

SECTION 15100

MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SPECIAL NOTICE

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

1.02 FLAME SPREAD PROPERTIES OF MATERIALS

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

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

- A. All horizontal runs of piping shall be suspended from the structural members above by means of approved hangers spaced as scheduled. Supports and hangers shall be installed to permit free expansion and contraction, the piping shall be guided and firmly anchored. No piping shall be self-supporting nor shall it be supported from the equipment connections or the suspension system furnished for suspended ceilings.
- B. All hangers shall be properly sized to fit the pipe or the insulation around the pipe which they are supporting. All hangers shall bear the name of the manufacturer by whom they are made. Pipe hangers shall be formed steel clevis type hanger with adjustable attachment to hanger rod. Hangers shall be properly sized to support weight of piping under operating conditions as recommended in the manufacturers’ published literature. For uninsulated copper or brass piping, use hangers as specified above

except that they shall be copper plated or plastic sheathed wherever they will be in contact with the copper pipe.

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

2.02 FLOOR AND CEILING PLATES

- A. In each finished space, furnish a chromium plated sectional escutcheon on each pipe or hanger rod penetrating a wall, floor or ceiling. Escutcheons shall be sized to fit snugly to all lines and where the lines are insulated, the escutcheons shall be fit snugly over the insulation. Where required, these plates shall be provided with set screws so that they shall fit snugly against the finished surface. Furnish a galvanized or aluminum collar and flange on all ducts passing through floors, walls or ceilings.

2.03 ACCESS DOORS

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

2 1/2" and Smaller

Gate 125 # Crane Co. #428

Valve BB, Screwed

Globe 300# Crane Co. #7

Valves BB, Union Bonnet

Check 125# Crane Co. #34

Valves BB, Screwed

PVC Valves to be true union ball valves

C. Gas Cocks

1/4 inch to 1 inch inclusive, Crane #289

1 1/4 inch to 2 inches inclusive, Crane #272

2 1/2 inches to 4 inches, Crane #324

D. Hose Bibbs

Screw End

Solder End

Hose Bibbs Nibco #760

Nibco #70

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

2.05 COMBINATION TEMPERATURE AND PRESSURE RELIEF VALVES

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

2.06 UNIONS

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

2.07 STRAINERS

- A. Strainers shall be of the basket or wye type in sizes as indicated on the drawings and shall be provided with 1/2 inch valved drain and unless the strainer design is devoid of air pockets, a 1/4 inch air vent cock.
- B. All strainers shall have cast iron or bronze bodies of ample strength for the pressure to which they shall be subjected, removable cylindrical or conical screens of nickel, copper or brass and suitable flanges or tappings to connect with the piping they serve. Strainers 2 1/2 inches and larger shall be provided with flanged covers.
- C. The free area of each screen shall not be less than three times the area of the strainer inlet and the mesh size shall be suitable for the service intended.
- D. Approved Manufacturers: Armstrong, Cash, Crane, Keckley, McAlear, Mueller, Sarco.

2.08 AIR CHAMBERS

- A. Install one air chamber on each hot water and each cold water pipe to each plumbing fixture or behind each group of plumbing fixtures. Air chambers shall be constructed from copper pipe. If one air chamber is installed on each hot and cold water pipe to each plumbing fixture, it shall be the full size of the supply and 18 inches tall, properly capped; if one is furnished for each group it shall be 2 inch pipe, 24 inches tall. At the subcontractor's option, he may use factory fabricated chambers with volume at least equal to those herein specified for each type installation.
- B. Approved Manufacturers: Nibco, Wolverine.

2.09 IDENTIFICATION AND LABELING

- A. General: Make it possible for the personnel operating and maintaining the equipment and systems in this project readily 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 function are not obvious. For example, it would not be expected that valves at a pump in a machine room would be tagged. These tags shall be 1/8" thick brass discs, 1-1/2" in diameter. Each tag shall be attached to its valve with copper clad annealed iron wire or other approved material. Valves above the ceilings shall have a red, 1/2" round or square, press tape marking on the ceiling access panel or the tee bar at lift-out ceiling panel access.
- D. Pipe Identification Markers: In addition, pipe runs throughout the building including those lift-out ceilings, under floor, and those exposed to view when access doors or access panels are opened, shall be identified by means of Brady Markers. Concealed areas, for purposes of this identification section, are those areas which cannot be seen except by demolition of the building elements. Markers shall be made of laminated plastics and shall have acrylic plastic over coating to shed dirt, grease, and, moisture. In addition to the pipe markers, arrow markers shall be used to indicate the direction of flow. The following specific instruction shall apply to the application of these markers.
1. Provide a pipe marker at each valve to indicate proper identification of pipe contents. Where several valves exist on one header, it is necessary to mark only the header.
 2. Provide an arrow marker with each pipe marker pointing away from the pipe marker to indicate direction of flow.
 3. Provide a double-ended arrow marker when flow can be in either or both directions.
 4. Provide a pipe marker and arrow marker at every point of pipe entry or exit where the lines go through a wall or service column.
 5. Provide pipe markers and arrow markers at intervals not exceeding 5 feet.
 6. Markers shall be located on the two lower quarters of the pipe where view is unobstructed.
 7. Use Brady Marker with 2" letter height on pipes with outside diameters (including insulation) of 3" or more. Use 1" letter height on all pipes with outside diameters less than 3".
 8. Brady Markers shall conform to ASA A-13 "Scheme for the Identification of Piping Systems". Arrow markers must have the same ASA background colors as their companion pipe markers.
 9. Brady Markers shall have a 3/4" pressure sensitive adhesive strip on the inside edge of each marker to seal the marker to itself.

PART 3 - EXECUTION

3.01 EQUIPMENT FOUNDATIONS

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

3.02 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 depths 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 insure that jointing and material are not damaged.
- B. Copper piping systems shall be joined with solder joints except that water distribution systems buried below building slabs shall be joined with compression type fittings.

For solder type joints, the tubing shall be cut smooth and square and all burrs removed with a reamer and when necessary, tubing shall be rounded out with a sizing tool. All surfaces shall be properly cleaned by polishing both cup of fitting and the tube end with steel wool or fine sand cloth. After cleaning, flux shall be applied evenly to male end of tubing and shall be inserted into the fitting, revolving the fitting once or twice on the tubing end to spread the flux evenly. After inserting tubing in cup of fitting, apply flame to outside of cup only. do not apply solder until after the fitting and pipe have reached proper heat. After connection is made, remove excess solder with brush and wipe clean. Solder shall be recommended by the manufacturer for the pressures involved, but shall

generally be 95 - 5 hard solder. Refrigerant piping shall be joined as hereinafter specified for that particular application.

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

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 15200

PLUMBING FIXTURES AND EQUIPMENT

PART 1 - GENERAL

1.01 SPECIAL NOTICE

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

PART 2 - PRODUCTS

2.01 PLUMBING FIXTURES

- A. All fixtures as hereinafter specified shall be furnished complete with all working trim at each location and as indicated by symbol and abbreviation on the drawings. Fixtures shall be standard products of approved manufacturers and shall be similar and equal in the Engineer's opinion to those specified by manufacturer's name in quality, material, appearance and operation. Care shall be taken when selecting substitutions to see that physical appearance and arrangement very nearly approaches the descriptions given hereinafter.
- B. Each unit shall be furnished with the first line chromium plated all brass trim, unless specifically mentioned to the contrary and shall be furnished with chromium plated wheel handle stops and flexible risers, except that service sink fittings have built-in screw driver stops. "P" traps on sinks, lavatories and similar fixtures shall not be less than 17 gauge brass tubing, chromium plated with screw type cleanouts. Connection between wheel handle stops and piping systems shall be chromium plated brass threaded nipple.
- C. All fixtures shall be installed so as to meet the requirements of the drawings, specifications and local plumbing codes.

- D. Where handicapped fixtures are designated on architectural drawings, they shall be furnished and installed to comply with applicable ANSI Standards.
- E. Handicapped water closets "P-1" shall be vitreous china, floor mounted, water saver, coupled tank type with elongated siphon action reverse trap bowl, white solid plastic open front seat and china bolt covers. Fixture shall be similar to American Standard 2998.012 Flush lever to be on open side. Open front seat Church 9500C.
- F. Wall hung handicap lavatories "P-2" shall be 21 1/4 x 22 inch white vitreous china with front overflow and concealed wall hanger. Lavatory shall be furnished complete with single lever ceramic cartridge type faucet with aerator. Lavatory shall be similar to American Standard 0954.000 with lever handle faucet 2385.404. Offset tailpiece with Delta #70415 ABS plastic grid strainer. Tailpiece and exposed piping shall be covered to meet ADA standards with shroud/knee contact guard 0059.020.
1. Alternate sink: Wall hung handicap lavatories "P-2A" shall be 20-1/2 x 18-1/4 inch white vitreous china with front overflow and exposed wall hanger. Lavatory shall be furnished complete with single lever ceramic cartridge type faucet with aerator. Lavatory shall be similar to American Standard Lucerne 0356.041 with lever handle faucet 2385.404. Offset tailpiece with Delta #70415 ABS plastic grid strainer. Tailpiece and exposed piping shall be covered to meet ADA standards with shroud/knee contact guard 0059.020.
- G. Dialysis prep sink "P-3" shall be Corian #804 (17 1/2" x 17 1/2" x 8 3/4" nominal dimension; 15 3/4" x 15 3/4" x 8 1/8" inside dimension) solid surfacing sink bowl (or equal) to be fabricated integrally as part of the Work of Section 06402. Sink color to be Corian "Bone" or equal. Faucet shall be manufactured by Sloan, model ETF-770 (110V) with trim plate, plug-in transformer ETF-233, laminar flow and mix valve, Delta #70415 ABS plastic grid strainer.
1. Alternate sink for plastic laminate countertop installations: Dialysis prep sink "P-3L" shall be 19 x 18 inch self-rimming stainless steel with soft satin finish bowl, back ledge and sound dampened exterior. Sink shall be similar to Elkay LR-1918 (3 hole), faucet shall be manufactured by Sloan, model ETF-770 (110V) with trim plate, plug-in transformer ETF-233, laminar flow and mix valve, Delta #70415 ABS plastic grid strainer.
- H. Dialysis prep sink "P-3H" shall be a custom fabricated (17 1/2" x 17 1/2" x 8 3/4" nominal dimension; 15 3/4" x 15 3/4" x 8 1/8" inside dimension) solid surfacing sink bowl to be fabricated integrally as part of the Work of Section 06402. Sink color to be Corian "Bone" or equal. Faucet shall be manufactured by Sloan, Model E T F-77(110V) with laminar flow and mix valve, Delta #70415 ABS plastic grid strainer with off-set tailpiece. Tailpiece and exposed piping shall be covered with plastic laminate panel to meet ADA standards and shall have smooth finish.

