

SECTION 15050

BASIC MATERIALS AND METHODS

PART 1

1.1 SECTION INCLUDES

- A. General & Supplementary Conditions & Division 1
- B. Mechanical basic requirements.
- C. Electric Motors.
- D. Pipe, Valve, & Equipment Identification.
- E. Pipe Hangers & Accessories
- F. Access Boxes & Panels
- G. Vibration Isolators
- H. Flashing & Sleeves
- I. Painting of Equipment

1.2 SYSTEM DESCRIPTION

- A. Provide complete and fully operational systems with facilities and services to meet requirements indicated and in accord with applicable codes and ordinances.

1.3 REGULATORY REQUIREMENTS

- A. Plumbing: Conform to latest International Plumbing Code (International Code Council, ICC)
- B. Obtain permits, and inspections from authority having jurisdiction.
- C. HVAC: Conform to latest International Mechanical Code (International Code Council, ICC), NFPA 90A (Air Conditioning & Ventilating Systems) and NFPA 90B (Warm Air Heating & Air Conditioning Systems).
- D. Conform to all Local, City, & State codes as well as requirements of Fire Marshall, governmental agencies and Fire Rating Bureau having jurisdiction.

1.4 SUBMITTALS

- A. Submit under provisions of Division 01000.
- B. Submit shop drawings and product data grouped to include complete submittals of related systems, Products, and accessories in a single submittal.
- C. Mark dimensions and values in units to match those specified.

PART 2 PRODUCTS

2.1 ELECTRIC MOTORS

- A. Each contractor to provide motor starters and transfer switches for motors & pumps under their contract.
- B. Electric Service: Refer to Division 16000 for required electrical characteristics.
- C. Motors: For continuous operation in 40 degrees C environment, and for temperature rise to ANSI/NEMA MG 1 limits. Motor will operate satisfactorily without failure for a period of two (2) hours or more at ambient temperature of 120°F & with a minimum service factor of 1.5.
- D. Single Phase Motors: Split phase, Permanent split capacitor, or Capacitor start as required.
- E. Three Phase Motors: Squirrel cage motors to ANSI/NEMA MG 1 Class B, high efficiency type with thermistor system for motor frame sizes 254T and larger, ball bearings.
- F. Motors to be squirrel-cage type drip-proof enclosure unless otherwise indicated, constant speed, & across-the-line normal starting torque designed for quiet operation. Where T-frame motors are used, oversize motor by at least 10%.
- G. Motors to be sized to develop the required brake horsepower & to operate satisfactorily with a voltage variation of $\pm 10\%$, conforming to NEMA motor standards, dynamically balanced, & held to commercial tolerance.

2.2 PIPE, VALVE, & EQUIPMENT IDENTIFICATION

- A. Equipment Nameplates: Laminated three-layer plastic (Bakelite) with engraved black letters on light background color. Or aluminum with etched or engraved lettering on black background. 2.5"x.75" size, securely fastened to the equipment.
- B. Valve Tags: 18-gage polished brass, 1.5" in diameter & stamped for the appropriate service in .25" backfilled letters & stamped with 1.75" brass S-Hook.
- C. Pipe Labels: Plastic clamp on legend & arrows, indicating contents of pipe & direction of flow. Identification shall be color coded per A-13.1 "Scheme of Identification of Piping Systems."

2.3 PIPE HANGERS AND ACCESSORIES

- A. Manufacturers: Fee & Mason
- B. Locations and Models:
 - 1. Water & Hydronic piping - #212 split ring hangers with support rods & Semco "trisulators".
 - 2. Soil & Waste piping - #212 adjustable ring hangers with support rods & #241 riser clamps at each floor and as required.
 - 3. Gas piping - #212 split ring hangers with support rods.

2.4 ACCESS BOXES & PANELS

- A. Walls: Smith #4730 or Josam #8650 with polished chrome plate face in tile walls. Smith #4730-AKL, or Josam #SLA or #SLB, with bonderized prime-coated steel face & Allen lock in walls of other finished rooms.
- B. Ceilings: Acom #8211-3-AKL or Josam #SLA bonderized prime-coated steel face with Allen lock.
- C. Floors: Smith #4910 or Josam #8630-5 with XH plain aluminum or nickel-bronze non-skid top. Smith #4920 for floors covered with vinyl reinforced or pure vinyl tile.
- D. Yard Boxes: Brooks 36 HF or Frazer #2 cast concrete boxes with cast iron rim & hinged self-closing cast iron lid marked for function (eg. gas shutoff, water, fuel, etc.), size to 12"x18"x12". Set flush with finished grade with 4" thick concrete pad under perimeter (but not under interior) of box.

2.5 VIBRATION ISOLATORS

- A. Equipment: Thy Curb Vibrocurbs or equal
- B. Ducts: Vent-fabric flexible connections with minimum of 6" full length.
- C. Piping: Flexible connections, isolation hangers & expansion/contraction connectors.
- D. Pumps: Metraflex "Metra-Mini" stainless steel pump connectors.
- E. All devices shall not exceed a noise criterion curve of 35 db SPL when measured on the flat response "C" scale, in occupied spaces.

2.6 FLASHING & SLEEVES

- A. Concrete: "Sperzel", rust-proof, "Crete-Sleeve" at all penetrations through concrete, masonry, studs walls, or finished ceiling sized as required.
- B. Drywall, wood, synthetic stucco, etc: Provide sheet metal sleeves with minimum of 1/2" lip for all exposed locations. Prefinished backed enamel finish on exterior & chrome or painted finish on interior (verify colors with Architect).
- C. Roof: York Manufacturing, Inc. "Superflash" with elastomer collar & nailable base of galvanized steel or aluminum, pitched to match roof slope. Flashing at all piping roof penetrations to have elastomer or neoprene collar/caulking ring & a nailable base of galvanized steel or aluminum pitched to match roof slope, by one of the following manufacturers:
 - 1. York Manufacturing, Inc. (Superflash)
 - 2. Anderson Metals Corporation (AMC) (1-800-821-5672)
 - 3. Midland Metal Manufacturing Co. (1-800-821-5725)
 - 4. Willard Industries (1-800-438-5052)

2.7 PAINTING OF EQUIPMENT:

- A. See Division 09000 for painting standards & requirements
- B. Verify colors with Architect.

