

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. 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. Sizes:
 2½" 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
 PVC Valves to be true union ball valves
- D. 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

- E. Hose Bibbs
Nibco QT56X12 – ½” copper sweat or male thread.
- F. Approved Manufacturers: Crane, Homestead, Kennedy, Rockwell, 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, 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.
- B. Approved Manufacturers: Crane, 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 2½ 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, 1½" 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 EXCAVATION AND BACKFILL

- A. All necessary excavation and backfill for the installation of the mechanical work shall be accomplished by each subcontractor under his phase of the work. All such work shall be included regardless of the type of materials encountered in the excavation. All excavation on this project shall be performed in accordance with applicable sections of Division 2 of the specifications or this article of the specification, whichever is the most stringent.
- B. Trenches for all underground piping shall be excavated to the required depths. The bottoms of the trenches shall be tamped hard and graded to secure maximum fall. Bell holes shall be excavated to assure the pipes resting for its entire length on solid ground. Should rock be encountered, it shall be excavated to a depth of 6 inches below the bottom of the pipe and before laying the pipe, the space between the bottom of the pipe and rock surface shall be filled with gravel and thoroughly tamped. Pipe laid in trenches dug in fill shall be supported down to load bearing undisturbed soil. After the pipes have been tested, inspected and approved by the Engineer and the local inspection authorities, the trenches shall be backfilled with clean dirt as follows:
- C. Backfill shall be installed in layers 12 inches deep, adequately tamped and wetted down or flushed before the second layer of earth is laid in place. This process shall be continued until the trenches are filled. No roots, rocks or foreign material of any description shall be used for backfill by this subcontractor, and any excess materials and debris shall be removed from the site by this subcontractor. Any special backfill material shall be provided as hereinafter specified and as shown on the drawings.
- D. All excavating and backfilling shall be done in a manner so as not to disturb adjacent structure and any shoring required shall be furnished.

3.03 OPENING AND RECLOSING OF CONCRETE FLOORS AND WALKS

- A. Where excavation requires the opening of existing concrete floors, walks, or other paved areas, the pavement shall be cut as required to install new lines and make connections to existing lines. The size of the cut shall be held to a minimum consistent with the work to be accomplished. After the installation of the new work is completed, the excavation shall be properly backfilled to the level required for the replacement of paving. All concrete work for the finishing of these openings will be performed by the General Contractor.

3.04 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.

3.05 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 ensure 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.

3.06 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 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 their 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 SANITARY VENT PIPING

- A. In ground, inside building: 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 hub and spigot cast iron soil pipe ASTM A 74 (Refer to additional specific drain pipe and fitting requirements for dialysis related drain piping on plumbing plans when PVC is not allowed by code).
- B. (FOR USE IN CHICAGO ONLY) In ground, inside building where indicated on the drawings: Soil, waste and vent pipe and fittings shall be Polypropylene Schedule 40,

ASTM D4101, ASTM F1412 as manufactured by Orion or equivalent. Joints below the floor shall be fused hermetically sealed joints conforming to ASTM 1290, Technique I.

- B. 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.
- C. 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.

2.01 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.
- 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.

2.02 ROOF STORM DRAIN AND ROOF OVERFLOW DRAIN PIPING

- A. In ground, inside building: Storm drain and storm drain overflow 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 hub and spigot cast iron soil pipe ASTM A 74.

- B. Above ground, single story buildings: Storm drain and storm drain overflow pipe and fittings shall be PVC Schedule 40, ASTM D2665, ASTM D1785 where allowed by local plumbing code. Where PVC is not allowed and for buildings greater than one story in height, service weight no-hub cast iron pipe and fittings ASTM A74. Hub and spigot where no-hub is prohibited by local authority having jurisdiction.

PART 3 - EXECUTION

3.01 SANITARY DRAINS

- A. The sewage 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, bullhead 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 1½ inches 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 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 pipefitting 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 ROOF STORM DRAIN AND ROOF OVERFLOW DRAIN PIPING

- A. Extend storm drain pipe to all points according to pitch and elevation shown. Lay all inside drain below floor, except where otherwise shown or specified to required depth for proper pitch to outlets. Support pipe laid on filled of loose soil as required by Plumbing Code, or as directed.
- B. Install all rain conductors as shown on the drawings. Support substantially in place with approved pipe clamps and supports, along with necessary supports for horizontal branches.
- C. Install cleanouts as shown on drawings and at each change in direction of the line, at the end of each run, and at the foot of each rain conductor. Cleanouts shall be installed at not more than 80 foot intervals in horizontal lines, taking care to locate cleanouts where they are easily accessible.

3.04 CONNECTIONS TO EQUIPMENT NOT FURNISHED UNDER THIS SECTION OF WORK

- A. Plumbing connections for miscellaneous equipment will be furnished by this contractor. He 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.

3.06 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.

3.07 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 15520

SPLIT SYSTEM CONDENSING UNITS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes Air-Cooled Split System Units.

B. Related Sections:

1. Section 00700 "General Conditions."
2. Section 07500 "Roof Remodeling."
3. Section 15100 "Mechanical Materials & Methods."
4. Section 15510 "Air Handling Units with Coils."
5. Section 15530 "Refrigerant Piping & Specialties."
6. Section 16000 "Electrical."

1.02 REFERENCES

A. Air Conditioning Condensing Units shall comply with the following standards:

1. AHRI 365-87, "Performance Rating of Commercial and Industrial Unitary Air-Conditioning Condensing Units."
2. ANSI/UL303 Current Edition, "Refrigeration and Air-Conditioning Condensing and Compressor Units."
3. AHRI 270 Current Edition "Sound Performance Rating of Outdoor Unitary Equipment."

1.03 SYSTEM DESCRIPTION

A. Performance Requirements

1. Installed air-conditioning condensing units shall be rated a minimum 13.0 Seasonal Energy Efficiency Rating (SEER)

1.04 SUBMITTALS

A. Product Data:

1. Split systems condensing unit, and controls.

B. Shop Drawings

1. Split system condensing units, and controls.

1.05 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 and 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 weeks from the time of delivery, store the units indoors, in the original packing 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.

1.06 WARRANTY:

A. Provide manufacturer's warranty as follows:

1. 1 year on the installed system and 5 years on the compressor.
- B. Warranty term shall commence from date of beneficial use as agreed upon by the owner and contractor.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

- A. JCI / York International Corporation.
- B. Carrier Corporation
- C. The Trane Company

2.02 EQUIPMENT:

- A. General Description:
 1. Units shall be factory-assembled, individually packaged and ready for installation.
 2. The units shall be factory wired, piped, charged with R-410a refrigerant and factory tested prior to shipment. All units wiring shall be color coded.
 3. Unit shall include:
 - a. Air-cooled condenser, and controls.
 - b. Full factory charge of R-410a to accommodate 25' of interconnecting lines.
 - c. Brazed refrigerant line connections with reusable service valves.
 - d. Liquid line filter/drier.
 - e. Five minute off-cycle timer.
- B. Condenser Unit Cabinet:
 1. Unit cabinet shall be 18 gauge pre-painted galvanized sheet steel that complies with ASTM-B117 salt spray test or 500 hours minimum.
 2. Drain holes shall be incorporated in the base pan for drainage.
 3. Cabinet screws shall comply with ASTM-B117 salt spray test for 750 hours minimum.
- C. Condenser Fan Assembly:
 1. The fan motor shall be driven by an inverter drive capable of controlling the unit speed.
 2. Condenser fan motor shall be permanent, split capacitor type, have permanently lubricated sleeve bearings, directly connected to the fan blade and shall be equipped with internal overload protection.
- D. Refrigerant Components:
 1. Compressor:
 - a. Shall be high efficiency, isolator mounted including an automatic reset internal pressure relief valve, temperature and pressure overload protection, and a high torque, refrigerant-cooled motor. The compressor shall be driven by an inverter controller providing stepless capacity.
 2. Condenser Coil:
 - a. Shall be constructed of copper tubes mechanically expanded into enhanced aluminum fins.
- E. Electrical Requirements:
 1. All unit power and control wiring shall enter the unit cabinet at a single, factory provided location.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. For ground level applications, condensing units must be set on a minimum 6" thick concrete pad, 6" larger than condensing unit in all directions.
2. Unit must be set level to within 1/2" across the entire dimension of the unit in all directions.
3. Locate the unit to maintain the minimum service and airflow clearances as recommended by the manufacturer.
4. Rig the unit into place only by the lifting holes in the base of the unit. Use spreaders longer than the cross dimensions of the unit.
5. Follow manufacturer's instructions to place the unit into service.

3.02 FIELD QUALITY CONTROL

A. Tests:

1. Cycle unit through all sequences of operation as recommended by the manufacturer. Check operation of all components. and repair or replace any parts found to be 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 15530
REFRIGERANT PIPING & SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Refrigerant piping and specialties for HVAC systems.
- B. Related Sections:
 - 1. Section 00700 “General Conditions.”
 - 2. Section 022300 “Earthwork.”
 - 3. Section 07920 “Joint Sealants & Waterproofing Membranes”
 - 4. Section 15100 “Mechanical Materials & Methods.”
 - 5. Section 15250 “Mechanical Insulation.”
 - 6. Section 15510 “Air Handling Units with Coils.”
 - 7. Section 15520 “Split System Condensing Units”

1.02 REFERENCES

- A. Comply with the following standards:
 - 1. ANSI B31.5 “ASME Code for Pressure Piping - Refrigerant Piping.”
 - 2. ANSI/ASHRAE Standard 15 “Safety Code for Mechanical Refrigeration.”
 - 3. American National Standards Institute (ANSI).
 - 4. American Welding Society (AWS).
 - 5. Air Conditioning, Heating and Refrigeration Institute (AHRI).
 - 6. National Electrical Manufacturer’s Association (NEMA).

1.03 SUBMITTALS

- A. Product Data:
 - 1. Refrigerant Pipe.
 - 2. Refrigerant Pipe Valves.
 - 3. Strainers.
 - 4. Flexible Connectors.
- B. Quality Control Submittals:
 - 1. Test Reports:
 - a) Pressure Test Report/certification.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Qualify brazing operators and processes in accordance with ASME “Boiler & Pressure Vessel Code,” Section IX, “Welding & Brazing Qualifications.”

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Protection:
 - 1. Maintain protective seal on all refrigerant piping. Clean pipe as specified in this section if protective seal is compromised.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Refrigerant Valves & Specialties:

1. Parker-Hannifin Corp., Refrigeration & Air Conditioning Division.
2. Henry Valve Company.
3. Alco Controls Division, Emerson Electric.
4. Sporlan Valve Company.

2.02 MATERIALS

A. Copper Pipe/Tubing:

1. Above Grade: above ground applications shall conform to ASTM B280, Type "ACR", hard-drawn straight lengths, soft annealed coils, seamless copper tubing. Tubing shall be factory cleaned and sealed, ready for installation.
2. Below Grade: below ground applications shall be Type "K," annealed copper tubing.

B. Fittings: wrought copper fittings meeting ANSI B16.22.

C. Brazing Filler Metals: AWS A5.8, classification BAg-1, silver.

2.03 EQUIPMENT

A. Valves:

1. Valve assemblies: shall be U.L. listed and conform to AHRI 760.
2. Globe Valves: shall be constructed of a cast bronze body with cast bronze or forged brass wing cap and bolted bonnet, replaceable seat disc and plated steel stem. Valve shall be capable of being repacked under pressure. Valve shall be straight-through or angle pattern, with solder connections. Valve shall be rated for 450 psig operating pressure at 275°F operating temperature.
3. Solenoid Valves: shall be forged brass with Teflon valve seat, two-way straight through pattern and solder connections. Valves shall have a manual operator to open the valve. Furnish complete with NEMA I solenoid enclosure with 1/2 inch conduit adapter and 24 volt, 60 Hz. normally closed holding coil.
4. Thermostatic Expansion Valves: shall be thermostatically adjustable, modulating type, sized as required for specific evaporator requirements. Valves shall have copper fittings for solder connections, sensing bulb, distributor with side connection for hot-gas bypass line and external equalizer line.
5. Check Valves - Smaller than 7/8 inch: shall have a cast brass body, removable piston, Teflon seat and stainless steel spring. Valves shall be straight through pattern with solder connections. Valves shall be rated for 500 psig operating pressure at 300°F operating temperature.
6. Check Valves - 7/8 inch and larger: shall have a cast bronze body, cast bronze or forged brass bolted bonnet, floating piston with mechanically retained Teflon seat disc. Valve shall be straight-through or angle pattern with solder connections. Valves shall be rated for 450 psig operating pressure at 300°F operating temperature.

B. Strainers: shall have forged brass body with Monel 80 mesh screen, screwed cleanout plug, Y-pattern and solder connections. Strainers shall be rated for 500 psig operating pressure.

- C. Moisture/Liquid Indicators: shall have a forged brass body, replaceable, polished optical view window and solder connections. Indicators shall be rated for 500 psig operating pressure at 200°F operating temperature.
- D. Filter/Driers: shall have steel shell, flange ring and spring, ductile iron cover plate with steel cap screws and wrought copper fittings for solder connections. Filter/driers shall be rated for 500 psig operating pressure at 225°F operating temperature.
- E. Flexible Connectors: shall have seamless tin-bronze or stainless-steel core, high tensile bronze braid covering and solder connections. Connectors shall be rated for 500 psig at 300°F operating temperature.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Refrigerant Piping:
 - 1. Install in the most direct arrangement possible with the fewest number of fittings possible.
 - 2. Install to permit inspection and servicing of all equipment normally requiring service.
 - 3. Insulate all suction piping. Do not insulate until pressure test has been performed and all leaks repaired.
 - 4. Slope as follows:
 - a. Horizontal Suction Lines: 1/2 inch per 10 feet slope towards the compressor. Take special care to avoid dead ends and long traps which may separate oil from the refrigerant.
 - b. Horizontal Hot-Gas Lines: 1/2 inch per 10 feet slope away from the compressor.
 - c. Horizontal Liquid Lines: no slope.
 - 5. Install traps and double risers where required to entrain oil in vertical runs.
 - 6. Install all exposed piping parallel or at right angles to building walls.
 - 7. Conceal all piping in walls, pipe chases, utility spaces, above ceilings, below grade or floors unless otherwise indicated.
 - 8. For below grade installations install copper tubing inside 3" schedule 40 PVC pipe vented on both ends.
- B. Pipe Joints:
 - 1. Brazed: install brazed joints as recommended in the AWS "Brazing Manual."
 - 2. Specialties:
 - a. Solenoid Valves: remove coil prior to brazing. Replace coil when valve body has sufficiently cooled to prevent damage to coil.
 - b. Sight Glass: remove glass prior to brazing. Replace glass when the glass body has sufficiently cooled to prevent damage to the glass.
 - c. Valves: remove stems, seats and packing prior to brazing. Replace when valve body has sufficiently cooled to prevent damage to valve components.
 - 3. Fill pipe and fittings with an inert gas during brazing to prevent scale formation.
- C. Valve Installations:
 - 1. Globe Valves: install globe valves on each side of strainers and driers, liquid and suction lines at evaporators and elsewhere as indicated.
 - 2. Solenoid Valves: install solenoid valves upstream of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal runs with the coils facing upward.
 - 3. Thermostatic Expansion Valves: install as close as possible to the evaporator. Where refrigerant distributors are used, mount the distributor directly on the expansion valve

outlet. Secure the expansion valve-sensing bulb to a clean, straight horizontal section of the suction line using two bulb straps. Do not mount the sensing bulb in a trap or at the bottom of the line. Where external equalizer lines are required, make the connection where it will clearly reflect the pressure in the suction line at the bulb location.

4. Pressure Regulating & Relief Valves: shall be installed in accordance with the manufacturer's instructions. Valves shall be located in accordance with ASHRAE Standard 15.

D. Specialties:

1. Strainers: install immediately upstream of each expansion valve, solenoid valve, hot-gas bypass valve, and compressor suction valve, and as required to protect refrigerant piping system components.
2. Moisture/Liquid Indicators: install in liquid lines between filter/driers and thermostatic expansion valve and in liquid line to receiver.
3. Unions: install to allow removal of solenoid valves, pressure-regulating valves, expansion valves and at compressor and evaporator connections.
4. Flexible Connectors: install at the inlet and discharge connections to compressors and condensing units.
5. Eccentric Reducer Fittings: install with the straight side down.
6. Filter/Driers: install core in filter/driers after pressure test but before evacuation.

E. Penetrations:

1. Exterior Wall: seal using mechanical-sleeve seals.
2. Fire Barrier: maintain fire rating with approved sealant or mechanical seals.
3. Smoke Barrier: maintain smoke barrier rating with approved sealant or mechanical seals.

3.02 FIELD QUALITY CONTROL

A. Charge the system as follows:

1. After all piping modifications, pressure test for leaks at 125 percent of the maximum operating pressure using dry carbon dioxide or nitrogen.
2. After repairing all leaks, maintain test pressure for 24 hours minimum. System shall not be considered leak free until no discernible drop in pressure is detected after test duration.
3. Evacuate system to 29.82 inches of mercury column vacuum. Close system and check vacuum after 24 hours. If no loss of vacuum is detected, system shall be considered leak-free.
4. Charge system with new, dehydrated refrigerant to the proper amount as recommended by the equipment manufacturer including additional refrigerant required by piping installation.
5. Start entire system and check for proper operation. Check all safeties by simulating conditions to activate safety device.