1. Alternate sink for plastic laminate countertop installations: Dialysis handicap prep sink "P-3H/L" shall be 19" x 18" x 5 1/2" deep self-rimming stainless steel with soft satin finish bowl, back ledge and sound dampened exterior. Sink shall be similar to Elkay L.R.A.D. 1918 (3 Hole), faucet shall be manufactured by Sloan, Model E T F-77(110V) with laminar flow and mix valve, Delta #70415 ABS plastic grid strainer with off-set tailpiece. Tailpiece and exposed piping shall be covered with plastic laminate panel to meet ADA standards and shall have smooth finish.

- I. Dialysis medicine sink "P-4" shall be Corian #804 (17 1/2" x 17 1/2" x 8 3/4" nominal dimension; 15 3/4" x 15 3/4" x 8 1/8" inside dimension) solid surfacing sink bowl (or equal) to be fabricated integrally as part of the Work of Section 06402. Sink color to be Corian "Bone" or equal. Faucet shall be Chicago #350 with Delta #70415 ABS plastic grid strainer. (Note Texas only, replace Chicago faucet #350 with Sloan model ETF-770).
 1. Alternate sink for plastic laminate countertop installations: Dialysis medicine sink "P-4L" shall be 15 x 15 inch self-rimming stainless steel, satin finish bowl and sound dampened exterior. Sink shall be similar to Elkay BLR15 (1 hole), faucet Chicago #350, Delta #70415 ABS plastic grid strainer. (Note Texas only, replace Chicago faucet #350 with Sloan model ETF-77).

- J. Lounge sink "P-5" shall be a custom fabricated (17 1/2" x 17 1/2" x 8 3/4" nominal dimension; 15 3/4" x 15 3/4" x 8 1/8" inside dimension) solid surfacing sink bowl (or equal) to be fabricated integrally as part of the Work of Section 06402. Sink color to be Corian "Bone" or equal. Sink shall be furnished complete with American Standard 4205.000 single lever faucet with swing spout and aerator, ABS strainer drain (color: white) and off-set tail piece. Tailpiece and exposed piping shall be covered with plastic laminate panel to meet ADA standards and shall have smooth finish.
 1. Alternate sink for plastic laminate countertop installations: Lounge sink "P-5L" shall be single compartment counter top sink 25 x 22 inch nominal size, single bowl, self-rimming sink with satin finish interior and sound deadening exterior application. Sink shall be similar to Elkay GEGR-2521-R 4 holes with American Standard 4205.000 single lever faucet and ABS strainer drain (Plumbest #B02004 - color: Bone) and off-set tailpiece. Tailpiece and exposed piping shall be covered with plastic laminate panel to meet ADA standards and shall have smooth finish.

- K. Refrigerator ice box connection "P-5A" Guy Gray Bim 875.

- L. Exam lavatory "P-6" shall be Corian #804 (17 1/2" x 17 1/2" x 8 3/4" nominal dimension; 15 3/4" x 15 3/4" x 8 1/8" inside dimension) solid surfacing sink bowl (or equal) to be fabricated integrally as part of the Work of Section 06402. Sink color to be Corian "Bone" or equal. Faucet American Standard 6530.170 with 372H wrist blade handles and Delta #70415 ABS plastic grid strainer.

1. Alternate sink for plastic laminate countertop installations: Exam lavatory "P-6L" shall be 19 x 18 inch self-rimming stainless steel with soft satin finish bowl, back ledge and sound dampened exterior. Sink shall be similar to Elkay LR1918 3 hole. Faucet American Standard 6530.170 with 372H wrist blade handles and Delta #70415 ABS plastic grid strainer.
- M. Laundry tub "P-7" shall be a 24 x 24 inch deep nominal size molded stone laundry tray with fiberglass legs, swing spout mixing faucet and perforated grid strainer. Sink shall be similar to Fiat model FL-1, with A.S. 7490.000, faucet and 172 H wrist blade handles.
- N. Mop sink "P-8" shall be a 24 x 24 inch cast stone floor model mop sink with 3" outlet stainless steel rim guard and combination supply faucet with integral stops and vacuum breaker hose connection, fixture shall be similar to Fiat MSB2424 with Crane 830AA faucet and 832AA hose kit.
- O. Eye and face shower "P-9" shall be equal to Encon model #01-0502-16. A pressure reducing valve shall be installed for adjusting flow to 25 gallons per minute.
- P. CAPD/Home Hemo clean sink "P-10" shall be Corian #804 (17 ½" x 17 ½" x 8 ¾" nominal dimension; 15 ¾" x 15 ¾" x 8 1/8" inside dimension) solid surfacing sink bowl (or equal) to be fabricated integrally as part of the Work of Section 06402. Sink color to be Corian "Bone" or equal. Faucet American Standard 6530.170 with 372H wrist blade handles and Delta #70415 ABS plastic grid strainer.
 1. Alternate sink for plastic laminate countertop installations: CAPD/Home Hemo clean sink "P-10L" shall be 15 x 17 inch self-rimming stainless steel with soft satin finish bowl. Back ledge and sound dampened exterior. Sink shall be similar to Elkay LR1517 (3 hole). Faucet American Standard 6530.170 with 372H wrist blade handles and Delta #70415 ABS plastic grid strainer.
- Q. CAPD/Home Hemo clean sink "P-11" shall be Corian #804 (17 ½" x 17 ½" x 8 ¾" nominal dimension; 15 ¾" x 15 ¾" x 8 1/8" inside dimension) solid surfacing sink bowl (or equal) to be fabricated integrally as part of the Work of Section 06402. Sink color to be Corian "Bone" or equal. Faucet Chicago 335-E12 (cold water) "Tip-Tap" slow metering and Delta #70415 ABS plastic grid strainer.
 1. CAPD/Home Hemo dirty sink "P-11L" shall be 15 x 15 inch self rimming stainless steel, satin finish bowl and sound dampened exterior. Sink shall be similar to Elkay BLR 15 (1 hole). Faucet Chicago 335-E12 (cold water) "Tip-Tap" slow metering, and Delta #70415 ABS plastic grid strainer.
- R. Mop sink "P-12" (bicarb mixer) shall be a 24x24 inch cast stone floor model mop sink with 3" outlet similar to Fiat MSB2424 with Crane 830AA faucet and optional hose kit #832-AA.

- S. Soiled utility lavatory "P-13" shall be a 20"x18" white vitreous china with front overflow and concealed wall hanger. Sink shall be similar to American Standard 0194.076 with faucet 6832.000 and 372H wrist blade handles.
- T. Clinical service sink "P-14"
 - 1. For Massachusetts only shall be vitreous china, wall mounted blow out flushing action, flushing rim, 1 1/2" jet spud, A.S. 9512.013 with Sloan royal 117H flush valve. A.S. 7582.067 bedpan washer and J.R. Smith wall hanger Mod. #629.
 - 2. All other states shall be vitreous china, floor mounted, water saver, coupled tank type with elongated siphon action reverse trap bowl, white solid plastic open front seat and china bolt covers.

(Fixture shall be similar to American Standard 2998.012 flush lever to be on open side. Open front seat Church 9500C.)
- U. Blood lab sink "P-15" shall be 25 X 22 inch self rimming acid-resisting enameled steel and white color. Sink shall be similar to A.S. 7143.803 (3 hole). Faucet American Standard 6530.170 with 372H wrist blade handles and Delta #70415 ABS plastic grid strainer.
- V. Bed pan washer for use in patient toilet room shall be A.S. 7582.067 bed pan washer and J.R. Smith hanger model #629.
- W. Water Cooler shall be Elkay model #EBFATL8C, two station barrier-free, wall mounted, electric refrigerated type.
- X. Approved Manufacturers: Plumbing Fixtures and Brass: American Standard, Crane, Kohler, Elkay, Just, Fiat, and Williams.

2.02 DOMESTIC WATER AND PROCESS HEATERS

- A. Domestic water heater shall be AGA approved glass lined, steel tank, gas fired units as scheduled. Units shall be complete with fiberglass insulation, protective sheet metal jacket with baked enamel finish, cast iron or stainless steel gas burner for use with natural gas, 100% safety pilot, adjustable thermostat control, automatic main gas valve, manual main and pilot gas valves, pressure regulator, backdraft diverter and magnesium anode. Heater tank shall be fabricated so that the water will not come in contact with any ferrous metals. Tank shall have a minimum guarantee of 100% replacement for the first two years. Reference drawing for sizing.
- B. Approved Manufacturers: Rheem, Rudd, A.O. Smith, Payne, / State Stove, P.V.I., and Lochinvar.
- C. Expansion Blator Tank

- D. See section 15400 2.02 E for process H.W.H.

2.03 GAS VENTING SYSTEM

- A. Gas venting system shall be a double wall, insulated gas vent pipe from the downdraft diverter to the point of termination above the roof including flue cap. Vent system shall include draft hood connectors, roof flashing, storm collars and vertically louvered non-directional, bird-proof, rain-proof galvanized steel or aluminum flue caps and shall be listed by National Fire Protection Association. Install within minimum clearances to combustible materials in accordance with UL listings and local building codes.
- B. Outer walls shall be constructed of galvanized steel or aluminum with both walls seamed together in an integral unit with ends die formed for mating, alignment and locking for a gas tight installation.
- C. Where roofs are bonded, roof flashing shall conform with bonding company's requirements. A square curb base shall be furnished for flat tar and gravel roofs or roofs where curbed openings are provided by the General Contractor.
- D. Approved Manufacturers: Ammervent, Dura-Vent, and Metalbestos. See Section 07800 Roof Penetrations.