PART 3

3.1 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions. Provide all required items for a complete installation & coordinate with other trades all items needed to complete installation. If it is necessary to provide additional items for complete installation not specifically shown on plans that requires work by other trades, it is the responsibility of each contractor to coordinate that required work with other trades prior to bidding.
- B. Install equipment & accessories to permit access for maintenance. Relocate items as necessary to provide such access & without cost to the Owner.
- C. Examine the areas & conditions under which work of this section will be performed. Correct conditions detrimental to timely & proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.
- D. Proceed in a timely & proper manner as rapidly as the building construction will permit.
- E. Thoroughly clean items before installation.
- F. Each contractor (fire protection, Plumbing, & HVAC) shall be responsible to provide & install the required identification, hangers, vibration isolators, flashing, sleeves, motors, access panels & accessories as required for the installation of their systems under their applicable sections.
- G. Each Contractor shall be responsible to provide concrete thrust blocks, supports, vaults/pits, condenser pads, etc. as required for equipment under their contract in conformance with Division 03000 (Concrete Work).
- H. Provide for connection to electrical service & controls of all equipment as required. Refer to Division 16.

3.2 INSTALLATION OF IDENTIFICATION SYSTEMS

- A. Pipe: Clamp on legend & arrows, indicating contents of pipe & direction of flow located as follows:
 - 1. Adjacent to each valve.
 - 2. At each branch & riser takeoff.
 - 3. At least once in each area that a pipe passes through (except finished areas) & at least every 40 feet.
- B. Valves: Identify valves by distinguishing numbers & letters assigned to them & listed on a valve chart. Attach a brass tag on each valve with 1" to 3/4" #10 Brass-S-Hooks. Furnish 3 copies of printed valve list showing tag letter-number, service, & location. Include in each maintenance manual.
- C. Equipment: Identify equipment with nameplates securely fastened to the equipment. Install nameplates with adhesive or screws. Install metal tags with corrosion resistant metal chains. Install material in accordance with manufacturer's instructions.

3.3 INSTALLATION OF PIPE SUPPORTS

- A. Support suspended piping with clevis or trapeze hangers & rods per Table 308.5 IPC.
- B. Space hangers & supports for all sizes of horizontal PVC pipes at a maximum of 4'-0"
- C. Space hangers & supports for horizontal Steel pipes according to the following schedule:

Pipe Size:	Maximum Spacing on Centers:
1.25" or smaller	8'-0"
1.5" to 3"	10'-0"
4" or larger	12'-0"
- D. Space hangers & supports for horizontal Copper tubing according to the following schedule:

Tube Size:	Maximum Spacing on Centers:
1.25" or smaller	6'-0"
1.5"	7'-0"
2"	8'-0"
2.5"	9'-0"
3" or larger	10'-0"
- E. Provide sway bracing on hangers longer than 18". Support vertical piping with riser clamps secured to the piping & resting on the building structure. Provide at each floor unless otherwise noted.
- F. Provide insulation continuous through hangers & rollers. Protect insulation by galvanized shields.

- G. Arrange pipe supports to prevent excessive deflection, & to avoid excessive bending stress.
- H. Support piping from inserts or anchors in concrete slabs. Provide the inserts under this Section & arrange for the placing under Division 03000 of these Specifications.
- I. Hubless Piping: Provide hangers on the piping at each side of, & within 6" of, hubless pipe coupling so the coupling will bear no weight. Do not install hangers on couplings. Provide hangers adequate to maintain alignment & to prevent sagging of the pipe. Make adequate provision to prevent shearing & twisting of the pipe & the joint.

3.4 INSTALLATION OF ACCESS BOXES & PANELS

- A. Install access boxes or panels as required where piping, valves, equipment, etc. is concealed in walls, floor, or ceilings & will require maintenance or service.
- B. Boxes or panels to be flush with surfaces - level, square, & plumb, installed per manufacturer's requirements.

3.5 INSTALLATION OF VIBRATION ISOLATORS

- A. Provide isolators on both sides of all pumps.
- B. Provide isolators at all connections of duct work to equipment (except rangehoods & dishwasher hoods).
- C. Mount vibrating equipment on "Thy-Curb Vibrocurbs" with a minimum static deflection of 1".
- D. Isolate piping from structure in a manner to prevent transmission of vibration.
- E. Eliminate the source of any objectionable noise or vibration, or completely isolate it, without cost or inconvenience to the Owner.
- F. Provide expansion/contraction joints or fittings to allow perfect freedom of movement of piping during expansion & contraction without buckling. Erect piping so the strain & weight does not come upon apparatus.

3.6 INSTALLATION OF SLEEVES & OPENINGS

- A. Provide sleeves for each pipe passing through walls, partitions, floors, roofs, & ceilings. Set pipe sleeves in place before concrete is placed. (Alternate method to core drill after concrete placement).
- B. For uninsulated pipe, provide sleeves two pipe sizes larger than the pipe passing through, or provide a minimum of 1/2" clearance between inside & outside of the pipe. For insulated pipe, provide sleeves of adequate size to accommodate the full thickness of pipe covering, with clearance for packing & caulking.
- C. Coordinate the caulking of the space between sleeve & pipe, equipment, pipe covering or duct by the fire-proofing contractor, see Division 07000.
- D. Caulk the space between sleeve & pipe, equipment, pipe covering or duct, using a non-combustible, permanently plastic, waterproof, non-staining compound which leaves a smooth finished appearance, or pack with noncombustible material to within 1/2" of both surface faces, & provide the waterproof compound described above. See Division 07000 for Firestopping, for requirements & materials. Provide "ProSet" firestop systems for all PVC piping applications.
- E. Where items under your contract penetrate the roof, outer walls or waterproofing of any kind, provide under this Section, all base flashing & counterflashing required at such penetrations.