3.03 ADJUSTING

A. Thermostatic Expansion Valve:

1. Adjust as required to maintain 10°F subcooling.

3.04 CLEANING

A. Copper Tubing & Pipe other than type "ACR" or contaminated type "ACR":

1. Draw a clean, lint-free cloth through pipe.
2. Draw a clean, lint-free cloth saturated with trichloroethylene through pipe. Repeat until cloth is removed clean.

3. Draw a clean, lint-free cloth dampened with compressor oil and squeezed dry through the pipe.
4. Draw a clean, lint-free cloth through the pipe.

3.05 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 15540
POWER VENTILATORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Centrifugal direct drive roof exhausters
2. Centrifugal belt drive roof exhausters
3. In-line cabinet fans
4. Centrifugal direct drive sidewall exhausters
5. Centrifugal belt drive sidewall exhausters

B. Related Sections:

1. Section 00700 "General Conditions"
2. Section 07500 "Roof Remodeling"
3. Section 15100 "Mechanical Materials & Methods"
4. Section 15600 "Ductwork"
5. Section 15610 "Ductwork Accessories"
6. Section 15800 "Testing, Adjusting and Balancing"

1.02 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

1.03 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Powered ventilators shall bear the AMCA performance seal.

1.04 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

1.05 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.

1.06 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

2.01 MANUFACTURERS

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

2.02 EXHAUST AIR FANS

D. Roof Mounted Centrifugal Exhaust Fans

1. Direct Drive Mounted Type:
 - a. 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.
 - b. The motor and drive housing shall be mounted on vibration isolators and shall be completely sealed from the exhaust air.
 - c. The motor and wheel shall be removable through the support structure without dismantling the fan housing.
 - d. Capacity and characteristics shall be as indicated on Contract Drawings. The fan shall bear the AMCA Seal for rated sound and capacity and UL 705 listed.
 - e. Units shall include a factory mounted and prewired NEMA 3R (NEMA 1 where protected from weather) fan motor disconnect switch.
 - f. Units shall include a speed controller for each fan. Speed controller to be used for final air balancing of the fan.
 - g. 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. 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.
 - h. 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.
2. Belt Drive Mounted Type:
 - a. 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.

- b. The motor and drive housing shall be mounted on vibration isolators and shall be completely sealed from the exhaust air.
- c. The entire drive assembly and wheel shall be removable through the support structure without dismantling the fan housing.
- d. 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.
- e. Capacity and characteristics shall be indicated on Contract Drawings. The fan shall bear the AMCA Seal for rated sound and capacity and UL 705 listed.
- f. Units shall include a factory mounted and prewired NEMA 3R (NEMA 1 where protected from weather) fan motor disconnect switch.
- g. 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. 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.
- h. 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.

E. Square Inline Cabinet Fans:

1. Direct Drive Type:

- a. Fan shall be direct drive backward inclined wheel type constructed of aluminum. Housing shall be galvanized steel construction. Housing shall have access doors. Fan motor shall be of the electronically commutated type.
- b. The fan shall bear the AMCA seal for rated sound and capacity and UL 705 listed.
- c. Unit shall be provided with a speed controller. Speed controller to be used for final air balancing of the fan.
- d. Unit shall include a factory mounted and prewired NEMA 1 fan motor disconnect switch.
- e. Provide ½ inch square galvanized wire mesh inlet screens for fans without inlet ductwork.
- f. Provide each fan with neoprene isolation hangers.
- g. Capacity and characteristics shall be as indicated on Contract Drawings.

2. Belt-Driven Type:

- a. 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.
- b. 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. Motor and belt protection/guard shall be provided.
- c. The fan inlet shall be a spun venture throat overlapped by a backward curved centrifugal wheel with spun cone for maximum performance.

- d. Each in-line type fan shall be furnished with hanging isolators and factory mounted and wired disconnect switch.
- e. Fan housing shall be an acoustically lined with minimum 1/2" thick fiberglass coated to prevent erosion.
- f. Single phase motors shall have built-in thermal overload protection.
- g. Capacity and characteristics shall be as indicated on Contract Drawings.
- h. Unit shall include a factory mounted and prewired NEMA 1 fan motor disconnect switch.
- i. Provide ½ inch square galvanized wire mesh inlet screens for fans without inlet ductwork.

F. Propeller Fans:

- 1. 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.
- 2. Wire safety guards. Provide on exposed inlet and outlet.
- 3. Size and capacity shall be as indicated on Contract Drawings. Fans shall be bear the AMCA seal for rated sound and capacity and UL 705 listed.
- 4. Units shall include a factory mounted and prewired NEMA 1 fan motor disconnect switch.
- 5. For direct drive units, furnish speed controller for each fan. Speed controller to be used for final air balancing of the fan.
- 6. 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. 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.
- 7. 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. Fan shall be complete with heavy-duty low leakage louver cooling thermostat when temperature in space becomes excessive.

2.02 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.

PART 3 - EXECUTION

3.01 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.

2. Fan drive sheaves on belt driven units shall be adjusted or replaced by the contractor to provide design air volumes.
3. Furnish 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 ceiling, 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.

3.02 NAME PLATES

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

3.03 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.

3.04 DEMONSTRATION

- A. Train 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 15560

GAS FIRED HEATERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Gas-fired furnaces
- B. Related Section:
 - 1. Section 00700 "General Conditions."
 - 2. Section 15600 "Mechanical Materials & Methods."
 - 3. Section 15300 "Plumbing Piping Systems."
 - 4. Section 15600 "Ductwork."

1.02 REFERENCES

- A. Comply with the following standards:
 - 1. ANSI Z83 Current Edition, Gas-fired Duct Furnaces
 - 2. ANSI Z21.64 - Current Edition, Direct Vent Central Furnaces.

1.03 SUBMITTALS

- A. Product Data:
 - 1. Gas-fired furnaces
- B. Shop Drawings:
 - 1. Gas-fired furnaces

1.04 DELIVERY STORAGE AND HANDLING

- A. Packing and Shipping:
 - 1. Maintain the manufacturer's original packing and crating until the unit is onsite 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 units are not going to be installed for more than two weeks from the time of delivery, store the units indoors, in the original packing 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.

1.05 WARRANTY

- A. Provide manufacturer's one-year warranty on the complete unit.
- B. Warranty is agreed to begin upon final acceptance and beneficial occupancy of premises of owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. JCI/York International Corporation.
- B. Carrier Corporation
- C. The Trane Company
- D. Modine Manufacturing Company
- E. Sterling Equipment
- F. Reznor

2.02 EQUIPMENT

- A. General Description:
 - 1. Unit shall be factory-assembled, completely tested and inspected, ready for installation.
 - 2. Unit shall be indirect, induced combustion-type furnace, high efficiency automatic ignition, integral blower/motor assembly, controls, gas valve, heat exchanger, burner and unit casing.
- B. Unit Casing:
 - 1. Unit casing shall be minimum 18-gauge galvanized steel with a baked-enamel finish.
 - 2. Unit shall have removable panels to provide easy access to all serviceable components of the unit.
 - 3. Unit shall have filter rack to accommodate 1” disposable filters.
 - 4. Filter rack must be located for ease of accessibility to replace filters.
- C. Heat Exchanger:
 - 1. Heat exchanger shall be minimum 20-gauge aluminized steel and sectionalized design.
- D. Blower Motor Assembly:
 - 1. Blow and motor assembly shall be belt drive with adjustable or changeable sheaves. Blower motor shall have internal overload protection, permanently lubricated ball bearings and a minimum service factor of 1.15.
- E. Gas Controls:
 - 1. Automatic gas valve adjustable gas pressure regulator main, a pilot gas electric ignition and a heat exchanger high temperature limit cut out control.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Rig the unit into place and support only as recommended by the manufacturer.
 - 2. Locate the unit to maintain the minimum service and operational clearances as recommended by the manufacturer.
 - 3. Install flexible connectors, electrical connections, and unit filters as instructed by the manufacturer.
 - 4. Follow the unit manufacturer’s instructions to place the unit into service.

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 parts.

3.03 DEMONSTRATION

- A. Train 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 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."
 - 2. Section 01340 "Shop Drawings, Product Data and Samples."
 - 3. Section 15100 "Mechanical Materials & Methods."
 - 4. Section 15610 "Ductwork Accessories."
 - 5. Section 15700 "Covering and Insulation."
 - 6. Section 15800 "Testing, Adjusting & Balancing."

1.02 REFERENCES

- A. Comply with the following standards & codes:
 - 1. International Mechanical Code, NFPA 90A, ASHRAE 170 & 90.1, ASHRAE Handbook HVAC Systems and Equipment and (NFPA 99 Current Edition where required).

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 SMACNA publications.
- 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 MATERIALS

- A. Metal Duct:
 - 1. Sheet metal shall be lock-forming quality, ASTM A 653, with G90 galvanized coating. Provide mill phosphatized finish for ducts exposed to view. 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 2 inch (R-6) fiberglass insulation blanket with a vapor barrier jacket of polyethylene or metalized reinforced film laminate. Maximum perm rating of vapor barrier jacket to be 0.05 perm.
- B. 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.
- C. Duct Sealant:
1. Manufacturer: 3M 800, 3M 900, Foster, Hardcast, Lockformer cold sealant, Mon-Eco Industries, United Sheet Metal, or approved equal
 2. Water based low VOC fiber reinforced mastic sealant rated for indoor and outdoor applications, mold and mildew resistant, UV resistant. Silicone sealants are not allowed in any type of ductwork installation.
 3. 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.

2.02 FABRICATIONS

- A. Shop Assembly:
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 conical 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 stamped 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 (stamped) 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.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. All ducts shall be installed in accordance with 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.

B. Hanging and Supporting:

1. Rigid round or rectangular metal ducts shall be installed with support systems in accordance with SMACNA "HVAC Duct Construction Standards - Metal and Flexible". 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.
2. Ductwork shall be installed prior to installation of external insulation. **Pre-insulated ductwork segments will not be accepted.**
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.

C. 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".

3.02 FIELD QUALITY CONTROL

- A. Duct Leakage Tests. Ductwork that is designed to operate at static pressures in excess of 3 in. of water and all ductwork located outdoors shall be leak-tested according to industry-accepted test procedures. Representative sections totaling no less than 25% of the total installed duct area for the designated pressure class shall be tested. All sections shall be selected by the building owner or the designated representative of the building owner. Positive pressure leakage testing is acceptable for negative pressure ductwork.
- 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 rooms shall be positively sealed 100 percent. No leakage shall be permitted.

3.02 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.
- B. Related Sections:
 - 1. Section 00700 "General Conditions."
 - 2. Section 15100 "Mechanical Materials & Methods."
 - 3. 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 "Standard for Fire Dampers", Current Edition
 - 4. U.L Standard 555S "Standard for Fire/Smoke Dampers", Current Edition

1.03 SUBMITTALS

- A. Product Data:
 - 1. Flexible connectors.
 - 2. Access doors.
 - 3. Fire dampers.
 - 4. Fire/smoke dampers.
 - 5. Isolation dampers
 - 6. Turning vanes.
 - 7. Louvers
- B. Shop Drawings:
 - 1. Fire dampers.
 - 2. Fire/smoke dampers.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Registers, Grilles, Diffusers:
 - 1. Titus.
 - 2. Price Industries.
 - 3. Softaire Diffusers, Inc.

4. Nailor
5. MetalAire

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 detail in 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. Frame:
 - a. Frame shall be galvanized sheet steel of the thickness as specified. Frame shall have foam or neoprene gasket to provide and airtight seal.
2. Door:
 - a. Door shall have a continuous foam or neoprene gasket to prevent leakage.
 - b. 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.
3. Insulation:
 - a. Insulation shall be one-inch thick fiberglass or flexible elastomeric foam board.
4. General:
 - a. Access doors to be designed and constructed for the pressure class of the duct in which the door is to be installed.
 - b. 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. Incremental adjustment type dampers of any kind 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 rated as indicated on the contract documents.
2. 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.
3. 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.
4. Model CRD-60 Ceiling Radiation dampers shall be listed to meet U.L. Standard 555C "Standard for Ceiling Dampers" current edition.
5. 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.
6. 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.

7. 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/Isolation 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. Fire/Smoke 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. Fire/Smoke dampers shall be rated as indicated on the contract documents for fire resistance and leakage class.
5. 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.
6. Fire/Smoke 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 zinc plated steel.
 - d. Bearings: Stainless Steel sleeve type.
 - 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: Extruded silicone rubber.
 - 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.
7. Fire/Smoke damper sleeves shall be sized so the sleeve does not extend more than six inches beyond the rated opening except on the actuator side where the sleeve may extend to a maximum of sixteen inches beyond the rated opening.
8. 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.
9. 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.
10. 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.

11. 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
12. 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. Turning Vanes:

1. Turning Vanes shall be single-thickness type.
 - 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 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 air velocity 2000 fpm or greater.

G. Grilles, Registers and Diffusers: Aluminum, non-rusting fully insulated.

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. Where lay-in type panels and frames are specified, 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. Square and Rectangular Ceiling Diffusers (CD): Titus Model TDC.
 - a. aluminum construction with standard off white finish, designed for one, two, three, and four-way diffusion as indicated on plans.
 - b. Where lay-in ceilings occur, mount each diffuser in a 2' x 2' lay-in ceiling panels with finish to match diffuser.
 - c. Where plaster or gypsum board ceiling occur use type 1 border with plaster frame.
 - d. Provide diffuser with square/rectangular to round adapter where required.

- e. The diffuser back pan shall be externally insulated with an R-value of six with vapor barrier.
- 5. Wall Supply Register/grille (WSR/G): Double deflection, 3/4 inch blade spacing, equal to Titus Model 300FS.
 - a. Aluminum construction with standard white finish.
 - b. Provide opposed blade damper on registers.
- 6. Ceiling Return Grille (CRG): Shall be egg rate style grille with 1/2" x 1/2" x 1/2" aluminum grid, 1-1/4 inch aluminum border. Construction shall be aluminum. Provide with standard white enamel finish. Grille shall be to Titus Model 50R.
- 7. Ceiling Exhaust Grille (CEG): Same as specified above for ceiling return grille.
- 8. Ceiling Transfer Grille (CTG): Same as specified above for ceiling return grille.
- 9. Wall Return Register (WRR): Wall return registers shall be aluminum construction, 1/2" blade spacing, and 30 degree deflection, equal to Titus Model 25R. Provide with opposed blade volume damper and white finish. Select such that blades are parallel to floor.
- 10. Wall Return Grille (WRG): Wall return grilles shall be the same as the wall return registers specified above except omit opposed blade damper.
- 11. Wall Transfer Grille (WTG): Same as wall return registers specified above except omit opposed blade damper.

H. 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 Titus Brick 'n Block Vent.
- 3. Acceptable Manufacturers for brick vents are Titus, Reliable, Ruskin or Industrial Louvers.

I. Weatherproof Louvers:

- 1. American Warming, Cesco, Dowco, Industrial Louvers, Inc., Louvers & Dampers, Inc., Shipman Industries, Greenheck and Vent Products.
- 2. Furnish drainable blade louvers with .081" extruded aluminum alloy blades, frame and supports, horizontal "J" style drainable blades with maximum of 4'-0" unsupported length in a fixed 4" core, 4" minimum blade depth, 3-1/4" blade spacing and 37.5 deg. blade angle, 50% free area and mullions invisible from exterior face.
- 3. Furnish louvers with channel type frame for installation in new construction and flange type frame for installation in existing construction with 3/4" mesh .051" aluminum bird screen in extruded U frame mounted behind blades. All screws, bolts, hardware, etc., shall be stainless steel.
- 4. Units to have baked enamel finish of color as selected by the Architect.

J. Electric Duct Heaters:

- 1. Electric Duct Heater (EDH): 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. 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. Manual resets shall be resettable without opening cover. Units shall be UL listed and equal to Markel CHMS series. 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. Acceptable Manufacturers for electric duct heaters are Markel and Warren.

PART 3 - EXECUTION

3.01 EXECUTION

A. Flexible Connectors:

1. Install in accordance with the manufacturer's 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".

B. 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.

C. Fire Dampers:

1. Install fire dampers as detailed on the contract documents and as recommended by the manufacturer. Installation shall comply with U.L. Standard 555 current edition.
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.

D. 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.
- E. Isolation Dampers
1. Install an access door at each damper for inspection and maintenance.
- F. 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.
- G. 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.
- H. Louvers:
1. Furnish louvers to the General Contractor for mounting in exterior walls. Connect outside air intake duct to the louver, sealing all connections air and watertight.
 2. Install insulated metal panel on unused portion of louver. Panels must be sealed weathertight to louver assembly with flashing as required for proper drainage to outside of building. Paint outside surface of panel to match louver prior to installation. Where ductwork is visible through louver when viewed from outside the building, paint inside of duct to match louver color.
 3. Provide bird screen on inside of active louver area where none is provided with louvers. Where louvers are provide in a non-ducted application provide insect screen on inside face of louver.