2.04 DRAINS AND CLEANOUTS

- A. All drains and cleanouts shall be provided and installed as required and as shown. Drains shall have cast iron bodies with screwed or caulked connections of the sized and types shown and specified. Provide deep seal cast iron "P" traps on all floor drains connected to the sanitary sewer.
- B. Manufacturer's figure numbers are specified to indicate type, quality and construction. Similar and equal products of approved manufacturers may be substituted for those specified numbers shown.
- C. Floor drains "P-16" for use in dialysis area shall be similar Josam Series 30000-E1 cast iron floor drain with double drainage flange, weep holes, bottom outlet, flashing-clamping device and nickel chrome adjustable strainer. Where drains are used to receive indirect wastes they shall be furnished with 6" funnels, model F-6 cast brass finished to match the grate, or partial type grates all factory fabricated by the drain manufacturer and completely finished to match the grate (mount rim $\frac{3}{4}$ " AFF on first floor, mount rim flush on 2nd floor applications.)
- D. Floor sinks "P-18" shall be 12" square 6" deep, PVC sink with 4" hub bottom outlet, PVC internal dome strainer and removable grate. Grate shall be full or partial as necessary to fit specific installation requirements. Unit shall be similar to Plastic Odities Manufacturing Company Mod. #PFS-400H.

- E. Floor cleanouts shall be cast iron floor cleanouts with scoriated cut-off section, bronze internal plug and brass scoriated coverplate secured to plug by countersunk screw, similar to Josam Series 57000.
- F. Wall cleanouts, masonry wall, shall be cast iron caulking ferrule bronze plug and brass round access coverplate secured to plug by countersunk screw similar to Josam 58710.
- G. Wall cleanouts (except as specified above) shall be cast iron caulking ferrule with bronze plug and brass coverplate and frame, similar to J Hosam 58700.
- H. Approved Manufacturers: Josam, Jones Co., J.R. Smith, Wade or Zurn.
- I. Dialysis counter top clean out shall be Zurn model CO-2401-PVC and adapter for 2" PVC pipe.

2.05 PRESSURE BOOSTER PUMP "P-1"

- A. The pressure booster pump unit shall be a single pump water pressure booster pump system consisting of pump, controls and surge tank.

System shall be capable of automatically providing constant system pressure while supplying the scheduled flow rate. The system shall automatically provide complete pump shutdown during low-flow conditions while maintaining constant system pressure.

If building voltage is different than pump voltage rating then P.C. shall furnish a buck boost transformer to be installed and wired by electrical contractor.

- B. The system shall be the unit scheduled on the construction drawing.

PART 3 - EXECUTION

3.01 INSTALLATION OF EQUIPMENT

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

END OF SECTION

SECTION 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 his installation.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 15700 covering and insulation.

PART 2 - PRODUCTS

2.01 SANITARY DRAINS AND SANITARY VENT PIPING

- A. All soil waste and vent piping shall be constructed from service weight cast iron soil pipe, joined with cast iron bell and spigot fittings or no hub fittings of the same weight, or schedule 40 PVC soil pipe joined with drainage pattern fittings as allowed by code. 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. Install lead piping for waste connection when required by local code. Weights on lead piping shall be in accordance with local code. See Section 07800 Roof Penetrations.

2.02 DOMESTIC WATER PIPING

- A. All domestic water piping, except as hereinafter specified, shall be fabricated from type "L" copper tubing hard drawn, of the sized 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.

2.03 GAS PIPING

- A. Gas piping throughout the building shall be Schedule 40 black steel with malleable iron 150# beaded pattern screwed fittings on piping systems 2 inches in size and smaller with steel weld fittings on piping 2 1/2 inches in size and larger. Make taps from mains to branches using thread-o-lets or weld-o-lets or tee connections. Install interior piping in exposed locations only. Pipe below building lower floor shall be installed in cast iron sleeves vented at both ends.

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, bull head tees or crosses shall not be installed in the plumbing lines. Each piece of pipe shall be reamed to make the bore of the pipe at its end the same as the pipe. All exposed polished connections from the fixtures shall be made with special care showing no tool marks or threads. Under no conditions shall any piping be run in the floor except as shown on the plans or written approval has been received. Bushings shall not be used where any changes in pipe size occurs, only reducing fittings (or increasers) shall be used.
- B. Sanitary sewers shall be installed a neat manner, 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. Construct the flashing with a base of 10 inches beyond the pipe openings in all four directions and extend the vertical tube up the pipe and terminate by turning into the pipe cavity at least 2 inches on vent pipes 2 inches in size and larger and terminating in a specially fabricated flashing fitting on pipe sized 1 1/2 inch and smaller. The Plumbing Subcontractor shall fabricate flashing and turn over to the roofer to install at the roof level and after completion of this installation he shall finish the top of the flashing as hereinbefore specified.

3.02 INSTALLATION OF WATER PIPING

- A. Water piping systems shall generally be run level, free of traps, without any unnecessary bends, as high as possible and to suit the necessity of clearances for other mechanical work. Water piping shall be so graded and valved to provide for the complete drainage and control of the system. Piping shall be installed so as to cause no unusual noise from flow of fluid within the building system.
- B. Hot 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.

3.03 NATURAL GAS

- A. Natural gas service piping systems shall generally be run level, free of traps, and without unnecessary bends. Piping shall be routed as high as possible and arranged to provide necessary clearance with other mechanical work. Piping shall be provided with required drip legs, with drains. No unions shall be used on these lines except at connections to equipment.

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 shall be 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. Work shall be supervised by Owner and preformed by approved chemical testing laboratory and results sent to the Architect or Architect's representative for verification.

END OF SECTION

SECTION 15400

**MEDICAL EQUIPMENT PROCESS PIPING
SYSTEMS FOR REVERSE OSMOSIS WATER
AND CONCENTRATES**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes materials, equipment, labor and incidentals required for and to install complete and ready for operation, all reverse osmosis water treatment process piping and SDS Polyethylene Tubing Systems as shown on the contract documents and as specified herein.
- B. Owner furnished equipment installed by contractor (O.F.I.C.):
 - 1. Tech repair R.O. Water and Drain Kit.
 - 2. Dialysis Valve Box Assembly Kits.
 - 3. A & B Concentrate tubing.
 - 4. Heat exchanger.
 - 5. Solution Delivery System Head Vessel Assembly.
 - 6. Mixing Valve Unit
- C. Related Sections:
 - 1. Section 15100: "Mechanical Materials and Methods."
 - 2. Section 15700: "Covering and Insulation."
 - 3. Section 15800: "Testing, Adjusting and Balancing."
 - 4. Section 07800: "Roof Penetrations."

1.02 SYSTEM DESCRIPTION

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

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with Sections 00700 "General Conditions", and 00800 "Supplementary Conditions" of this specification and comply with pertinent provisions of Specification Section 01340.
- B. Product data: Within 20 calendar days after the Contractor has received the Owner's Notice of Proceed, submit the following:
 - 1. Materials list of items proposed to be provided under this Section;

2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
 3. Two foot sample of schedule 80 PVC R.O. water pipe split longitudinally for interior wall smoothness inspection by, Project Manager.
- C. Submit certifications to Project Manager that PVC schedule 80 piping to be used for R.O. water has been manufactured from the same extrusion "lot" as the sample above, prior to delivery and installation at the job site.

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

- A. Special care shall be taken to protect R.O. water process piping and piping components from dirt and debris entering the pipe and piping system components prior to installation. FMC's water treatment vendor shall be responsible to unpack and set equipment into place.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. All PVC pipe, fittings and appurtenances shall be constructed from class 12454-B PVC compound. **All medical equipment process piping connections to fittings shall be socket welded type only.** Threaded connections shall be limited to the true union ball valves unions and the socket by threaded coupling at the owner furnished valve box. Pipe and fittings shall meet the following requirements:
1. The R.O. water pipe shall show no irregular pitting or micro orifices under 10X magnification. Pitting and micro orifices would allow the attachment of cellular masses to the interior wall orifice cavity of the PVC pipe and thus protecting the embedded cells from the microbicidal action of disinfectants, subsequently serving as the reservoir for continuous contamination.
 2. Schedule 80 PVC pipe 3/4" & 1" for R.O. water shall be manufactured by (Charlotte Pipe, Foundry Company and Harvel) or approved equal. Pipe shall have a smooth interior wall without imperfections, as noted in paragraph one above. (Apache brand pipe manufactured by Certainteed, Inc. has a history of micro orifices and not to be used).
 3. Pipe: 3/4" - 2" shall be seamless schedule 80 PVC pipe meeting ASTM specification D-1785.
 4. Fittings: 3/4" - 2" shall be socket type fittings meeting ASTM specification D-2467.
 5. Couplings: 3/4" - 2" shall be socket type couplings meeting ASTM specification D-2467.

6. Unions: 3/4" - 2" shall be socket type unions meeting ASTM specification D-2467.
7. Flanges: 3/4" - 2" shall be socket type flanges meeting ASTM specification D-2467.
8. Gaskets: shall be flat ring, 1/8" thick viton.

2.02 COMPONENTS

- A. Backflow preventers shall be reduced-pressure type, sized as scheduled or noted as manufactured by Watts Regulator Co., series 909 with WYE Strainer and blow off valve with 5/8" hose bibb.
- B. Pressure Gauges shall be 3 1/2 inch, stainless steel case, white dial with black figures and graduations, acrylic window, black stainless steel pointer, phosphor bronze bourdon tube, 1/4 inch NPT brass socket, bottom outlet. Pressure gauges shall meet ANSI B40.1, grade A 1% accuracy standard. Pressure gauges shall be equal to #690 as manufactured by H.O. Trerice Co.
- C. Ball valves shall be PVC or CPVC double true union ball valves with EPDM o-rings, teflon seats and socket by threaded union connections. Valves shall be full port design and have a fine pitch threaded seal retainer for seat adjustments. Valve seat shall be reversible and self-lubricating. Valves shall be rated to 225 psi at 70°F. Valves shall be equal to Safe-Block true union ball valves as manufactured by Hayward Industrial Products, Inc.
- D. Ball check valves shall be PVC or CPVC with socket connections. Seals and seats shall be EPDM. Valves 1/4 inch and 3/8 inch shall be of trim-check design. Valves 1/2 inch to 4 inches shall be of double true union design. Seat and o-ring shall be square-cut for positive sealing with minimal backpressure. Valves shall be equal to ball check valves as manufactured by Hayward Industrial Products, Inc.
- E. Process Water Heaters:
Gas Fired: shall be capable of providing water as scheduled on the drawings. Units shall be ASME approved over 199,900 BTUH for 150 psi working pressure and equipped as follows:
 - a. Burners – steel alloy with burner tray easily removable for inspection
 - b. Refractory Panels – interlocking construction
 - c. Headers – shall be bronze and designed to prevent damage due to thermal shock.
 - d. Tank exterior - galvanized or corrosion resistant steel with baked enamel finish.
 - e. Heat shields - galvanized or stainless steel.
 - f. Fittings - corrosion resistant steel.
 - g. Tank exterior lining - suitable for potable water service.
 - h. Controls – factory wired for single connection to electrical service and rated for 14 inches wc.