3.7 TRENCHING & BACKFILLING

- A. Perform trenching & backfilling required for work under each section in strict accordance with pertinent provisions of Division 02000 of these specifications & following conditions.
- B. Cut bottom of trenches to grade. Make trenches 12" wider than the greatest dimension of the pipe.
- C. Bedding & backfilling:
 1. Install piping promptly after trenching. Keep trenches open as short a time as practicable.
 2. Under the building & parking, install pipes on a 6" bed of damp sand or pea gravel. Backfill to bottom of slab or paving with damp sand or pea gravel.
 3. Outside the building, install underground piping on a 6" bed of damp sand or pea gravel. Backfill to 12" above pipe with damp sand & backfill remainder with native soil. Tamp in firmly in lifts to achieve uniform compaction.
 4. Do not backfill until installation has been approved & until Project Record Documents have

been properly annotated.

3.8 FIELD QUALITY CONTROL

- A. Upon completion of the project, provide the Architect/Engineer with a certification that the installation has been inspected for proper operation & that it complies with all applicable codes.

END OF SECTION

SECTION 15400

PLUMBING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section 15050 - Basic Material & Methods
- B. Pipe and pipe fittings, valves.
- C. Plumbing Specialties: Floor drains, water hammer arrestors, & hose bibs/hydrants.
- D. Plumbing Fixtures.
- E. Plumbing Equipment.

1.2 SUBMITTALS

- A. Product Data: For review provide manufacturers literature for plumbing specialties, fixtures, and equipment.
- B. Operation & Maintenance Instructions: Comply with Division 01000 (Section 01700). Include within each manual a copy of the Project Record Documents showing all work of this Section. Include relevant instructions & data.

1.3 QUALITY ASSURANCE

- A. Testing & Adjusting: Test pipe installation as indicated, & obtain Architects inspection & approval of installation prior to burial or concealment by further construction.
- B. Sterilization Certificate: Upon completion of water line sterilization, deliver to the Architect two (2) copies of an acceptable "Certificate of Performance" for that activity.
- C. Cathodic Protection: Upon completion of the work of this Section, deliver to the Architect sufficient data to prove that wrapping of steel piping has been tested & meets the specified requirements. Show date of inspection, voltages used, & name & address of the inspector.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED BEYOND BUILDING

- A. Cast Iron Pipe: ASTM A74, service weight with neoprene gaskets or lead and oakum joints. All pipe, fittings, joints, etc. by one domestic manufacturer.
- B. PVC Pipe: 8" or larger, ASTM D3033 or D3034, SDR 35, with elastomeric gaskets. 6" or smaller, ASTM D2729 with solvent weld joints, Schedule 40 PVC.

2.2 SANITARY SEWER PIPING, BURIED UNDER BUILDING

- A. Cast Iron Pipe: ASTM A74, service weight, with neoprene gaskets or lead and oakum joints. All pipe, fittings, joints, etc. by one domestic manufacturer.
- B. PVC Pipe: ASTM D2729 with solvent weld joints, Schedule 40 PVC.

2.3 SANITARY SEWER PIPING, ABOVE GRADE, WITHIN BUILDING

- A. Cast Iron Pipe: CISPI 301, hubless, service weight, ASTM A888-90. All pipe, fittings, joints, etc. by one domestic manufacturer.
Coupling System: CLAMP-ALL CORP. couplings of 24 gauge type 304 stainless steel, with Hi-Torque clamps tightened 100 to 125 inch pounds of torque. Coupling gaskets (& bushings when used) shall be made of Neoprene & shall interlock with the housing assembly to make a slip-free joint.
- B. PVC Pipe: ASTM D2729 with solvent weld joints, Schedule 40 PVC.

2.4 WATER PIPING, BURIED BEYOND BUILDING

- A. Cast Iron Pipe: ANSI/AWWA C151 with ductile iron fittings rubber gasket, mechanical joints and 3/4

- inch (19 mm) diameter rods.
- B. Copper Tubing: ASTM B88, Type K, or ASTM B42, annealed with wrought copper fittings and compression joints.
- C. PVC Pipe: AWWA C902, or ASTM D1785, Schedule 40, or ASTM D2241, minimum 150 psig pressure rating with solvent weld joints.

2.5 WATER PIPING, BURIED UNDER BUILDING

- A. Copper Tubing: ASTM B88, Type K, annealed without fittings.
- B. Plex Piping: 1/4" to 1 1/2" pipe Equal Wirsbo "AQUAPEX", ASTM F876/ F877/F1960/F1961/F1807, CSA B137.5 potable, SDR 9, NSF-pw 14 and 61, Rated 200°F at 80 psi, 180°F at 100 psi, & 73.4°F at 160 psi,

2.6 WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L, hard drawn, with cast brass or wrought copper fittings and Grade 95TA solder joints.
- B. Plex Piping: 1/4" to 1 1/2" pipe Equal Wirsbo "AQUAPEX", ASTM F876/ F877/F1960/F1961/F1807, CSA B137.5 potable, SDR 9, NSF-pw 14 and 61, Rated 200°F at 80 psi, 180°F at 100 psi, & 73.4°F at 160 psi,

2.7 GATE VALVES

- A. Up to 2 Inches: Bronze body, non-rising stem & handwheel, inside screw, single wedge or disc, solder or threaded ends.
- B. Over 2 Inches: Iron body, bronze trim, rising stem & handwheel, OS&Y, single wedge, flanged or grooved ends.

