SECTION 15010 - BASIC MECHANICAL REQUIREMENTS

PART 1: GENERAL

1.01 WORK INCLUDED

A. The work of this section consists of furnishing all labor, equipment and materials, and performing all operations necessary to complete heating and ventilation work in accordance with these specifications.

B. Work includes, but is not limited to:

1. Toilet exhaust ventilation systems.
2. Sheetmetal work and materials.
3. Insulation: Hot and cold domestic water piping.
4. Electric water heater.
5. Hot water and cold water piping and plumbing specialties within building.
6. Storm drain, soil, waste, and plumbing vent lines.
7. Natural Gas Piping System.
8. Mechanical insulation.
9. Plumbing fixtures and trim.
10. Roof-Top Packaged Air Conditioning Units (Electrical Cooling/Gas Heating).
11. Testing.
12. All other items indicated on the drawings, specified herein, or needed for complete and proper systems' installation.

1.02 GENERAL CONDITIONS

A. Related Documents: The General Conditions and other documents of the contract apply to the work specified in this section.

B. Guarantee: All work executed under this section shall be guaranteed for one (1) year as stated in the General Conditions.

C. Permits and Laws:

1. Obtain and pay for all required permits, inspections, licenses, etc.
2. Execute all work to conform to the requirements of all local, state and federal

laws, regulations, etc., applicable to the work.

D. Drawings:

1. The general location of the apparatus and the details of the work are shown on the drawings, which form a part of this specification. Exact locations are to be determined at the building as the work progresses, and shall be subject to the Architect/Engineer's approval.

2. Anything shown on the drawings and not mentioned in the specifications, or vice versa, shall be furnished as if it were both shown and specified.

3. It is not intended that the drawings shall show every pipe, fitting, or appliance, but it shall be a requirement to furnish, without additional expense, all material and labor necessary to complete the system in accordance with the best practices of the trade.

E. Electrical Work:

1. Provide and erect all motors, starters, pilot lights, controllers, limit switches, etc., as herein specified.

2. All motors furnished shall meet NEMA requirements and shall have an operating temperature of not to exceed 40 degrees C. above ambient temperature and be so marked. Except as noted, all motors shall be of the open drip-proof type. Motors may be furnished of fully enclosed type if it is the standard equipment.

   a. Each motor shall be provided with a manual or magnetic starter with overload elements sized for proper protection of the motor in accordance with manufacturer's recommendations. Provide overload protection for each phase conductor. All magnetic starters shall have coil and wiring designed for 120 volt operation.

   b. Starters shall be as manufactured by Allen-Bradley Company, or approved equal, with NEMA-1 enclosures and be of similar manufacture for all the motors furnished under this section.

3. Controls: Wiring for controls shall be under this division.

4. Except as noted, all required line switches, fused switches, etc., and all necessary wiring to properly connect all equipment to motors and switches will be furnished and installed under Division 16 - Electrical section of these specifications.

F. Equipment Requirements:

1. Installation Directions: Obtain manufacturer's printed installation directions to aid in properly executing work on all major pieces of equipment.

2. Objectionable Noise and Vibrations:

   a. Mechanical and electrical equipment shall operate without objectionable noise or vibration, as determined by the Engineer.

b. If such objectionable noise or vibration should be produced and transmitted to occupied portions of the building by apparatus, piping, ducts, or by other part of mechanical and electrical work, make necessary changes and additions, as approved, without extra cost to the Owner.

3. Equipment Design and Installation:

a. Uniformity: Unless otherwise specified, equipment or material of same type of classification, used for same purpose shall be the product of same manufacturer.

b. Design: Equipment and accessories not specifically described or identified by manufacturer's catalog numbers shall be designed in conformity with ASHRAE, ASME, IEEE, AWWA, ANSI, ASTM, ASSE, PDI or other applicable technical standards, suitable for maximum working pressure and shall have neat and finished appearance.

c. Installation: Erect equipment in neat and workmanlike manner; align, level and adjust for satisfactory operation; install so that connecting and disconnecting of piping and accessories can be made readily, and so that all parts are easily accessible for inspection, operation, and maintenance and repair. Minor deviation for indicated arrangements may be made as approved.

d. Welding: Before any welder performs any welding, submit a copy of the welder's certification as a certified welding mechanic. All welding shall be executed using the best practices of the trade.

4. Site Visit: The Contractor estimating and submitting a bid for the work covered by this section of the specifications shall visit the site, and view conditions as they exist prior to submission of a bid. The submission of a bid shall be taken as evidence that the bidder has examined the existing conditions and has satisfied himself as to the various requirements, obstacles and advantages of performing the work. No subsequent allowances will be made in this respect due to failure of the Contractor to meet the full requirements of these specifications.