- i. Automatic flue damper
 - ii. Pressure relief valve
 - iii. Electronic ignition, thermostatically controlled
 - iv. Low water shut –off
 - v. High temperature shut-off
 - vi. Adjustable thermostat
 - vii. Automatic gas valve with safety shut-off on flame failure
 - viii. Combustion chamber pre-purge
 - ix. Gas pressure regulator
 - x. Manual gas shut-off
 2. Electric: shall be capable of providing water as scheduled on the drawings and shall be equipped as follows:
 - a. Elements – high efficiency, low watt density elements thermally fused to protect the tank as highest dry-firing
 - b. Factory prewired and tested and U.L listed.
 - c. Tank – designed for 150 psi working pressure and tested to withstand 300 psi hydrostatic test pressure and insulated with foam designed to meet efficiency requirements of ASHRAE std. 90 lb. Tank shall be also be furnished with an anode rod rigidly supported.
- F. Water heater flue system shall be factory prefabricated and laboratory tested, proven and certified for use with gas-fired boilers. The system shall be suitable for exhaust gases up to 600°F under continuous operating conditions. Stack shall be double-wall with galvanized steel, 0.025 inch thick outer jacket. The inner pipe shall be type 304 stainless steel 0.035 inch thick minimum. A 1 inch minimum air space shall be between the insulation and the outer jacket. The flue system shall include all flue piping, cleanout “Tees”, ventilated roof thimble, stack cap and supports as recommended by the manufacturer. Flue system shall incorporate one expansion devices for every 30 feet of flue pipe. Flue system shall be equal to “Metalbestos” model PS as manufactured by Selkirk Metalbestos, Co.
- G. Booster pump shall be sized as scheduled on the drawings. Pump shall be two-piece design coupled to double ball bearing motor. Normally serviceable parts shall be easily removable for replacement. Pump shall have 1 ½ inch NPT suction port and 1 ¼ inch discharge port. Pump shall be constructed of heavy-duty cast iron body, brass impellers and seal, and stainless steel, buna N and carbon/ceramic parts. Pump shall be 2PC series as manufactured by Teel for W.W. Grainger, Inc.
- H. Expansion tank shall be diaphragm type, shell construction, heavy duty butyl seamless diaphragm, separate non-corrosive water reservoir, mechanical seals, copper lined acceptance fitting, floor stand, polypropylene liner and two-part polyurethane finish. Liner shall be tested and listed by NSF. Tank shall be #WX-302 as manufactured by

Amtrol, Inc.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Pipe and pipe fittings:

1. All pipe and tubing shall be cut accurately to measurements established at the job site. All pipes shall be cut with tubing cutters designed for such purpose. Deburr and ream all sections of pipe prior to installation.
 - a. Threaded Connections - threaded connections at R.O. water pipe to dialysis box and true union ball valve shall be made leak tight with Teflon tape. Under no circumstances shall pipe dope, liquid, semi-liquid, paste or solid hardening leak **tight compound be used**. Upon final assembly, not more than three threads on the pipe shall remain exposed.
 - b. Socket welded connections - shall be made as recommended by the pipe and pipe fitting manufacturer. Special care shall be taken so that no dirt, debris or excess adhesive shall enter the piping system.
2. All pipe shall be installed such that any no part of the pipe or pipe system shall contact any surface through its normally installed position.
3. Install pipe so that no undue strain is imposed on any part of the piping system.
4. All connections to equipment shall be made with the appropriate reducers, unions, valves, ect. as required to facilitate the removal or servicing of equipment without extensive dismantling of the piping system.
5. Install valves with stems facing up on horizontal runs and facing opposite support wall on vertical runs.

B. Pipe supports:

1. Pipe supports and hangers shall be securely fastened to the structure above without overstressing any portion of the supports or the structure itself. No drilling or cutting of building steel shall be permitted. In cases where supplementary steel is required, steel support shall be designed in accordance with AISC specifications. Piping shall not be supported from gratings, fireproofing material, ducts, other pipes, electrical conduit, wires or other non-structural supports.
2. Secure pipe supports to steel by welded brackets or beam clamps. Secure pipe supports to concrete by means of inserts.
3. PVC piping supports shall be spaced at a maximum of the lessor 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.

3.02 FIELD QUALITY CONTROL

- A. All R.O. water piping shall be hydrostatically tested to a minimum of 50 psi and hold the test pressure for a minimum of 2 hours. All joints, valves, fittings, ect. shall be inspected for the presence of leaks after 2 hours but before the test pressure is released.

Any leaks, defects or failures found during the inspection shall be repaired in the following manner:

1. Pipe - cut and remove leaking section and replace with new.
 2. Threaded joints - tighten or remake joint.
 3. Flanged joints - tighten or remake joint.
 4. Socket joints - break and remake joint.
- B. Subsequent to repairing any leaks, defects or failures, the contractor shall retest the entire piping system in accordance with this specification. The piping system shall not be considered complete or acceptable until the entire piping system passes a complete systems' test with no failures requiring repair.
- C. All pipe and pipefittings shall be inspected prior to installation and no piece shall be installed which is determined to be defective. If any defective pipe or fittings are discovered to be defective they shall be replaced with like pipe of fittings determined to be defect-free.
- D. Manufacturer's Field Service

3.03 CLEANING

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

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 00800 “Supplementary General Conditions.”
 - 3. Section 07800 "Roof Penetrations."
 - 4. Section 15100 “Mechanical Materials & Methods.”
 - 5. Section 15700 “Covering and Insulation.”
 - 6. Section 15800 “Testing, Adjusting & Balancing.”

1.02 REFERENCES

- A. Comply with the following standards:
 - 1. SMACNA “HVAC Duct Construction Standards,” 2nd ed., 1995.

1.03 SUBMITTALS

- A. Product Data:
 - 1. Flexible Ducts

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Metal Duct:
 - 1. Sheet metal shall be lock-forming quality, ASTM A 527, with G 90 galvanized coating. Provide mill phosphatized finish for ducts exposed to view. (All ductwork serving “Patient Treatment Area” and “Water Treatment Storage Areas” to have no duct liner or interior insulation. No exposed fiberglass insulation or liner in total system.)

- B. Flexible Duct:
 - 1. Factory fabricated , insulated, round duct with an outer jacket enclosing 1-1/2 inch thick glass fiber insulation around a continuous inner liner (no exposed fiberglass). Duct shall have a steel-wire helix encapsulated in the inner liner. Outer jacket shall be glass-reinforced, silver mylar with a continuous hanging tab, integral fiberglass

tape and nylon hanging cord.

C. Tie Rods:

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

2.02 FABRICATIONS

A. Shop Assembly:

1. Except as otherwise specified, ductwork shall conform to the following Tables and Contract Drawings:

a. Rectangular:

1) 1" W.G.	<u>Duct Dimension</u>	<u>Metal Gauge</u>
	10" & less	26
	11" - 12"	26
	13" - 14"	24
	15" - 18"	22
	19" - 20"	20
	20" & greater	18

2) 2" W.G.	<u>Duct Dimension</u>	<u>Metal Gauge</u>
	10" & less	26
	11" - 12"	24
	13" - 14"	22
	15" - 18"	20
	19" - 20"	18
	20" & greater	16

- 3) Dimensions larger than 24 inches shall be reinforced to SMACNA Grade "D."

b. Round (positively pressured):

<u>Max. Diameter</u>	<u>Spiral Seam</u>	<u>Long. Seam</u>
8"		28ga.
14"	28ga.	26ga.
26"	26ga.	24ga.

c. Round (negatively pressured):

<u>Max. Diameter</u>	<u>Spiral Seam</u>	<u>Long. Seam</u>
10"		28ga.
13"		26ga.
15"	28ga.	
17"	26ga.	24ga.
20"		22ga.

23"	24ga.	
26"	22ga.	20ga.

1. 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.
2. Smooth radius elbows shall be constructed with a centerline radius equal to one and one half times the nominal duct width in the plane of direction change.
3. Rectangular transitions shall be constructed with a maximum convergence of 15 degrees on the transition edge.
4. 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.
5. Longitudinal joints shall be "Pittsburgh lock" or grooved seam type with a full continuous mastic seal provided prior to the final closure.
6. Reinforcements shall be as required by SMACNA standards.
7. All ducts not internally lined shall be cross-broken.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. All ducts shall be installed in accordance with SMACNA "HVAC Duct Construction Standards", 2nd ed., 1995 for the duct pressure class which they were designed for.
2. Ducts shall be installed with the fewest possible joints, fittings, changes in direction, sizes, shapes and connections as possible.
3. 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.
4. 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.

5. Install ducts concealed from view in finished and occupied spaces by locating ducts in mechanical shafts, hollow wall construction or above suspended ceilings.
 6. Coordinate diffuser, return grille and exhaust grille layouts with suspended ceiling, lighting and sprinkler heads layouts.
- B. Seam and Joint Sealing:
1. Seal all transverse joints and longitudinal seams with the specified duct sealant. Externally insulated ducts shall be sealed prior to insulation installation.
- C. Hanging and Supporting:
1. Rigid round, rectangular and flat oval metal ducts shall be installed with support systems in accordance with tables 4-1 to 4-3 and figures 4-1 to 4-8 of the SMACNA “HVAC Duct Construction Standards - Metal and Flexible”, 2nd ed., 1995. 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.
- D. Connections:
1. Branch connections shall comply with SMACNA “HVAC Duct Construction Standards - Metal and Flexible”, 2nd ed., 1995, figures 2-5 and 2-6.
 2. Offsets and transitions shall comply with SMACNA “HVAC Duct Construction Standards - Metal and Flexible”, 2nd ed., 1995 figure 2-7.

3.02 FIELD QUALITY CONTROL

- A. Conduct leakage tests, in the presence of the owners authorized representative, at static pressures equal to but not exceeding duct system design pressure. Maximum permissible leakage shall be as described in the 1989 ASHRAE Handbook, “Fundamentals” volume, chapter 32 and the following table:

<u>Duct Type</u>	<u>Leakage Classification</u>
Round	3
Flat Oval	3
Rectangular	6

- 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.

