manufactured by Young Regulator Co. Cleveland, OH.

B. Fire Dampers

1. Install as detailed on the contract documents and as recommended by the manufacturer. Installation shall comply with U.L. Standard 555-1990.
2. Install dampers square and free from racking. Do not compress or stretch the damper frame into the duct opening.
3. Install an access door at each fire damper, sized and located to permit resetting the damper and replacing the fusible link.
4. Manually test each fire damper for proper operation by removing the fusible link. Repair or replace all fire dampers that do not close completely. Re-install fusible link after test.

C. Fire/Smoke Dampers

1. Install Fire/Smoke dampers as detailed on the contract documents and as recommended by the manufacturer. Installation shall comply with U.L. Standard 555S current edition.
2. Provide ductwork transitions as required between duct sizes shown and damper sleeve.
3. F/S dampers shall be controlled by the fire alarm panel.
4. Install an access door at each smoke and combination damper for inspection and cleaning.

D. Isolation Dampers

1. Install an access door at each damper for inspection and maintenance.

- E. Install turning vanes where shown on the contract documents. Secure vane assemblies by means of sheet-metal screws or spot welds not more than 6 inches on center.

F. Grilles, Registers and Diffusers

1. Grilles and Diffusers shall be securely and neatly attached to the building construction or sheet metal duct flanges.
2. Adjust diffusers for a draft free air pattern.

END OF SECTION

SECTION 15700

COVERING AND INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The requirements of Division 1, The General Conditions, the Supplementary General conditions, and the Contract Drawings are hereby made a part of this section as fully as if repeated herein.

1.02 WORK INCLUDED

- A. Providing thermal insulation for the HVAC and plumbing systems to include piping, ductwork, fittings, casings, and equipment.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 07800 "Roof Penetrations"
- B. Section 15100 "Mechanical Materials & Methods"
- C. Section 15200 "Pipe Sleeves, Supports and Anchors for Medical Process Piping Systems"
- D. Section 15300 "Plumbing, Piping"
- E. Section 15530 "Refrigerant Piping & Specialties"
- F. Section 15600 "Ductwork"

1.04 QUALITY ASSURANCE

- A. The following manufacturers are acceptable:
 - 1. Insulation:
 - a) Certainteed Corp.
 - b) Johns Manville Products Co.
 - c) Owens-Corning Fiberglass Corp.
 - d) Knauf
 - 2. Adhesives
 - a) Foster
 - b) Chicago Mastic
 - c) Armstrong
 - d) Johns Manville Products Corp.

- e) Childers Inc.
- B. Insulation installers(s) shall have a minimum of five (5) years of successful installation experience on projects with pipe, duct, and equipment insulation similar to that required under this section.
- C. Jackets and Covers
 - a) Childers and Covers
 - b) Armstrong

1.05 SUBMITTALS

- A. Furnish a schedule and listing of each type of insulation, thickness, density, type of jackets, etc., and the work and service to which each type of insulation is to be applied.
- B. Submittals shall conform to the requirements as stated in Section 15100 Mechanical Materials & Methods.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation against dirt, water, chemical, and mechanical damage. No damaged insulation will be accepted.
- B. Deliver insulation, coverings, cements, adhesives, and coatings to the site in factory fabricated containers with the manufacturer's stamp or label affixed showing fire hazard ratings of the products.
- C. Store insulation in original wrappings and protect from weather and construction traffic.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material and equipment shall be new; and shall conform to the grade, quality, and standards specified here-in. Equipment or materials of the same type shall be the product of the same manufacturer throughout.

2.02 FIRE RESISTANCE

- A. Materials used as part of the thermal insulation shall have a fire hazard rating not to exceed 25 for flame spread and 50 for fuel contributed and smoke developed.
- B. Factory assembled materials shall be tested as assemblies. Materials that are field applied may be tested individually. Fugitive or corrosive materials used to impart flame resistance are not acceptable nor are treatments subject to deterioration due to the effect of moisture or high humidity.

- C. Determine ratings by the standard method of test for surface burning characteristics of building materials, ASTM E-84, or NFPA #255.
- D. Requirements to establish that fire hazard ratings for materials proposed for use do not exceed those specified shall conform to:
 - 1. Label or listing by Underwriter Laboratories, Inc.
 - 2. Certified test report from an approved testing laboratory.
- E. Materials exempt from the foregoing Fire Resistant Rating are:
 - 1. Jackets or canvas, PVC, and nylon.
 - 2. Polyurethane, polystyrene, cork, and flexible closed cellular insulation.
 - 3. Nylon anchors for securing insulation to ducts and equipment.
 - 4. Treated wood inserts used between shields and piping at hangers on low temperature piping.
 - 5. Factory premolded one-piece PVC fitting and valve covers.

2.03 INSULATION FOR PIPING

- A. Piping systems described shall be insulated as follows; including flanges, fittings, valves, and expansion joints. All piping subject to freezing such as in outdoor air, discharge plenums, or outdoors shall be insulated with a minimum of 2 inch insulation.

<u>PIPING SYSTEM</u>	<u>THICKNESS</u>
Cold Water (up to 1 1/4") (1 1/2 and larger)	1/2" - (Type P-1) 1" - (Type P-1)
Hot Water supply and return (up to 1 1/4") (1 1/2" and larger)	1" - (Type P-1) 1 1/2" - (Type P-1)
Drains from A.C. Units, cooling coil pans, and miscellaneous piping subject to condensation.	1" - (Type P-1)
Horizontal storm water piping and vertical leaders including roof drain bodies	1/2" - (Type P-1)
Refrigeration Suction Piping	1" - (Type P-2)
Refrigeration Hot Gas Piping	1/2" - (Type P-2)

B. Type P-1 Glass Fiber for Hot and Cold Pipes

1. Insulation shall be composed of hinged sections of molded heavy density resin bonded fiberglass.
2. Jacket: White kraft reinforced vapor barrier all service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of 0.02 perms and minimum beach puncture resistance of 50 units.
3. Concealed interior pipe insulation shall be 4 lbs. per cu. ft. density glass fiber with maximum K factor of .23 at 75 degrees F. mean temperature.
4. Fiberglass density shall be 6 lbs./cu. ft. in equipment rooms and where pipes are exposed.
5. For cold pipes, ends of insulation shall be sealed off with vapor barrier coating (BF 30-35) at flanges, valves, and fittings and at intervals of not more than 21 feet on continuous runs of pipe.
6. Fittings and valves shall be insulated with factory-premolded insulation fittings, mitered segments of 6 psf density fiberglass pipe covering, or fiberglass blanket insulation compressed a minimum of 2 to 1. Fitting insulation thickness shall be the same as the adjoining pipe insulation. The ends of the cover must be vapor sealed on cold piping.
7. Insulation for removable flanges shall be fabricated with sectional pipe insulation extending a minimum of 1 inch beyond the end of the bolts. Finish shall be the same as that specified in paragraph (5).
8. Concealed piping shall be banded in place with three (3) aluminum bands per section, one over each end of the joint sealing strip and one in the middle of the section. Where self-sealing laps are used, bands are not required.
9. Insulation shall be Owens Corning Fiberglass SSL II-ASJ or approved equal

C. Type P-2 Elastomeric Insulation

1. Armstrong AP Armaflex or Armaflex II or Halstead F/R Insul-Tube closed cell insulation, with minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.27 at 75°F mean temperature, and maximum water vapor transmission of 0.17 perm inch. The material shall have an acceptable application temperature range from 220°F to -40°F

D. Insulation shall be vermin resistant.

1. Pipe Insulation: Shall be equal to Owens Corning Fiberglass 25 ASJ, Johns-Manville type ASJ, CSG type ASJ, or approved substitute.