5. Protection of Equipment and Materials: Responsibility for care and protection of all materials and mechanical work rests with the Contractor at all times until the entire project has been completed, tested, and the project is accepted.

6. Foundations:

a. Ceiling Mounting: Where ceiling mounting is indicated or specified, use suspended platform or strap hangers, bracket or shelf, whichever is most suitable for equipment and its location. Construct of structural steel members, steel plates, rods, as required, brace and fasten to building structure or to ensure as approved.

b. Structural steel required to support equipment shall be furnished.

7. Shop Drawings: The Contractor shall, after the award of Contract, and before installation, submit for approval shop drawings and Owner's manuals and operating instructions of equipment to be furnished under this Contract. After shop drawings have been given final approval, three (3) copies of shop drawings shall be retained by the Architect/Engineer. The following items of equipment shall be submitted for approval:

   a. Hot water specialties including valves, etc.

   b. Exhaust fans.

   c. Insulation.

   d. Plumbing fixtures and trim.

   e. Plumbing specialties.

   h. Plumbing equipment.

   i. Roof-Top Packages A. C. Units.

   j. Other equipment as the Architect/Engineer may require.

8. Substitutions:

   a. The bid shall be based on the materials or products as specified. Whenever in the specifications a particular article is specified by proprietary name, names, or "approved equal", the bidder shall base his bid on one of the above.

   b. Any materials or products not herein specified, but worthy of consideration shall be so noted in a separate letter attached to his Proposal Form, stating supplier, manufacturer or name and the amount to be added to or deducted from base bid and his reasons for the suggested substitution. He shall also assume the costs necessary for revision in other trades due to this substitution.

PART 2: PRODUCTS

2.01 CEILING EXHAUST FANS

A. General: Furnish and install where indicated Cook or approved equal fans.

B. Main Components and Features: Fans shall be complete, including the following:

1. Acoustically insulated housing.

2. Chatter proof integral backdraft damper.

3. Resilient mounted motor.

4. Fans shall be located, sized and with capacities as scheduled on drawings.

5. Each fan shall have ceiling grille.

6. Fan motor shall have thermal overload protection. Provide disconnect switches where required.

C. Other Requirements: Disconnect furnished with fan. Furnish and install wall caps with backdraft damper where indicated on plans.

a. Fans shall be controlled through toilet room light switch.

2.02 ROOF MOUNTED VENTILATOTS

A. General: Furnish and install roof ventilators and sized as scheduled on the drawings as manufactured by Cook, I.L.G., or approved equal by Greenheck.

B. Main Components and Features: Fan shall be complete, including the following:

1. Aluminum housing.

2. 12" high insulated all welded aluminum roof curb for flashing into roof equal to Cook's "RCA".

2.03 PLUMBING FIXTURES

A. General: This Contractor shall furnish and install all plumbing fixtures as listed in the following paragraphs or of an approved equal. All fixtures and trim of the same general materials or construction shall be of the same manufacturer, for example, vitreous china fixtures all manufactured by American Standard, or all by Eljer, etc. Manufacturers are listed in the fixture schedules as a means of identifying the required quality.

B. All piping drops to fixtures shall be anchored solidly.

C. All fixtures shall be white.

D. Fixture Schedule:

1. P- 1 Water Closet - A.D.A.:

a. American Standard "Cadet" # 2377.100, 1.6 GPF, pressure assisted, elongated, siphon jet, vitreous china, flushometer tank type, floor mounted, 16 1/2" high rim.

b. McGuire No. BV172 quarter turn tank wall supply kit with wall flange, flexible tube riser with collar and loose key, all chrome plated.

c. Church No. 295 white, elongated, open front seat less cover.

2. P-2 Lavatory - A.D.A.:

a. American Standard “Lucerne” # 0355.012, 20 ½””, vitreous china, faucet holes on 4” centers, concealed arm support. A.D.A. compliant at

34" rim height.

b. Faucet: Symmons "Symmetrix" No. S-240-G centerset, metal lever handles, grid strainer, washerless valve cartridges, all chrome plated. A.D.A. compliant.

c. McGuire No. BV170 quarter turn angle wall supplies with wall flange, loose key stop and 12" flexible copper tube risers, all chrome plated.

d. McGuire #8090 adjustable swivel P-traps, 1-1/4" x 1-1/2", cleanout plug, #2127 brass nipple to wall with cast escutcheon, all chrome plated.

e. Provide Truebro, Inc. lavatory pipe insulation kit on supplies, trap and waste for A.D.A. lavatories.

f. J.R. Smith, Josam, Zurn, or Wade concealed arm carrier to meet building conditions.