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 15100 "Mechanical Materials & Methods."
- B. Section 15200 "Pipe Sleeves, Supports and Anchors for Medical Process Piping Systems."
- C. Section 15300 "Plumbing, Piping Systems."
- D. Section 15530 "Refrigerant Piping & Specialties"
- E. 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. Minnesota Mining and Manufacturing (3M)
 - c. Armstrong
 - d. Johns Manville Corp.
 - e. Childers Inc.

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.

- B. 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 herein. 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, UL 723 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. Where not in a Return Air Plenum 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 ¼” pipe)	½" (Type P-1)
Cold Water (1 and 1 ¼” pipe with water temps below 40 degrees)	1" (Type P-1)
Cold Water (1 ½” pipe and larger)	1" (Type P-1)
Domestic Hot Water supply and return (up to 1 ¼” pipe)	1" (Type P-1)
Domestic Hot Water supply and return (1 ½” pipe and larger)	1" (Type P-1)
Heating Hot Water supply and return (up to 1 ¼” pipe)	1 ½" (Type P-1)

Heating Hot Water supply and return (1 ½" pipe and larger)	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	½" (Type P-1)
Refrigeration Suction and Hot Gas Piping	¾" (Type P-1)

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

1. Insulation shall be composed of fiberglass, jacketed with a white kraft paper outer surface bonded to aluminum foil and reinforced with fiberglass yarn. The thermal conductivity (k) is not to exceed 0.243 BTU-in./sq. ft./degree F/hr. at 75 degrees F (O.C. SSL II w/ ASJ, J-M Micro-Lok or approved equal).
2. Fiberglass density shall be 65.5 lbs./cu. ft. in equipment rooms and where pipes are exposed and 4 lbs./cu. ft. density where pipes are concealed.
3. For cold pipes, ends of insulation shall be sealed off with vapor barrier coating (Foster 30-35) at flanges, valves, and fittings and at intervals of not more than 21 feet on continuous runs of pipe.
4. Fittings and valves shall be insulated with factory-premolded insulation fittings, mitered segments of 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.
5. 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).
6. 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.

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 SHEET METAL

B. Insulate sheet metal as follows:

1. Air conditioning system supply and return air ducts where concealed 2 inch type D-1.
2. 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 inch type D-3.
2. Exterior air conditioning system supply and return air ducts where exposed to weather;
 - a. Rectangular ductwork - 3 inch (2 - 1 ½" layers) type D-4.

C. Type D-1 Duct Insulation with Vapor Barrier:

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 75 degrees F mean temperature.

2. Insulation shall be strip adhered to the duct on sides and top, and completely adhered on the bottom with duct adhesive (Foster 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. Insulation shall be Owens Corning Fiberglass SOFTR Duct Wrap or approved equal.
- D. Type D-2 Rigid Duct Insulation with Vapor Barrier:
1. Rigid duct insulation shall be 3 lbs. per cu. ft. density glass fiber with maximum K factor of .23 at 75 degrees F. mean temperature. (Owens Corning Fiberglass Type 703 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.
- E. 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 8 inches and smaller, Insulation shall be Owens Corning Fiberglass SSL with ASJ Max or approved equal.
 4. Ductwork 10 inches and larger, Insulation shall be Owens Corning Fiberglass FLEXWRAP ASJ or approved equal.
- F. 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.
 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

- B. 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 area of diffuser and grill. Fasten insulation, overlapping all joints and seal with vapor barrier adhesive.

2.07 ADHESIVES

- A. Complying with UL 2395 Adhesives for use in Heating and Cooling Appliances to Secure Thermal Insulation.
- B. 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.
- 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.

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 piping 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 (Foster 30-35) (Foster 30-36 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" either using 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° 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 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° 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. The insulation shall be held on the pins by metal fasteners and the excess pin clipped off.

- D. 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.
- E. 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.
- F. 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. Standard 111-2008 – Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-conditioning and Refrigeration Systems.
 - 2. Applications Handbook 2019, Chapter 39 – 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:
 - 1. Submit company’s certification documents, including:
 - 2. Contractor Certification:
 - a. Supervisor Certification
 - b. Technician Certification

3. Submit name of testing agency to Owner within thirty (30) days on Notice to Proceed.
4. Submit list of projects completed by testing agency of similar size, scope and equipment. Include name of Contractor and building Owner contacts.
5. 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 Project Manager and RECS Atlanta Staff Engineer via email when it becomes available. 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 shall be a certified member of TABB (AABC and/or NEBB).
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 (AABC and/or NEBB).

- 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 – Quality Assurance Program

2. AABC – National Performance Guarantee
3. NEBB – Conformance Certification

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

- 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.

3.01 SITE TOLERANCES

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

3.02 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 duct to within 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.

3.03 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. 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.
 5. 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.
 6. Where available pump capacity is less than total flow requirements or individual system parts, proportional balancing must be performed.

3.04 ADJUSTING

- A. Recorded data shall represent actual measured or observed conditions.
- B. Permanently mark setting of valves, dampers and other adjustment devices allowing for settings to be restored. Set and lock memory stops.
- C. Leave systems in proper working, replacing belt guards, closing access doors, closing doors to electrical switch boxes and restoring thermostats to specified settings.
- D. 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.

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, than 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 whether 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 3/4" 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 (24) 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
- B. Review all drawings and all sections of the specifications for provisions therein affecting the work of this Section.
- C. As used in this Section the word “Provide” means “Furnish and Install.” The words “FP Contractor” shall mean the Fire Protection Contractor under this Section 15900.

1.04 WORK INCLUDED IN THIS SECTION

Reference Standards
General Requirements
Visiting the Premises
Codes and Regulations
Discrepancies
Certifications
Workmanship and Materials
Manufacturer's Recommendations
Electrical Coordination Prior to and After Submission of Bids
Design Criteria
Alternates

Submitted Data and Shop Drawings

Maintenance Manuals

Record Drawings

Openings, Cutting, and Repairing

Cleaning Equipment and Materials

Cleanup

Record Drawings

Protection

Lubrication

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 building owner, local, State, and insurance agencies having jurisdiction. Contractor shall obtain and pay for all required permits and fees related to the work. 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

- D. 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.
- E. Inspection and approval of detailed plans of installation with insurance approval shall be submitted to Architect prior to installation.

1.09 DISCREPANCIES

- F. 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

- G. 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

- H. 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.
 - I. 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.
 - J. 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.
 - K. Reference to standards are intended to be the latest revision of the standard specified.
 - L. Promptly inspect all shipments to insure that the materials being received are undamaged and comply with specifications.

1.12 MANUFACTURER'S RECOMMENDATIONS

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

1.13 ELECTRICAL COORDINATION

- N. Electrical Contractor will provide all power wiring and control wiring.
- O. 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

- P. Design and install a fully operational, code compliant, approved, complete hydraulically designed automatic sprinkler system for entire building.
- Q. 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. Pdf's 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. Double Check Assembly
 - d. Valves
 - e. Fire Department Connection
 - f. Alarm Devices
 - g. Tags, Labels and Signs
 - h. Valve Monitors
 - i. Installation Drawings and Calculations
 - j. 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. Pdf's of maintenance manuals, instructional data and operating instructions for equipment and materials in this Section shall be assembled by trade and sent/delivered 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. 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.
 - 3. Sprinkler heads are to be centered in ceiling tile or ceiling pattern as directed by Architect/Engineer.
- C. 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.
- D. It shall be the responsibility of this Contractor to ascertain that all chases and openings are properly located.
- E. 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.
- F. 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.
- G. 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. Hangers, rods and supports shall be NFPA approved type.
- B. 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.
- C. 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 Alarm System
 - 2.06 Fire Department Connection
 - 2.07 Hose Threads
 - 2.08 Valve Monitors
 - 2.09 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 (Dedicated) fire sprinkler 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 1/2 inch.
- G. CPVC fittings, where allowed by the authority having jurisdiction, 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 B16.4/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 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, 6.2.9.

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 ALARM SYSTEM

- A. Furnish and install flow switches. Autocall (or Watts, Potter-Electric equivalent) No. WWF-4, 115-volt, 60 cycle, 1 phase. Wiring by Electrical Contractor. Extra contacts for remote alarm. Weatherproof electric alarm bell with red painted metal housing, mounting base and gong; solenoid operator; weatherproofing o-ring seal and electrical characteristics compatible with alarm system.

2.06 FIRE DEPARTMENT CONNECTION

- A. Manufacturers: Elkhart Brass, Potter-Roemer, W.D. Allen.
- B. Exposed: Furnish and install Potter-Roemer, Inc. Model 5751-B Double Clapper rough brass projecting type fire department connection with polished brass name plate escutcheon labeled "AUTO SPKLR".
- C. Flush: Potter-Roemer, Inc. Model 5021, drop clappers, with polished brass name plate escutcheon labeled "AUTO SPKLR".
- D. Post Type: Potter-Roemer, Inc. Model 5761, 2-way cast brass angle body, brass seamless cover sleeve, cast brass identification base plate lettered "AUTO-SPKLR".

2.07 HOSE THREADS

- A. All hose connections for use by the Fire Department shall have hose threads that match those of the local Fire Department.

2.08 VALVE MONITORS

- A. Potter-Electric post indicator/butterfly valve supervisory switch (PIBV2) or outside screw-and-yoke supervisory switch (OSY2) shall be installed on each interior valve which controls water flow to sprinkler system. Switches shall be mounted so not to interfere with the normal operation of the valve and shall be adjusted to operate within two revolutions of the valve control or when the stem has moved no more than one-fifth of the distance from its normal position. The mechanism shall be contained in a weatherproof die cast metal housing, which shall provide a 3/4 inch tapped conduit entrance and incorporate the necessary facilities for attachment to the valve. The switch mechanism shall have a minimum rated capacity of 10 AMP, 125 Volt AC - 2.5 Volt DC. The entire installed

assembly shall be tamper-resistant. PIBV2 or OSY2 shall be Underwriter's Laboratories listed and Factory Mutual approved.

- B. On each control valve, medium-duty corrosion resistant chain with MasterLock model 500BRK-KA breakaway padlocks, keyed alike.

2.09 PRESSURE GAUGES

- A. Provide Terrice 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 midpoint 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.
- F. Specialty Valves: Install in vertical position fire protection riser. Install trim recommended by manufacturer including drain and test valves. Pipe drains to hub or floor drains. Test and

adjust operation of valves, alarms, pressure maintenance devices, and deluge/preaction controls.

G. Hose Outlet Valves: Install at each standpipe outlet and elsewhere where indicated approximately 4' above floor.

H. Fire Department Connections: Mount on wall or on site where indicated. Support from structure independent of piping. Locate between 2' to 3' above grade. Fill above grade wall penetration with insulation and caulk exterior and interior face of wall opening weathertight. Fill below grade wall penetration with Link Seal.

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

SECTION 16010

SPECIAL PROVISIONS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: Furnish all labor, materials, equipment, tools and services in connection with or properly incidental to the furnishing of equipment, installing equipment and the construction of electrical systems as described in this Division of the Specifications and/or shown on the accompanying Drawings, or reasonable implied therefrom, except as hereinafter specifically excluded.
- B. Related Work: Furnish all additional details or special construction as required for work indicated or specified in the division or work specified in other divisions. Furnish and install all material and equipment usually furnished with systems or required to complete and make operative the installation, whether specifically mentioned or not.

1.02 REFERENCE DOCUMENTS

- A. The Electrical Drawings are a combination of scale and symbolic representation of the electrical systems required to be installed. The drawings and specifications are based on qualified skilled craftsmen procuring and installing the work. The drawings include symbolic indication of branch circuit conductors, connections to devices, hook-up of electrical powered equipment, etc.
- B. Division 16 work includes proper routing or raceways, grouping of conductors, wiring to, and hook-up of devices and equipment in accord with the total provisions of the specifications. Refer to the symbol schedule for the basis of the drawing representation. Symbols other than those in the schedule are explained elsewhere or are those commonly used in the industry. Listing of a symbol in the schedule does not imply that the symbol is used on the final contract documents. The electrical drawings indicate general locations of devices and equipment, but final locations shall be determined in reference to the Architectural, Structural, Mechanical and Electrical Drawings.
- C. The Architectural, Structural and Mechanical Drawings and Specifications, including all Supplements issued thereto, are a part of these Specifications and the accompanying Electrical Drawings, and shall be complied with in every respect.

1.03 REGULATIONS, PERMITS AND APPROVALS

- A. The installation including all materials and equipment shall conform to NFPA 70, the applicable requirements of the utility companies supplying energy, communications and other services to the project; the laws of the City and/or Town pertaining to electrical installation; and with all national, state and local codes and laws relating to construction, building and public safety.
- B. Each of the above regulations is a minimum standard. Where the requirements of these minimum standards are less than or do not conflict with the requirements of the Contract Documents, the Contract Documents shall be followed.
- C. Obtain all permits and arrange for all inspections and approvals for the work including construction document review and site observations by the authorities having jurisdiction. Obtain certificates of inspection and acceptance, and transmit these to the Architect as a

condition of acceptance. Assume and pay all fees and other costs involved in obtaining the permits, inspection, certificates and approvals as a part of Division 16 Work.

1.04 SHOP DRAWINGS AND OTHER SUBMITTALS

- A. Submit shop drawings or fully descriptive catalog data for all items of materials and equipment proposed to be furnished and/or installed. Submit all submittals electronically.
- B. Submit on all Electrical Distribution Equipment, wiring materials, lighting fixtures and all components of communication, signal, protection and alarm systems. The submittal of freestanding electrical equipment shall include scale drawings indicating the proposed layout of this equipment, along with code-required clearances, within the space allocated and the proximity of existing work, other electrical work, and work installed under their divisions of work.
- C. Submit sufficiently early to allow ample time for checking without delaying delivery of the materials to job site. A review of any submittal which results in a requirement to resubmit shall not be justified basis of work delay or extra cost.
- D. The review of Shop Drawings or catalog data by the Architect shall not negate the Contractor's responsibility for deviations from the Drawings and Specifications unless, in writing, attention is specifically noted for such deviations at the time of submission and acceptance of the Architect is noted thereon. When attention is called to deviations from the Drawings and Specifications, state in letter of transmittal whether or not such deviations involve any change in Contract time and cost. Errors of any kind associated with submittal shall be the responsibility of the installer of Division 16 Work.

1.05 STANDARDS FOR ELECTRICAL MATERIALS

- A. Materials shall be new and free from defects and shall conform to the standards of the Underwriters' Laboratories, Inc., in every case where such standards have been established. Evidence of such conformance shall be the UL label or "listing" by Underwriters' Laboratories, Inc. under Re-examination Service.
- B. The Specifications indicate a standard of quality for materials. Manufacturers' names and catalog numbers are used to designate materials or equipment to establish grade and quality. Where several manufacturers are named, the bid shall be based on those named manufacturers' products. Where only one manufacturer is named, unless stated otherwise, manufacturers of equal quality products will, however, be considered as substitutions only after the award of the Contract.
- C. Materials conform to National Electrical Code (NEC) Annex A.

1.06 SUBSTITUTIONS

- A. In the event substitutions are to be submitted for Owner review, furnish descriptive catalog material, test data, samples, etc., of the specified material and the proposed substitute, as well as any other pertinent data necessary to demonstrate that the proposed substitutions are acceptable equals to the specified products.
- B. Substitutions shall not be made without written acceptance and the lack of acceptance shall not be a basis of change in work.

PART 2 - PRODUCTS

2.01 PAINTS AND PROTECTIVE COATINGS

- A. For exposed hangers and supports: not provided with factory-protected finish: Sherwin-Williams Kromik primer and Metalatex semi-gloss enamel.
- B. Materials and Equipment: Sherwin-Williams Kromik primer and Metalatex semi-gloss enamel.

2.02 NAMEPLATES

- A. Nameplates shall be laminate plastic nameplates with one-fourth inch (1/4") high letters engraved thereon, which give contract identification, electric service characteristics and source of power on each of the items of equipment. Nameplates for items of equipment on Life Safety System, including transfer switches, shall be red with white letters and all others shall be black with white letters unless specifically noted otherwise.
- B. Nameplates shall be fastened on with cadmium plated or stainless steel screws.

PART 3 - EXECUTION

3.01 EXAMINATION OF SITE

- A. Visit the site of the proposed work and carefully examine the existing conditions and limitations thereof, and include in the bid all costs of any kind whatsoever which are incurred through limitations of the existing conditions.
- B. No additional costs shall be brought upon the Owner for lack of this review.

3.02 SERVICE, CONNECTIONS AND PERMITS

- A. Obtain all permits, inspections and approvals for the work including construction document review and site observations by the authorities having jurisdiction. Obtain certificates of inspection and acceptance and transmit there to the Architect as a condition of acceptance. All fees and other costs involved in obtaining these permits, inspections and approvals shall be assumed and paid under the Division of the Work.
- B. Arrange for all services and pay all costs whatsoever to completely install and place in operation these electrical systems.