3.03 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) Turning vanes.
 - g) Accessories hardware.
- B. Related Sections:
 - 1. Section 00700 “General Conditions.”
 - 2. Section 00800 “Supplementary Conditions.”
 - 3. Section 15100 “Mechanical Materials & Methods.”
 - 4. Section 15600 “Ductwork.”

1.02 REFERENCES

- A. Comply with the following standards:
 - 1. SMACNA “HVAC Duct Construction Standards - Metal & Flexible”, 2d ed., 1995.
 - 2. NFPA 90A “Installation of Air Conditioning & Ventilating Systems”, 1993 ed.
 - 3. U.L. Standard 555-1990 “Standard for Fire Dampers”, 4th ed.
 - 4. U.L Standard 555S-1990 “Standard for Fire/Smoke Dampers”, 4th ed.

1.03 SUBMITTALS

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

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Fire Dampers, Fire/Smoke Dampers
 - 1. Ruskin Manufacturing Co.
 - 2. Air Balance, Inc.

2.02 EQUIPMENT

- A. Flexible Connectors:
 - 1. Flexible connectors shall be constructed of flame-retardant, non combustible fabrics, coatings and adhesives complying with U.L. Standard 181, class 1. Standard metal-edge connectors shall be factory fabricated with a flexible, fabric strip 3 inches wide minimum, 10 inches maximum, attached to two strips of three inch wide 24 gauge galvanized sheet steel or 0.032 gauge sheet aluminum. Select metal that is compatible with the duct system. Edges of metal strips shall be hemmed on the sides that connect to ducts. Fabric shall be fastened to metal similar to SMACNA “HVAC Duct Construction Standards,” 2d ed., 1995, figure 2-17.
- 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 be double-wall, galvanized sheet steel construction, one inch by one inch butt hinges and sash locks as specified. Door shall have a continuous foam or neoprene gasket to prevent leakage.
 - 3. Insulation:
 - a. Insulation shall be one inch thick fiberglass or polystyrene foam board.
 - 4. General:
 - a. Access door assembly shall be constructed in accordance with the following table:

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

4" w.g.	12" x 12"	2	1-S, 1-T, 1-B	20	20	26
to	16" x 20"	3	2-S, 1-T, 1-B	20	18	24
10" w.g.	24" x 24"	3	2-S, 2-T, 2-B	18	18	24
S = Side opposite hinges, T = Top, B = Bottom						

A. Volume Control Dampers:

1. 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 wingnut to permit locking. Damper shall be stiffened as required to prevent deflection and unwanted vibration.

2. 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.

B. Fire Dampers:

- 1. Fire dampers shall be listed to meet U.L. Standard 555-1990, "Standard for Fire Dampers."
- 2. Fire dampers shall be rated as indicated on the contract documents.
- 3. 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 "A", one-piece roll formed 22 gauge galvanized steel.

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 spring.

C. Fire/Smoke Dampers:

1. Fire/Smoke dampers shall be listed to meet U.L. Standard 555-1990 “Standard for Fire Dampers,” fourth edition and U.L. Standard 555S-1983 “Standard for Leakage Rated Dampers for use in Smoke Control Systems.”
2. Fire/Smoke dampers shall be rated as indicated on the contract documents for fire resistance and leakage class.
3. 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 steel.
 - d. Bearings: oil impregnated bronze.
 - e. Linkage: on-blade fixed type, located within the airstream, galvanized steel angle interconnect with plated steel brackets and pivots.
 - f. Stops: 18 gauge minimum steel.
 - g. Blade Seals: elastomer material.
 - h. Side Jamb Seals: stainless steel.
 - i. Sleeve: 20 gauge minimum or two gauges larger than the duct, whichever is greater.
 - j. Caulking: Hardcast Irongrip 601 or U.L. listed equivalent.
 - k. Finish: mill galvanized steel.
 - l. Actuator: electric with 165°F thermal disc or pneumatic with 165°F fusible link. Select actuator type compatible with building control system.
4. Fire/Smoke damper sleeves shall be sized so the sleeve does not extend more than six inches beyond the rationed opening except on the actuator side where the sleeve may extend to a maximum of sixteen inches beyond the rated opening.

D. Turning Vanes:

1. Turning Vanes shall be single-thickness type, welded to their runners.
 - a. Small Vanes shall have a radius of two inches, one and one half inch spacing and be constructed of 24 gauge minimum galvanized sheet steel.

E. 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. 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.

2. Manufacturers representative shall verify that grilles, registers and diffusers shall not exceed a NC level of 25 at airflow rate indicated.
3. Square and Rectangular Ceiling Diffusers (CD): Titus Model TDC, aluminum construction with standard off white finish, designed for one, two, three, and four-way diffusion as indicated on plans. Where lay-in ceilings occur, mount each diffuser in a 2' x 2' lay-in ceiling panels with finish to match diffuser. Where plaster or gypsum board ceiling occur use type 1 border with plaster frame. Provide diffuser with square/rectangular to round adapter where required. Provide opposed blade damper where fire damper is not indicated. Where fire damper is indicated, provide minimum 1-1/2 hour damper as specified herein before under "SHEET METAL DUCTWORK". Entire assembly shall be UL labeled and classified-coordinate with fire damper manufacturer as required.
4. Wall Supply Register (WSR): Double deflection, 3/4-inch blade spacing, aluminum construction, equal to Titus Model 300FS. Provide opposed blade damper and white finish.
5. Ceiling Return Grille (CRG): Shall be eggcrate 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.
6. Ceiling Exhaust Grille(CEG): Same as specified above for ceiling return grille.
7. Ceiling Transfer Grille (CTG): Same as specified above for ceiling return grille.
8. Wall Return Register (WRR): Wall return registers shall be aluminum construction, 1/2" blade spacing, 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.
9. Wall Return Grille (WRG): Wall return grilles shall be the same as the wall return registers specified above except omit opposed blade damper.
10. Wall Transfer Grille (WTG): Same as wall return registers specified above except omit opposed blade damper.

F. 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.

G. 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 manufacturers instructions.
 2. The flexible connector, in the final installed state shall not have any tensile or compressive forces imposed on the connector.
- B. Duct Mounted Access Doors:
1. Install access doors square and parallel to duct edges in a location which permits servicing of the equipment the access door is intended to serve.
 2. Secure access doors as recommended by the manufacturer.
- C. Volume Control Dampers:
1. Install dampers as close as possible to the branch take-off from the duct main.
- D. Install fire dampers as detailed on the contract documents and as recommended by the manufacturer. Installation shall comply with U.L. Standard 555-1990.
- E. 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-1990.

- 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.

END OF SECTION

SECTION 15700

COVERING AND INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

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

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 07800 “Roof Penetrations”
- B. Section 15100 “Mechanical Materials & Methods”
- C. Section 15400 “Medical Equipment Process Piping Systems”
- D. Section 15300 “Plumbing, Piping”
- E. Section 15600 “Ductwork”

1.04 QUALITY ASSURANCE

- A. The following manufacturers are acceptable:
 - 1. Insulation:
 - a) Armstrong Cork Co.
 - b) Certainteed Corp.
 - c) Manville Products Co.
 - d) Owens-Corning Fiberglass Corp.
 - e) Knauf
 - 2. Adhesives
 - a) Foster
 - b) Minnesota Mining
 - c) Chicago Mastic
 - d) Armstrong
 - e) Manville Products Corp.
 - f) 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 here-in. Equipment or materials of the same type shall be the product of the same manufacturer throughout.

2.02 FIRE RESISTANCE

- A. Materials used as part of the thermal insulation shall have a fire hazard rating not to exceed 25 for flame spread and 50 for fuel contributed and smoke developed.
- B. Factory assembled materials shall be tested as assemblies. Materials that are field applied may be tested individually. Fugitive or corrosive materials used to impart flame resistance are not acceptable nor are treatments subject to deterioration due to the effect of moisture or high humidity.
- C. Determine ratings by the standard method of test for surface burning characteristics of building materials, ASTM E-84, or NFPA #255.
- D. Requirements to establish that fire hazard ratings for materials proposed for use do not exceed those specified shall conform to:
 - 1. Label or listing by Underwriter Laboratories, Inc.

2. Certified test report from an approved testing laboratory.

E. Materials exempt from the foregoing Fire Resistant Rating are:

1. Jackets or canvas, PVC, and nylon.
2. Polyurethane, polystyrene, cork, and flexible closed cellular insulation.
3. Nylon anchors for securing insulation to ducts and equipment.
4. Treated wood inserts used between shields and piping at hangers on low temperature piping.
5. Factory premolded one-piece PVC fitting and valve covers.

2.03 INSULATION FOR PIPING

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

<u>PIPING SYSTEM</u>	<u>THICKNESS</u>
Cold Water	1/2"
Hot Water supply and return	1"
Drains from A.C. Units, cooling coil pans, and miscellaneous piping subject to condensation.	1"
Horizontal storm water piping and vertical leaders including roof drain bodies	1/2"
Refrigeration Suction Piping	3/4"

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 0.24 BTU-in/sq. ft./degree F/hr. at 75 degrees F (O.C. 25 ASJ, J-M Flame-safe AP or approved equal).
2. Fiberglass density shall be 6 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 (BF 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 6 psf density fiberglass pipe covering, or fiberglass blanket insulation compressed a minimum of 2 to 1. Fitting insulation thickness shall be the same as the adjoining pipe insulation. The ends of the cover must be vapor sealed on cold piping.
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. Insulation shall be vermin resistant.

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

2.04 INSULATION FOR SHEETMETAL

A. Insulate sheet metal as follows:

1. Air conditioning system supply and return air ducts where concealed 1 1/2 inch type D-1.
2. Air conditioning system supply and return air ducts where exposed 1 inch type D-2.
3. All ductwork serving “Patient Treatment Area” and “Water Treatment & Storage Areas” to have no duct liner or interior insulation. No exposed fiberglass insulation or liner in total system.

B. 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 (B. F. 85-20). Joints shall be butted with facing overlapping all joints at least 2 inches and sealed with vapor barrier adhesive. Seal all breaks and punctures with vapor barrier tape and adhesive. For ducts over 24 inches in width, the insulation shall be additionally secured to the bottom of the ducts with mechanical fasteners spaced on 18 inch centers, maximum. Seal penetrations of facing with vapor barrier tape. Fasten insulation with 16 gauge copper clad wire or fiberglass cord on 12 inch centers.
3. Insulation shall be Owens Corning Fiberglass type ED-10C or approved equal.