204 ELECTRICAL DOMESTIC WATER HEATER:

A. General: Furnish and install domestic water heater, A.O. Smith, model ELJF - 6, or approved equal.

B. Main Components And Features:

1) 1.5KW Input, 120 Volt, single phase.

2) 6 Gallon Capacity.

3) High silica ceramic porcelain tank lining.

4) Magnesium anode.

5) Dielectric waterway fittings.

6) Non-CFC foam insulation on top and sides of tank.

7) Fast acting thermostat.

8) Energy cut-off switch.

9) ASME rated T&P relief valve.

10) Combination ¾" inlet/drain fitting.

11) 1 year warranty tank and 1 year warranty on parts.

C. Shall meet energy efficiency performance criteria set forth by HUD, ASRAE 90 lb., BOCA, DOE and all local codes.

2.04 PIPING, FITTINGS, VALVES & MISCELLANEOUS

A. Piping:

1. Seamless scheduled 40 standard weight black steel, ASTM A-106 National Tube Co. or equal from Bethlehem, U.S. Steel Corp.

2. Hubless cast iron pipe and fittings conforming to FS WW-P-401; hub and spigot cast iron pipe conforming to ASTM A74.

3. Copper tubing shall be Type "L" rigid copper, ASTM standard specification B88.

B. Fittings:

1. Schedule 40 Pipe:

a. Screwed: 125 lb. best grade cast iron screw pattern with clean-out threads. (150 lb. malleable iron, ASTM B-16.3.)
b. Flanged: 150 lb. forged steel, slip-on or welding neck, raised or flat face as applicable.

c. Welded: Butt-welded, wrought carbon steel, schedule not less than adjacent pipe.

d. Unions: Screwed through 2", 250 lb. S.W.P. malleable iron, bronze to bronze (with brass to brass) seat, "Dart" or equal.

2. Copper Type "L" Pipe:

a. Cast bronze solder joint pressure fittings (ANSI B 16.18).

b. Wrought copper and bronze solder joint pressure fittings (ANSI B 16.22).

C. Valves shall be as manufactured by Nibco, Crane, Milwaukee, Hammond, Watts or approved equal.

1. Valves shall be provided as shown and as required to make the installation and its apparatus complete in operation; locate to permit easy operation, replacement and repair.

2. Gate Valves: 3" and smaller shall be 125# bronze, soldered ends, with renewable composition disc, non - rising stem, Nibco S - 211.

3. Globe Valves: 125# bronze, solder ends, with renewable composition disc, Nibco S-211.

4. Check Valves: 2-1/2" and smaller shall be 150# S.W.P. bronze swing check, regrinding bronze disc, screw in cap, Nibco S-433.

5. Drain Valves shall be gate valves and provided with hose nipples.

6. Ball Valves: 2-1/2" and smaller shall be 150# S.W.P., bull part, three piece body, blow-proof stem, chrome-plated bronze ball, Nibco S-595-Y.

D. Sleeves and Plates:

1. Pipes passing through masonry or concrete walls and floors shall be provided with sleeves of steel pipe.

2. Provide steel pipe sleeves or extra heavy cast iron soil pipe sleeves for piping passing through foundations, etc.

3. Pipes passing thorough partitions and ceiling other than the above shall be provided with minimum 24 gauge galvanized iron tubes with wired or hemmed edges.

4. Sleeves shall be of ample size to provide for renewal of piping and be securely fastened in floors, walls, etc.

5. Where exposed piping passes through walls, floors, partitions, cabinet work and ceilings, provide and set chrome-plated brass floor and ceiling plates of approved design with depth to cover sleeve-projection through floor or wall. Ceiling plates are not required on insulated piping.

E. Hangers and Supports:

1. Piping suspended from overhead shall be supported by approved wrought or malleable iron hangers with adjustable solid mold steel rods except as noted.

2. Piping smaller than 6" size shall be supported by approved clevis type hangers.

3. Piping run on side walls or partitions shall be supported by malleable iron brackets, adjustable swivel rings and rod hangers.

4. Hangers and supports shall be as manufactured by Grinnell Co., Inc. or approved equal.

5. Pipe supports on copper tubing shall be all copper plated.

2.05 WATER SPECIALTIES

A. General: Furnish and install all hot water specialties as indicated and required for a complete installation.

B. Main Components and Features:

1. Drain Valves at all low points complete with hose end and caps.

2. Shock Arresters: All domestic water piping shall be protected from water hammer or shock by P.D.I. approved shock-absorbing devices. Install where required according to P.D.I. standard WH-201.