3.03 COORDINATION

- A. Coordinate work with that of other trades and adjacent projects to make proper connections at appropriate locations and times. Review the construction of other trades and adjacent projects to determine the physical needs and time requirements imposed in providing connections to them as shown on the drawings and in accordance with the project schedule.
- B. Coordinate work with that of the other trades so work may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Give precedence to lines which require a stated grade for proper operation. Where space requirements conflict, the electric conduit shall, in general, yield to all other trades.
- C. When an electrical device is operable and it is to the advantage of the project, the equipment may be operated providing that prior approval of the Owner is received and proper supervision of the equipment operation performed. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner. Regardless of whether the equipment has or has not been operated, properly maintain the

equipment; and at the completion of the work, properly clean, adjust, and complete all items before final acceptance is requested.

- D. The Architect or others may, during the execution of the work, desire to make connections to or modifications of work installed in this Division of Work. Permission for the Architect or others to make these connections or modifications shall be granted without relieving responsibility for work installed under this Division of Work.

3.04 RECORD DRAWINGS AND BROCHURES

- A. During the execution of work, maintain a complete set of reproducible drawings upon which all dimensional locations of equipment, deviations and changes in the work shall be recorded. These Record Drawings shall be in good condition and shall be marked "Record Drawings", signed, dated and transmitted with two sets of prints under a transmittal letter to the Architect upon completion and acceptance of the work and before final payment is made.
- B. The following data as applicable to the Work shall be included in items furnished for use by the Owner:
 - 1. Record Drawings as specified above and elsewhere.
 - 2. Electronic copies of lighting fixtures with copies of data of each installed luminaire. Index each PDF indicating fixture type, manufacturer and catalog number, voltage, and lamping.
 - 3. Electronic copies of Electrical Distribution Equipment with final Drawings, operating instructions and maintenance instructions.
 - 4. Electronic copies of communication, signal protection and alarm systems installed with final installation and connection diagrams; and equipment operating, test and maintenance instructions.

3.05 CARE AND CLEAN UP OF EQUIPMENT AND MATERIALS

- A. Protect each item and component of electrical equipment from moisture, concrete, mortar, paint, dust and other foreign materials from the time it arrives on the job site until installed, placed in service and accepted by the Owner, using signs, barriers and other means whereby others are made fully aware of the importance of protecting equipment from damage.
- B. Keep all electrical construction materials clean of all foreign materials from the time of arrival on the site until their installation. Time the installation of each item to avoid unnecessary exposure of the materials to destructive elements or destructive environment. Clean all installed materials of all foreign materials including concrete, mortar, spilled paint, and dust prior to final inspection. All unused electrical construction materials shall be removed from the site.
- C. After the installation is complete and before equipment is energized, thoroughly clean the interior and exterior of all equipment and materials. After the building is completed and cleaned, arrange for a power outage on each item of equipment and repeat the cleaning. This cleaning shall be performed just before final inspection. Each component shall be cleaned with air pressure, vacuumed and wiped clean of all dust and other foreign material. Components shall be cleaned of all oxidation. Any portion needing touch-up finishing and/or protective coating shall be so finished to equal the specified finish on the product. The entire inside and outside of all equipment shall be wiped with a lemon-oiled rag after all other cleaning and touch-up is complete.
- D. Provide for the removal of all unused, scrap, material containers and other rubbish or trash resulting from Division 16 Work from within and around all work and work areas on a basis that it will not interfere with other trades, other work or the completion of any work.

3.06 PAINTING AND PROTECTION

- A. Electrical equipment such as primary switches, switchboards, panelboard fronts, motor control centers and transformers shall be delivered to the job with suitable factory finish. Finishes marred in transit or during installation shall be refinished under this Division of Work to present a neat, workmanlike appearance equal to the factory finish.
- B. Except as elsewhere required, painting of equipment, boxes, conduit, etc. furnished under this Contract will be performed under another division of work. Clean electrical work of all trash, dirt, marks, and other foreign materials under this Division of Work prior to the application of finishes.
- C. Electric work in areas of the construction to remain unpainted shall be protective finished under this Division of Work as follows unless indicated otherwise:
 - 1. Paint all exposed and non-rust inhibited hangers and supports not provided with a factory finish with primer and two (2) coats of enamel.
 - 2. Material and equipment with suitable factory-applied finishes may be left unpainted provided the Architect's approval to do so is obtained. Prime and paint material and equipment that does not obtain such approval with two (2) coats of semi-gloss enamel.
- D. Painting in finished areas of the construction where finished coatings are applied under other divisions of work shall be performed under other Division of Work and shall include:
 - 1. All exposed hangers and supports and all exposed conduits and boxes with a coat of primer and two (2) coats of semi-gloss enamel, and all panelboards and other cabinets with two (2) coats of semi-gloss enamel.
 - 2. Concrete foundations are to be finished with one (1) coat of masonry paint and one (1) coat of enamel. Refer to the manufacturer's requirement for concrete curing time after placement.
 - 3. Equipment with suitable factory-applied finishes left unpainted provided Architect approval is obtained prior to beginning of painting in the area. Material and equipment that does not obtain such approval shall be primed and painted two (2) coats of enamel.
- E. Painting done shall be in colors designated by the Architect. Successive coats of paint shall be different shades.

3.07 CUTTING AND PATCHING

- A. Do all cutting necessary for the installation of Division 16 Work. Cutting shall be carefully and neatly done so as not to damage or cut away more than necessary.
- B. Where Division 16 workmen damage or cut away work excessively, patching will be performed as a part of Division 16 Work. Patching will be by craftsmen experienced in performing this type of work.

3.08 NAMEPLATES

- A. Install nameplates which give contract drawing identification and electric service characteristics on equipment unless specifically indicated otherwise including switchgear, switchboards, transformers, panelboards, and main control cabinets for alarm systems. Typed directories shall be provided for branch panelboards.
- B. In each case where compartments, equipment, etc. are required to be "labeled" or "identified," it shall be construed that nameplates are to be installed.
- C. Locate nameplates on the exterior face of the equipment so as to be clearly visible when the equipment is in place.

- D. Fasten nameplates on with screws except contact-type permanent adhesive shall be used where screws cannot or should not penetrate enclosure or substrate.

3.09 ELECTRICAL SERVICE CONNECTIONS

- A. All provisions for electrical power service, installation at service gutter, service feeders, current transformers and metering, and main service switches will be furnished and installed under Section 16410.
- B. Service for telephone will be extended to the main telephone board installed under the base contract and terminated in an empty conduit strapped to the telephone board.
- C. All other electrical work illustrated on the accompanying drawings and specified herein shall be included under the base contract.

3.10 TESTS

- A. On completion of the work, make voltage, resistance and ground tests of all wiring installed under this Contract.
- B. Such tests shall show results in accordance with the requirements of the Code. See specific items for other specific test requirements.
- C. Any defect found shall be repaired under this Contract to the satisfaction of the Architect.

3.11 GUARANTEE

- A. Warranty all work done and all materials and equipment furnished to be free from defects.
- B. Promptly repair or replace defective work, material and equipment without charge to the Owner at a schedule suitable to the Owner.
- C. The warranty shall be for a period of one year after acceptance for beneficial use by the Owner unless otherwise indicated elsewhere.

END OF SECTION

SECTION 16110

RACEWAYS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install complete systems of raceways for the installation of electrical conductors and other materials as specifically indicated.
- B. Provide complete raceway systems for each conductor of electric power, to be installed in this division of the work and for other work where so indicated except as specifically indicated otherwise.

1.02 REFERENCE DOCUMENTS

- A. The Special Provisions for Electrical Work are hereby made a part of this section of the work. Refer to Section 16010.
- B. See Section 16190 for Supporting Devices.
- C. Materials shall conform to National Electrical Code (NEC) Annex A.

1.03 SUBMITTALS

- A. Submit complete information including manufacturer, material, and finish on each type of raceway to be installed.
- B. Submit complete information on methods and materials for support of each type of raceway.

1.04 QUALITY ASSURANCE

- A. Each raceway shall bear the UL Label where UL Standards have been established for the type of raceway being provided.
- B. Each raceway shall be suitably protective coated for the installation and each portion of the protective coating that is damaged during receiving, handling and installation shall be refinished equal to factory protection.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Raceways include conduits, ducts, wire ways, gutters, cable trays, boxes, fittings, and similar items as indicated in other sections of the work.
- B. Raceways fabricated for special pull boxes, junction boxes, gutters, and similar connections shall be code-gauge steel fully rust inhibited and finish painted to match adjacent switchgear. Interiors shall be accessible through screw covers. Supports and interior protection shall be provided for conductors.

2.02 SLEEVES

- A. Sleeves shall be galvanized steel, formed to meet the size and shape of the raceway to pass through the sleeve.
- B. Sleeves for conduits through exterior walls shall be galvanized steel Schedule 40 pipe or conduit.

- C. Sleeves for conduits through interior walls that are not subject to moisture may be non-metallic conduit.
- D. Sleeves through waterproof walls, floors and roofs shall be provided with water-stop flanges at the point of waterproofing membrane.
- E. Sleeves through waterproof floors shall be as specified for exterior walls below grade except steel pitch pan around the sleeve.
- F. Sleeves through fire-rated construction shall be non-combustible.

2.03 PITCH PANS

- A. Pitch pans shall be galvanized iron or steel pans of the shape of the raceway passing through the waterproofing membranes, of the size to provide 1" to 2" space between the outside of the raceway and the vertical side of the pan, and of a depth to be set on the waterproofing membrane and extend 1" above the finished roof.

2.04 SMOKE AND FIRE STOP SEALANT

- A. Smoke and fire stop sealant caulk shall be 3M Company Type CP-25, and putty shall be 3M Company Type 303. Larger openings shall be stuffed with 3M Company fire barrier composite sheet No. CS195 in accordance with the manufacturer's directions. Silicone foam penetration sealant shall be General Electric PENSIL 851 or Dow-Corning RTV as approved for the installation.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Each raceway shall be suitably supported from, installed and aligned with the main structural components of the building.
- B. Raceways shall be installed to avoid interference with work of other trades.

3.02 PROTECTION AND CLEANING

- A. Raceways will be cleaned both internally and externally of all dirt, debris, and other foreign materials. Raceways in areas to be finish-painted shall be cleaned properly prior to the painting. Raceways not indicated to be finish-painted on the job shall be protected from foreign objects and materials during construction, and cleaned and touch-up coated before completion of the work.

END OF SECTION

SECTION 16111

CONDUIT AND FITTINGS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnishing and installing of complete systems of electrical conduits as part of the raceway systems for installation of conductors for electrical systems.

1.02 REFERENCE DOCUMENTS

- A. The Special Provisions for electrical work are hereby made a part of this section of the work. Refer to Section 16010.
- B. See Section 16190 for Supporting Devices.
- C. Conforming to National Electrical Code (NEC) Annex A.

1.03 SUBMITTALS

- A. Submit complete manufacturers' specifications data on each type and manufacture of conduit and fitting proposed to be furnished and/or installed on the project.

1.04 QUALITY ASSURANCE

- A. Conduits shall be accord with ANSI Standard C 80.
- B. Each length of conduit shall bear the UL Label.

PART 2 - PRODUCTS

2.01 RIGID METALLIC CONDUITS AND FITTINGS

- A. Rigid metallic conduit shall be standard hot-dipped, galvanized mild rigid steel. Conduit shall have galvanized threads. Each length shall be provided with a coupling, and ends without couplings shall be furnished protected with a suitable covering. All bends in conduit one and one-quarter inch (1-1/4") in size and larger shall be made with factory-manufactured elbows. Rigid metallic conduit shall be equal to Republic Galvite Rigid Steel Conduit.
- B. Locknuts and bushing shall be galvanized steel except Emerson O-Z Type "A," or approved equal molded canvas bakelite bushings may be used for 2" trade size and O. Z. Type "B" bakelite insulated, lined steel bushings may be used for conduits two and one-half inches (2-1/2") and larger.

2.02 INTERMEDIATE METALLIC CONDUIT (IMC.)

- A. Intermediate metal conduit shall be hot-dipped galvanized steel tubing with galvanized threads equal to IMC manufactured by Allied Tube and Conduit Corporation.
- B. Fittings and accessories shall be the same as set forth for rigid metallic conduit

2.03 ELECTRICAL METALLIC TUBING AND FITTINGS

- A. Electrical metallic tubing shall be standard galvanized E.M.T. equal to Republic Electrunitite E.M.T.

- B. Couplings and connectors for EMT shall be T & B or equal, steel set screw type with steel gland nuts. Connectors shall be un-insulated throat type. Indenter fittings are prohibited.

2.04 FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Flexible metal conduit shall be Southwire Inc. or equal, spirally wound galvanized steel or aluminum.
- B. Terminators of flexible conduit shall be compatible with the manufacturer and comply with NEC Article 348.
- C. Empty conduit shall conform to UL Standard 1479 for 1, 2, and 3 hour Through Penetration of Fire Stop Systems; UL listed per UL 1, Standard for Safety for Flexible Metallic Conduit; and meet NEC Type Designation – Article 348, Type FMC.
- D. Filled conduit conductors must contain copper wiring for power wiring with Aluminum grounding conductor acceptable if allowed.

2.05 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT AND FITTINGS

- A. Liquid tight flexible metal conduit shall be UL recognized File E31196; IP 65 certified for watertight application with an operating temperature from -4F to 140 F.
- B. Terminators shall comply with NEC Article 348.

2.06 SPECIAL FITTINGS

- A. Split couplings shall be Emerson O-Z or equal, Type SP.
- B. Expansion joints shall be Emerson O-Z or equal, Type AX expansion joints with Type AJ bonding jumpers.
- C. Pull rope shall be 3/16" polyester stranded JET LINE rope.

2.07 RIGID PVC CONDUITS AND FITTINGS

- A. Conduit and fittings shall conform to U.L.-651 and NEMA TC-2, and shall be listed and labeled by the Underwriters Laboratories Inc.
- B. PVC conduit and fittings shall be equal to Carlon “Plus 40” systems. They shall be designed for use underground, shall be non-conductive and shall assure a safe system. Conduits and fittings shall be non-corrosive, impervious to most chemicals, provide lower expansion and contraction features, and shall be suitable for direct earth burial or encasement in concrete.
- C. PVC conduit and fittings shall be rated for 90 degree centigrade conductors or cable and for use in direct sunlight.

2.08 RIGID PVC FITTINGS

- A. Codes applicable to PVC conduit shall also apply to PVC Fittings.
 - 1. Expansion couplings equal to Carlon E945 or E955 as required.
 - 2. Bell ends equal to Plus 80 or 40 plain bell for use with non-metallic solvent welds.
 - 3. Standard couplings socket type for solvent cement attachment.
 - 4. PVC rigid adapters E942 or E943 threaded to metallic systems and socket attachment by solvent cement.

PART 3 - EXECUTION

3.01 MATERIAL SELECTION

- A. Raceways shall be standard galvanized steel rigid metal conduit unless otherwise indicated or, where allowed by the Authority Having Jurisdiction, empty or prewired Flexible Metallic Conduit may be substituted for above ceiling or unexposed locations.

3.02 CONDUIT

- A. Intermediate metal conduit (IMC) may be used wherever rigid conduit is required except for raceways embedded in concrete slabs, in contact with the earth, underground not encased in concrete and in corrosive locations.
- B. Aluminum rigid metal conduit may be used wherever rigid conduit is required except embedded in concrete slabs or underground.
- C. Electrical Metallic Tubing (EMT) may be used for raceways above furred ceilings, within dry wall partitions, in rooms with exposed construction, and in mechanical and electrical rooms for sizes of four inches (4") and smaller.
- D. Wiring connections to motors, transformers, or other devices, which are subject to vibration or require adjustment, shall be flexible metallic conduit. The flexible conduit shall be more than 12 diameters but less than 18 diameters in length. Where these connections are outdoors, or in damp locations, or are connections to any kitchen or water treatment equipment, liquid-tight flexible conduit shall be used.
- E. Wiring to each recessed lighting fixture shall be run in an independent length of flexible conduit extended from an accessible junction box located above the ceiling. The flexible conduit shall be of sufficient length to allow the connection point to the fixture to drop at least 12" below the finished ceiling, and shall be at least 48" long but not more than 72" long. Recessed lighting fixtures which have UL approved prewired circuit junction boxes and fixture wire extensions may be used and wired directly to the branch circuit runs without the added flexible conduit connections.
- F. Elbows shall be of the same materials as the conduit. Elbows in EMT and small rigid conduits three-quarters (3/4") and under may be job-fabricated with a bender made specifically for the purpose.
- G. Conduits shall be sized as indicated on the drawings and as required to accommodate the wires to be pulled into the conduit. Conduit shall not be less than three-quarters inch (3/4") in size except EMT for branch circuit runs may be one-half inch (1/2"), and three-eighths inch (3/8") flexible metallic conduit may be used for individual connections to recessed lighting fixtures.
- H. Flexible metal conduit and fittings not acceptable for water chases. Provide liquid tight metallic conduit for flexible connection to dialysis cabinet removable panels.