2.04 INSULATION FOR SHEETMETAL

A. Insulate sheet metal as follows:

1. Air conditioning system supply and return air ducts where concealed 2 inch type D-1.
2. Interior air conditioning system supply and return air ducts where exposed;
 - a) Rectangular ductwork – 1 1/2 inch type D-2.
 - b) Round ductwork – 1 1/2 type D-3
3. Exterior air conditioning system supply and return air ducts where exposed to weather;
 - a) Rectangular ductwork - 3 inch (2 - 1 1/2" layers) type D-4.
4. All ductwork serving to have no duct liner or interior insulation. **No exposed fiberglass insulation or interior liner in total system.**
5. All ductwork between an exterior wall louver or roof jack and an inline fan shall be insulated. Insulation type shall be as note above. (exposed ductwork shall be type D-2 or D-3 depending on shape.)

B. Type D-1 Duct Insulation with Vapor Barrier: (Minimum R6 insulation)

1. Flexible duct insulation shall be 1 lb. per cu. ft. density glass fiber with a laminated kraft paper and aluminum foil reinforced with fiberglass yarn. Maximum K factor of 0.27 at 100 degrees F mean temperature, rated for service to 250 degrees F.
2. Insulation shall be strip adhered to the duct on sides and top and completely adhered on the bottom with duct adhesive (B. F. 85-20). Joints shall be butted with facing overlapping all joints at least 2 inches and sealed with vapor barrier adhesive. Seal all breaks and punctures with vapor barrier tape and adhesive. For ducts over 24 inches in width, the insulation shall be additionally secured to the bottom of the ducts with mechanical fasteners spaced on 18 inch centers, maximum. Seal penetrations of facing with vapor barrier tape. Fasten insulation with 16 gauge copper clad wire or fiberglass cord on 12 inch centers.
3. Stop and point insulation around access doors and damper operators to allow operation without disturbing insulation or jacket material.
4. Insulation shall be Owens Corning Fiberglass SOFTR Duct Wrap or approved equal.

C. Type D-2 Rigid Rectangular Duct Insulation with Vapor Barrier (Minimum R6 insulation)

1. Rigid duct insulation shall be 6 lbs. per cu. ft. density glass fiber with maximum K factor of .23 at 75 degrees F. mean temperature. (Owens Corning Fiberglass Type 705 with ASJ facing or approved.)
 2. Insulation shall be impaled over welded pins applied to duct surface on 12 inch centers. Use a minimum of two rows of fasteners on each side of duct. Secure insulation with suitable speed washers or clips firmly imbedded into insulation.
 3. All joints, edges, speed washers, and breaks in the vapor barrier shall be sealed with 3 inch wide strips of the vapor barrier facing adhered with vapor barrier adhesive.
 4. Insulation shall be Owens Corning 705 with ASJ facing or approved equal.
- D. Type D-3 Semi-Rigid Round Duct Insulation with Vapor Barrier (Minimum R6 insulation)
1. Semi-Rigid duct insulation shall be 2.5 lbs. per cu. ft. density glass fiber with maximum K factor of .24 at 75 degrees F. mean temperature.
 2. Jacket: White kraft reinforced vapor barrier all service jacket, factory applied to insulation, maximum permeance of 0.02 perms and minimum beach puncture resistance of 50 units.
 3. Ductwork 6 inches and smaller, Insulation shall be Owens Corning Fiberglass SSL with ASJ Max or approved equal.
 4. Ductwork 8 inches and larger, Insulation shall be Owens Corning Fiberglass FLEXWRAP ASJ or approved equal.
- E. Type D-4 Rigid Rectangular Duct Insulation with Vapor Barrier (Minimum R12 insulation)
1. Rigid duct insulation shall be 6 lbs. per cu. ft. density glass fiber with maximum K factor of .23 at 75 degrees F. mean temperature. (Owens Corning Fiberglass Type 705 with ASJ facing or approved.)
 2. Insulation shall be impaled over welded pins applied to duct surface on 12 inch centers. Use a minimum of two rows of fasteners on each side of duct. Secure insulation with suitable speed washers or clips firmly imbedded into insulation.
 3. All joints, edges, speed washers, and breaks in the vapor barrier shall be sealed with 3 inch wide strips of the vapor barrier facing adhered with vapor barrier adhesive.
 4. Provide with weather-tight, vermin resistant jacket.
 5. Insulation shall be Owens Corning 705 with ASJ facing or approved equal.

2.05 ALUMINUM ACCESS COVERS

- A. Sections of equipment requiring periodic servicing such as removable heads, pumps, etc., shall be insulated with aluminum covers lined with the same material and thickness as the adjoining insulation.

2.06 DIFFUSERS, RETURN AND EXHAUST AIR GRILLES

- A. Insulation shall be adhered to completely covering all surface areas of diffusers and grilles. Fasten insulation, overlapping all joints and seal with vapor barrier adhesive.

2.07 ACCESSORIES

- A. Products shall be compatible with surfaces and materials on which they are applied, and be compatible for use at operating temperatures of the systems to which they are applied.
- B. Adhesives shall comply with UL 2395 Adhesives in HVAC Appliances to secure Insulation.
- C. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- D. Vapor barrier coatings to be non-flammable, fire resistant, polymeric resin.
- E. Insulation tape shall be compatible with the type of insulation applied to and as recommended by the insulation manufacturer.

PART 3 - EXECUTION

3.01 WORKMANSHIP

- A. All work shall be performed by workmen skilled in the trade required for the work. All materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer and the best practices of the trade and in conformance with the Contract Document. The Contractor shall promptly notify the Engineer in writing of any conflict between any requirements of the Contract Documents and manufacturer's directions and shall obtain written instructions from the Engineer before proceeding with the work. Should the Contractor perform any work that does not comply with the manufacturer's directions or such written instructions from the Engineer, he shall bear all costs arising in correcting such deficiencies.

3.02 GENERAL

- A. Install all insulation systems subsequent to testing and acceptance of tests.
- B. Ductwork shall not be insulated prior to installation of ductwork. All insulation shall be installed only after ductwork has been installed to minimize damage to insulation and vapor barrier.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full length units of insulation, with a single cut piece to complete the run. Do not use cut pieces or scraps abutting each other.

- D. Clean and dry surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
- E. Maintain integrity of vapor barrier jackets on insulation and protect to prevent puncture or other damage.
- F. Extend insulation without interruption through walls, floors, and similar pipe/duct penetrations.
- G. Install protective metal shield and insulated inserts wherever needed to prevent compression of insulation.
- H. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- I. Protect all insulation requiring protection during the construction period to avoid damage and deterioration.
- J. All materials shall be applied per manufacturer's recommendations.