3. Expansion Compensators: Furnish and install where necessary to absorb expansion and contraction in copper lines, Flexonics model HB expansion compensators having two-ply phosphor bronze bellows, brass shrouds and end fittings.

2.06 ROOF TOP PACKAGED AIR CONDITIONING UNIT (ELECTRIC COOLING/GAS HEAT)

A. General: Furnish and install, where indicated, roof top unit of sizes and capacities as scheduled on the drawings and as manufactured by Lennox or approved equal.

1. Summary: This Section includes the following:

a. Rooftop gas fired air conditioning units.

b. Roofcurbs.

2. Submittals:

a. Product Data: Include rated capacities, furnished specialties, and accessories.

b. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other Work. For installed products indicated to comply with design loads, include structural analysis data.

2. Wiring Diagrams: Power, signal, and control wiring.

3. Quality Assurance:

a. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

b. Comply with AGA Z223.1 for gas-fired furnace section.

c. Power supply to switches, fused switches, outlets, motor starters, to line terminals of equipment, and all related wiring and fuses to properly connect and operate all electrical equipment specified shall be furnished and installed under "ELECTRICAL" (Electrical Contractor). Coordinate all wiring between Mechanical and Electrical to provide a complete and operating system.

d. NRCA Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.

4. Extra Materials: Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

a. Filters: Furnish one installed and one spare set of each type of filter specified.

c. Fan Belts: Furnish one installed and one spare set of belts for each belt-driven fan in energy recovery units.

B. Main Components and Features: Units shall be complete, including the following:

1. Rooftop Units Smaller Than 6 Tons: Factory assembled and tested; designed for roof or slab installation; and consisting of compressors, condensers, evaporator coils, condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers.

a. Casing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, removable panels or access doors with neoprene gaskets for

inspection and access to internal parts, minimum 1/2-inch- thick thermal insulation, knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs.

b. Evaporator Fans: Forward curved, centrifugal, directly driven with permanently lubricated motor bearings.

c. Condenser Fans: Propeller type, directly driven with permanently lubricated motor bearings.

d. Refrigerant Coils: Aluminum-plate fin and seamless copper tube in galvanized steel casing with equalizing-type vertical distributor.

e. Compressors: Hermetic with integral vibration isolators and crankcase heaters.

f. Low Ambient Control: Head-pressure control, designed to operate at temperatures as low as 30 degrees F.

g. Thermostat: Staged heating and cooling with manual or automatic changeover on standard sub base.

h. Smoke Detector: On units of 2000 cfm capacity or greater, furnish and install a photoelectric smoke detector will be in the supply air plenum. Arrange detector to stop unit upon sensing smoke. Detector shall be furnished and installed by Division 16.

C. Other Requirements:

1. Install units according to manufacturer's written instructions.

2. Install units level and plumb, maintaining manufacturer's recommended clearances.

3. Curb Support: Install roof curb on roof structure, level, according to NRCA's written installation instructions. Install and secure rooftop units on curbs and coordinate roof penetrations and flashing with roof construction.

4. Unit Support: Install unit on structural curbs and level. Coordinate wall penetrations and flashing with wall construction.

5. Install piping to allow service and maintenance.

6. Gas Piping: Conform to applicable requirements of Section "Natural Gas Piping." Connect gas piping to burner, full size of gas train inlet, and provide union with sufficient clearance for burner removal and service.

7. Install ducts to termination in roof mounting frames. Where indicated, terminate air duct through roof structure and insulate space between roof and bottom of unit.

8. Electrical: Conform to applicable requirements in Electrical Sections.

9. Ground equipment.

a. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

207 NATURAL GAS SYSTEM:

A. DESCRIPTION:

1) Work includes, but is not limited to:

a) Natural Gas Piping System within building and on roof.

B. REGULATORY:

1) Installation of the gas system shall meet the requirements of the NFPA National Fuel Gas Code, and applicable ANSI, ASPE and ASHRAE Codes.

2) Work done by this Contractor shall conform to local and State codes having jurisdiction. State and local codes are considered a part of these specifications.

C. PIPING AND ACCESSORIES:

1) General: Provide all piping and accessories for a complete system.

2) Main Components and Features: Piping to handle gas shall be complete, including the following:

a) Underground piping and piping exposed to the elements (on roof, etc.) shall be schedule 80 carbon steel conforming to ASTM A106 and A53. Fittings shall be 300 lb. forged steel.