2.8 GLOBE VALVES

- A. Up to 2 Inches: Bronze body, rising stem and handwheel, inside screw, renewable composition disc, solder or screwed ends, with back seating capacity.
- B. Over 2 Inches: Iron body, bronze trim, rising stem & handwheel, OS&Y, plug-type disc, flanged ends.

2.9 BALL VALVES

- A. Up to 2 Inches: Bronze or stainless steel body, stainless steel ball, Teflon seats and stuffing box ring, lever handle, solder or threaded ends.
- B. Over 2 Inches: Cast steel body, chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, flanged.
- C. On Bicarb, Process Water & Acid system use CPVC body, ball, Teflon seat and O-ring seals, with lever handle.

2.10 BUTTERFLY VALVES

- A. Iron body, bronze disc, resilient replaceable seat for service to 180°F, wafer or lug ends, 10 position lever handle.

2.11 WATER PRESSURE REDUCING VALVES

- A. Up to 2 Inches: Bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded and single or double union ends.
- B. Over 2 Inches: Cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.12 RELIEF VALVES

- A. Bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.13 CLEANOUTS

- A.
- | | | MODEL NUMBERS | | | |
|----------------|-------|---------------|-----------------|-------------------|----------|
| Manufacturers: | | Exterior | Finished Floors | Unfinished Floors | Walls |
| 1. | Smith | 4253 | 4023 | 4223 | 4532 |
| 2. | Josam | 58860 | 58010 | 56050-22 | 58790-4 |
| 3. | Zurn | Z-1460-15 | Z-1400-2 | Z-1420-25 | Z-1445-1 |
- B. Floor: Lacquered cast iron, two piece body with double drainage flange, weep holes, reversible clamping collar, and adjustable nickel-bronze strainer, round scoriated cover in service areas and round or square depressed cover to accept floor finish in finished floor areas.
- C. Wall: Line type with lacquered cast iron body and round epoxy coated gasketted cover, and round stainless steel access cover secured with machine screw.
- D. Coverplates: heavy polished stainless steel, wall & floor cover plates, installed flush with floor or wall, with adjustable watertight covers in floors & round chrome plated or stainless steel access plate & screw in walls.
- E. Cleanout plugs of extra heavy bronze.
- F. All exterior coverplates & cleanouts to have stainless steel screws.

2.14 WATER HAMMER ARRESTORS

- A. Manufacturers:
1. Smith, Model 5000 series
 2. Josam, Model 1585
 3. Sioux Chief, Model "Hydra-Rester"
- B. Type To PDI WH-201, precharged suitable for operation in temperature range -100 to 300°F & maximum 250 psig working pressure.

2.15 HOSE BIBS/HYDRANTS

- A. See plans Manufacturers & Model numbers.
- B. Interior Hose Bib: Bronze or brass, replaceable hexagonal disc, hose thread spout, chrome plated with vacuum breaker.
- C. Wall Hydrant: Non-freeze, anti-siphon, automatic self-draining type with chrome plated with wall plate hose thread spout, [removable key], and vacuum breaker.

2.16 SCHEDULED EQUIPMENT ON PLANS

- A. See Plans for equipment

2.17 WATER HEATERS

- A. See plans for Manufacturers & Models.
- B. Electric: Factory-assembled & wired, electric, vertical storage type. Welded steel pressure vessel; glass or copper lined, with automatic immersion water thermostat, flanged or screw-in nickel chrome elements, high temperature limit thermostat, and ASME rated temperature and pressure relief valve.

2.18 PIPE & VALVE INSULATION

- A. Glass Fiber Insulation: ANSI/ASTM C547; 1" to 3" thick Owens/Corning fiberglass, noncombustible insulation, 3 lb. density, "25 ASJK/SSL-11" for Hot & Cold Water lines.
- B. Cellular Foam: Flexible, plastic; 1/2" Armstrong "Armaflex sealed with Armstrong adhesive for condensate lines above ceilings or concealed in walls.
- C. Jacket:
1. Vapor Barrier Jackets: Factory applied fiberglass reinforced vinyl 25ASJ vapor barrier with self-sealing adhesive joints.
 2. PVC Jackets: One piece, pre-molded type, Manville "Zeston 25/50"
- D. Accessories:
1. Insulation bands: 3/4" wide, galvanized steel.
 2. Fibrous Glass Cloth: Untreated; 9 oz/sq.yd. weight.

- E. Safety Insulation: Equal "Handy Shield" foam insulated, vinyl jacked relaseable protective covers.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside piping before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Coordinate cutting or forming of roof or floor construction to receive drains to required invert elevations.
- E. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
- F. Verify adjacent construction is ready to receive rough-in work of this Section.
- G. Examine the areas & conditions under which work of this section will be performed. Correct conditions detrimental to timely & proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.
- H. Thoroughly clean items before installation.