3.03 INSTALLATION FOR PIPING

- A. The insulation shall be secured with copper clad wire and covered with a coat of insulating cement. After the cement is dried, a 1/16" coat of vapor barrier mastic (BF30-35) (BF30-36 for hot piping) is to be applied into which is imbedded a 10 x 10 weave white glass reinforcing cloth. The cloth is to overlap itself at least 1" and the adjoining pipe insulation by 2". Apply a final 1/16" coat of vapor barrier mastic and smooth the surface. In lieu of the field applied finish, factory-premolded PVC fitting covers may be used over the insulation.
- B. Jackets shall be neatly fitted around supports, anchors, etc., and drawn smooth and tight.
- C. All joints and seams shall lap at least 1 1/2" using either a joint tape of the same material as the jacket or an extension of the jacket itself, either of which is secured by pressure sensitive cement or bonding adhesive.
- D. Exposed work shall be banded at least every 18" or an extension of the jacket itself, either of which is secured by a pressure sensitive cement or bonding adhesive.
- E. Vapor barrier must be complete moisture and vapor seal including all joints. The barrier must be free of any breaks or punctures. Where penetrations and openings exist, such as hangers, the barrier must be carried down to the metal around the protrusion or opening in either case, insulation must be completely shielded from the atmosphere by the vapor barrier.
- F. Fittings and valves shall be covered with a blanket type glass fiber which shall be enclosed by fabricated fittings and valve jackets which overlap the adjoining pipe

covering. All pressure sensitive vinyl tape which shall overlap all joints and breaks in the jacket by at least 1 1/2".

- G. Where the pipes are operating below ambient, this entire portion of the insulation shall receive a vapor barrier coating. Insulation, coatings, and jackets shall be continuous through wall and floor openings.
- H. Fittings operating above ambient may in lieu of the preceding paragraph, be covered with a three-hour hydraulic setting combination insulating and finished cement having a "k" factor not greater than 0.87 at a mean temperature of 200^o F. The thickness of the cement shall be such that the surface is substantially flush with the pipe covering. Where the insulation terminates at a fitting that is not covered, the end of the insulation shall be beveled off with this same cement. All fittings insulated in this manner shall be covered by a fabric jacket as specified and cemented down with lagging adhesive as specified.
- I. Expansion joints which are to be insulated shall be covered with readily removable sections of insulation of the same thickness as provided for adjacent piping. The removable insulation shall be provided with a jacket of .016" thickness galvanized steel which shall be installed in a manner to permit removal and reinstallation of the section without damage and which shall be suitable for the service.

3.04 INSTALLATION FOR DUCTS

- A. Insulation sections are to be butted together and the joints wrapped with 3 inch wide butt strips securely sealed in place. The longitudinal joints shall be completely sealed with an approved adhesive. In lieu of field applied adhesives, insulation with self-sealing laps and butt strips way shall be used.
- B. Vapor barrier must be a complete moisture and vapor seal including all joints. The barrier must be free of any breaks or punctures. where penetrations and openings exist, such as at hangers, protruding shafts and access panels, the barriers must be carried down to the metal around the protrusion or openings or extend along the protrusion and sealed thoroughly. In either case, the insulation must be completely shielded from the atmosphere by the vapor barrier.
- C. Insulation boards shall be installed by impaling them on metal pins which are either anchored to the duct by a waterproof cement specifically made for attachment to metal and in successful use for at least five years and guaranteed to hold at temperatures up to 200^o F or are welded to the metal so as not to distort or burn through the metal. In either case, the pins shall be placed approximately 3" from each corner of the insulation and so spaced that no portion of the insulation, 20" x 20" sq., will be without a pin. Each pin shall be able to support a load of 20 pounds. Install pins without damage to the interior galvanized surface of the duct. Clip pins back to washer and cover penetrations with tape of same material as jacket.

- D. One piece, insulated PVC covers may be used for fittings if insulation thickness and thermal performance is the same as adjoining insulation. Seams, joints between PVC cover and adjoining duct insulation, and any staples or tacks used to secure seams in PVC covers, must be covered with 2 inch wide, 10 mil PVC tape and one coat of vapor barrier mastic.
- E. The edges around access doors and nameplates and the corners of ducts and casings in exposed places must be protected with continuous corner beads and installed flush with the finished surface.
- F. Insulation, when applied, shall allow adequate length for wrapping so that stretch out distance is adequate and thickness integrity of insulation is maintained as previously specified.
- G. Outdoor insulation shall be weatherproof type (aluminum jacket), minimum .016" thickness, moisture barrier adhered to inside face, secured to insulation with stainless steel or aluminum bands, and sealed joints.

END OF SECTION

SECTION 15800

TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Testing, Adjusting, and Balancing
 - 1. Air condition equipment, including air distribution devices, supply ducts, air handling units, condensing units, fans, coils, and related equipment
 - 2. Hydronic systems, including pumps, water distribution systems, chillers, boilers, heat exchangers , coils, and related equipment

1.02 REFERENCES

- A. American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE):
 - 1. Standard111-2008 – Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-conditioning and Refrigeration Systems.
 - 2. Applications Handbook 2011, Chapter 38 - Testing Adjusting and Balancing.
- B. Testing, Adjusting and Balancing Bureau (TABB) – International Standards for Environmental Systems Balance
- C. Sheet Metal and Air Conditioning Contractors’ National Standards for Total System Balance
- D. Associated Air Balance Council (AABC) – National Standards for Total System Balance
- E. National Environmental Balancing Bureau (NEBB) – Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems

1.03 DEFINITIONS

- A. Adjusting: Varying of system flow by modifying settings of dampers and valves, in combination with varying fan speeds to obtain optimum operating conditions for the entire system

- B. Balancing: Proportioning of air and hydronic flows through system mains, branches and terminal devices using standardized procedures to obtain specified air or hydronic flow while imposing the least amount of restriction on the HVAC system
- C. Testing: Use of specialized and calibrated instruments to measure temperatures, pressures, rotational speeds, electrical characteristic, air and hydronic flow in velocities or quantities used in evaluating the performance of an HVAC system

1.04 COORDINATION

- A. The testing, adjusting and balancing Contractor shall coordinate his work with the mechanical system and temperature control system installing Contractors to accomplish coordination and verification of system operation and readiness for testing, adjusting and balancing.
- B. Coordinate and assist CxP with all verification activities defined within section (15030) including providing all required sampling data necessary for the commissioning process.

1.05 SUBMITTALS

A. Qualification Statements

- a. Submit company's certification documents, including: Contractor Certification
 - b. Supervisor Certification
 - c. Technician Certification
2. Submit name of testing agency to Owner within thirty (30) days on Notice to Proceed
 3. Submit list of projects completed by testing agency of similar size, scope and equipment. Include name of Contractor and building Owner contacts.
 4. Submit a certification letter stating that the TAB agency is an independent entity not owned in part or in whole by any subcontractor employed on the current project.

B. Reports

1. Deficiency Report: Following examination of installed system, prior to balancing, submit report indicating system deficiencies that would prevent proper testing, adjusting and balancing of systems and equipment to meet specified performance.
2. TAB Report: Submit a copy of the complete testing, adjusting and balancing report to FMC Project Manager and RECS Atlanta Staff Engineer via email.

Report shall include any drawings indicating air outlets, thermostats and equipment identified to correspond with data sheets.

- a. Reports shall be on TABB/SMACNA, (NEBB or AABC), forms that indicate information addressing each of the testing methods, readings and adjustments.