1) Underground piping may be plastic, rated for natural gas service, and in accordance with Northern Utilities requirements.

b) Above Ground Piping within building shall be schedule 40 carbon steel conforming to ASTM A106 and A53. Fittings shall be malleable iron type.

c) Valves: 1/2" through 2" shall be full port, chrome-plated bronze ball, screwed ends, bronze body, Teflon seat, T-lever handle, 600 lb. wog. ball valves, Nibco T-595-Y, or approved equal. 2-1/2" through 3" shall be three piece body, conventional port, Nibco T-590-Y, or approved equal.

d) Gas Equipment Pressure Regulators: Maxitrol #325-series, or approved equal, if not furnished with equipment.

e) Roof Piping Supports: Miro Industries model 3-R polycarbonate pillow block pipe stands and 3-R spacers, or approved equal, with roller and pipe strap on each unit. Pipe stand spacing shall be according to manufacturer's recommendations for amassed loading.

D. INSTALLATION OF GAS SYSTEM:

1) General: Install gas systems complete according to these specifications and drawings.

2) Piping and Equipment:

a) General:

1) Install all piping promptly, capping or plugging all open ends and making pipe generally level and plumb, free from traps, and in a manner to conserve space for other work.

2) The entire installation should conform to applicable NFPA requirements and local and state codes.

3) Caulk the spaces between the pipe and walls, ceilings and floor, and gas and water tight.

b) Joints and Connections:

1) Pipe joints shall be threaded or welded. Fittings shall be malleable cast iron. Joint compounds shall be resistant to the action of natural gas.

3) Pressure Testing And Inspection:

a) General:

1) Gas piping shall be tested in accordance with applicable N.F.P.A. Codes and to the satisfaction of state and local authorities.

b) Detection of Leaks and Defects:

1) The piping system shall withstand the test pressure specified without showing any evidence of leakage or other defects. Any reduction of test pressures as indicated by pressure gages shall be deemed to indicate the presence of a leak unless such reduction can be readily attributed to some other cause.

2) The leakage shall be located by means of an approved combustible gas detector, soap and water, or an equivalent nonflammable solution, as applicable. Matches, candles, open flames, or other methods which could provide a source of ignition shall not be used. Caution: Since some leak test solutions, including soap and water, may cause corrosion or stress cracking, the piping shall be rinsed with water after testing, unless it has been determined the leak test solution is noncorrosive. When leakage or other defects are located, the affected portion of the piping system shall be repaired or replaced and retested.

c) Leakage Check After Gas Turn On:

1) Before Turning Gas On: Before gas is turned into a system of new gas piping, or back into an existing system after being shut off, the entire system shall be checked to determine that there are no open fittings or ends and that all valves at outlets and equipment are closed.

2) Check for Leakage: Immediately after turning on the gas, the piping system shall be checked to ascertain that no gas is escaping. If leakage is indicated, the gas supply shall be shut off until the necessary repairs have been made.

3) Placing Equipment in Operation: Gas utilization equipment may be placed in operation after the piping system has been tested and determined to be free of leakage and lines purged.

2.08 DUCT ACCESSORIES

A. General: Provide and install all ductwork accessories of sizes and design as shown on the drawings or specified.

B. Main Components and Features:

1. Duct Insulation - (External): 1 1/2" - 3/4 lb. density fiberglass with FRK facing.

2. Flexible Connections shall be neoprene coated glass fabric with sewed seams equal to Vent Glass.

C. Other Requirements: See Part 3 - Execution for additional items.

2.09 REGISTERS, GRILLES AND LOUVERS

A. General: Provide and install all registers and grilles of the sizes and design shown on the drawings or specified. Sizes indicated are catalog register size. Regis ter and grilles shall be as manufactured by Anemostat or Titus.

B. Main Components and Features:

1. Supply:

a. Ceiling:

1) Square type, round neck, directional ceiling diffusers, aluminum construction, removable core, for flush mounting lay-in ceilings, shall be equal to Anemostat type "EPL". Provide directional tabs for pattern as scheduled. Provide type "ED" equalizing deflector.

2. Return/Exhaust:

a. Ceiling:

1) Grille, equal to Anemostat Type "GC50", aluminum construction, 1/2" x 1/2" x 1/2" grid core, for surface mounting or lay-in ceiling mounting as scheduled and opposed blade damper where scheduled.