3.2 INSTALLATION

- A. Proceed as rapidly as the building construction will permit.
- B. Provide dielectric connections wherever jointing dissimilar metals.
- C. Install piping to conserve building space and not interfere with use of space. Group piping whenever practical at common elevations.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Provide clearance for installation of insulation and access to valves and fittings.
- F. Slope water piping and arrange to drain at low points.
- G. Install under slab water piping without joints where possible.
- H. Install bell and spigot pipe with bell end upstream.
- I. Install specialties in accordance with manufacturer's instructions.
- J. Cut square, remove burrs, & clean inside of female copper tubing, filing to a bright finish. Apply solder flux with brush to tubing. Remove internal parts of solder-end valves prior to soldering.
- K. Soil piping shall be graded a minimum of 1/8" per foot & a maximum of 1/2" per foot in the direction of flow.
- L. Cutting & Patching: Provide cutting, patching, hangers, foundation openings & bucks, including cutting & patching of concrete, brick, paving, & curbs.
- M. Install Los Angeles pattern cast brass traps with brass nuts (chrome plated) for lavatories & sinks, except service sinks.
- N. Install all water piping within the building insulation envelope. No piping is to be on the cold side of the vapor barrier or in unheated attic spaces. Keep all piping concealed in walls, mechanical chases & spaces. Plumbing contractor to coordinate work with Insulation contractor to assure location of insulation envelope. The Architect shall promptly be notified of any difficulties in accomplishing this. Any deviations from this will be grounds for rejecting work.
- O. Minimum size of all waste, drain, and vent lines under slab shall be as follows: 2" diameter for all lines 2" or less, & 4" diameter for all lines larger than 2" diameter.
- P. Install water heaters in accordance with manufacturer's instructions and to AGA, NSF, NFPA, & UL requirements. Coordinate with plumbing piping and related fuel piping, gas venting, or electrical work to achieve operating system.
- Q. Layout the plumbing system in careful coordination with the drawings, determining proper elevations for all components of the system & using only the minimum number of bends to produce a satisfactory functioning system.
- R. Layout pipes to fall within partition, wall or roof cavities, & to not require furring other than as shown on the drawings.
- S. Show no tool marks or threads on exposed plated, polished, or enameled connections from fixtures. Tape all finished surfaces to prevent damage during construction.
- T. Make changes in directions with fittings, make changes in mains sizes with eccentric reducing fittings. Unless otherwise noted, install water supply & return piping with straight side of eccentric fittings at top of the pipe.

- U. Screwed piping joints deburr cuts & treads to requirements of ANSI B2.1. Do not ream exceeding internal diameter of the pipe. Use teflon tape on male thread prior to joining other services.
- V. Remake leaky joints with new material, removing leaking section and/or fitting as directed. Do not use thread cement or sealant to tighten joint.

3.3 APPLICATION

- A. Use grooved mechanical couplings and fasteners, and dielectric connections only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- D. Install pressure regulators as required for each system or piece of equipment on all air, gas & water services
- E. Install piping, equipment, & accessories to permit access for maintenance. Relocate items as necessary to provide such access & without cost to the Owner.
- F. Provide access doors where valves, motors, or equipment requiring access for maintenance are located in walls or chases above ceilings. Coordinate location of access doors with other trades as required.

3.4 SERVICE CONNECTIONS

- A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with water meter. Provide sleeve around service main to 6 inch above floor and 6 feet minimum below grade.

3.5 INSTALLATION OF PLUMBING FIXTURES

- A. Set fixtures level and in proper alignment with respect to walls & floors, & with fixtures equally spaced.
- B. Install each fixture with chrome plated rigid or flexible supplies in proper alignment with fixtures & with each other, & with screwdriver stops, reducers, & escutcheons.
- C. Install flush valves in alignment with the fixture, without vertical or horizontal offsets.
- D. Grout or caulk wall and floor mounted fixtures watertight where the fixtures are in contact with walls & floors.
- E. Caulk deck-mounted trim at the time of assembly, including fixture and casework mounted. Caulk selfrimming sinks installed in casework.
- F. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- G. Cap pipe openings to exclude contaminants (dirt, bugs, etc.) until fixtures are installed & final connections made.

3.6 INSTALLATION OF FINISH & ESCUTCHEONS

- A. Smooth up rough edges around sleeves with plaster or spackling compound.
- B. Provide 1" wide chrome or nickel plated escutcheons on all pipes exposed to view where passing through walls, floors, partitions, ceilings & similar locations. Size the escutcheons to fit pipe & coverings. Hold escutcheons in place with set screw.

3.7 INSTALLATION OF VALVES

- A. Provide valves in water, air, & gas systems. Locate & arrange so as to give complete regulation of apparatus, equipment, & fixtures. Locate valves for easy accessibility & maintenance.
- B. Provide valves in a least the following locations:
 - 1. In branches &/or headers of water piping serving a group of fixtures.
 - 2. On both sides of apparatus & equipment.
 - 3. For shutoff of risers & branch mains.
 - 4. For flushing & sterilizing the system.
 - 5. Where shown on plans.

- C. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install globe, ball or butterfly valves for throttling, bypass, or manual flow control services.
- E. Provide spring loaded check valves on discharge of water pumps.

3.8 INSTALLATION OF PIPING INSULATION

- A. Install materials in accordance with manufacture's instructions.
- B. Maintain ambient temperatures & conditions required by manufacturers of adhesive & insulation.
- C. Continue insulation vapor barrier through penetrations.
- D. Piping Insulation:
 - 1. Locate insulation & cover seams in least visible places.
 - 2. Neatly finish insulation at supports, protrusions, & interruptions.
 - 3. Insulation with Vapor Barrier: Insulate fittings, valves, unions, flanges, strainers, flexible connections, & expansion joints.
 - 4. Insulation without Vapor Barrier: Bevel & seal ends of insulation at equipment, flanges, & unions.
 - 5. Provide insert between support shield & piping, under the finish jacket, on piping 2" diameter or larger. Fabricate of cork or other heavy density insulating material suitable for temperature, not less than 6" long, of same thickness & contour as adjoining insulation.
 - 6. Insulate all hot & cold water supply & return lines with glass fiber with thickness as follows: 1" or less with 1/2", 1.25" to 4" with 1", & greater than 4" with 1.5". Insulate condensate lines above ceilings or concealed in walls with cellular foam.
 - 7. Insulate all exposed drain & supply lines exposed under wall hung fixtures & lavatories with safety insulation to meet ANSI A177 & ADA codes for protection & accessibility of physically handicapped persons.
 - 8. Insulate all Bicarb, Processed Water & Acid lines with glass fiber with vapor barrier face of 2" thickness.
- E. Pipe Insulation Jackets:
 - 1. Indoor, Concealed Hot Pipes: Furnish standard factory applied jackets with or without vapor barrier. Finish fittings, joints, & valves with glass cloth & adhesive. PVC jackets may be used.
 - 2. Indoor, Concealed Cold Pipes: Furnish with vapor barrier jackets, factory applied. Furnish fittings, joints, & valves with glass cloth & vapor barrier adhesive.
 - 3. Indoor, Exposed Pipes: Finish with PVC jackets.