3.01 INSTALLATION

- A. Run conduits concealed from view in all areas except in electrical and mechanical equipment rooms. Run at levels and locations to avoid interference with the structure, finished ceilings, walls and all lines of other trades requiring grading of runs. Coordinate with other trades to allow available spaces to be used in the most efficient and workmanlike manner. FMC may be used in concealed areas only. Run only rigid conduit in exposed locations.

- B. Route exposed conduits parallel with or at right angles to building walls and neatly rack. Carefully lay out conduit proposed to be run within the structure such as floors, beams, roof, or walls to avoid building up the density of conduits too excessive for the construction. Relocate conduits when excessive build-up occurs.
- C. Install conduits out of close proximity to any potentially hot device, any steam pipe, hot water pipe or other heating duct or appliance. Conduit shall not be run within three inches (3") of the exterior insulation of such device, pipe or duct, except in crossing, and such crossing shall be at least one inch (1") from the cover of the device, pipe or duct crossed.
- D. Place conduits through the roof or exterior walls in time to allow the trade to seal around the raceways as work is installed. Conduits through roof shall run through galvanized pitch pans.
- E. Cover each end of each conduit with an approved capped busing as soon as the conduit is installed to prevent entry of foreign material. Conduits shall be dry and clean before wires are pulled.
- F. Locate junction boxes and raceways above accessible ceilings such as lay-in ceiling to provide adequate space for recessed fluorescent fixtures of the type specified elsewhere to be installed, in any place in the ceiling without relocating the installed raceways, boxes or support now or in the future.
- G. Arrange conduit runs within building interiors to be no longer than 80 feet between pull or junction boxes, cabinets, or circuit interrupting device enclosures unless there is no direction change and only a straight-in-line pull of wire is involved. In such straight-in-line runs between boxes, cabinets or devices, runs not exceeding 100 feet in length may be made.
- H. Non-metallic conduit installed outdoors under concrete slabs or walkways shall have 24 inches cover and may be in contact with the earth. Conduit service laterals installed under driveways, or roadways shall be concrete encased. Support runs on PVC spacers 5'-0" center-to-center and encases in reinforced concrete duck banks. Reinforcing shall be #4 deformed longitudinal bars, one each corner, with #3 stirrups tied at 1'-0" reinforcing concrete shall cover bar minimum 2 inches around each corner face. Non-metallic conduit installed indoors shall have 12 inches cover.
- I. When using FMC, support runs at no more than 3'-0" spacing. All associated home runs to the panelboard shall be in appropriate metallic conduit.

3.02 FITTINGS

- A. Install double locknuts and a bushing at each rigid conduit termination except for terminations into threaded hubs.
- B. Wherever standard threaded couplings cannot be used, split couplings can be used.
- C. Provide expansion joints in conduits at all building expansions joints and wherever else the length of run requires.
- D. Coat all threaded connections subject to moisture or under ground with cold galvanizing before making connection up.

3.03 PULL ROPE

- A. Install a pull rope with each end properly marked for use and termination of the other end in each conduit installed and in which no conductors are installed under this Division of Work.

END OF SECTION

SECTION 16120

WIRE AND CABLE - 600 VOLTS AND UNDER

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install electrical wires and cables for the distribution of electric power, controls, grounding and signals for the electrical systems.

1.02 REFERENCE DOCUMENTS

- A. The Special Provisions for Electrical Work are hereby made a part of this section of the work. Refer to Section 16010.

1.03 SUBMITTALS

- A. Submit complete manufacturers' specification data on each type of conductor to be supplied to the job.
- B. Include proposed colors, color markings and other identification as a part of the submittal.

1.04 QUALITY ASSURANCE

- A. Electrical conductors shall be UL listed and bear the UL label.

PART 2 - PRODUCTS

2.01 CONDUCTORS

- A. Wires and cables shall have conductors of soft-drawn annealed copper having a conductivity of not less than 98% of that of pure copper. Wire and cable shall be equal to that manufactured by Anaconda.
- B. As a minimum standard, all conductors shall comply with the applicable edition of the National Electrical Code.
- C. Where not specifically indicated otherwise, wire and cable insulation type shall be as follows:
 - 1. For general use - Type THHN or THWN, 600 volt.
 - 2. For branch circuits of No. 12 and No. 10 AWG - Type THHN, 600 volt.
 - 3. For control wiring - Type THHM, 600 volt, No. 14 AWG minimum size.
 - 4. Wiring run underground - Type THHN/THWN, or XHHW, 600 Volt.
 - 5. For fixture wiring - Type AF, 300 volt, No. 12 AWG minimum size.
 - 6. For branch circuit wiring run in fluorescent fixture channels - Type THHN, 600 volt, No. 12 AWG minimum size.
 - 7. See other sections of work for alarm communications and other low-energy systems wiring.
 - 8. All communication, and low voltage control wire run in plenum above ceilings and not protected by conduit shall be rated plenum cable as required by code.
 - 9. Service and/or feeder wiring to panelboards may be XHHW at the Contractors option.
- D. Wire shall be solid for No. 10 and smaller and stranded for No. 8 and larger.

- E. All wire and cable shall be factory-color coded. Colors for each phase and neutral shall be used consistently throughout each system. The following color codes shall be used and maintained throughout the system:

208/120 V SYSTEMS		480/277V SYSTEMS
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green w/Tracer
Switch Legs	Purple	

On wires No. 6 and larger and where factory color is not available, wires and cables shall be color-coded by a one inch (1") wide band of colored Scotch tape on ends of each conductor, or by coating a 3" band at the end of the cable and in each pull box with brilliant waterproof lacquer.

2.02 TERMINATIONS, SPLICES AND TAPS

- A. Cable terminations, splices and taps for copper conductors shall be:
1. For terminations - Emerson O-Z or equal, Type XLH.
 2. Splices and Taps - Emerson O-Z or equal, clamp-type solderless connectors except splices and taps for No. 8 AWG and smaller conductors may be Scotchlock Spring Connectors, Buchanan "B" cap, Ideal Wing Nuts or T & B "Piggy" connectors.

2.03 SUPPORTS

- A. Supports for wiring in cabinets, panels, pull boxes, wireway and junction boxes shall be Zip Tie cable clamps and cable ties.
- B. Supports in vertical feeders shall be two-piece conduit type equal to Emerson O-Z Style "S."

PART 3 - INSTALLATION

3.01 CONDUCTOR SELECTION

- A. The minimum size of wire shall be No. 12 AWG except as noted otherwise on the Drawings or specified herein. All branch circuit home runs over 70 feet from panel, measured along the length of the raceway, shall be wired with No. 10 AWG minimum.
- B. The Drawings generally indicated the number of wires in a conduit. Provide the proper number of wires in each conduit to complete the entire electrical system.

3.02 INSTALLATION

- A. Route each conductor through an approved Electrical Raceway. Pull conductors into conduit only after all conduits and outlet boxes are permanently in place. Pull wires or strings shall be inserted only after the raceway installation is complete.
- B. Run feeders and mains continuously without splice from line to load terminals and identify phases each pull box and in the gutters of each switchboard and panelboard in which they connect. Splices in feeders may be made only where designated on the Drawings or where specific prior approval is given.

- C. Neatly train, control and circuit wiring in cabinets, panels, pull boxes, wire ways, and junction boxes and tie with Zip Tie nylon cable ties. Clamp or fasten control or circuit cabling in cabinets or other equipment with non-metallic nylon Zip Tie cable clamps and mounting brackets.
- D. Install cable supports per N.E.C. in all vertical feeders and in boxes provided for the feeders where not terminated in electrical panels or equipment within code distances. Supports shall be of the two-piece conduit type, which clamp each individual conductor firmly and tightens due to weight of cable.

3.03 TERMINATIONS, SPLICES AND TAPS

- A. Connections of conductors to terminals shall be made by pressure connections. Solder joints will be permitted only for low voltage controls. Joints and splices shall be made with clamp type solderless connectors and insulated with rubber and friction tape or Scotch No. 33 plastic tape. Spring connectors may be used for splicing No. 8 AWG or smaller conductors.

3.04 SUPPORTS

- A. Install supports to hold conductors in place in each panelboard, cabinet, pull box, junction box and wire-way.
- B. Install cable supports in vertical runs of conductors in cabinets and pull boxes.

END OF SECTION

SECTION 16131
JUNCTION AND PULL BOXES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install junction and pull boxes where indicated or where necessary for installation of the wiring systems.
- B. Secure prior approval of the Architects for locations of all boxes not specifically located on the Drawings.

1.02 REFERENCE DOCUMENTS

- A. The Special Provisions for Electrical Work are hereby made a part of this Section of the Work. Refer to Section 16010.
- B. See Section 16190 for Supporting Devices.

1.03 SUBMITTALS

- A. Shop Drawings shall be submitted on each specifically fabricated junction or pull box.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Junction and pull boxes shall be flush or surface type as indicated on the drawings or as required to fit into the building construction. Junction and pull boxes shall have screw covers. Small junction boxes, 100 cubic inches and smaller, for control or branch circuit wiring, shall be as specified for outlet boxes and with blank covers.
- B. Junction and pull boxes installed in walls and ceiling spaces shall be code-gauge galvanized steel with galvanized steel covers.
- C. Junction and pull boxes installed in floors shall be galvanized malleable cast iron with gasketed covers.
- D. Junction and pull boxes installed outdoors shall be weatherproof with watertight gasketed covers fastened with corrosion resistant screws.
- E. Boxes shall be sized per NEC 314.28.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install junction and pull boxes in a neat workmanlike manner and support in accord with the provisions set forth elsewhere for panel boards and for hangers and supports.
- B. Arrange for raceways to enter boxes only in places specifically planned for raceways in the sizing and construction of the cabinets.
- C. Provide auxiliary conductor supports in large boxes per N.E.C. 314.28 (B) where conductors must be supported.
- D. Conductors passing through the boxes shall be marked as to phase.

END OF SECTION

SECTION 16134
OUTLET BOXES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install suitable outlet boxes for lighting fixtures, devices, empty raceway devices, small junction boxes, and other locations as required by the installation.

1.02 REFERENCE DOCUMENTS

- A. The Special Provisions for Electrical Work are hereby made a part of this Section of the Work. Refer to Section 16010.

1.03 SUBMITTALS

- A. Submit manufacturer's specification data on each type of box and trim to be furnished to the job.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Outlet boxes, except where otherwise specifically indicated or required, shall be of one piece or welded assembly construction. Outlet boxes shall be with covers of the same manufacturer as the box and selected to meet the conditions of the installation.
- B. Outlet boxes shall be equal to the following; Appleton, Steel City or RACO types, except that where more conduits enter the boxes, structural conditions interfere, or wiring requires more space, larger boxes of similar construction shall be used. Multi-gang boxes for switches of different voltages shall be provided with interior barriers.
 - 1. In Gypsum Board Walls, for single and two-gang outlets, Type 4S and 4SD with No. 846 and 847 covers not more than 1" thick. Where boxes serve one wiring device, a single gang handy box may be used. All Gypsum Board Wall boxes shall receive far-side box supports and shall be Caddy J-1A.
 - 2. In concrete block or similar masonry walls, No. M1-250, M2-250 or M3-250 for 1, 2, and 3 gang outlets in 4" thick walls, No. M1-350 for 1, 2, and 3 gang outlets in thicker walls and the same series for more gangs in common boxes in similar walls.
 - 3. In poured concrete, plaster and similar masonry walls, No. 4S and 4SD boxes with No. 846 covers for single gang outlets, No. 2G-5075 boxes with No. 2GC-75 covers for 2 gang outlets and corresponding G-5075 boxes and G C-75 covers for 3, 4, 5, and 6 gang outlets. Covers shall be a maximum of 1" high.
 - 4. In concrete ceilings, Type O C R boxes and O C P covers.
 - 5. In other ceilings, Type 4/0 and 4/0D boxes. Outlet boxes for surface or pendant lighting fixtures shall have 3/8" fixture studs.
 - a. In poured concrete floors, Steel City 600 Series cast iron, watertight fully adjustable with threaded conduit openings, expendable cap to prevent ingress of concrete during pour, carpet or tile plate and P-60 DR duplex lift lid with steel seating plate for receptacle.
 - b. Recessed Service Floor Boxes – for power, data and phone under table at conference room floor:
 - 1) Legrand RFB9 Recessed Floor Box (large capacity)

2) Legrand RFB119CTCGY – Floor Box Cover with carper cover assembly

a) Color: Grey

- C. Exposed outlet boxes mounted in protected areas shall be solid gang switch boxes with flat covers. Boxes shall be of size and number or gang for device requirements, except no box shall be smaller than 4" square.
- D. Outlet boxes exposed on exteriors of buildings, flush in non-waterproofed walls below grade or in wet locations shall be Type FS or FD threaded outlet cast boxes with suitable gasketed cast covers.
- E. Small junction boxes shall be the same as device boxes except shall be provided with blank plates.
- F. Dialysis Chase Panels – Use 4" Square Covers (aka Mud Rings) mounted to the rear of the chase electrical panels – 3/4" raised.
 - 1. Appleton 8468 –3/4" Raised or equal

PART 3 - EXECUTION

3.01 MATERIAL SELECTION

- A. Outlet boxes shall be of the standard stamped galvanized steel type except for exterior use where they shall be hot-dipped galvanized cast iron with gaskets. Boxes shall be of the proper size to accommodate the wiring and device for which they are provided.
- B. Ceiling outlet boxes shall generally be four inch (4") octagon, and wall outlet boxes shall be switch boxes or be 4" square with covers to suit device to be mounted thereon, except that in masonry walls without applied finish, boxes shall be rectangular masonry boxes.
- C. Through-the-wall type boxes shall not be used.

3.02 INSTALLATION

- A. Install and leave boxes in a neat, clean and workmanlike manner. Set plaster covers to within 1/8" of the finished surface.
- B. Determine exact locations of all outlets from the Architectural Scale Drawings or at the site by the Owner. Modify outlet locations from those shown on the Drawings to accommodate door swings or to fit other construction details without cost to the Owner. Set wall boxes in advance of wall construction and move where required for any outlets, which are displaced during the operation of other trades without expense to the Owner.
- C. Each recessed lighting fixture shall be independently connected from an above ceiling junction box, which is readily accessible through the lighting fixture opening.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install wiring devices and cover plates of the type and kind as herein after indicated on the drawings.

1.02 REFERENCE DOCUMENTS

- A. The Special Provisions for Electrical Work are hereby made a part of this Section of the Work. Refer to Section 16010.

1.03 SUBMITTALS

- A. Submit complete manufacturer's specification data on each type of wiring device proposed to be furnished to the job.

1.04 QUALITY ASSURANCE

- A. Each wiring device shall be of design, type and configuration established by NEMA Standards for the application used.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Devices shall be Specification grade, UL and CSA certified, listed NEMA Standard, and suitable for the service required in the intended use of the device in this installation.
- B. Where devices manufactured by Arrow - H&H, Bryant, Hubbell via GrayBar, P&S or Sierra are named, only equivalent devices by the other of these manufacturers will be acceptable. Unless otherwise indicated, devices shall be as follows:
 1. Wall Switches: 20 ampere, 120 and 277 volt AC, P&S No. CSB-20 AC1 I, CSB-20 AC2 I, CSB-20 AC3 I AND CSB-20 AC4 I for single pole, double pole, three-way and four-way, respectively.
 2. Convenience Outlets: Duplex receptacles P&S 5362-I or 5361-I 20 ampere, 125 volts with pair of NEMA 5-20R Standard 3 contact grounded parallel slot contacts Ivory finish.
 3. Disconnect Switches: Provide as appropriate at R.O. machine, HVAC equipment, electric hot water heaters, etc.
 4. Standard Patient Station Dedicated Receptacles: NO SUBSTITUTIONS
 - a. At each patient station, provide the following:
 - 1) One (BROWN) 20 amp, GFCI Hospital Grade – dedicated for dialysis machines. Hubbell via GrayBar Part # GFRST83.
 - 2) One (IVORY) GFCI Hospital Grade on a ganged 20 amp circuit (max. 2 receptacles per circuit) – dedicated to two adjacent patient stations for ancillary medical equipment. Hubbell via GrayBar Part # GFRST83I
 - 3) One (WHITE) 20 amp, GFCI Hospital Grade (max. 6 duplex receptacles per circuit) – for general use by patients and staff. Hubbell via GrayBar Part # GFRST83W

- 4) Each receptacle must be mounted in separate box with separate cover plate-color to match.
5. Nocturnal Patient Station Dedicated Receptacles:
- a. At each patient station, provide the following:
 - 1) One (BROWN) 20 amp, GFCI Grade – dedicated for dialysis machines. Hubbell via GrayBar Part # GFRST83.
 - 2) Two (IVORY) GFCI Hospital Grade on a ganged 20 amp circuit (max. 2 receptacles per circuit).
 - a) Dedicated to two adjacent patient stations for ancillary medical equipment.
 - b) One dedicated for hospital bed or heat/massage dialysis chair.
 - 3) One (WHITE) 20 amp, GFCI Hospital Grade (max. 6 duplex receptacles per circuit) for general use by patients and staff.
 - 4) Each receptacle must be mounted in separate box with separate cover plate-color to match.
 6. All GFCI receptacles shall be Hubbell via GrayBar: Commercial Standard Hospital Grade with a green power indicator, red trip indicator and self-test technology.
 7. Outlet for R.O. machine shall be NEMA L15-30R for 3 & 5 hp (30 amp), and Leviton Model #CS83-69 (50 amp) for 7.5 hp motor.
 8. Switched outlets for R.O. holding tank shall be Bryant Model #70520FR.
 9. Manual motor starter Square D class 2510 with overload heater sized to the motor.
 10. Flush floor outlets shall be Hubbell or equal, B2537 shallow floor box semi-adjustable with S-3725 brass duplex screw cover and NEMA 5020R receptacle.
 11. Switch/pilot light for staff lounge fan shall be Cooper Wiring model #77WBOX.
 12. Other receptacles: Other receptacles shall be of type and characteristics and NEMA configuration to provide service as indicated for the special service as indicated elsewhere.