C. Closeout Submittals

1. Provide complete copy of testing, adjusting and balancing report. Include report in operation and maintenance manual.

1.06 QUALITY ASSURANCE

A. Qualifications

1. Testing and balancing shall be performed by a testing agency who specializes in testing, adjusting and balancing of heating, ventilating, air-moving equipment, air-conditioning systems and hydronic systems and has a minimum of one (1) year experience.
2. Testing agency shall have successfully completed a minimum of five (5) projects, similar in size and scope.
3. Testing agency and technician shall be a certified member of TABB, (AABC, and/or NEEB). Certification number and seal of registration shall be included with each balancing report.
4. Maintain a copy of applicable standards at the project site.

B. Certifications

1. TAB Technician shall be certified by a nationally recognized certifying agency.

C. Perform total system balance in accordance with Testing, Adjusting and Balancing Bureau (TABB) – Quality Assurance Program for Environmental Systems Balance, and (AABC National Standards for Field Measurement and Instrumentation and/or NEBB Quality Assurance Program – Conformance Certification).

1.07 PROJECT CONDITIONS

- A. Testing, adjusting and balancing shall commence after the HVAC systems installation is complete and in working order. Associated areas of general construction shall be in place; including: interior and exterior doors, windows, walls, ceilings and existing conditions.

1.08 SPECIAL WARRANTY

- A. Provide warranty for period of ninety (90) days following physical occupancy of clinic, during which time, the Owner may request a re-check of up to 10% of total number of terminals, or resetting of any outlet, coil or device listed in the test report. This period of time shall be no longer than 180 days after submission of the completed report.
- B. Warranty shall meet the requirements of the following program(s):
 - 1. TABB – International Quality Assurance Program
 - 2. AABC – National Project Performance Guarantee
 - 3. NEBB – Conformance Certification

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Prior to commencing testing, adjusting and balancing of environmental system(s), verify the following conditions, if deficiencies are evident, submit Deficiency Report to Architect. Do not begin testing, adjusting and balancing of environmental system until deficiencies have been remedied.
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed, complete, and operable.
 - 3. Automatic and manual dampers are operable and fully open.
 - 4. Thermal overload protection is in place for fans, pumps, chillers and other equipment.
 - 5. Start up air filters are removed.
 - 6. Final filters are clean and properly installed.
 - 7. Duct and fan systems are clean.
 - 8. Fans are rotating correctly.
 - 9. Fire and volume dampers are in place and open.
 - 10. Air coils fins are cleaned and combed.
 - 11. Access doors are closed and duct end caps are in place.

12. Air outlets are installed and connected.
13. Hydronic systems are pressure tested, flushed, filled and properly vented.
14. Leak testing on duct system has been performed in accordance with SMACNA Standards, or as specified.
15. Pumps are rotating correctly.
16. (Start-up/construction) strainers have been removed and all permanent strainers are clean and in place.
17. Gauges and/or test parts are properly located for balancing.
18. Service and balance valves are fully open.

3.02 SITE TOLERANCES

- A. Air Handling Systems: Adjust to within minus 5 to plus 10 percent of outlet total plus allowable leakage rate.
- B. Air Outlets and Inlets: Adjust to within minus 5 to plus 10 percent of design for the space.
- C. Hydronic Systems: Adjust to within minus 5 to plus or minus 10 percent of design flow.
- D. Hydronic Terminal Devices: Adjust to within minus 5 to plus or minus 10 percent of design flow.

3.03 AIR SYSTEMS PROCEDURE

- A. Adhere to the following procedure:
 1. TABB – HVAC Testing, Adjusting and Balancing International Standards; with particular focus on the following chapters:
 - a. Preliminary TAB procedures
 - b. General air systems TAB procedures
 - c. TABB procedures for specific (VAV, CAV, Multizone, Dual duct, etc.) air systems
 2. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) HVAC Systems – Testing, Adjusting and Balancing.
 3. NEBB – Procedural standards for TAB of environmental systems.
 4. AABC – National standards for total systems balance.

- B. Minimum air procedures should include the following:
1. Test and adjust fan RPM to design requirements.
 2. Test and record motor full load nameplate rating and actual ampere draw.
 3. Test and record system static pressures, fan suction and discharge.
 4. Adjust all main supply and return air outlets/inlets to within the tolerances listed in this section of work.
 5. Test and adjust each diffuser, grille and register. Reading and tests of diffusers, grilles and registers shall include design velocity (FPM) and adjusted velocity, design CFM and adjusted CFM.
 6. Test and record outside, mixed air, and discharge temperatures (D.B. for heating cycle, D.B. and W.B. for cooling cycle).
 7. In coordination with the ATC contractor, set adjustments of automatically operated dampers to operate as specified, indicated and/or noted.
 8. Test and adjust air handling and distribution systems to provide required or design supply, return, outside and exhaust air quantities within design tolerance.
 9. In air systems employing filters, blank off filter area to simulate a pressure drop that is midway between that of a clean filter and that of a dirty filter.
 10. Make air velocity measurements in ducts by Pitot tube traverse entire cross sectional area of duct in accordance with SMACNA equal area method or Log Linear method.
 11. Measure air quantities at all air inlets and outlets.
 12. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels.
 13. Vary total system air quantities by adjustments of fan speeds. Provide drive changes recommendations. Vary branch air quantities by damper regulation.
 14. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for loading of filters and coils.
 15. Adjust outside air automatic dampers. Outside air, return air and exhaust dampers for design conditions within specified tolerances.
 16. Where modulating dampers or economizers are provided, take measurement at full return air, minimum outside air and 100 percent outside are mode of operation.

17. Verify and record, in the T&B Report, “K” factors for all VAV air terminal devices and air flow stations.

3.04 HYDRONIC SYSTEM PRESSURE

A. Adhere to the following procedure:

1. Testing, Adjusting and Balancing Bureau (TABB) – International Standards for Environmental Systems Balance
2. SMACNA – HVAC Testing, Adjusting and Balancing International Standards; with particular focus on the following chapter:
 - a. Hydronic TAB procedures
3. NEBB – Procedural standards for TAB of environmental systems.
4. AABC – National standards for total systems balance.

B. Hydronic balancing shall include the following minimum data:

1. Prepare itemized equipment schedules, listing all heating and/or cooling elements and equipment in the systems to be balanced. List, in order on equipment schedules, by pump or zone according to the design, all heating and/or cooling elements, all zone balancing valves, and circuit pumps, ending with the last items of equipment or transfer element in the respective zone or circuit. Include on schedule sheet column titles listing the location, type of element or apparatus, design conditions and measured conditions. Prepare individual pump report sheets for each zone or circuit.
2. Use calibrated Venturi tubes, orifices, metered fittings, pressure gages and direct reading instrumentation to determine flow rates for system balance. Where flow-metering devices are not installed, flow balance in temperature difference across various heat transfer elements in the system is acceptable.
3. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
4. Effect system balance with automatic control valves fully open to heat or cooling transfer elements.
5. Adjust hydronic distribution systems by means of balancing cocks, valves and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
6. Test pumps and adjust flow. Record the following on pump report sheets:

- a. Suction and discharge pressure;
 - b. Running amps and brake horsepower of pump motor under full flow and no flow conditions;
 - c. Pressure drop across pump in feet of water and total GMP pump is handling under full flow conditions.
7. Where available pump capacity is less than total flow requirements or individual system parts, proportional balancing must be performed.