C. Other Requirements:

1. Ceiling diffusers and registers to be white to match ceiling.

PART 3: EXECUTION

3.01 PIPING - GENERAL

A. Provide and erect in a workmanlike manner, all piping shown and required to complete the installation intended. Erect piping to allow sufficient clearance for expansion, application of insulation and finish painting with offsets as required to avoid other work.

B. Sizes and general arrangement, as well as methods of connecting all piping, valves, equipment, etc., shall be as indicated, or so as to meet the requirements of the Architect/Engineer.

C. All pipe used is to be new material, and all threads on piping must be full length and clean-cut with inside edges reamed smooth to full inside bore.

D. In the erection of mains, special care must be used in the support, working into place without springing or forcing.

E. Make such offsets are shown and required to place the pipes and risers in proper position to avoid other work.

F. Pipes shall be anchored, guided, etc., where necessary, to prevent vibration or to control expansion.

G. Install a sufficient number of flanged fittings or unions to facilitate making possible future alterations or repairs. Unions shall be installed at all equipment, traps, fixtures and risers.

H. Piping shall be erected so as to provide for the easy passage and noiseless circulations of water, steam and condensation under all working conditions.

I. Provide 1/2" minimum size valved draw-offs with hose connection at all low points of the piping systems, apparatus, etc. Copper piping and fittings shall be installed with soldered joints using the following alloy - per ASTM standard B32.

1. 95-5 tin-antimony solder (200 degrees F at 200 psi).

2. All domestic water piping shall be made up with non-lead bearing solder equivalent to "Silver-Brite."

3.02 PIPING - MISCELLANEOUS MATERIALS

A. Sleeves and Plates: All sleeves through all floors and through all masonry and all fire walls shall be caulked air tight with high temperature rope and sealed with lead rope (1/2" depth).

B. Hangers and Supports:

1. All hangers shall be supported from steel beams or steel angles installed between top chord or two bar joists or wood floor framing. Provide steel angles as required. No attachments shall be made to the floor sheathing or the roof deck.

2. All anchors and guides from joist construction shall be supported from steel beams or angle iron and other steelwork provided and installed between three adjoining joists.

3. Support all horizontal piping of steel wrought iron and brass as per following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
Up to 1-1/2" (Incl.)	3/8"	8'0"
1-1/2" and 2"	3/8"	10'0"
2-1/2" and 3"	1/2"	10'0"

4. Provide and set all required hangers, clamps, plates, beams, brackets, anchors, guides, expansion bolts, and ironwork required to support all piping and equipment.

3.03 PIPING - INSULATION

A. General:

1. Provide and install insulation for all surfaces of piping, equipment, and specialties, as indicated and specified.

2. Systems shall be tested and proven tight, and surfaces painted where required before application of insulation.

3. Insulation on all piping systems shall include all valves, fittings, flanges and appurtenances to match the piping insulation jacket, vapor barrier, and finish. Prefabricated "Zeston" or equal fittings will be acceptable.

4. All insulation shall have noncombustible vapor barrier jacket applied in accordance with manufacturer's instructions. Seams shall be concealed where possible. Provide 6" high 20 gauge aluminum protector sleeves on all insulation passing through floor on exposed piping.

5. Labels and trademarks shall be removed.

6. Insulation shall be neatly finished at pipe hangers, pipe anchors, and pipe covering protection saddles as specified for fittings and valves.

7. Materials shall be as manufactured by Johns-Manville, Carey, Armstrong, Owens-Corning or Gustin-Bacon.

B. Piping Systems:

1. All domestic hot water and cold water piping shall be completely insulated. Vapor seal all insulation on cold water piping.

2. All piping shall be insulated as follows:

a. Generally, piping 7 lb. minimum density glass fiber as a jacket. Fiberglass 25 with ASJ jacket.

b. All insulation shall have a flame-spread rating of 25 or less and a smoke developed rating of 50 or less as tested by the ASTM E84 method.

c. Minimum pipe insulation size:

Pipe	Supply and Return	Domestic Hot	Domestic Cold
1" and less	1"	1”	1”
1-1/4" to 2"	1-1/2"	1”	1”
2-1/2" to 4	1-1/2"	1-1/2”	1”

4. Insulation shall not be applied to the following:

a. Screwed unions.

b. Valve hand wheels.

c. Vents to atmosphere, discharges from safety and relief valves.

d. Plumbing fixture supplies (accept as noted in fixture specifications).

3.04 SHEET METALWORK AND MATERIALS

A. General: Furnish and install all required sheet metalwork, including: manual dampers, turning vanes, manual operators, collars, sleeves, baffles, access doors, flexible connections, supports, etc., for the complete installation in accordance with the intent of the drawings and specifications.