2.02 COVER PLATES

- A. General: Opening in Plates properly fit the wiring devices associated with the outlets. Plates shall overlap outlet box edges for installation over finished room surfaces and shall be the non-over hanging type to fit conduit boxes used with exposed conduit runs. All plates shall be smooth.
 1. Future or Abandoned Outlet: Blank Plate.
 2. All Finished Spaces: Stainless Steel.
 3. All Dialysis Casework Electrical: To match receptacle color.

2.03 LABELING

- A. All switches and receptacles throughout the facility shall be marked with the correct panel and circuit number with a permanent, legible label affixed to the outside of the cover plate.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Each device shall be suitable for type of service for which it is installed. Device shall be of NEMA configuration and of Specification Grade and/or Hospital Grade for those services to which the device is installed where those standards are established. Devices indicated adjacent

to each other shall be in the same box and set under a common plate. Suitable barriers shall be provided in the box for separation of each device from adjacent devices where required by code.

- B. Install suitable cover plates on all wiring devices.
- C. Device colors shall be Ivory unless selected and installed to match the decor of the occupancy and other standard colors as set forth elsewhere in these contract documents or as selected by the Owner. Other colors shall be provided when so directed by the Owner.
- D. Bedside devices shall consist of one brown receptacle on dedicated circuit and one ivory duplex outlet gang connected in separate boxes with separate cover plates.
- E. Mount all switches and/or devices as shown on electrical drawings and Architectural Standards Mounting heights detail.
- F. Wire all devices with proper polarity and suitably grounded. Provide Appleton or equal SCR 1032 PTL1 green head grounds screw and 6 inch pigtail in every box.

END OF SECTION

SECTION 16150

MOTORS, CONTROLLERS, AND ELECTRIC POWERED EQUIPMENT

PART 1- GENERAL

1.01 WORK INCLUDED

- A. Furnish and install all wiring necessary to completely connect all motors, electric powered equipment and electric controlled equipment that is furnished by the Owner, other Contractors, or the Divisions of Work. This includes HVAC equipment, plumbing equipment, fire protection, and similar items that are installed by others.
- B. The Owner, other Contractors, or other Divisions of the Work will furnish locations of equipment and all instructions and wiring diagrams necessary to select the materials required to install this equipment properly. Furnish and install all conduit wire boxes and common wiring materials to make the installation complete and operative.

1.02 REFERENCE DOCUMENTS

- A. The Special Provisions for Electrical Work are hereby made a part of this Section of Work. Refer to Section 16010.
- B. Refer to other Divisions of the Drawings and Specifications for information as to the scope of this work. All notations for electrical work to be "By Electrical" or "By Mechanical," or "See Electrical" or "See Mechanical" shall be deemed instructions for work in Division 16.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. The Owner or other Contractors will furnish and deliver to the job site the motors, controllers, switches, and other controls for the equipment which they furnish, except as indicated otherwise.
- B. Motor controllers shall be in accordance with NEMA standards for the application; a product of a NEMA member; NEMA rated voltage, frequency and power of the motor; housed in a NEMA standard enclosure suitable for the environment of controller location; and equipped with necessary auxiliary contacts required for control and/or interlock to operate in the systems indicated. Each controller shall be equipped with an overload in each ungrounded leg selected on the nameplate full load current of the actual motor installed on the job that the device serves.
- C. Except as indicated otherwise, controllers for three phase and large single phase motors shall be magnetic, non-reversing, full voltage, across-the-line type. Combination units shall have fused switch disconnects. Manual starters shall be used for small single-phase motors and shall be flush mounted toggle switch-type, trip free and trip indicating with neon pilot lights and Type 304 stainless steel cover plates.
- D. Each magnetic starter unit shall be provided with a fused 120 volt control transformer sized to handle the holding coil, pilots, etc., plus the requirements for relays, EP switches, interlocks, remote pilots and other devices as set forth for the temperature controls and operation control. Each magnetic starter unit shall be equipped as required with a hand-off-automatic switch and pilot light or a push button and pilot light, and all necessary interlocks as required to operate the equipment served by the unit and the auxiliaries and control and indication devices

associated with the equipment. Pilot lights may be omitted on intermittent operating equipment such as sump pumps and sewage ejectors, but hand-off-automatic switches on these types of devices on all equipment which could be damaged by being left in the “hand” position shall be spring return from the “hand” to the “off” position.

- E. Motor controllers for reduced voltage or increment winding starting shall be as specified for the particular piece of equipment controlled. Each such controller shall match the motor and shall be equipped with proper overload protection for the device and the motor windings, a proper timer for the first step, and shall be closed transition between steps.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Set in place all controllers, switches, and control devices. Furnish and install all supports, conduit, wire, boxes and common wiring materials, etc., as required. Furnish and install all interlocks and interconnecting wiring for equipment controls and safeties and make all other electrical connections for proper operation.
- B. Furnish and install a suitable disconnect switch for each motor and electric powered equipment which does not have such a disconnect as an integral part of the equipment or which is not within sight of a feeding branch circuit protective device which meets the requirements of a disconnect.

END OF SECTION

SECTION 16170

DISCONNECT SWITCHES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install a suitable disconnect switch where indicated on the Drawings, or where required by the Specifications or the Code.

1.02 REFERENCE DOCUMENTS

- A. The Special Provisions for Electrical Work are hereby made a part of this Section of the Work. Refer to Section 16010.

1.03 SUBMITTALS

- A. Submit complete manufacturer's specification on each type of disconnect switch proposed to be furnished for the job.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Disconnect switches serving motor loads shall be properly NEMA rated for these motors. Disconnects shall be rated for the space in which where they are located with NEMA rain-tight construction for units located outdoors.
- B. Disconnects shall be Square D Company NEMA Type HD, quick-make, quick-break. Disconnects shall be fused type where so indicated.
- C. Where shown on the Plans, Furnish and Install Class "R" rejection type Fuse clips within the Designated Device.
- D. Disconnect switches shall conform to U.L. 98-1981 and shall be so labeled.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install disconnects for motors, controllers, transformers, electric heaters and all other devices where so indicated, specified or required by code and where manual operating branch circuit protection devices are not within sight and within 50 feet of the device.
- B. Mount disconnects 48" above floor on walls, columns or free standing rigid steel frame unless otherwise indicated.
- C. All disconnect cover and switch plates shall be labeled to describe what device they disconnect.
- D. Where equipment is furnished to the job with a suitable disconnect as part of the equipment an additional disconnect will not be required to be added at the equipment.
- E. Provide fuses as designated on the drawings.

END OF SECTION

SECTION 16190

SUPPORTING DEVICES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install all necessary hangers, supports, bases and connections for properly installing all electrical equipment and materials.

1.02 REFERENCE DOCUMENTS

- A. The Special Provisions for Electrical Work are hereby made a part of this Section of the Work. Refer to Section 16010.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Provide hot-dipped galvanized malleable iron one-hole pipe straps, beam clamps, or hand-on-steel rod hangers for single runs of conduit to be fastened to the structure. Rod hangers shall be selected for weight supported but shall not be smaller than No. 8.
- B. Rod hangers and adjustable "J" pipe hangers shall be equal to Kindorf Type C-149 for conduits. Conduits two inches (2") and smaller may be fastened with pipe hangers equal to Kindorf Type 6H.
- C. Caddy spring steel clamps and hangers and steel one-hole snap straps may be used in lieu of above to fasten single runs of conduit up to one inch (1") size to steel structures and support rods where this conduit is run within the ceiling space.
- D. Continuous channel inserts or trapeze hangers made of steel framing channel and fastened with single bolt channel pipe straps shall be provided to support multiple runs of conduit and other raceways.
- E. Galvanized U-bolts or Kindorf C-210 riser pipe clamps on channel iron bearing plates at intervals of at least one clamp per joint shall be provided for support of vertical runs of conduits of more than twelve feet (12').
- F. Suitable angle iron or framing channel supports shall be used to support all panelboards, cabinets, junction and pull boxes where indicated as not mounted to the building structure.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Securely fasten and support conduits and raceways of all types and all electrical boxes, devices, and equipment from the main building structure except as specifically indicated otherwise. Support conduits within three feet (3') of each end of each bend, of each termination and at intervals along the run that will maintain true raceway alignment, without sag or deformation either during pull-in of conductors or after conductors are in place. On exposed raceways, provide supports at a minimum of six feet (6') on centers and on each side of each bend. Vertical conduits shall be supported at not more than 10' on center in addition to the above.
- B. Maintain horizontal and vertical alignment of raceways so as not to adversely affect the building structure in strength or appearance. Cable, strap, or wire hangers or fasteners shall not be used.

- C. Place conduits on spacers when running exposed on or adjacent to walls after wall surface is installed to allow wall to be painted after conduit is installed.
- D. Support cabinets and boxes to the floor and to the structure above independent of all raceways entering the boxes. Structural walls or columns may be used to support these cabinets or boxes only after specific approval is given.
- E. Fasten cabinets, boxes, panelboards, disconnects, motor controls and similar devices indicated other than at walls on channel iron racks mounted to floor and structure above. Three-fourths inch (3/4") thick plywood backboards painted to match the equipment finish may be used as part of the rack.
- F. Support outlet boxes and junction boxes 100 cubic inches and smaller as specified for raceways. Locate outlet and junction boxes above accessible ceilings so they will not interfere with the installation of a lay-in type lighting fixture in any space in the ceiling.
- G. Rust inhibit all supports by galvanizing or other approved means. Supports shall be on site rust inhibited at all cuts, breaks, welds, or other points where rust inhibitor coating is broken.

END OF SECTION

SECTION 16400

CLASS "B" FIRE ALARM SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Install, program and configure a class B, non-proprietary addressable automatic fire alarm system. The system shall include but not be limited to system cabinet: power supply, 32 character LCD annunciator, programming keypad, built in dual line Digital Communicator associated peripheral devices, batteries, wiring, and other components and accessories required to furnish a complete Life Safety Code compliant system.
- B. All final connections, testing and adjusting of the systems shall be done under the direct supervision of the manufacturer's representative. After completion of the installations, a trained technician employed by the system supplier shall demonstrate the system to the satisfaction of the Fire Marshall and Owner's representative.
- C. All equipment shall be provided by a single manufacturer and be commercial grade. All equipment must be UL listed for its intended purpose. (Do not install proprietary technology.)
- D. Referenced Standards:
 - 1. The following agency standards shall apply to the system components as intended:
 - a. NFPA 101 Life Safety Code, current edition.
 - b. NFPA 70 National Electrical Code, current edition.
 - c. NFPA 72 National Fire Alarm Code, current edition.
 - d. Local AHJ adopted Building, Mechanical and Fire Prevention Codes.
 - e. Americans With Disabilities Act (ADA).

1.02 SHOP DRAWINGS

- A. System Shop Drawings are required to be submitted for approval containing the following information:
 - 1. A detailed list of each piece of equipment with model numbers for each system component.
 - 2. Manufacturer's specification sheets on each item of equipment.
 - 3. A description of how each specified system functions.
 - 4. Confirmation that the manufacturer's representative will provide job site supervision during the installation of the system and instruct the operating personnel on the operation of each system.
 - 5. Standby battery calculations showing system power requirements and formulas utilized to compute the sixty (60) hours of required standby power.
 - 6. Detailed one-line schematic wiring diagrams of each specified system and the interconnection wiring between all systems.

1.03 OPERATION

- A. The activation of any manual fire alarm pull station, or the automatic actuation of any thermal detector, system smoke detector, or any other alarm initiating device shall result in the following:

1. Activate the evacuation alarm.
 2. Deactivate the door holding magnets (if any) of the doors located on firewalls. See Section 08710 for the model number of the holding magnets. All visual alarm signals shall be ADA rated for synchronize flash at a rate of one hundred twenty (120) flashes per minute (per ADA regulations).
 3. If alarm signals are silenced for any reason, they shall automatically resound if another alarm zone is tripped.
 4. A signal shall be sent either through the designated fire alarm loop to the Fire Department or to the U.L. approved alarm-monitoring provider designated by Fresenius Medical Care NA., at the direction of the local operations team through direct contract negotiation by the Director of Operations.
- B. Fire System only: The following information must be prepared, as described below:
1. ZONE LIST:

The installing technician will indicate the format and will have prepared a zone list with actual reporting codes. The description of the zone signals needs to be specific; for example: E1102 Smoke Detector – Vestibule.

 - a. Zone list shall be provided to the following parties:
 - 1) Clinic – inside alarm panel.
 - 2) FMC approved - Alarm Monitoring Company
 - 3) FMC Project Manager – in the Closeout Documents.
 2. SYSTEM TROUBLE:

The installing technician will identify actual reporting codes, incidents such as Low Battery, A/C Fail, Phone #1 or Phone #2 Fail. This will include 24-hour com test-system ok and com test system ok but system in trouble. All panels will be programmed to send this 24-hour test signal.
 3. COMPLETE TEST:

The programming to the central station will be complete only after a complete test of all signals is successfully executed and FMC approve monitoring company records and confirms they have been received.

PART 2 - PRODUCTS

2.01 GENERAL

2.02 CONTROL PANEL

- A. The Fire Alarm Control Panel (FACP) Manufacturer shall be Silent Knight, Bosch, Fire Lite, Honeywell, or approved equal.
- B. The FACP must be capable of supporting eight (8) conventional fire zones, expandable to 30 or a minimum of 50 addressable points.
- C. The panel must have a 32 character LCD annunciator/keypad with the capability of having an additional two supervised remote annunciators/keypads connected in the field.
- D. The FACP must have a built in UL approved digital communicator. The communicator must allow local and remote up/downloading of system operating options, event history, and detector sensitivity data.

2.03 SYSTEM WIRING

- A. All system wiring shall be wired with standard NEC 760 compliant wiring, no twisted, shielded or mild capacitance wiring is required for standard installations. All FACP screw terminals shall be capable of accepting 12, 14 and 18 AWG wire. All system wiring shall be in accordance with the requirements of NFPA 70, the National Electric Code (NEC) and also comply with article 760 of the NEC.

2.04 POWER LIMITED WIRING

- A. For Power Limited wiring, use FPLP approved wiring.

2.05 ANNUNCIATORS

- A. The main control must have a built in annunciator with a 32-character LCD display and feature LED's for General alarm, System trouble, System silence and Power. All controls and programming keys are membrane style buttons. The annunciator must be able to silence and reset alarms through the use of a keypad-entered code, or by just pushing the desired function key, depending on how the system is configured. The annunciators must have three levels of user codes that will allow the limitation of operating system programming to authorized individuals.

2.06 REMOTE ANNUNCIATORS

- A. The fire system shall be capable of supporting up to two remote annunciators. LCD Remote annunciator shall have the same control and display layout so that they match identically the built in annunciator. Remote annunciators shall have the same functionality and operation as the built in annunciator. All annunciators must have 32-character LCD displays and must feature four LED's for general alarm, system trouble, system silence, and system power.
- B. The annunciator must be able to silence and reset alarms through the use of a code entered on the annunciator keypad. The annunciator must have three levels of user codes that will limit the operating system programming to authorized individuals.

2.07 DIGITAL COMMUNICATOR

- A. The digital communicator must be an integral part of the control panel and be capable of reporting all points and all zones of alarm, supervisory, and trouble as well as all system status information such as loss of AC, low battery, ground fault, loss of supervision to any remote devices with individual and distinct messages to a Central Station or Remote Station. The communicator must also be capable of up/downloading all system programming options, Event history and Sensitivity compliance information to a PC on site or at a remote location.
- B. The communicator shall have an answering machine bypass feature that will allow the panel to respond to communication even on phone lines that have other communication equipment present. The communicator must be capable of reporting via 4/2, BFSK, SIA, Contact ID and 3/1 formats. The communicator shall have a delayed AC loss report function which will provide a programmable report delay to help ease traffic to the central station during a power outage. No controls that use external modems for remote programming and diagnostics shall be accepted.