3.9 INSTALLATION OF CLEANOUTS

- A. Secure the Architect's approval of locations for cleanouts in finished areas prior to installation. Locate at intervals of not more than 100 feet.
- B. Provide cleanouts of same nominal size as the pipes they serve, except where cleanouts are required in pipes 4" & larger provide 4" cleanouts unless otherwise noted.
- C. Make cleanouts accessible & ensure clearance at cleanout for rodding of drainage system.
- D. Extend cleanouts to finished floor or wall surface & provide cover plates as required.
- E. After pressure testing thoroughly lubricate threaded cleanout plugs with mixture of graphite and linseed oil.
- F. Provide exterior cleanouts with stainless steel screws and set in 4" thick concrete poured 12" around all sides, flush with finish grade.

3.10 INSTALLATION OF WATER HAMMER ARRESTERS

- A. Provide water hammer arresters on hot & cold water lines.
- B. Install in upright position at all quick closing valves, solenoids, isolated plumbing fixtures, & supply headers at plumbing fixture groups. Install water hammer arresters behind access panels.
- C. Locate & size as specified or as shown on the Drawings, & where not shown locate in accordance with Plumbing & Drainage Institute Standard WH-201. Locate water hammer arresters on all flushometer valves, showers, shower/tubs, sinks, & electronic solenoid valves.
- D. Where fixtures are not protected by water hammer arresters, provide 24" high air chambers on each water supply, properly sized & designed for maintenance & drainage.
- E. Install water hammer arresters complete with accessible isolation valve.

3.11 DISINFECTION/STERILIZATION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flush & clean. Notify the Architect at least 48 hours prior to start of the disinfection process & perform disinfection process under Architect's observation. Ensure PH of water to be treated is between 7.4 & 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- B. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form, throughout system to obtain 50 to 80 mg/L residual. Bleed water from outlets to ensure distribution.
- C. Maintain disinfectant in system for 24 hours. If final disinfectant residual test less than 25 mg/L, repeat treatment.
- D. Flush disinfectant from system. Take samples no sooner than 24 hours after flushing, & analyze in accordance with AWWA C601.
- E. Upon completion of sterilization, & 24 hours after final flushing, secure an analysis by a laboratory approved by the Architect, based on water samples from the system, showing test negative for coli-aerogene organisms. Provide a total plate count of less than 100 bacteria per cc, or equal to the control sample. Take a minimum of 4 samples from the building system as remote from each other as possible.
- F. Upon completion of sterilization, secure & submit a Certificate of Performance required under Article 1.4 of this Section, stating system capacity, disinfectant used, time & rate of disinfectant applied, & resultant residuals in ppm at completion. Also give the results of coli-aerogene tests.
- G. If analysis results are not satisfactory, repeat the disinfection procedures & retest until specified standards are achieved.

3.12 FIELD QUALITY CONTROL

- A. Upon completion of the plumbing installation the plumbing contractor shall provide the Architect/Engineer with the certifications that the installation has been inspected for proper operation & that it complies with all applicable codes including the International Plumbing Code.
- B. Plumbing system including, but not limited to, plumbing fixtures & trim, water piping (supply & DWV), etc. shall be tested & inspected.
- C. Plumbing Contractor shall submit the following:
 - 1. Sterilization Certificate per 1.04 of this Section
 - 2. Plumbing Certificate of Performance
 - 3. Certification of Backflow Prevention devices by state certified tester.
 - 4. As built/record drawings of actual installation to the Architect after completion of the project.
- D. Testing & Adjusting
 - 1. Temporary plug waste, vent, & roof drain lines fill with water to the roof level, & allow to remain so for 24 hours without leakage.
 - 2. Test hot & cold water lines at 125 psi for a period of 12 hours without leaking/
 - 3. On all piping systems, a final test shall be made upon completion of system piping. The test pressure shall be the maximum operating pressure of the system. No leaks shall be detected. Comply with all local codes & ordinances & make all tests required by governing bodies.
- E. Where tests show material or workmanship to be deficient, replace or repair as necessary, & repeat the tests until the specified standards are achieved.
- F. Adjust systems to optimum standards of operation.

END OF SECTION

SECTION 15781

PACKAGED HEAT PUMP UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section 15050: Basic Materials & Methods
- B. Packaged roof top unit.
- C. Packaged terminal air conditioning units.
- D. Packaged terminal heat pump units.
- E. Unitary air conditioners.
- F. Computer room air conditioning units.
- G. Controls and control panels.
- H. Maintenance service.

1.2 SUBMITTALS

- A. Section 01001 - Basic requirements: Procedures for submittals.
- B. Shop Drawings: Provide for manufactured products and assemblies required.
- C. Product Data: Provide for manufactured products and assemblies required. Indicate electrical rough-in connections
- D. Operating and Maintenance Instructions: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

1.3 WARRANTY

- A. Section 01001 - Basic Requirements: Provide a minimum five year warranty to include coverage for heat pump refrigeration compressors. _____.]

1.4 MAINTENANCE

- A. Section 01001 - Basic Requirements: Provide manufacturer's maintenance services on packaged heat pump units for one year from Date of Substantial Completion. Submit copy of service call work order or report, and include description of work performed.