3.05 ADJUSTING

- A. Recorded data shall represent actual measured or observed conditions.
- B. Provide fan and motor drive sheave adjustments to obtain design performance. If fan and motor drive sheaves require replacement to obtain design air volumes, provide sheave replacements at no additional cost to the project.
- C. Permanently mark setting of valves, dampers and other adjustment devices allowing for settings to be restored. Set and lock memory stops.
- D. Leave systems in proper working, replacing belt guards, closing access doors, closing doors to electrical switch boxes and restoring thermostats to specified settings.
- E. Areas or rooms designed to maintain positive, negative or balanced air pressures with respect to adjacent spaces, as indicated by the design air quantities, require special attention. Adjust fan drives, distribution dampers, terminals and controls to maintain indicated pressure relationship.
- F. Final system measurements shall be within the following ranges:
 1. Air Terminals 0 to +10%
 2. Fans 0 to +10%
 3. Pumps -5% to +10%
 4. Coils -5% to +10%

PART 4 - EXECUTION

4.01 PLUMBING SYSTEMS

- A. The contractor installing the plumbing systems shall follow all tests as required to prove compliance with all local codes. Tests performed shall be equal to or exceed that hereinafter specified. All piping systems shall be tested before they are covered or made unavailable for the complete inspection of all joints. In addition to the above, each and every system to be insulated shall be thoroughly tested before the insulation is applied.
- B. Domestic Piping Systems: Upon completion of a section of the entire water supply system, it shall be tested and proved tight under a water pressure of 125 lbs., or not less, that 10 percent in excess of the working pressure under which it is to be used. The water used for tests shall be obtained from a potable source of supply.

- C. Sanitary Sewer Systems: All sanitary sewer systems shall be tested wither in sections or in their entirety, in accordance with all requirements of the local Plumbing Code, and to the satisfaction of the local Plumbing Inspector. These tests shall be examined if desired by the Engineer or his representative during the test period and ample notice of performance of these tests shall be given.
- D. Gas Piping Systems: The natural gas piping systems on the low pressure side of the meters and regulators shall be tested to a pressure of 50 PSIG and shall be held at this pressure for a period of eight (8) hours.
- E. Medical Equipment Process Piping System: With completion of each process piping loop and dialysis valve boxes installed a dry nitrogen pressure test must be administered. The system pressure shall be slowly elevated to 50 PSIG after which the source is removed and piping system closed. The test shall be deemed successful once system maintains pressure with no fluctuations over a 24 hour period.

4.02 WATER SYSTEM STERILIZATION

- A. On the incoming water service provide a ¾” connection through which chlorine shall be introduced into the water piping systems to sterilize those systems thoroughly. Sterilization shall be performed in all cold and hot water systems.
- B. After completion of the testing, the entire new cold and new 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. The chlorinating material shall be either liquid chlorine, conforming to U.S. Army Specification No. 4-1, or calcium hypochlorite or chlorinated lime conforming to the requirements of Federal Specification O-C-114, and shall be pumped into the system through the connection described above. The sterilizing 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 is not greater than .02 parts per million.

END OF SECTION

SECTION 15900
BASIC FIRE PROTECTION GENERAL REQUIREMENTS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. Applicable requirements of instruction to bidders, conditions of contract and of Sections listed under related Sections of this Division apply to all work specified in this Division 15000.

1.02 RELATED SECTIONS OF THIS DIVISION

- A. 15900-Basic Fire Protection General Requirements
- B. 15910-Basic Fire Protection Materials and Methods
- C. 15920-Fire Protection Systems

1.03 RELATED WORK OF OTHER SECTIONS OR DIVISIONS

- A. Division 1
 - 1. 15000 - Plumbing
 - 2. 15000 - HVAC
 - 3. 16000 - Electrical

1.04 WORK INCLUDED IN THIS SECTION

- 1.05 Reference Standards
- 1.06 General Requirements
- 1.07 Visiting the Premises
- 1.08 Codes and Regulations
- 1.09 Discrepancies
- 1.10 Certifications
- 1.11 Workmanship and Materials
- 1.12 Manufacturer's Recommendations
- 1.13 Electrical Coordination Prior to and After Submission of Bids
- 1.14 Design Criteria
- 1.15 Alternates
- 2.01 Submitted Data and Shop Drawings
- 2.02 Maintenance Manuals
- 2.03 Record Drawings
- 3.01 Openings, Cutting, and Repairing
- 3.02 Cleaning Equipment and Materials

3.03 Cleanup

3.04 Record Drawings

3.05 Protection

3.06 Lubrication

3.07 Guarantee

1.05 REFERENCE STANDARDS

- A. NFPA 72 Installation, Maintenance And Use Of Protective Signaling Systems
- B. ASSE 1015 Double Check Valve Backflow Preventers
- C. NFPA 13 Installation of Sprinkler Systems.
- D. NFPA 14 Installation of Standpipe and Hose Systems.
- E. NFPA 20 Installation of Centrifugal Fire Pumps.

1.06 GENERAL REQUIREMENTS

- A. This is a Performance Specification for a contractor Design/Build Fire Sprinkler System. This fire protection contractor shall be the engineer of record as well as the contractor for the fire sprinkler system and related components. This section of the specifications is intended to establish a standard and a level of quality for bidding purposes and for construction. This Section of the work shall be responsible for preparing installation drawings, complete code-compliant design, engineering and construction coordination with other trades, hydraulic calculations, and submission of same to local, State, and insurance agencies having jurisdiction. Refer to Plumbing Plans for water service, riser, Fire Department connection location. Refer to Architectural reflected ceiling plans for preferred sprinkler locations/patterns.
- B. Prior to submitting bid, contractor shall perform flow test to verify flow and pressure information, and prepare a preliminary hydraulic calculation to verify necessity of and horsepower of fire pump. Contractor shall include results along with electrical requirements with bid.
- C. In all exposed structure ceilings, sprinkler piping shall be installed as concealed as possible to ensure an unobtrusive, aesthetically appealing installation. Refer to structural plans and coordinate piping locations and purlin and beam penetrations prior to construction. Owner/architect/engineer shall reserve the right to adjust exposed piping design at Shop Drawing stage at no additional cost to owner.
- D. Obtain information on conditions affecting work at building, including the following:
 - 1. Complete information as to details of building constructions, pipe and equipment layout, in order to install and revise existing system to clear structural work and piping of equipment of other trades.

2. Storage Space: Stored materials shall be located so as to facilitate prompt inspection. See Conditions of Contract.
- E. On all conditions affecting work, obtain at building conditions of structure and surfaces to support pipe and equipment.
1. Examine details of building construction in order to install system to clear all structural work and finished work.
 2. Examine electrical, heating and ventilating and special equipment and piping layouts and specifications.
 3. As used in these sections, the word “provide” shall mean “furnish and install”.

1.07 VISITING THE PREMISES

- A. The Contractor, before submitting his bid on the work, must visit the site and familiarize himself with all visible existing conditions.
- B. As a result of having visited the premises, the Contractor shall be responsible for the installation of the work as it relates to such visible existing conditions.
- C. The submission of a bid will be considered an acknowledgment on the part of the bidder of his visitation to the site.

1.08 CODES AND REGULATIONS

- A. Design, materials and installation shall comply with latest standards of Factory Mutual Fire Insurance Company (FM), National Fire Protection Association (NFPA) Standards, State and local codes, local Fire Chief or Fire Marshall.
- B. Inspection and approval of detailed plans of installation with insurance approval shall be submitted to Architect prior to installation.