C. Type D-2 Rigid Duct Insulation with Vapor Barrier

1. Rigid duct insulation shall be 6 lbs. per cu. ft. density glass fiber with maximum K factor of .22 at 75 degrees F. mean temperature. (Owens Corning Fiberglass Type 705 with ASJ facing or approved.)
2. Insulation shall be impaled over welded pins applied to duct surface on 12 inch centers. Use a minimum of two rows of fasteners on each side of duct. Secure insulation with suitable speed washers or clips firmly imbedded into insulation.
3. All joints, edges, speed washers, and breaks in the vapor barrier shall be sealed with 3 inch wide strips of the vapor barrier facing adhered with vapor barrier adhesive.
4. Provide type D-2 for exterior duct with weather-tight, vermin resistant jacket.

2.05 ALUMINUM ACCESS COVERS

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

2.06 ALUMINUM DIFFUSERS, RETURN AND EXHAUST AIR GRILLES

- B. 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.

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. 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.

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

3.03 INSTALLATION FOR PIPING

- A. The insulation shall be secured with copper clad wire and covered with a coat of insulating cement. After the cement is dried, a 1/16" coat of vapor barrier mastic (BF30-35) (BF30-36 for hot piping) is to be applied into which is imbedded a 10 x 10 weave white glass reinforcing cloth. the cloth is to overlap itself at least 1" and the adjoining pipe insulation by 2". Apply a final 1/16" coat of vapor barrier mastic and smooth the surface. In lieu of the field applied finish, factory-premolded PVC fitting covers may be used over the insulation.
- B. Jackets shall be neatly fitted around supports, anchors, etc., and drawn smooth and tight.
- C. All joints and seams shall lap at least 1 1/2" using either a joint tape of the same material as the jacket or an extension of the jacket itself, either of which is secured by a 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 a complete moisture and vapor seal including all joints. The barrier must be free of any breaks or punctures. Where penetrations and openings exist, such as 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”.

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.

- G. Fittings operating above ambient may in lieu of the preceding paragraph, be covered with a three-hour hydraulic setting combination insulating and finished cement having a “k” factor not greater than 0.87 at a mean temperature of 200^o F. The thickness of the cement shall be such that the surface is substantially flush with the pipe covering. Where the insulation terminates at a fitting that is not covered, the end of the insulation shall be beveled off with this same cement. All fittings insulated in this manner shall be covered by a fabric jacket as specified and cemented down with lagging adhesive as specified.
- H. 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 be used.
- B. Vapor barrier must be a complete moisture and vapor seal including all joints. The barrier must be free of any breaks or punctures. where penetrations and openings exist, such as at hangers, protruding shafts and access panels, the barriers must be carried down to the metal around the protrusion or openings or extend along the protrusion and sealed thoroughly. In either case, the insulation must be completely shielded from the atmosphere by the vapor barrier.
- C. Insulation boards shall be installed by impaling them on metal pins which are either anchored to the duct by a waterproof cement specifically made for attachment to metal and in successful use for at least five years and guaranteed to hold at temperatures up to 200^o F or are welded to the metal so as not to distort or burn through the metal. In either case, the pins shall be placed approximately 3” from each corner of the insulation and so spaced that no portion of the insulation, 20” x 20” sq., will be without a pin. Each pin shall be able to support a load of 20 pounds. 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 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 START-UP, TEST AND ADJUSTMENT

- A. The purpose of starting, testing and adjusting this equipment is to put it into final operating condition for the owner's use and benefit. All tests of equipment and systems required to prove compliance with the drawings and specifications shall be performed in the presence of the Architect and/or Engineer and the Owner's maintenance personnel. The contractor shall instruct the Owner's personnel in the proper operation of the system and advise him as to the type of logs and performance data which should be maintained in order to provide for proper future maintenance. The Owner's operating personnel shall be made completely familiar with the complete working of all the mechanical systems and the contractor shall provide whatever personnel is required to properly instruct the Owner's maintenance personnel for the complete operation of the building.
- B. All testing, balancing and operation of the system shall be performed by competent and experienced personnel who have formerly done similar work and whose qualifications and performance shall be subject to the approval of the Engineer. The tests shall demonstrate the specified capacities and operation of all equipment and materials comprising the systems. Such tests other than as described herein which are deemed necessary by the Engineer to indicate the fulfillment of the Contract, shall be made at no additional charge. All data required by these specifications shall be typed on white bond paper in triplicate and submitted to the Engineer for approval.
- C. The testing, balancing and adjusting of all systems installed by the Plumbing Subcontractor and other subcontractors except for the air conditioning systems shall be performed as hereinafter specified by the contractor installing the systems.

The testing, adjusting and balancing of the air conditioning systems shall be performed by and under the direction of a technician not normally on the staff of the Air Conditioning Contractor and certified as competent by the "Associated Air Balance Council" or the "National Environmental Balancing Bureau" and a certificate of guarantee and reports shall be issued in accordance with the Associations standard procedure.

- D. The remainder of the testing, balancing and operation of the system shall be performed by competent and experienced personnel who have formerly done similar work and whose qualifications and performance shall be subject to the approval of the Engineer. The tests shall demonstrate the specified capacities and operation of all equipment and materials comprising the systems. Such tests other than as described herein, which are deemed necessary by the Engineer to indicate the fulfillment of the contract, shall be made. All data required by these specifications shall be typed on white bond paper in triplicate and submitted to the Engineer for approval. Complete approval will be necessary before final payment is made. The subcontractor shall then make available to the Engineer such instruments as are required for spot checks on the system.

PART 2 - GENERAL

NOT APPLICABLE

PART 3 - EXECUTION

3.01 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% in excess of the working pressure under which it is to be used. The water used for tests shall be obtained from potable source of supply.
- C. Sanitary Sewer Systems: All sanitary sewer systems shall be tested either in sections or in their entirety in accordance with all the 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 hours.

E. Medical Equipment Process Piping System:

With completion of each process piping loop and dialysis valve boxes installed a compressed air tightens 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 suggestful once system maintains pressure with no fluctuations over a 24 hour period.

3.02 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 that 50 parts per million of available chlorine. The chlorinating material shall be either liquid chlorine, conforming to U.S. Army Specification No. 4-1, or calcium hypochlorite or chlorinated lime conforming to the requirements of Federal Specification O-C-114, and shall be pumped into the system through the connection described above. The sterilizing solution shall be allowed to remain in the system for a period of eight 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 that 0.02 parts per million.

3.03 HEATING AND AIR CONDITIONING SYSTEMS

- A. Each of the heating and air conditioning systems shall be properly tested, balanced and adjusted in accordance with the standards set forth by the agency certifying the technician. Reports shall be presented in the manner as directed by the agency and shall include, but not limited to, complete equipment reports on air handling equipment, including exhaust fans, as well as reports on air distribution, outside air qualities and damper adjustment.

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 No. 70-1996 Edition; 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 are minimum standards. 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 SUBMITTAL

- A. Submit shop drawings or fully descriptive catalog data for all items of materials and equipment proposed to be furnished and/or installed. Submit sufficient copies to provide reviewed copies as needed to be returned plus three (3) copies for retention by the Architect.
- B. Submit on all Electrical Distribution Equipment, wiring materials, lighting fixtures and all components of communication, signal, protection and alarm systems. The submittal of free standing electrical equipment shall include scale drawings indicating the proposed layout of this equipment 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 with 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. Manufacturer's 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 manufacturer's 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.

1.06 SUBSTITUTIONS

- A. In the event substitutions are to be submitted for Owner review, furnish descriptive catalog material, test data, samples, etc., of both 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 or plated 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.

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 equipment 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. Four (4) brochures of lighting fixtures with copies of data of each installed luminaire. Index each brochure indicating fixture type, manufacturer and catalog number, voltage, and lamping.
 3. Four (4) brochures of Electrical Distribution Equipment with final drawings, operating instructions and maintenance instructions.
 4. Four (4) brochures each for 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 protection 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 cleans 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 on-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 Architects' 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 with one (1) coat of masonry paint and one (1) coat of enamel.
 - 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 craftsman 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 fact 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

RENOVATIONS TO SOUTHERN MAINE DIALYSIS – PORTLAND, MAINE #1190

- 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.

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, wireways, 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 switch-gear. 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 that the collar shall be located at the level of the waterproofing membrane.
- F. Sleeves through the roof shall be as specified for waterproof floors, plus a galvanized iron or steel pitch pan around the sleeve.
- G. 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.
- C. Raceways and boxes within the dialysis counter to be installed in metal raceways and boxes conforming to NEC 517-13 and shall be painted per Specification Section 09900.

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.

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 O. Z. Manufacturing Company 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 Electrinite 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 uninsulated throat type. Indentor fittings are prohibited.
- C. Painting of conduit inside dialysis counter.

2.04 FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Flexible metal conduit shall be Triangle Conduit and Cable Company or equal, spirally wound galvanized steel.
- B. Terminators of flexible steel conduit shall be T & B or equal “Tite-Bite” insulated connectors and T & B or equal, “Tite-Bite” combination couplings.

2.05 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT AND FITTINGS

- A. Liquidtight flexible metal conduit shall be equal to American Brass “Sealtite” Type UA, light gray color.
- B. Terminators shall be T & B or equal, insulated throat screw-in ground cone connectors.

2.06 SPECIAL FITTINGS

- A. Split couplings shall be O.Z. or equal, Manufacturing Company Type SP.
- B. Expansion joints shall be O.Z. or equal, Manufacturing Company 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. Codes and standards shall conform with 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.
- B. 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.
- C. Aluminum rigid metal conduit may be used wherever rigid conduit is required except embedded in concrete slabs or underground.
- D. Electrical Metallic Tubing (EMT) may be used for raceways above furred ceilings, within dry wall partitions, exposed in rooms with exposed construction and in mechanical and electrical rooms for sizes of four inches (4”) and smaller except that feeder conduits of EMT of three inch (3”) and larger shall contain a green grounding conductor.
- E. 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.

- F. 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.
- G. 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.
- H. 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.

3.02 CONDUIT

- 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. In general, space and routing requirements of all other trades shall take precedence over the conduit installation.
- 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 encase 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.