PART 2 PRODUCTS

2.1 PACKAGED HEAT PUMP UNITS

- A. Unit: Self-contained, packaged, factory assembled and prewired unit, consisting of cabinet and frame, supply fan, electric heating elements, controls, air filters, refrigerant coil and heat pump compressor, condenser coil and condenser fan]
- B. Cabinet: Galvanized steel with baked enamel finish, access doors or removable access panels with quick fasteners
- C. Insulation: neoprene coated glass fiber.
- D. Heat Exchangers: Aluminized steel, of welded construction.
- E. Supply Fan: Forward curved centrifugal type, resiliently mounted with direct drive, and rubber isolated hinge mounted motor or direct drive.
- F. Air Filters: One inch thick permanent washable or One inch thick glass fiber disposable media in metal frames.
- G. Electric Heating Elements: Finned tube or Helical nickel-chrome resistance wire coil with automatic reset thermal cut-out, built-in contactors, control circuit transformer and fuse, manual reset thermal cut-out. Controls to start supply fan before electric elements and continue operation until air temperature reaches minimum setting.
- H. Indoor Coil: Copper or aluminum tube aluminum fin coil assembly with capillary tubes or thermostatic expansion valves, galvanized drain pan and connection.
- I. Compressor: Hermetic or semi-hermetic compressor, 3600 rpm, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection,

SECTION 15880

AIR DISTRIBUTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section 15050, Basic Materials & Methods
- B. Filters.
- C. Ductwork & ductwork accessories.
- D. Volume control dampers.
- E. Flexible duct connections.
- F. Diffusers, boots, registers, grilles.
- G. Exhaust Fans

1.2 SUBMITTALS

- A. Shop Drawings: Indicate for manufactured products & assemblies, & include electrical characteristics & connection requirements.
- B. Operating & Maintenance Instructions: Include instructions for lubrication, filter replacement, spare parts lists, & wiring diagrams.

PART 2 PRODUCTS

2.1 FILTERS

- A. Washable Permanent Panel Filters: 14 mesh steel screen, zinc electroplated, stainless steel, or aluminum, rod reinforced; enclosed in galvanized steel or stainless steel frame. Size as required with thickness of 1/2 inch to one inch.
- B. Disposable Panel Filters: Fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive. Size as required with 1" thickness set in casing of cardboard frame with perforated metal or plastic retainer. Galvanized steel frame with expanded metal grid on outlet side & steel rod grid on inlet side required on filter larger than 30"x30". Performance Rating to be 500 FPM face velocity.
- C. Filter Rack & Glide / Packs:
 - 1. Side access housings for single or multistage air filtration to equal Farr model 4P (single) or 3P (two stage) glide pack with two access doors (one each side), sealed holding frames, extruded aluminum tracking, & 16 gauge housing & doors.

2.2 DUCTWORK

- A. Materials
 - 1. Steel Ducts: Galvanized steel sheet, lock-forming quality.
 - 2. Insulated Flexible Ducts: Flexible duct wrapped with flexible 1" thick glass fiber insulation, enclosed by seamless vapor barrier jacket.
 - 3. Sealant: Non-hardening, water resistant, fire resistive, used alone or with tape.
- B. Metal Ductwork
 - 1. Fabricate & support in accordance with SMACNA HVAC Duct Construction Standards - Metal & Flexible except as indicated.
 - 2. Construct T's, bends, & elbows with radius of 1-1/2 times width of duct on center line. Where not possible provide turning vanes.
 - 3. Increase duct sizes gradually, not exceeding 30 degrees divergence & 45 degrees convergence.
 - 4. Connect flexible ducts to metal ducts with liquid adhesive plus tape or adhesive plus sheet metal screws.
 - 5. Use crimp joints with or without bead for joining round duct sizes 8 inch & smaller with crimp in direction of air flow.

2.3 VOLUME CONTROL DAMPERS.

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal & Flexible, & as indicated.
- B. Fabricate splitter dampers of material same gage as duct to 24 inches size in either direction, & two gages heavier for larger sizes. Secure with continuous hinge or rod. Operate with minimum 1/4 inch diameter rod.
- C. Fabricate single blade dampers for duct sizes to 12 x 30 inch.
- D. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch. Assemble center & edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- E. Except in round ductwork 12 inches & smaller, provide end bearings.
- F. Provide locking, indicating quadrant regulators on single & multi-blade dampers. Where width exceeds 30 inches provide regulator at both ends.

2.4 AIR TURNING DEVICES/EXTRACTORS

- A. Multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.
- B. Multi-blade device with radius blades attached to pivoting frame & bracket, steel or aluminum construction, with push-pull operator strap.

2.5 FLEXIBLE DUCT CONNECTIONS

- A. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, approximately 3 inches wide, crimped into metal edging strip.

2.6 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal & Flexible.
- B. Access doors smaller than 12 inches square may be secured with sash locks. Access doors with sheet metal screw fasteners are not acceptable.

2.7 AIR OUTLETS & INLETS

- A. Manufacturers:

1. Anemostat	4. J & J Register	7. Metalaire
2. Carnes	5. Krueger	8. Price Industries
3. Hart & Cooley	6. Lima	9. Tuttle & Bailey
- B. Ceiling Diffusers: Round or Rectangular adjustable pattern, stamped or spun, multi-core type diffuser to discharge air with sectorizing baffles where indicated; radial opposed blade damper & equalizing grid; baked enamel off-white finish.
- C. Modified Light Troffer Diffusers: Single or Double plenum type constructed of galvanized steel with welded or soldered joints & finish matte black inside, with volume & pattern controllers, 5 inch round or oval top or side air inlet.
- D. Registers/Grilles: Streamlined & individually adjustable blades, with baked enamel off-white finish.