1.09 DISCREPANCIES

- A. The drawings and specifications are intended to cooperate. Any materials, equipment or systems related to this Section and exhibited on the Architectural and Fire Protection Drawings, but not mentioned in the Specifications are to be executed to the intent and meaning thereof, as if it were both mentioned in the Specifications and set forth on the Drawings. In the event of differences in the requirements between drawings, specifications, NFPA, State and Local codes or insurance agency, the more stringent requirement shall apply.

1.10 CERTIFICATIONS

- A. Fire protection system components shall be UL listed and labeled. All components shall be Factory Mutual approved with the exception of sprinkler heads, double check valves and air compressors.

1.11 WORKMANSHIP AND MATERIALS

- A. Workmanship shall be of the best quality and none but competent mechanics skilled in their trades shall be employed. The Contractor shall furnish the services of an experienced superintendent who will be in charge of the erection of the work until completed and accepted.

- B. Unless otherwise hereinafter specified, all materials and equipment under this Division of the Specifications shall be new, or best grade and as listed in printed catalogs of the manufacturer. Each article of its kind shall be the standard product of a single manufacturer.
- C. All manufactured materials shall be delivered and stored in their original containers. Equipment shall be clearly marked or stamped with the manufacturer's name and rating.
- D. Reference to standards are intended to be the latest revision of the standard specified.
- E. Promptly inspect all shipments to insure that the materials being received are undamaged and comply with specifications.

1.12 MANUFACTURER'S RECOMMENDATIONS

- A. Equipment installed under this Division of the Specifications shall be installed according to manufacturers' recommendations.

1.13 ELECTRICAL COORDINATION

- A. Electrical Contractor will provide all power wiring and control wiring.
- B. Furnish wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Contractor and indicated to be wired by the Electrical Contractor.

1.14 DESIGN CRITERIA

- A. Modify existing automatic sprinkler system installed during shell construction and design and install a fully operational, code compliant, approved, complete hydraulically designed automatic sprinkler system for entire building.
- B. Verify all design criteria with local water utility prior to installation drawing preparation and calculation. Perform flow tests if required for positive verification. Coordinate with local water utility.

1.15 ALTERNATES

PART 2 – PRODUCTS

2.01 SUBMITTED DATA AND SHOP DRAWINGS

- A. Five (5) copies of each of brochures, shop drawings and material lists as required by the specifications, shall be prepared and submitted to the Architect for review within 30 days after award of the Contract. No work indicated on any one shop drawing shall be started until such drawings have been reviewed by the A/E.
- B. This contractor shall review all the shop drawings for complete compliance to the drawings and the specifications before submitting the drawings to the A/E. The contractor's review shall verify the following:
 - 1. All items requiring submittal are included in first submittal.

2. Equipment being submitted was specified.
 3. Quantities submitted are correct.
 4. Sizes and capacities are as specified.
 5. Electrical characteristics have been checked with the electrical contractor, or verified at the site.
- C. Any deviations from the drawings or the specifications shall be pointed out and provided with an explanation with the submittal.
- D. The contractor shall stamp the shop drawings with his own review stamp, or submit a separate statement that the enclosed shop drawings have been reviewed in accordance with the specifications. The shop drawings shall not be reviewed without the contractor's review stamp or written statement.
- E. Final review of the drawings by the A/E or his representative shall not relieve the contractor from the responsibility of complying with the requirements of the drawings and specifications.
- F. Submittal Data:
1. Submit complete brochures giving names of manufacturers and catalog figure numbers, trade names, technical data and requested information of each item listed as follows:
 - a. Sprinklers
 - b. Flow Switch
 - c. Valves
 - d. Tags, Labels and Signs
 - e. Installation Drawings and Calculations
 - f. Spare Sprinkler Cabinet
 2. Submittals shall be bound in sets between cover and all sets within a section shall be identical.
 3. Prior to start of work, Contractor shall obtain approval of installation drawings from Owner, Owner's Insurance Company, Local Authorities having jurisdiction and Architect/Engineer.

2.02 MAINTENANCE MANUALS

- A. Maintenance manuals, instructional data and operating instructions for equipment and materials in this Section shall be assembled by trade and delivered to the following:
1. Two (2) copies to the Owner.

2.03 RECORD DRAWINGS

- A. Provide record drawing documentation including installation drawings, hydraulic calculations, materials list, and inspection certification.

PART 3 – EXECUTION

3.01 OPENINGS, CUTTING, AND REPAIRING

- A. This Contractor shall cooperate with the work to be done under other Sections in providing information as to openings required in walls and floors for all piping and equipment, including sleeves where required.
- B. Any drilling or cutting required for the performance of work under this Section shall be the responsibility of this Contractor and the cost thereof shall be borne by him.
- C. It shall be the responsibility of this Contractor to ascertain that all chases and openings are properly located.
- D. This Contractor shall provide and patch all wall, floor and ceiling openings for installation of Fire Protection equipment in the existing building, unless this work is specifically mentioned to be done by another Contractor.
- E. This Contractor shall remove and replace suspended ceiling tiles and supports as required to install new Fire Protection work. This Contractor shall pay for repair of any unnecessary damage.
- F. Finished conditions shall be not less than existing conditions.

3.02 CLEANING EQUIPMENT AND MATERIALS

- A. Provide for the safety and good condition of all materials and equipment until final acceptance by the Owner. Protect all materials and equipment from damage. Provide adequate and proper storage facilities during the progress of the work.
- B. All piping, finished surfaces and equipment shall have all grease, adhesive labels and foreign materials removed.

3.03 CLEANUP

- A. Remove from the premises all unused material and debris resulting from the performance of work under this section.

3.04 RECORD DRAWINGS

- A. Record drawings, showing dimensions, locations of all piping, plugged outlets and equipment shall be kept up-to-date. Master copy shall be kept on the job.

3.05 PROTECTION

- A. Open ends of all piping must be effectively closed and kept closed during construction.

3.06 LUBRICATION

- A. Lubricate all bearings with lubricant as recommended by the manufacturer before the equipment is operated for any reason. Once the equipment has been run, maintain lubrication in accordance with the manufacturer's instructions until

the work is accepted by the Owner. Include lubrication requirements in the Operating and Maintenance Manuals.

3.07 GUARANTEE

- A. All materials and equipment provided and/or installed under this Section of the Specifications shall be guaranteed for a period of one year from the date of acceptance of the work by the Owner. Should any trouble develop during this period due to defective materials or faulty workmanship, the Contractor shall furnish all necessary labor and materials to correct the trouble without any cost to the Owner. Any defective materials or inferior workmanship noticed at time of installation and/or during the guarantee period shall be corrected immediately to the entire satisfaction of the Owner.
- B. In the event of occupancy by the Owner prior to final acceptance of the project, the guarantee date for equipment placed in operation shall be mutually agreed to by the Contractor and the Owner's representative.