1. Furnish and install all duct work connected to units, wall caps, and other equipment furnished under these specifications.

2. Toilet venting shall conform to Maine and BOCA Plumbing Code.

3. Exhaust ductwork.

B. Installation: Fabricate and install in accordance with applicable requirements of the ASHRAE Guide and SMACNA Manual. Ductwork shall conform to 2" SMACNA Pressure Class except where SMACNA requirements are exceeded by these specifications. Ductwork shall be neat, accurate, rigidly constructed and mechanically tight, as well as substantially airtight and shall provide quiet system of air transportation. Offsets of exposed ductwork shall be made on sides opposite to walls and ceilings, unless otherwise shown on the drawings or specified. Sizes, as marked on the drawings, shall be adhered to as closely as possible. The right is reserved to vary the size of ducts and flues to accommodate structural conditions during the progress of the work, without additional cost to the Owner.

C. Materials: Ductwork shall be of galvanized sheet metal. Galvanized sheet metal shall be new copper bearing (or prime grade) galvanized steel sheets of lock-forming quality. Zinc coating that will flake or peel under any forming operation, or laminated sheets will not be allowed.

1. Thickness of metal for rectangular ducts, including elbows and other details, shall be as follows:

Longest Rectangular Dimension of Duct Inches	Thickness of Galvanized Steel USS Gauge
Up thru 12	26
13 thru 30	24

2. Thickness of metal for round ducts, including elbows and other details, shall be as follows:

Duct Diameter Inches	Galvanized Steel USS Gauge	Aluminum Inches
Up thru 10	26	.040

D. Construction: Seams, joints, bracing angles and stiffeners.

1. Longitudinal Seams: Longitudinal joints in ducts not exceeding 60" in either dimension, and ducts exceeding 60" in the larger dimension but not exceed 18" in the smaller dimension, shall be either Pittsburgh lockseams or grooved seams.

2. Round Ducts: The downstream end of each section of round duct shall be crimped and beaded. Assembly shall be made by inserting the crimped end into the upstream end of the adjoining section. The joints shall be fastened in place by three or more sheet metal screws spaced not over eight inches apart.

3. Transverse Joints and Bracing Angles of Rectangular Duct shall be as follows:

Duct Size Long Side Inches	Minimum Rigidity Class	Transverse Joints	Bracing Angles Size - Inches	Flat Bar
18 or less	A	Plain, "S" or Drive Slip	None	----------
19 thru 26	B	Standing Drive Slip Reinforced Drive Slip Reinforced Hemmed "S" Slip	3/4 x 3/4 x 1/8	1-1/2 x 1/8
27 thru 30	C	Standing Drive Slip Reinforced Drive Slip Reinforced Hemmed "S" Slip	3/4 x 3/4 x 1/8	1-1/2 x 1/8

Alternative joint/reinforcement methods may be used, subject to approval by the Engineer, provided that the rigidity classification is met.
Lock type as described in SMACNA Low Velocity Duct Manual.

a. Transverse Joints: Drive slips shall be used on short sides of transverse duct joints if side is less than 18". Metal and thickness of S slips and drive slips shall be same as duct. Ends of drive slips shall be bent over at least 1/2" at corners. Bar slips shall be fastened with sheet metal screws

on 12" centers. Corners of all bar slip joints shall be folded over and riveted. Where intermediate type reinforcements are used as supplements for joints, they shall be attached to duct wall within 3" of the joint.

b. Stiffeners: All ducts over 18" wide shall be provided with stiffeners which may be either transverse joints or angle bracing, as indicated above. The center-to-center spacing of stiffeners shall not be over four feet for ducts not exceeding 60" (long side) and shall not be over two feet for ducts not exceeding eight feet in any case. Flat area of uninsulated ducts over 18" wide shall be stiffened by cross-breaking. Uninsulated exposed ducts shall have flat bar reinforcement and flush seams in lieu of bracing angles and projecting seams.

c. Bracing Angles shall be of the same metal as the duct. Angles shall be riveted to the ducts on 6" centers, and shall be applied on all four sides. On vertical ducts, set of bracing angles shall be located with heel down at the floor line wherever duct passes through floor. End of two opposite angles shall extend as required to catch floor construction.

E. Duct Turns: Long radius elbows shall be provided, except as indicated hereinafter:

1. Long Radius Elbows shall be constructed with a throat radius equal to not less than the dimension to the duct width in the plane of the duct turn. Where space does not permit the use of a long radius elbow, vaned mitered elbows shall be provided.