2.08 DRY CONTACTS

- A. The FACP will have two form "C" dry contacts that can be programmed for alarm, trouble notification, water flow, and supervisory.

2.09 GROUND FAULT DETECTION

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

2.10 OVERCURRENT DETECTION

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

2.11 TEST FUNCTIONS

- A. A “Lamp Test” mode shall be a standard feature of the fire alarm control panel and shall test all LED’s and the LCD display on the main panel and remote annunciators.
- B. A “Walk Test” mode shall be a standard feature of the fire alarm control panel. The walk test feature shall function so that each alarm input tested will operate the associated notification appliance for two seconds. The FACP will then automatically perform a reset and confirm normal device operation.
- C. A “Fire Drill” mode shall allow the manual testing of the fire alarm system notification circuits. The “Fire Drill” shall be capable of being controlled at the main annunciator and remote annunciators.

2.12 REMOTE INPUT CAPABILITIES

- A. The control panel shall have provisions for supervised switch inputs for the purpose of Alarm reset and silence operations.

2.13 ON-BOARD PROGRAMMER

- A. The FACP shall have an on-board programmer which will allow for all system functions and options to be programmed via the on board annunciator keypad. Any panel that does not have this capability will not be accepted.

2.14 SYSTEM OPERATION

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

are silenced the silenced LED on the control panel and on any remote annunciators shall remain lit until the alarmed device is returned to normal.

B. Troubles:

1. When a device indicates a trouble condition, the control panel System Trouble LED should light and the LCD should prompt the user as to the current events. The trouble information must be stored in event memory for later review. Event memory must be available at the main and all remote annunciators.
2. When the device in trouble is restored to normal, the control panel shall be automatically reset. The trouble restore information must be stored in event memory for later review. Event memory must be available at the main and all remote annunciators. A trouble shall be silenced by pushing the silence button at the main control or entering a code and pushing the silence button on the remote annunciators. When silenced, this shall not prevent the resounding of subsequent events if another event should occur.

C. Supervision Methods:

1. Each indicating appliance circuit shall be electrically supervised for opens, grounds and short circuit faults, on the circuit wiring, and shall be so arranged that a fault condition on any indicating appliance circuit or group of circuits will not cause an alarm to sound. The occurrence of any fault will light the trouble LED and sound the system trouble sounder, but will not interfere with the proper operation of any circuit which does not have a fault condition.

D. Monitoring of Signals:

1. All alarm, trouble, or supervisory signals shall be sent to the UL approved alarm monitoring provider designated by Fresenius Medical Care NA.
2. System Information must be prepared as described below:
 - a. **ZONE LIST:**
The installing technician will indicate the format and will have prepared a zone list with actual reporting codes. The description of the zone signals needs to be specific; for example: E1 102 Fire Alarm Zone 2.
 - b. **SYSTEM TROUBLE:**
The installing technician will identify actual reporting codes, incidents such as Low Battery, A/C Fail, Phone #1 or Phone #2 Fail. This will include 24 hour com test-system ok and com test system ok but system in trouble. All panels will be programmed to send this 24-hour test signal.
 - c. **COMPLETE: TEST:**
The programming to the central station will be complete only after a complete test of all signals is successfully executed, and FMC approved monitoring company records and confirms they have been received.

PART 3 - SYSTEM COMPONENTS

3.01 CONTROL UNIT

3.02 SYSTEM CABINET

A. Mounting:

1. The system cabinet shall be either surface mounted, or flush mounted. The cabinet door shall be easily removable to facilitate installation and service.

- B. Key lock to prevent tampering:
 1. The cabinet shall have a physical key and lock system to prevent unauthorized tampering to the control panel, power supply and any wiring within the cabinet.
- C. Audible System Trouble Sounder:
 1. An audible system trouble sounder shall be an integral part of the control unit. Provisions shall also be provided for an optional supervised remote trouble signal.
- D. Power Supply and Charger:
 1. The entire system shall operate on 24 VDC power supply with the rated current available of 4 Amps. The FACP must have a battery charging circuit capable of complying with the following requirements:
 2. Twenty Four (24) hours of battery standby with five (5) minutes of alarm signaling at the end of this twenty four (24) hour period (as required per NFPA 72) using rechargeable batteries with automatic charger to maintain standby sealed lead-acid batteries in a fully charged condition.
 3. The power supply shall comply with UL Standard 864 for power limiting.
 4. The FACP will indicate a trouble condition if there is a loss of AC power or if the batteries are missing or of insufficient capacity to support proper system operation in the event of AC failure. A "Battery Test" will be performed automatically every three minutes to check the integrity of the batteries. The test must disconnect the batteries from the charging circuit and place a load on the battery to verify the battery condition.
- D. Connections and Circuits:
 1. Connections to the light and power service shall be on a dedicated branch circuit in accordance with the National Fire Alarm Code NFPA 72, National Electrical Code (NEC) NFPA 70, and the local authority having jurisdiction (AHJ).
 2. The circuit and connections shall be mechanically protected. A circuit disconnecting means shall be accessible only to authorized personnel and shall be clearly marked "FIRE ALARM CIRCUIT CONTROL."

PART 4 - ACCESSORY COMPONENTS

4.01 MANUAL FIRE ALARM STATION

- A. Manual Fire Alarm Stations shall be non-coded double action type, with a key operated test-reset lock in order that they may be tested, and so designed that after actual Emergency Operation, they cannot be restored to normal except by use of a key. The reset key shall be so designed that it will reset Manual Station and open FACP without use of another key.
- B. An operated station shall automatically condition itself so as to be visually detected, as operated, at a minimum distance of fifty feet, front or side. Manual Stations shall be constructed of die cast metal with clearly visible operating instructions on the front of the stations in raised letters.
- C. Stations shall be suitable for surface mounting on matching back box, or semi-flush mounting on a standard single-gang box, and shall be installed within the limits defined by the Americans with Disabilities Act (ADA) dependent on Manual Station accessibility or per local requirements.

4.02 REMOTE POWER SUPPLIES

- A. The Remote Power Supplies for Notification appliances shall be Altronics AL802ULADA or equal. It will support 8 amps of 24-volt DC power, with four NAC circuits rated at 2.5 Amps each.
- B. The remote power supply model AL802ULADA may also be used as a conventional power expander on the system. These power supplies are activated by the panel's NAC circuit and support 1 Amp of 24 VDC power, with four notification circuits, rated at 2.5 Amps each. These power boosters may also be activated from another notification circuit from either the fire alarm control, another distributed power supply.

4.03 NOTIFICATION DEVICES

- A. The visible and audible/visible signal devices shall be System Sensor or equal signal devices and be listed by Underwriters Laboratories Inc.
- B. The notification appliance (combination audible/visible units only) shall produce a peak sound output of 90dba or greater as measured in an anechoic chamber. The signaling appliance shall also have the capability to silence the audible signal while leaving the visible signal energized with the use of a single pair of wires. Additionally, the user shall be able to select either continuous or temporal tone output with the temporal signal having the ability to be synchronized.
- C. The visible signaling appliance shall maintain a minimum flash rate of 1 Hz or greater regardless of power input voltage. The appliance shall also be capable of meeting the candela requirements of the blueprints presented by the Engineer and ADA.
- D. The appliance shall be polarized to allow for electrical supervision of the system wiring. The unit shall be provided with terminals with barriers for input/output wiring and be able to mount to a single gang or double gang box or double workbox with the use of an adapter plate. The unit shall have an input voltage range of 20-30 Volts with either direct current or full wave rectified power.

4.06 SMOKE DETECTORS

- A. Two wire smoke detectors shall be UL listed compatible with the fire alarm control panel.
- B. The smoke detector shall have a flashing status LED for visual supervision. When the detector is actuated, the flashing LED will flash at a faster rate, or lock on solid. The detector may be reset by actuating the control panel's reset switch.
- C. Smoke detectors shall be mounted as per NFPA 72 mounting and spacing requirements.

PART 5 - WIRING

5.01 INSTALLER'S RESPONSIBILITIES

- A. The installer shall coordinate the installation of the fire alarm equipment.
- B. All conductors and wiring shall be installed according to the manufacturer's recommendations.
- C. It shall be the installer's responsibility to coordinate with the supplier regarding the correct wiring procedures before installing any conduit or conductors.

5.02 INSTALLATION OF SYSTEM COMPONENTS

- A. System components shall be installed in accordance with NFPA 72, the requirements contained herein, National Electrical Code, local and state regulations, the requirements of the fire department and other applicable authorities having jurisdiction (AHJ).
- B. All wire used on the fire alarm system shall be UL Listed as fire alarm protection signaling circuit cable per National Electrical Code, Article 760. We require the use of FPLP wiring for power limited applications.

5.03 GUARANTEE AND FINAL TEST

- A. Guarantee all equipment and wiring free from inherent mechanical and electrical defects for not less than one year from the date of substantial completion.
- B. At the completion of the Work, the complete system shall be tested to the satisfaction of and in the presence of an authorized representative of the State or Local Fire Marshal and/or Fire Department. The test shall include all wiring and proper operation of all equipment. Tests shall also be made of the operation of each automatic and manual alarm indicating device of the system, without impairing such alarm initiating device. Each device shall also be tested to ascertain that it operates on the designated zone and proper coding. Additional tests shall be made as required by the authorities having jurisdiction or Fire Department. Submit test report co-signed by the Electrical Subcontractor's alarm system manufacturer at completion of testing to Owner, Engineer, and Fire Department or Fire Marshal.
- C. In the event the clinic opening has been delayed for periods of up to three (3) months at a time, the fire alarm contractor is required to continue testing the fire alarm system on a quarterly basis throughout the complete warranty period or up until the clinic is certified and licensed, whichever occurs first.
- D. A Knox Box may be required to be provided at the discretion of the Fire Department at no additional cost to FMC.

5.04 DOCUMENTATION

- A. At the completion of the Project, a complete set of the fire alarm submittal book, point-to-point wiring diagrams, plus a complete listing of the quantity and type of initiating and signaling devices shall be left at the fire control panels for the Fire Department's use.

5.05 WIRING

- A. Furnish and install all wiring, conduit and outlet boxes required. Internal wiring shall be low energy fire alarm cable installed according to NEC requirements. Color-coding shall be used and maintained throughout the installation of this system. All wires shall be tested to ensure that they are free from grounds or crosses between conductors. The system wiring shall be carried through all equipment; no pigtail connections will be allowed. Final connections between equipment and wiring system shall be made under direct supervision of a representative of the manufacturer. All manual initiating devices shall be connected first. Smoke and heat detectors shall be wired after manual initiating devices but before the supervisory devices.
- B. Minimum conductor shall be #16 AWG copper solid type THHN.

END OF SECTION

SECTION 16471

PANELBOARDS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install circuit breakers into panelboards as indicated on the Drawings.

1.02 REFERENCE DOCUMENTS

- A. The Special Provisions for Electrical Work are hereby made a part of this Section of the Work. Refer to Section 16010.
- B. See Section 16190 for Supporting Devices.

1.03 SUBMITTALS

- A. Submit complete manufacturer's specification data on each type of circuit breaker including manufacturer, trip and type proposed to be furnished.
- B. Submit a complete description and listing of devices proposed for each existing panelboard.

1.04 QUALITY ASSURANCE

- A. Circuit breakers shall be listed by Underwriter's Laboratories, Inc. for the service to be performed and shall bear the UL label.
- B. Circuit breakers shall be constructed in accordance with the applicable NEMA PB1-1977 Standards for Panelboard Construction.

PART 2 - PRODUCTS

2.01 DEVICES

- A. Circuit breakers shall have overload tripping in each pole. Multi-pole breakers shall open all poles simultaneously on manual operation and overload of any pole. Circuit breakers shall have magnetic arc blowout coils and shall be trip free and trip indicating with quick-make, quick-break mechanism.
- B. Circuit breakers shall be provided with high pressure type solderless lugs for the proper size and type to accept the feeder cables.
- C. Panelboards shall be manufactured by Square D, G.E., Siemens or Eaton.
- D. Branch panelboards on 208/120V systems shall be equipped with bolt-in circuit breakers with a minimum interrupting capacity of 10,000 amperes symmetrical on 120VAC, 60 Hertz. Where indicated on panelboard schedules, higher interrupting capacities shall be furnished.
- E. Branch panelboards on 480/277 systems shall be equipped with bolt-in circuit breakers with a minimum interrupting capacity of 14,000 amperes symmetrical on 277 VAC, 60 Hertz. Where indicated on panelboard schedules, higher interrupting capacities shall be furnished.
- F. All panelboards shall have solid copper buss bars.
- G. No panelboards shall be more than 75% full. Install 10% spare breakers.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install circuit breakers in accordance with manufacturer's published instructions.
- B. Arrange for raceways and conductors to enter panelboards only in factory recommended locations and to avoid excessive build-up of conductors in any area of the cabinets.
- C. Conductors shall be trained to their points of connection, labeled with their circuit numbers, and bound securely with ties between the lug connections and the raceway entries to the panelboard.
- D. Install spare conduits from each panelboard. Where ceiling above is furred down, stub three 3/4" conduits from each panel to an accessible space above the ceiling. Where ceiling is exposed, stub three 3/4" conduits up and turn out at the ceiling. Where there is ceiling space or crawl space below, stub three 3/4" conduits to below in a similar manner.
- E. The circuit breaker servicing the Fire Alarm Panel shall be protected from accidental tripping with an anti-trip switch.

3.02 LABELING

- A. Provide a neatly, typewritten directory of circuits for each existing panelboard as indicated for additions or modifications.
- B. The circuit breaker for the Fire Alarm Panel shall be clearly labeled inside the panelboard.
- C. The outside of the panelboard that contains the circuit breaker for the Fire Alarm Panel shall be clearly labeled so that it is easily identifiable.

END OF SECTION

SECTION 16476

FUSES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install all fuses in each device furnished under Division 16 as indicated on the Construction Drawings.

1.02 REFERENCE DOCUMENTS

- A. The Special Provisions for Electrical Work are hereby made a part of this Section of the Work. Refer to Section 16010.

1.03 SUBMITTALS

- A. Submit complete manufacturer's specification on each application and each type of fuse proposed to be furnished to the job.
- B. Include a listing of the device in which each type and size of fuse is to be mounted.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. All fuses shall be Bussman or equal except where specifically indicated otherwise.
- B. Fuses for motor loads shall be Buss LPN-RK or LPS-RK UL Class RK1. Size for factory recommended protection unless otherwise indicated.
- C. Fuses on lighting loads shall be Buss KTN-R or KTS-R UL Class RK1.
- D. Equal fuses as manufactured by Gould Shawmut will be acceptable in lieu of Bussman fuses.
- E. Other fuses shall be of type and design specifically required for the protection needed.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Furnish one (1) complete duplicate spare fuse in original carton for each fuse installed, except that not more than ten (10) of any type and size of spare fuse need be furnished. These spare fuses shall be furnished to the Owner at the time of final inspection, in a single container and accompanied with letter of transmittal and list of type and quantity of fuses furnished.

END OF SECTION

SECTION 16501
LIGHTING FIXTURES & CONTROLS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install lighting fixtures, lamps, and accessories for lighting outlets in accordance with the Drawings. Furnish and install a lighting fixture of the same type as indicated for areas of similar usage wherever the type designation is omitted on the Drawings.
- B. Furnish and install a plaster frame for each recessed fixture as required by the type of building construction. Furnish and install hangers, bolts, or other devices required to properly and adequately support each lighting fixture from the structure. Fixtures may be supported from the suspended ceiling where specifically permitted by the construction specified in other Divisions of Work. Suspended pendent fixtures shall be supported as recommended by fixture manufacturer.

1.02 REFERENCE DOCUMENTS

- A. The Special Provisions for Electrical Work are hereby made a part of this Section of the Work. Refer to Section 16010.
- B. Each lighting fixture shall be constructed in accordance with the applicable provisions of the Electrical Code as suitable for the location where they are indicated to be installed.
- C. Each lighting fixture shall bear the Underwriters' Label indicating the fixture is suitable for the application and installation location.

1.03 SUBMITTAL

- A. Submit adequately descriptive data including published catalog data or Shop Drawings for each type listing of lighting fixture for review prior to purchases or installation.

PART 2 - PRODUCTS

2.01 LIGHTING FIXTURES

- A. A National Account has been established with Graybar Electric in Atlanta and Smart Lighting Solutions as the FMC sole source vendor for all Acuity Brands products including, but not limited to, Lithonia Lighting, Healthcare Lighting, Gotham, Sensor Switch, and Blue Box. Contact projectquote@smartltg.com for pricing.
- B. A National Account has been established with LightArt by 3Form as the sole source provider for the L-5 pendent and the L-11 wall sconce lighting fixtures. For Project quotes and to place an order, call 206-524-2223 or contact fmc@lightart.com.
- C. Lighting fixtures shall be of the type, manufacturer, and construction as indicated in the Lighting Fixture Schedule or equal.
- D. Each fixture shall be complete with all proper components and accessories.
- E. Recessed LED fixtures for ceiling that have insulation shall be Type IC.