END OF SECTION

SECTION 15910

BASIC FIRE PROTECTION MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED SECTIONS OF THIS DIVISION

15900 - Basic Fire Protection General Requirements

15920 - Fire Protection Systems

1.02 WORK INCLUDED IN THIS SECTION

2.01 Sleeving and Fire Stopping

2.02 Hangers and Inserts

2.03 Identification

2.04 Escutcheons

2.05 Electric Wiring

3.01 Installation

3.02 Hanger Support and Spacing

3.03 Tests

PART 2 - PRODUCTS

2.01 SLEEVING AND FIRE STOPPING

A. All penetrations of walls, floors, or roofs shall be done by use of sleeves manufactured for that purpose. Sleeves in concrete, masonry, or precast concrete shall be Schedule 40 steel pipe. All other sleeves to be #22 gauge galvanized steel.

B. Installation:

1. Provide clearance of 1/2" around piping.

2. Each sleeve to pass through entire floor, wall, or roof construction and end to be set flush with surrounding surface in which it is installed; sleeves through floors must project 2" above finished floor.

3. Fire rated floor and wall penetrations: Fill opening between pipe and sleeve with Nelson CLK or Tremco or 3M Fire Stop material. Fire and smoke rating of sealant shall match rating of wall or floor being penetrated.

2.02 HANGERS AND INSERTS

A. Vertical support and bracing for steel risers shall be by use of carbon steel riser clamps at every floor and braced laterally at every floor or midspan, B-Line B3373, Grinnell 261.

- B. Horizontal lines shall have hangers and rods adequate for size, material, and service. Total weight of equipment, including valves, fittings, pipe, pipe contents, and insulation, are not to exceed the limits indicated.
 - 1. Hanger Rod Sizes (Per NFPA-13, Table 2-6.4)
 - 2. 1" to 4" = 3/8" diameter rod
 - 3. 5" to 8" = 1/2" diameter rod
 - C. All supports, guides, brackets, and braces shall be adequately fastened to the structure. No work shall be supported from any structural bridging angles.
 - D. Pipe Hangers and Supports:
 - 1. Swivel Ring, UL listed specifically for Fire Protection, all sizes.
 - 2. Multiple or Tapeze Hangers:
 - a. Steel strut channels by B-Line or Grinnell.
 - 3. Floor Support:
 - a. Carbon steel pipe saddle, stand and bolted floor flange.
 - E. Beam Clamps:
 - 1. MSS SP-69 Types 19 and 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a retaining ring and threaded rod of 3/8, 1/2 and 5/8 inch diameter. Furnish with a hardened steel cup point set screw. B-Line B3036L/B3034, Grinnell 86/92.
 - 2. MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1-1/2" diameter. B-Line B3054, Grinnell 228.
 - F. All anchors, hangers, and supports to be designed to meet local structural requirements and Architect's approval.
 - G. All hangers of one type shall be catalog items of one manufacturer.
 - H. No pipes shall be hung or supported by other pipe or ductwork.
- 2.03 IDENTIFICATION
- A. Identification of all systems and valves shall be by means of purchased signs that shall indicate portions controlled by each valve or riser, list design criteria, valve duty, etc. in conformance with NFPA and F.M. standards.
 - B. Signs shall be 0.022 aluminum, red and white Argco Trim-Line or approved equivalent.
- 2.04 ESCUTCHEONS
- A. Provide on all pipe passing through finished floor, walls, and ceilings with outside diameter sufficient to cover sleeved openings and inside diameter to fit snugly around pipe.

2.05 ELECTRIC WIRING

- A. All line voltage wiring shall be by Electrical Contractor; Fire Protection Contractor shall furnish wiring diagrams to Electrical Contractor for electric equipment furnished.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. As per NFPA rules and regulations and insurance carrier recommendations.
- B. Cutting and boring through structural members shall be done only when approved by and under supervision of Architect and/or Structural Engineer.
- C. Size, apply and install supports and anchors in compliance with manufacturer's recommendations.
- D. Drawings were prepared with intent that all lines clear all obstructions such as pipes, beams, lights, hangers, and similar items. Examine building and plans confirming dimensions before pipe is cut, fabricated and/or installed, to determine if offsets are necessary. Where required, offsets shall be made without additional cost to Owner.
- E. Following general scheme shall be employed when locating sprinkler heads unless restricted by Rules and regulating bodies.
 - 1. Unless otherwise indicated, conceal pipe in finished portions of building and exposed elsewhere. Locate concealed piping above suspended ceilings. Install exposed piping parallel or perpendicular to walls.
 - 2. Lines at or above ceilings shall be held as high as possible and be run to avoid conflicts. Include fittings and material required to accomplish this result.
- F. Install supports to provide for free expansion of the piping system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands.
- G. Coordinate hanger and support installation to properly group piping of all trades.
- H. Perform welding in accordance with standards of the American Welding Society.

3.02 HANGER AND SUPPORT SPACING

- A. Place hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.
- B. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- C. Support riser piping independently of connected horizontal piping.
- D. Space hangers for pipe as follows (NFPA-13, Table 4-14.2.2.1):

<u>Pipe Material</u>	<u>Pipe Size</u>	<u>Maximum Horizontal Spacing</u>	<u>Maximum Vertical Spacing</u>
Steel	1/2" through 1-1/4"	12' 0"	15' 0"
Steel	1-1/2" through 8"	15' 0"	15' 0"

3.03 TESTS

- A. Conducted as required in accordance with NFPA Standards.
- B. Test new and existing systems under normal operating conditions and demonstrate that parts are functioning properly. Conduct test and secure final certificates of approval. Deliver copies of Certificate to Architect/Engineer.
- C. Tests shall include, but not be limited to the following:
 - 1. Two hour, 200 pound hydrostatic test above ground system.
 - 2. Working test all systems. Testing of sprinkler piping system to be witnessed by Fire Marshal and Owner or his representative.
 - 3. Include cost and run such tests as may be necessary to demonstrate that equipment equals or exceeds capacities specified upon request.
- D. Notify Owner's representative twenty-four hours before testing.
- E. In the event that the clinic opening has been delayed for periods of up to three (3) months at a time, the fire sprinkler contractor is required to continue testing the fire sprinkler system on a quarterly basis throughout the complete warranty period or up until the clinic is certified and licensed, whichever happens to come up first.

END OF SECTION

SECTION 15920
FIRE PROTECTION SYSTEMS

PART 1 - GENERAL

1.01 RELATED SECTIONS OF THIS DIVISION

- 15900 - Basic Fire Protection General Requirements
- 15910 - Basic Fire Protection Materials and Methods

1.02 WORK INCLUDED IN THIS SECTION

- 1.03 Kind and Quality of Materials
- 1.04 Water Supply System
- 2.01 Pipe and Fitting Materials
- 2.02 Valves
- 2.03 Sprinklers and Cabinets
- 2.04 Ceiling Plates
- 2.05 Pressure Gauges
- 3.01 Installation
- 3.02 Valving
- 3.03 Protection of Finished Work

1.03 KIND AND QUALITY OF MATERIALS

- A. Materials, appliances, and fixtures to be new, of best quality and grade, in strict accordance with specification requirements.

1.04 WATER SUPPLY SYSTEM

- A. Water Service: Combined water service furnished and installed by Site Utility Contractor. Connect to and extend from water service inside building.