3.03 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 expansion 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.

3.04 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 1996 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 volts, No. 14 AWG minimum size.
 4. Wiring run underground - Type THHN/THWN, or XHHW 600 Volt.
 5. For fixture wiring - Type AF, 300 volts, No. 12 AWG minimum size.
 6. For branch circuit wiring run in fluorescent fixture channels - Type THHN, 600 volts, 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 Teflon coated 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 AWG 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 - O. Z. Manufacturing Company or equal, Type XLH.
 2. Splices and Taps - O. Z. Manufacturing Company 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 T& B Ty-Rap cable clamps and cable ties.
- B. Supports in vertical feeders shall be two-piece conduit type equal to O. Z. Company 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, wireways, and junction boxes and tie with T & B Ty-Rap nylon cable ties. Clamp or fasten control or circuit cabling in cabinets or other equipment with non-metallic nylon T & T Ty-Rap 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 out doors shall be weatherproof with watertight gasketed covers fastened with corrosion resistant screws.
- E. Except as otherwise indicated, boxes shall be not less than code requirements and their size shall be determined as follows:

1. For straight pulls involving conductors of No. 6 or larger and for raceways of 1-1/4" and larger, the length shall be a minimum of 8 times the diameter of the largest raceway, and the width shall be three (3) times the diameter of the largest raceway plus the sum of the diameters of all other raceways in the same side of the box or cabinet.
2. For angle pulls or direction changes, the distance between any entering raceway and the opposite side of box shall be a minimum distance of six (6) times the diameter of the largest raceway and the minimum distance between raceway entries enclosing the same conductor shall not be less than 6 times the diameter of the larger raceway. Additional raceways in the same wall of the box shall require increase of these dimensions by the sum of the diameters of the added raceways. In no event shall any cabinet or box contain more than 20% of its' cross sectional area in conductors. Where conductors cross a box, a maximum of nine (9) conductors may be laid parallel without the use of a barrier or compartment. Where junction or pull boxes involve dimensions over 36 inches on any side, conductors crossing such distances must be supported on approved racks or clamps in such a manner as to avoid greater unsupported spans of more than 36 inches. Where such boxes exceed 60 inches in any dimension, all conductors shall be so supported regardless of direction of travel.

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 panelboards 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. 370-23 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 Manufacturers' 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 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.
 6. 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.
- 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.

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. Unless noted otherwise on the Drawings, indicated on Architect's Drawings, or directed by the Architect at time of installation, place outlet boxes at the locations scaled from the floor plans and at the following heights from the center of box above the finished floor level:
 - 1. Wall Switches: 48" and immediately adjacent to strike side of door.
 - 2. Convenience Receptacles: 16" vertically oriented except 23" for E W C's and 48" when indicated above counters.
 - 3. Telephone Outlets: Unless indicated otherwise 16" vertically oriented except they shall be 54" for wall phones and 4" above backsplash or trim when indicated above counters.
 - 4. Wall Bracket Outlets: 78"
 - 5. Receptacles in the water treatment area and at dialysis counters shall be mounted at heights noted on Drawings.

- D. 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 coverplates 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 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, 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. Patient Station Dedicated Receptacles one (BROWN) 20 amp, GFCI Hospital Grade (Hubbell is not an acceptable manufacturer on this device), and one (IVORY) Hospital Grade on a ganged 20 amp. circuit (max. 2 receptacles per circuit) each mounted in separate box with separate cover plate-color to match.
5. 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.
6. Switched outlets for R.O. holding tank shall be Bryant Model #70520FR
7. Manual motor starter Square D class 2510 with overload heater sized to the motor.
8. 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.
9. 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.

C. COVERPLATES

1. 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.
2. Future or Abandoned Outlet: Blank Plate.
3. All Finished Spaces: Sierra Type RP smooth plastic.
4. On the inside face, on each coverplate, record corresponding panel board and circuit number in permanent marker.

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 coverplates 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.
- G. Each cover plate shall be marked with the panel and circuit number with permanent marker on the inside of the cover plate.

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 1610.

1.03 SUBMITTALS

- A. Submit complete manufacturer's specification on each disconnect proposed to be furnished to 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 environmentally mentally rated for the area where 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 where manual operating branch circuit protection devices are not within sight and within 50 feet of the device.

RENOVATIONS TO SOUTHERN MAINE DIALYSIS – PORTLAND, MAINE #1190

- B. Mount disconnects 48” up on walls, columns or free standing rigid steel frame unless otherwise indicated
- C. 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.
- D. Provide proper selection and sized fuses where disconnects are indicated to be fused.

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 effect 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 16450

GROUNDING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install proper grounding systems for the entire electrical 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 REQUIREMENTS OF REGULATORY AGENCIES

- A. Special attention is directed to Article 250 and Article 517 National Electrical Code (NFPA-70) for sizing and connecting of the grounding systems.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Grounding conductors shall be green colored insulated annealed copper sized, unless specifically indicated otherwise, with an ampacity of at least 50 percent of feeder supplying the equipment to be grounded and no ground wire shall be smaller than No. 6 except, where the feeder supplying the equipment is smaller than No. 6, the grounding conductor in that case shall be the same size as the feeder conductor.
- B. System Ground connections shall be Burndy Type GAR or equal.
- C. Cable connections shall be solderless, bolted pressure connectors.
- D. A grounding conductor shall be installed in every conduit. All conduit, boxes, fixtures, etc. shall be bonded to the common grounding bus. At boxes provide Appleton or equal, green head, grounding screws. All fluorescent fixture ballast housings shall be securely bonded to the ground system.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The common Ground Bus is defined as the main Ground Bus located within the Building Service Entrance Switchgear. This shall be the common Ground point for all ground connections. Stray grounds to the Building frame and/or structural members will not be permitted. A separate color coded insulated grounding conductor shall be run in each and every Raceway as noted on the accompanying drawings and shown in the panel Schedules. The Grounding conductor shall be of the same insulation as the circuit conductors sized in accordance with Article 250 NEC and as illustrated on the drawings.
- B. In the Lighting System, BX pigtails or Aluminum grounds will not be permitted. As such six foot fixture pigtails shall be installed in flexible Steel conduit “Greenfield” utilizing green coded copper grounding conductors. Fluorescent fixture ballasts shall be grounded by bonding jumper from the fixture frame to the ballast retaining bolt.
- C. Testing
 - 1. At the completion of the Grounding System, Meggar test all grounding to the satisfaction of the Architect and Engineer. The Ground System shall be Meggar 5 OHMS or less

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., UL-50-1974 UL-67-1979, 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. Branch panelboards on 208/120V systems shall be equipped with G.E. Type THQB; Square D Type QOB; or Westinghouse Type BAB 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.
- D. Branch panelboards on 480/277 systems shall be equipped with G.E. Type TED; Square D Type EHB or Westinghouse Type GHB 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.
- E. All panelboards shall have solid copper buss bars.

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.

3.02 LABELING

- A. Provide a neatly, typewritten directory of circuits for each existing panelboard as indicated for additions or modifications.

END OF SECTION

SECTION 16501

LIGHTING FIXTURES

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.
- B. If a substitute for a fixture specified is proposed, submit, when so requested, photographs, laboratory test data and samples of both the specified and the proposed fixture to demonstrate that the proposed substitute is an acceptable equal to the specified fixture. Rejection of an offered substitute shall not be basis for work delay or extra compensation.

PART 2 - PRODUCTS

2.01 LIGHTING FIXTURES

- A. Lighting fixtures shall be of the type, manufacturer, and construction as indicated in the Lighting Fixture Schedule.
- B. Each fixture shall be complete with all proper components and accessories.
- C. Recessed incandescent fixtures for ceiling that have insulation shall be Type IC.
- D. Surface mounted fluorescent fixtures shall have spacers to achieve required separation from low-density ceilings construction.
- E. Fixture housing shall be reinforced steel, 90% reflective white enamel finish.
- F. Provide 0.125 thick prismatic virgin acrylic refractor lenses.
- G. Lighting Standards 2007:
 - 1. Treatment Room: Ceiling height above 8'-6" but not above 12'-6" shall be provided with suspended linear indirect lighting. Any ceiling higher than 12'-6" shall be consulted with the engineer for special design. Lighting Fixtures shall be 2-lamp-T8 sectional, two-circuit linear and shall be pendant type Finelite "Series8-P" or equal by Lightolier "Baselyte" or Corelite "Class A Perf" with Osram/Sylvania FO32/830/ECO 4' T8 lamp and utilizing electronic ballast and Ballast Factor of no less than 0.88. Lamps to be 3000° Kelvin, 80 + CRI. Hanging height shall not be below 7'-6" to the bottom of the fixture. Minimum distance between the ceiling and the top of the fixture shall be 9". Also, the bottom height may have to be adjusted to clear the top of the patient privacy curtain rails where used. Any ceiling height lower than 8'-6" shall be semi-indirect recessed and same as described in item 2 below.
 - 2. All Offices, Reception, Waiting and Training Rooms: Lighting shall be semi-indirect type. Lighting fixtures shall be 2'x4" lay-in with semi-indirect perforated baffle and three (3) T-8 lamps with electronic ballast. Fixtures shall be model "Ovation" 2-RDI-332-RP--ER81 as manufactured by Metalux or equal by Lightolier or Lithonia.
 - 3. Conference Room: Lighting shall be semi-indirect type. Lighting fixtures shall be 2'x4" lay-in with semi-indirect perforated baffle and three (3) T-8 lamps with electronic ballast. Fixtures shall model "Ovation" 2-RDI-332-RP- -LU-FDB-4827- -3 as manufactured by Metalux or equal by Lightolier or Lithonia and shall be provided with dimmer switches. Dimmer shall be a white Lutron "Nova T-Star" slide-to-off wall box and located beside the occupancy sensor.

4. All other rooms shall be same as indicated on the lighting fixture schedule on the Construction Drawings.

2.02 LAMPS

- A. Lamps shall be energy saving and suitable for the lighting fixture installed and in accordance with the schedules and shall be manufactured by General Electric, Sylvania, or North American Phillips Corporation.
- B. Incandescent lamps shall be general service inside frosted type except as listed for specific application.
- C. Fluorescent lamps shall be standard (T-8) 3000K except as listed for color, energy savings, or special duty.
- D. Other lamps shall be as specifically listed and be for the duty, lighting quality and application selected.