- F. Surface mounted LED fixtures shall have spacers to achieve required separation from low-density ceilings construction.
- G. Fixture housing shall be reinforced steel, 90% reflective white enamel finish.
- H. Lighting Standards:
 - 1. Refer to FMC Master Lighting Fixture Schedule for complete listing of clinic fixtures.

2.02 LAMPS

- A. LED lamps shall be standard 3500K except as listed for color, energy savings, or special duty.

2.03 OCCUPANCY SENSORS

- A. A National Account has been established with Graybar Electric in Atlanta and Smart Lighting Solutions as the FMC sole source vendor for all Acuity Brands products including, but not limited to, Lithonia Lighting, Healthcare Lighting, Gotham, Sensor Switch, and Blue Box. Contact projectquote@smartltg.com for pricing.
- B. Occupancy sensors shall be of the type, manufacturer, and construction as indicated in the Lighting Control Schedule or equal.
- C. The following rooms and areas shall be provided with line voltage, passive dual technology, wall switch occupancy-sensor switches (Cat# WSX-PDT) located at strike side of the door when possible, or as required by code. All private or shared offices and the Conference Room shall be provided with dimmable controls in addition to the occupancy sensor (Cat# WSX-PDT-D). Rooms or areas that are larger than 200 square feet shall be provided with a low voltage passive dual technology, ceiling mounted occupancy sensor (Cat# CM-PDT-9) and relay / power pack (Cat# PP20).
 - 1. All Rooms other than Water Treatment, Waiting, Treatment, Separation, Wiring Closet (when enclosed room), and Sprinkler Riser Room/Backflow Preventer Closet.
 - 2. Visitors and Staff Toilets.
 - 3. Conference Rooms.
 - 4. Medical Records and Multi-Purpose Offices.
 - 5. Staff Lounge.
 - 6. Medical Waste.
 - 7. All Corridors (ceiling mounted).
 - 8. Storage Room (ceiling mounted).
- D. Set all occupancy sensor timer settings as directed by FMC Project Manager.

2.04 TREATMENT ROOM

- A. Lighting in Treatment Room shall be controlled by the relay panel in three zones (refer to lighting plan and lighting control panel for further information):
 - 1. Zone 1 - Lighting over Patient Care shall be switched on/off via relay panel based upon time of day schedule or signal from security system. Local, line voltage switches shall provide for additional local dimming control (Cat# ISD-BC) as shown on the Drawings.
 - 2. Zone 2 - Lighting over Nurse Station shall be switched on/off via relay panel based upon time of day schedule or signal from security system. Local, line voltage switches shall provide for additional local dimming control (Cat# ISD-BC) as shown on the Drawings.

- For Nocturnal Care locations, this control zone shall be capable of being scheduled for 24 hour operation.
3. Zone 3 – Down Lights over walkways shall be switched on/off via relay panel based upon time of day schedule or signal from security system. Local, line voltage switches shall provide for additional local dimming control (Cat# ISD-BC) as shown on the Drawings. For Nocturnal Care locations, this control zone shall be capable of being scheduled for 24 hour operation.

2.05 RELAY PANEL

- A. Relay panel shall be Acuity Brand Blue Box #GR1416 LT INT 16NCL DTC DV.
- B. Exterior lighting shall be controlled by the relay panel as shown on the Drawings.
- C. Relay panel time schedules shall be programmed to comply with all applicable codes and requirements.

2.06 DAYLIGHT HARVESTING ADD ALTERNATE

- A. Each daylight harvesting zone indicated on the Drawings shall be provided with a lighting control sensor that automatically dims the designated lighting.
 1. Private offices or spaces with line voltage wall switch sensor: Acuity Controls Cat# WSX PDT D.
 2. Other spaces: Acuity Controls Cat# CM ADC or CM ADC DZ.

2.07 ACCESSORIES

- A. Recessed lighting fixtures for mounting in lay-in type ceilings shall be provided with tee clamp lock-in supports when it is acceptable to support the fixtures from the tees. Recessed fixtures will have all required plaster frames, concrete inserts, gaskets, sight shields and similar accessory components required for the particular installations in this Project.
- B. Lighting fixtures indicated to have integral battery, charger and inverter for emergency light shall have equipment specially designed for and installed in the fixture. Units shall meet or exceed Life Safety 101, 90-minute illumination capability.

2.08 SWITCHING

- A. All undercabinet lighting shall be switched at the wall with room ceiling fixtures.
- B. All lighting in Water Treatment, Wiring Closet (when enclosed room), and Sprinkler Riser Room/Backflow Preventer Closet shall be switched at the wall.

PART 3 - EXECUTION

3.01 FIXTURES

- A. See standard Lighting Fixtures Schedule included in this Specification.
- B. Each lighting fixture shall be carefully installed in accordance with the manufacturer's directions and to fit the general construction of the walls, ceilings or other areas where the fixture is indicated. Refer to reflected ceiling plans, elevations and other details for the exact locations of fixtures. Where those details or other instructions do not indicate lighting fixture

locations, position the fixtures proportionally in spaces using the arrangement indicated on the Electrical Drawings; plus, center, parallel and space the lighting fixtures and rows of fixtures on and with general construction lines.

- C. Install suspended and recessed lighting fixtures in accordance with the lighting fixture manufacturer's instructions for the application. Install above-ceiling junction boxes to provide ready access through the ceiling opening. Install hangers to support fixtures independent of suspended ceilings unless the ceiling is specifically designed to support the fixture. Any above-ceiling insulation materials are prohibited to be within 3" of recessed lighting fixtures.
- D. Mount surface lighting fixtures to the ceiling in accordance with the lighting fixture manufacturer's instructions. Provide through-ceiling-to-structure-above supports for each lighting fixture mounted on suspended ceiling unless the ceiling is specifically designed to support the lighting fixture.

Narrow channel or box-mounted lighting fixtures on tee-bar type ceilings shall be connected through outlet boxes centered above the fixture and supported squarely on the tees. Provide auxiliary above-ceiling supports for the ceiling where tees must be cut.

- E. Securely anchor bracket-mounted fixtures to maintain vertical and horizontal alignment. Provide that all mounting devices are concealed.

3.02 TESTING, CLEANING, AIMING AND ADJUSTING

- A. Each fixture shall be replaced in proper operating condition, and properly fitted and adjusted to aim, focus, and physically work in the spaces and construction where installed. Fixtures shall be left clean of all dust, dirt, grease and other foreign materials. Reflectors and lenses shall be clean and undamaged. Trims, finishes, and housings shall fit together and to the building construction and show no evidence of damage, handling, and misalignment.
- B. All emergency egress lighting fixtures, including exit signs, wall packs and exterior fixtures, must be tested monthly by GC until building is handed over to Owner.

END OF SECTION

SECTION 16603
EMPTY RACEWAY SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install complete systems of raceways, outlets, junction boxes, terminal boards, cabinets, interconnections, grounding and pull ropes in inaccessible construction for future installation of wires and cables under other Sections of Work, other Divisions of Work, other Contractors or Vendors, or by the Owner. See the Drawings or other Sections of Work for and descriptions of the systems.
- B. This Work includes provisions for systems such as television and telephones where the installation of the system is outside the scope of this Contract.

1.02 REFERENCE DOCUMENTS

- A. The Special Provisions for Electrical Work are hereby made a part of this Section of the Work. Refer to Section 16010.
- B. The raceway systems shall be in accordance with materials and methods described in Section 16100 of Work.

1.03 SUBMITTALS

- A. Submit complete manufacturer's specification data on each type of material to be used.
- B. Submit complete information on raceway routing and tagging to enable others to utilize the raceways in the proper sequence of the work.

PART 2 - PRODUCTS

2.01 RACEWAYS

- A. Raceways, including wireways, conduits, junction boxes, pull boxes, cabinets, terminal boards and outlets shall be as set forth elsewhere in this specification.

2.02 PULL ROPE

- A. Pull ropes shall be 3/16" Jet Line Poly rope or equal.

2.03 TAGS

- A. Tags for identification of termination of raceway shall be 1" x 3" linen paper tags with eyelets and string ties or equal.

PART 3 - EXECUTION

3.01 RACEWAYS

- A. Raceways including wireways, conduits, junction boxes, pull boxes, cabinet's terminal boards and outlets shall be installed as set forth elsewhere in this Specification.

3.02 PULL ROPE

- A. Install a pull rope in each conduit installed in this Division of Work that does not have wire, and cable installed under this Division of Work. Leave 18" of pull rope at each end of each termination.
- B. Coil the pull rope inside of each outlet box cabinet or pull box where raceways are terminated in this equipment. Tie the pull rope at each end terminated otherwise to avoid accidental removal of the pull rope.

3.03 TAGGING

- A. Provide a line tag on each end of each pull rope installed in this Section of Work. Securely attach this tag to the pull rope.
- B. Label this tag with a description of the raceway system being provided and with a complete description of the other end of the pull rope.

END OF SECTION

SECTION 16730
CATEGORY 6, COAXIAL, AUDIO & VIDEO CABLE

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install Category 6 and coaxial wire for the phone, data, patient care entertainment and Clinical Network System.
- B. This Work includes conduit and wiring as illustrated on the accompanying Drawings and hereinafter specified.

1.02 REFERENCE DOCUMENTS

- A. The Special Provisions for electrical work are hereby made a part of this Section of the Work. Refer to Section 16010.

1.03 SUBMITTALS

- A. Submit complete manufacturer's specification data on the type of CAT 6 wire and RG6 coax cable material to be used.
- B. Submit a certified copy of the following for approval:
 - 1. Voice and data, CAT6 test reports required and described by this Specification and in accordance with ANSI/TIA 568-C.1 and ANSI/TIA 568-C.2 field testing procedures.

1.04 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. Local and State Code.
- C. Electronic Industry Association (EIA).
- D. Telecommunication Industry Association (TIA).

PART 2 - PRODUCTS

2.01 CATEGORY 6 CABLE

- A. Cable Construction
 - 1. Cable Conductors shall be 23 AWG solid bare annealed copper with Polyolefin for non-plenum and (3) pairs FEP plus (1) pair Polyolefin for plenum insulation.
 - 2. Cable Conductors shall be color coded as follows:
 - Pair 1: Blue – White/Blue
 - Pair 2: Orange – White/Orange
 - Pair 3: Green – White/Green
 - Pair 4: Brown – White/Brown, non-plenum Brown – White, plenum.
 - 3. Rip cord is applied longitudinally under cable jacket.
 - 4. Cable jacket shall be :
 - a. Non-plenum flame retardant PVC.
 - b. Plenum, low-smoke, flex guard flame-retardant PVC.

- B. Cable Physical Data:
 1. Nominal cable diameter, 0.022 inches.
 2. Minimum bend radius, 1 inch.
 3. Maximum pulling force, 25 lbs.
- C. The cable jacket colors for their intended use shall be:

Blue	Patient station, Clinical
White	Patient station, Auxiliary Data, Wireless Access Points
Yellow	Workstation Data
Gray	Voice, Telephone
- D. Provide all Category 6 cable from one manufacturer. Cable specifications and performance shall meet and or exceed General Cable, Gen Speed 6000 product line. Manufacturer's cable shall be UL performance level tested product.

2.02 COAXIAL CABLE, RG-6/U QUAD SHIELD

- A. Cable Construction:
 1. Cable conductor shall be 18 AWG bare copper.
 2. Insulation shall be gas-injected or foam polyethylene.
 3. Shield shall be 95% bare copper braid.
 4. Jacket shall be:
 - a. Non-plenum, PVC compound.
 - b. Plenum, low-smoke, flex guard flame-retardant PVC.
- B. Provide all coaxial cable from one manufacturer.
- C. For all low voltage hospital TV systems installations provide either of the following RG-6/U CCTV Coaxial Cable products. **No substitutions.**
 1. West Penn 806
 2. Belden 533945
- D. For all overhead/soffit-mounted TV installations, provide either of the following non-plenum RG-6/U CATV Coaxial Cable products. **No substitutions.**
 1. West Penn 841
 2. Coleman 92003

2.03 AUDIO & VIDEO CABLE

- A. For all hard wired TV audio cable installations from soffit to dialysis chase. **No substitutions.**
 1. West Penn 231

2.04 PLENUM GRADE

- A. The Contractor shall adjust the conductor's jacket for Plenum rating as required by local or State regulations, or as job requirements dictate.

2.05 GROUND BAR

- A. Provide telecom ground bar with #6 insulated green grounding conductor back to electrical service entrance ground bar. Owner's equipment installer shall terminate each rack to telecom ground bar.

PART 3 - EXECUTION

3.01 CATEGORY 6 INSTALLATION

- A. Provide recessed mount 4-square box with single gang mud ring with 1" conduit sleeve to 6" A.F.C. for all locations and at heights as shown on Contract Drawings.
- B. Run cables continuously without splice from wiring closet rack punch down to wall box jack with corresponding identification numbers on each end of each wire.
- C. Terminate wire in accordance with 568B standard wiring code at all telephone, data, patient entertainment, and Clinical Network System terminal locations as designated on the Contract Drawings.

3.02 COAX TV CABLE INSTALLATION

- A. Run coax cable continuously without splice from wiring closet patch panel to each patient entertainment location as shown on the Contract Drawings with corresponding identification numbers on each end of every cable. Provide 5'-0" whip at each end for television vendor to terminate.

3.03 AUDIO CABLE INSTALLATION

- A. Run coax cable continuously without splice from electrical panel @ dialysis chase to each patient entertainment location as shown on the Contract Drawings with corresponding identification numbers on each end of every cable. Provide 5'-0" whip at each end for television vendor to terminate.

3.04 CABLE SUPPORT

- A. Where wires and cables are permitted to be run without conduit. They shall be independently supported from the building structure at intervals not exceeding four (4) feet on center, utilizing cable supports (J-Hooks, Arlington Loops) specifically approved for the purpose.
- B. Wires and cables shall not rest on or depend on support from suspended ceiling media (tiles, spines, runners, bars, or support wires in the plane of the ceiling), nor shall they be supported from pipes, ducts or conduits.
- C. Where cables are bundled together, separate bundles shall be provided separately for each type of cabling and separately for each independent system. Bundling and/or supporting ties shall be of a type suitable for use in a ceiling air handling plenum regardless of whether or not installed in a plenum.
 - 1. Cables shall be tagged or labeled at each termination point and in each intermediate-junction box, pull box or cabinet through which they pass.
- D. Comply with applicable requirements for locating and routing circuitry, for installing circuitry, and for-fire-stopping as described in other sub-section of Section 16010 and Section 07841.

3.05 FIELD TESTING AND CERTIFICATION

- A. The installing Contractor shall submit test plans, test design specifications and procedures for all field tests to the Architect. The test plans shall be sufficiently documented by the Contractor to ensure that each test is comprehensive and representative of the functions noted in item "D" below.

- B. 100 OHM transmission performance testing for Category 6 cables shall meet or exceed the applicable requirements in AHSI/TIA 568-C.1 and C.2 including their addenda.
- C. Link test configuration shall be tested as a channel from each outlet connector through the patch panel device.
- D. The wire map test for all pairs shall be performed and recorded for all segments. Wire map test electrical performance at 100MHz frequency shall meet or exceed the values expressed below in db per 328ft (100m) length.
 - 1. PSACR 10.32
 - 2. ACR 13.3
 - 3. Attenuation 22.0
 - 4. PSNEXT 32.3
 - 5. NEXT 35.3
 - 6. PSELFEXT 20.8
 - 7. ELFEXT 23.8
 - 8. Return Loss 20.1

Any pair that fails to meet the above performance values will require cable replacement and retesting.
- E. Field test measurements data documentation for each pair shall be printed in a summary report and made available to Fresenius Medical Care, Project Manager within 5 days following the test.

END OF SECTION

SECTION 16910
TEMPERATURE CONTROLS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The furnishings of the temperature controls are, in general, not within the scope of Division 16. However, wiring and connecting of all equipment operator controls and indication equipment provided and set in place by others that is not performed under other Division of Work shall be a part of this Division of Work.
- B. Refer to Division 15 of these Drawings and Specifications for information as to the scope of this Work.

1.02 REFERENCE DOCUMENTS

- A. The Special Provisions for Electrical Work are hereby made a part of this Section of the Work. Refer to Section 16010.
- B. Refer to Division 15, "15550 Controls" for work and materials.
- C. Refer to Sections 16100 Series for materials to be furnished and installed.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Raceways as specified in Section 16110 and Section 16111, Conduit.
- B. Wire and cable as specified in Section 16120.
- C. Pull boxes, Junction Boxes, Cabinets, and Outlet Boxes as specified in Sections 16131, 16133 and 16134.
- D. Hangers and Supports as specified in Section 16190.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Furnish and install all conduit, wire, boxes and common wiring materials necessary for the Work unless specifically excluded elsewhere in the Specifications or on the Drawings.
- B. The Owner or other Contractors or other Divisions of Work will furnish the exact locations or equipment, and also all instructions and wiring diagrams necessary to select the materials required to install this equipment properly.

END OF SECTION