PART 2 - PRODUCTS

2.01 PIPE AND FITTING MATERIALS

- A. Pipe and pipe fittings are to conform to the appropriate commercial standards or Federal or American Society for Testing Materials specifications listed.
- B. Overhead Distribution: Black steel pipe; 2" and under Allied Super 40, ASTM A135/A795, Type E, Grade A (or American Tube Dyna-Thread-40 equivalent). 2-1/2" and larger Allied Super Flo ASTM 795, Type E, Grade A (or American Tube Dyna-Flow-10 equivalent).
- C. Grooved couplings and mechanical fittings shall be malleable iron, 500PSI working pressure, in accordance with ASTM A 47. Grooved couplings and mechanical fittings shall be tested and listed by UL, FM, or NFPA 13 approved.

- D. Plastic piping, where allowed by the Authority Having Jurisdiction, shall be CPVC conforming to NFPA 13. Installation must strictly adhere to the manufacturer's instructions.
- E. Flexible stainless steel piping can be substituted for malleable iron in jurisdictions where acceptable and meets NFPA 13 Section 6.3.
- F. Reducing bushings are not permitted in more than one outlet of any tee or any two outlets of any cross. Bushings are not permitted in any elbow or when the reduction in size of the outlet is less than ½ inch.
- G. CPVC fittings shall be UL listed and meet the requirements of ASTM F437 (SCH 80 threaded), ASTM F437 (SCH 80 socket), or ASTM F438 (SCH 40 socket) as applicable.
- H. Malleable Iron Class 150 ASTM A197/ANSI B16.3 or cast iron Class A, ASTM A126 threaded fittings and pipe ends for 1" thru 2" sizes. Victaulic (Central or Gruvlok) couplings and mechanical grooved end fittings with EPDM gaskets for sizes 2 1/2 inch and larger. Gaskets for mechanical joints on dry systems shall be EPDM, flush seal.
- I. Absolutely no threading of Schedule 10 or thin wall pipe and no plastic pipe allowed.
- J. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
- K. Finish: Hot dipped zinc coated (galvanized) finish on piping and fittings used in dry pipe systems, preaction systems, piping exposed to weather and piping exposed to corrosive environments where indicated. Thread or cut groove hot dipped zinc coated pipe ends for fitting connections.
- L. Unions and Flanges:
 1. 2" and smaller steel: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping.
 2. 2-1/2" and larger: ASTM A181 or A105, Class 150, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized steel. ANSI B16.1 or ANSI B16.5, Class 150 cast iron threaded flanges. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment.

2.02 VALVES

- A. Valve manufacturers: Kennedy, Milwaukee, Nibco, Stockham, Central, Watts.
 1. Control valves shall be Milwaukee #F2885FP or NIBCO 7607-RW gate type with iron body, resilient wedge, outside screw and yoke and bolted bonnet or Central Model 'A' butterfly with slow close control or approved equivalent.
 2. Check type shall be iron body with bronze disc, butterfly, or wafer style, 1/2".
 3. Drain valves shall be NIBCO KT65-UL, Milwaukee #536, bronze globe type, or Milwaukee #5361 angle globe.

4. Valves shall be suitable for tamper-switch installation on main and floor control valves.
 5. Double Check Assemblies: Manufacturers: Beeco, Cla-Val, Watts, Ames.
- B. ASSE 1015: Double check backflow preventer with 2 independent spring loaded check valves, 2 isolation ball or gate valves with 4 valved test ports. Construct of stainless steel, bronze or epoxy coated cast iron body with bronze and plastic internal parts, stainless steel springs, silicone rubber valve discs, bronze seats, rated for 175 psig. Ames model 2000SS for 2-1/2" and larger, Watts model 007-QT-S for sizes 2" and smaller (or Wilkins, Watts equivalent).
- 2.03 SPRINKLERS AND CABINET
- A. New sprinklers as manufactured by Viking, Star, Central, or approved equal.
 - B. Sprinklers:
 1. Suspended Ceilings: Viking Micromatic Model "M" recessed pendant, polished chrome finish. Sprinkler with Viking Model E-1, recessed, chrome finish escutcheon.
 2. Exposed Areas without Ceilings: Viking Model "M" upright, bronze.
 3. Sidewall Sprinklers: Viking Model "M", chrome finish.
 - C. Use Quick Response Sprinklers where applicable.
 - D. Select fusible link temperature rating to not exceed maximum ambient temperature rating allowed under normal conditions at installed location. Provide ordinary temperature (165°) fusible link except at skylights, sealed display windows, attics and roof spaces, over cooking equipment, adjacent to diffusers, unit heaters, uninsulated heating pipes or ducts, or where other heat sources exist.
 - E. Cabinets: Furnish and install one (1) red enameled steel sprinkler cabinet having spare sprinklers, which include all types and ratings installed. Also include a special wrench for removal and installation. Cabinet to be wall mounted; install on wall next to sprinkler riser or as directed by Building Maintenance. Quantity of heads as per NFPA 13, 2-2.7.
- 2.04 CEILING PLATES
- A. Provide Ritter, Carpenter and Patterson, Beaton, and Cadwell No. 10 chrome plates on lines passing through ceiling in finished areas. Provide chrome button plates on hanger rods passing through finished ceilings.
- 2.05 PRESSURE GAUGES
- A. Provide Trerice 500X 6" diameter dial duragage precision pressure gauge with white face and black numbers. Ashcroft or Marshalltown gauges manufactured to these specifications are acceptable.
 - B. Gauge to be provided with stainless steel movement, bronze socket and tube, solid front enclosure and 1/4" isolating globe valve (200 lb.) fittings and gauge cocks.
 - C. Select gauges so that the normal operating pressure is at the mid point of the scale.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install piping so that system can be drained. Where possible, slope to main drain valve. Slope dry pipe and preaction systems subject to freezing at minimum 1/4"/10' on mains and 1/2"/10' on branches. Where piping not susceptible to freezing cannot be fully drained, install nipple and cap for drainage of less than 5 gallons or valve/nipple/cap for drainage over 5 gallons. Pipe main drain valves to grade or to air gap sewer.
- B. Sprinklers: Locate sprinkler heads as indicated on fire protection plan and reflected ceiling plan maintaining minimum clearances from obstructions, ceilings and walls. Install sprinkler heads level in locations not subject to spray pattern interference. Where sprinklers are to be installed in suspended ceilings, sprinklers shall be located in the center of 2' x 2' tiles and in the center of 2' x 2' half of 2' x 4' tiles.
- C. Switches: Locate flow and pressure switches where indicated and where required to obtain specified zoning to isolate floors and major areas of floors. Provide valved test connection for flow switch. Test flow switch to verify proper operation.
- D. Gauges: Provide a valved pressure gauge in main fire protection riser, at the top of each piping riser, at inlet and outlet of pump and elsewhere as indicated.
- E. Valves: Properly align piping before installation of valves. Do not support weight of piping system on valve ends. Mount valves in locations which allow access for operation, servicing and replacement. Install all valves with the stem in the upright or horizontal position. Valves installed with the stems down will not be accepted. Provide a riser shutoff valve and a capped hose thread drain valve at the bottom of each riser. Provide capped hose thread drain valves to allow draining of each portion of piping.

3.02 VALVING

- A. Valving: Approved type test valves, control valves, and drain valves at points required throughout system. All points of system shall be able to be drained through drain valves. All drain valves shall be exposed to view below ceilings of mechanical or storage spaces.

3.03 PROTECTION OF FINISHED WORK

- A. Repair, replace, and pay for breakage of glass, patching, and repairing of all damage to finished work caused by this Section of the work.

END OF SECTION