2.03 BALLASTS

- A. Each lighting fixture shall be equipped with a proper energy saving electronic ballast in accordance with the operating requirements of the lighting fixture. Each ballast shall be UL listed and carry a UL label for the lighting fixture and installation specified. Ballasts shall be manufactured by Advance, GE, Jefferson or Universal.
- B. Fluorescent ballasts shall be CBM certified, high power factor type and sound rated for the lowest rating available for the application. Ballasts for lamps rated 430 ma and below shall be sound rating "A". Each ballast shall have the sound rating listed thereon. Ballasts shall be Premium Class P for those types where the requirements have been established. Other ballasts, where indicated, shall be energy saving type and shall be equal to Advance Mark III.
- C. Other gaseous discharge lamp ballasts shall be high power factor constant wattage type. These ballasts for fixtures on building interior mounting shall be fully enclosed in a metal housing which if filled with thermo-setting sound absorbing and encapsulating material. The interior ballast shall, on recessed fixtures, be mounted separate from the reflector and socket but shall be removable without tools through the fixture ceiling opening. Each ballast shall be provided with a line disconnecting device and thermal protection.

2.04 OCCUPANCY SENSORS

- A. Occupancy Densors: Model WSD-PDT-WH as manufactured by SensorLite or equal by WattStopper or Lightolier. The following rooms and areas shall be provided with occupancy-sensor switch located at strike side of the door when possible.

1. All Offices.
2. Visitors and Staff Toilets.
3. Conference Rooms.
4. Medical Records and Multi-purpose Rooms.
5. Staff Lounge and Locker Rooms.
6. Medical waste.
7. Tech Repair Area.

2.05 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. Units for fluorescent fixtures shall be Siltron Unit-Pak.
- C. Pendant fixtures shall be provided with supports and all other accessories for proper suspension as recommended by the manufacturer and to provide a complete installation.

PART 3 - EXECUTION

3.01 FIXTURES

- A. 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 reflect 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.
- B. 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.

- C. 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.

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

3.02 LAMPS

- A. Each fixture shall be equipped with a set of new lamps of the size and type specified, and left in a condition such that there is a new lamp in each receptacle in each fixture upon completion and acceptance of the work. Low-energy or energy-saving type lamps shall be furnished and installed where indicated and shall specifically match the fixture, socket and ballast selection.
- B. Use permanent fixtures with final lamps to allow final touch-up painting to be performed under completed building light. Permanent fixtures used for other temporary lighting shall have the used lamps removed and not reused for final lamping of the job. Specific approval by the Owner shall be obtained for installation of the final lamps.
- C. Replace all lamps that fail or have blackened ends during the period of touch-up painting, replacing all lamps that have been used more than 1/4 of their rated life. The use time will be determined by the Owner’s records.

3.03 TESTING, CLEANING AIMING AND ADJUSTING

- A. Each fixture shall be replaced in proper operating condition, equipped with the proper lamps 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.

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 16100 Sections 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, which 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 16702

NURSE CALL EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install a complete nurse call system between the nurse's station and the isolation CAPD and patient toilet rooms.
- B. This work includes a master station, remote stations, dome lights, transformer, 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 complete system and each type of material to be used.

PART 2 - PRODUCTS

2.01 MASTER NURSE CALL

- A. Furnish and install Cornell Series 4000 Annunciator, Model #A-4006. Provide Model #A-4010 if more than 6 nurse calls, #A-4020 if more than 10, #A-4030 if more than 20, etc. Station complete with flush box, cover, visual LED's, buzzer and silence switch for operation at 24V A.C. at Nurse Station, as shown on Drawing.
- B. Furnish and install Cornell Series 4000 Power Supply, Model #P-512243A, 120/24V, 30 VA capacity.

2.02 REMOTE STATIONS

- A. Patient toilet stations (2-Reqd.) shall be Cornell Series 4000, Model #E-114-3 single switch, with flush plate and pull cord mounted adjacent to W.C.
- B. Isolation, CAPD Room and (exam rooms only in Texas) call stations (1-Reqd.) shall be Cornell Series 4000, Model #E-114-3 single switch, flush wall plate, with call-placed indicator light mounted on single gang flush cover.

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- C. Dome lights shall be Cornell Series 4000, Model #L-101, with white lamp mounted above door trim.
- D. Nocturnal bedside Station located at each patient station (Nocturnal Application Only) shall be Cornell Series 4000, Model #B-111/EP, bedside station with reset switch, call confirmation LED, and receptacle for pendant Model #SW-510.
- E. Changing Rooms (Nocturnal Applications Only) shall be Cornell Series 4000, Model #E-114-3, pull station with single switch, flush wall plate, and call placed indicator light mounted on single gang flush cover.
- F. Lounge Duty Station (Nocturnal Application Only) shall be Cornell Series 4000, Model #DS-110, annunciator with LED indication and manual high or low volume tone.

2.03 SYSTEM WIRING

- A. Wire transformer (2) 12# THHN, (1) 12# Cu Gnd. - 1/2" C; From transformer secondary extend (2) 14# THHN, (1) 14# Cu Gnd. fused at transformer, to master nurse call annunciator.
- B. From annunciator extend (4) 16# AWG to each call station with (2) 16# to each call station dome light.

PART 3 - EXECUTION

3.01 STATIONS

- A. Mount master station flush at 50" above finished floor plans with building.
- B. Mount signal devices flush where shown on the plans.
- C. All Low-Voltage interconnecting wiring shall be not smaller THHN 16#AWG.

END OF SECTION

SECTION 16730

CATEGORY 5e AND COAXIAL CABLE

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install Category 5e and coaxial wire for the phone, data, patient care entertainment and Clinical Network System.
- B. This work includes conduit, wiring and terminations 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 5e wire and RG6 coax cable material to be used.
- B. Submit a certified copy of the following for approval:
 - 1. Voice and data, CAT5e test reports required and described by this specification and in accordance with ANSI/TIA 568-B.1 and ANSI/TIA 568-B.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 5e CABLE

A. Cable Construction

1. Cable Conductors shall be 24 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 :
 1. Non-plenum, flame retardant PVC
 2. Plenum, low-smoke, flex guard flame-retardant PVC

B. Cable Physical Data

1. Nominal cable diameter, 0.20 inches
2. Minimum bend radius, 1 inch
3. Maximum pulling force, 25 lbs

C. Listed below are the cable jacket colors for their intended use:

Green	Patient station, Direct Touch
Blue	Patient station, Clinical
White	Patient station, Auxiliary Data
Yellow	Workstation Data
Gray	Voice, Telephone

- D. Provide all category 5e cable from one manufacturer. Cable specifications and performance shall meet and or exceed General Cable, Gen Speed 5000 product line. Manufacturer's cable shall be UL performance level tested product.

2.02 COAXIAL CABLE, RG 6/U

A. Cable Construction

1. Cable conductor shall be 18AWG Copper-clad steel
2. Insulation shall be cellular polyethylene.
3. Shield shall be foil shield with aluminum braid.
4. Jacket shall be;
 1. Non-plenum, PVC compound
 2. Plenum, low-smoke, flex guard flame-retardant PVC.

- B. Provide all coaxial cable from one manufacturer. Cable specification and performance shall meet or exceed General Cable, Carol Brand coaxial cable part number C5775. Manufacturer's cable shall be UL performance level tested product.

2.03 PLENUM GRADE

- A. The contractor shall adjust the conductor's jacket for Plenum rating as required by local or state regulations.

2.04 GROUND ROD

- A. Provide ground rod with wire as shown on contract drawing for use by owners equipment installer.

PART 3 - EXECUTION

3.01 CATEGORY 5e INSTALLATION

- A. Provide recessed mount single gang wall box with 3/4" 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 drawing.

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 drawing with corresponding identification numbers on each end of every cable.
- B. Terminate Coax cable at each patient entertainment location with a RG6-F type single twist, Model 40985-TWG manufactured by Liviton or approved equal.

3.03 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 feet on center, utilizing cable supports specifically approved for the purpose.

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.

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

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.

30.4 FIELD TESTING AND CERTIFICATION

- A. The installing Contractor shall submit test plans, test design specifications and procedure for all field test to the Architect. The test plan 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 5e cables shall meet or exceed the applicable requirements in AHSI/TIA 568-B.1 and B.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 which 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 16760

INTERCOMMUNICATION EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install a complete intercommunication system between the nurses station, reception, front entry and supplies delivery door.
- B. This work includes a master stations, door stations, transformer, 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 complete system and each type of material to be used.

PART 2 - PRODUCTS

2.01 MASTER STATION, NURSES STATION AND RECEPTION ROOM

- A. Aiphone Cat. No. LEF-3 master station wall mounted reception room and desk mounted at Nurse's station, 12-16 V.A.C. for private intercom consisting of hand instrument, voice and tone volume control.
- B. Curbell Electronics, Executone Model 3307-002G Nurse's call with light at nocturnal beds.

2.02 DOOR STATION

- A. Aiphone Cat. No. LE-D audio door station surface mounted with stainless steel cover at delivery door. Consists of 2-way communicator with call button. After master replies to the call of the door station, talk is hands-free. When master hangs up, door station resets automatically.
- B. Aiphone Cat. No. LE-DA audio door station flush mounted with stainless steel cover at front entry. Consists of 2-way communicator with call button. After master replies to the call of the door station, talk is hands-free. When master hangs up, door station resets automatically.

2.03 CONTROL POWER TRANSFORMER

- A. Aiphone Cat. No. PS-12 Power Transformer 120/12-16 V.A.C., 60 HZ.

2.04 COMMUNICATION CABLE

- A. Cable shall be multi-conductor cable with an overall shield, non-twisted, 18 AWG solid copper.
 - 1. Three conductor cable between LE-D, or LE-DA and LEF-3, equal to Aiphone Model # 82180325.
 - 2. Nine conductor cable between LEF-3 and LEF-3, equal to Aiphone Model # 82181025.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Wall mount master station at 34 inches above finished floor where shown on the plans. Mount base level and plumb with wall.
- B. Desk mounted master station per Architectural Details.
- C. Flush mount door unit in recessed outlet box at 52 inches above finished grade.
- D. Surface mount door unit to be mounted at 52 inches above finished grade.
- E. Install control transformer at panel board. Extend wire in metal conduit, concealed above the lay-in ceiling or down hollow cavity walls. Conduit run under slab to be scheduled 40 PVC conduits.

END OF SECTION