2.8 DUCTWORK INSULATION

- A. Flexible Glass Fiber: ASTM C612; flexible, non-combustible blanket, 'K' Value of 0.29 at 75°F, Density of 3/4 lb/cu.ft. interior & 1.5 lb/cu.ft. exterior, & Vapor Barrier Jacket of Kraft paper reinforced with glass fiber yarn & bonded to aluminized film, secured with pressure sensitive tape.
- B. Rigid Glass Fiber: ASTM C612; rigid, noncombustible blanket. 'K' Value of 0.29 at 75°F, Density of 2.0lb/cu ft, & Vapor Barrier Jacket of Kraft paper reinforced with glass fiber yarn & bonded to aluminized film, secured with pressure sensitive tape.
- C. Duct Liner: ASTM C553; flexible, noncombustible blanket, 'K' Value of ASTM C518, 0.28 at 75°F, Density of 1.5 lb/cu ft, Maximum Velocity on Coated Air Side: 6,000 ft/min, use waterproof fire retardant type Adhesive, with Liner Fasteners of galvanized steel, self adhesive pad or welded with press on head.

2.9 CABINET & CEILING EXHAUST FANS

- A. See plans for Manufacturers, Models & Performance.
- B. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with 1/2 inch acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
- C. See plans for Electrical Characteristics & Components & refer to Section 16180. Disconnect Switch via cord & plug in housing for thermal overload protected motor & wall mounted switch, timer, multiple speed switch, or solid state speed controller as noted.
- D. Grille: Molded white plastic or aluminum with baked white enamel finish.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated, & fan has been test run under observation.
- C. Install fans with resilient mountings & flexible electrical leads. Install flexible connections specified between fan inlet & discharge ductwork. Flexible connectors shall not be in tension while running.
- D. Provide backdraft dampers on discharge of exhaust fans & as indicated.
- E. Install flexible connections specified between fan inlet & discharge ductwork. Flexible connectors shall not be in tension while running.
- F. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets. All filters not in factory installed filter rack in units are to have hinged & gasketed filter rack or glide/pack with access door sized for filters with hand or screw latches.
- G. Locate ducts with sufficient space around equipment to allow normal operating & maintenance activities.
- H. Connect diffusers or troffer boots to low pressure ducts with 5 feet maximum length of flexible duct. Hold in place with strap or clamp.
- I. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- J. Provide vent-fabric flexible connections immediately adjacent to equipment in ducts associated with fans & motorized equipment, of minimum 6" full length.
- K. Provide duct access doors for inspection & cleaning before & after filters, coils, fans, automatic dampers, at fire dampers, & elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access.
- L. Check location of air outlets & inlets & make necessary adjustments in position to conform with architectural features, symmetry, & lighting arrangement.
- M. Provide balancing dampers on duct take-off to diffusers, & grilles & registers, regardless of whether dampers are specified as part of the diffuser, or grille & register assembly. Also provide manual dampers on Fresh Air (FA) ducts at connection to Return Air (RA) ducts to balance F.A. from 0 to 100% of duct cap.
- N. Paint ductwork visible behind air outlets & inlets matte black. Refer to Division 09000.
- O. Connect branch take-offs to include prefabricated air scoops or air take-offs formed of galvanized sheet metal. Provide operating handles when required.

3.2 INSTALLATION OF DUCTWORK INSULATION

- A. Provide insulation with vapor barrier when air conveyed may be below ambient temperature.
- B. Secure insulation with vapor barrier with wires & seal jackets joints with vapor barrier adhesive or tape to match jacket.
- C. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging.
- D. Seal vapor barrier penetrations by mechanical fasteners, with vapor barrier adhesive. Stop & point insulation around access doors & damper operators to allow operation without disturbing wrapping.
- E. Secure insulation without vapor barrier with staples, tape or wire.
- F. Interior supply, return, & fresh air ductwork shall have coated 1/2" duct liner with adhesive applied to cover 100% of duct interior, for all rectangular ducts.
- G. All supply & return air ducts outside the building insulation envelope (in attic), & all fresh air ducts shall be wrapped with 2" duct insulation.
- H. Interior round sheet metal ducts shall be wrapped with 1", 3/4 lb. R=3.5 foil backed duct insulation.

END OF SECTION

SECTION 15990

TESTING, ADJUSTING, & BALANCING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air systems.

1.2 SUBMITTALS

- A. Draft Reports: Submit for review prior to final acceptance of Project.
- B. Test Reports: Submit prior to final acceptance of project & for inclusion in operating & maintenance manuals. Provide in soft cover, letter size, 3-ring binder, with index page & tabs, & cover identification. Include reduced scale drawings with air outlets & equipment identified to correspond with data sheets, & indicating thermostat locations.
- C. Report Forms: to equal AABC National Standards for Total System Balance forms or Forms prepared following ASHRAE 111.

PART 2 PRODUCTS - not used

PART 3 EXECUTION

3.1 EXAMINATION & PREPARATION

- A. Before commencing work, verify that systems are complete & operable.
- B. Report any defects, deficiencies, or abnormal conditions in mechanical systems which prevent system balance.
- C. Beginning of work means acceptance of existing conditions.
- D. Recorded data shall represent actually measured or observed condition.
- E. Permanently mark settings of valves, dampers, & other adjustment devices. Set & lock memory stops.

3.2 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within $\pm 5\%$ for supply systems & $\pm 10\%$ for return & exhaust systems of design.
- B. Air Outlets & Inlets: Adjust to within $\pm 10\%$ of design.
- C. Hydronic Systems: Adjust to within $\pm 10\%$ of design.

3.3 AIR SYSTEM PROCEDURE

- A. Adjust air handling & distribution systems to provide required or design supply, return, & exhaust air quantities.
- B. Make air quantity measurements in ducts by traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets & outlets.
- D. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers.
- E. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- F. Measure static air pressure conditions on air supply units, including filter & coil pressure drops, & total pressure across the fan. Allow for 50 % loading of filters.
- G. Adjust automatic outside air, return air, & exhaust air dampers for design conditions.
- H. Measure temperature conditions across outside air, return air, & exhaust air dampers to check leakage.
- I. Where modulating dampers are provided, take measurements & balance at extreme conditions.

END OF SECTION