2. Mitered Elbows: All mitered elbows shall be constructed with factory-fabricated, turning vanes equal to Barber-Colman "Ducturns".

F. Flexible Connections: Furnish and install flexible connections between all fans and ducts or casings where required to prevent excessive movement of long ducts and wherever ducts cross building expansion joints. Material shall be fabricated with sewed seams. Connections shall be approximately 4" long and installed with sufficient slack to prevent transmission of vibration.

G. Duct Hangers:

1. Ducts up to and including 36" in width shall be hung by 1" x 1/8" flat straps bent under bottom of duct a minimum of 2" and securely fastened to duct.

2. Ducts larger than 36" in width shall be hung using 3/8" steel rods and 2" x 2" x 1/4" angle trapeze hanger. Rods shall be supported by 2-1/2" x 2-1/2" x 1/4" minimum steel angles secured to two or more joists.

H. Joint Sealants:

1. Low Pressure Ductwork: Seal joints in accordance with SMACNA Low Pressure Duct Construction Standards, Seal Class B.
   a. Sealant: Resistant to gasoline, oil and water. Thermal range from minus 25 degrees F to plus 200 degrees F, flame spread rating of not more than 25 and smoke developed rating of not more than 50, withstand duct air

pressure 25 percent in excess of leakage test pressure. Supplier of sealant shall certify that sealant has been successfully marketed and used for a period of three (3) years without change in formula.

b. Tape: In conformance with Fed. Std. 147, polyethylene coated cloth backing with rubber resin adhesive, four inches wide, not less than 0.0125 inches thick, withstand minimum temperature of 180 degrees F, tensile strength not less than 35 pounds per inch width and water vapor transmission rate not over 1.2 grains per 100 square inches per 24 hours.

3.05 JOB CLOSING

A. Operating and Performance Tests:

1. Prior to the final inspection perform required tests and submit the test reports and records.

B. Testing and Adjusting:

1. Testing Piping Systems: All piping shall be tested periodically during the progress of the work. The Contractor shall provide necessary labor, test pump, gauges, meters, other instruments and materials. All tests shall be made in the presence of the Engineer. No joint or section of piping shall be left untested.

a. Before testing piping systems, remove or otherwise protect from damage, control devices, air vents, other parts which are not designed to stand test pressures.

b. Hydrostatic Pressure: Test hydrostatically, piping to one and one-half times the maximum working pressure, but in no case to less than 75 psig for at least four (4) consecutive hours, during which time pressure shall remain constant without pumping. Subject welded joints to hammer test while under hydrostatic pressure.

c. Domestic water piping shall be tested in accordance with the State of Maine Internal Plumbing Rules, Chapter 11, Article H.

d. Sanitary piping shall be tested in accordance with State of Maine Internal Plumbing Rules, Chapter 4, Article P.

e. Do not paint, cover or conceal piping, including swing joints and the like, before testing and obtaining approval.

C. Sterilization of Pipes

1. General:

a. After preliminary purging of the system, chlorinate the entire new potable water system in accordance with the current recommendations of the American Water Works Association and in accordance with all pertinent codes and regulations.

b. Chlorinate only when the building in unoccupied.

2. Flushing:

a. Upon completion of the sterilization, thoroughly flush the entire potable water system.

b. When sterilization and flushing are complete, a sample shall be collected from the end of the longest main, or at any other location selected by the Architect/Engineer, and a water analysis test provided. The test must prove the water acceptable or additional disinfecting of system performed. A copy of the test report shall be submitted to the Architect/Engineer.

D. Air System:

1. All controls should be checked out by the Control Contractor and be operating correctly prior to start-up of the system. Final set points and adjustments may be made during or after the balancing. All lubrication, electrical connections, air filters, etc., necessary for proper operation of the system shall be completed prior to start-up of the system.

2. Upon start-up of a system, check fan for the following and record readings as indicated.

a. Check fan drives for rotation and slippage and record fan rpm.

b. Measure and record voltage and actual amperage draw on each phase leg. Determine that motor is not overloaded.

c. Take all necessary airflow or pressure measurements to determine air quantities in ducts and outlets. Make all adjustments necessary to proportion the airflow correctly. Make final adjustments to fan drives to establish correct total airflow.

d. Take final readings and record the following data:

1) Fan rpm, voltage, amperage draw on each phase leg, and calculated BHP all fans, outlets, etc.

e. Submit for approval all initial and final readings as specified. Compare measured readings to design quantities and note deviation.

E. Cleaning:

1. After satisfactory completion of pressure tests, before permanently connecting equipment, strainers, and the like, clean equipment thoroughly, blow and flush piping for a sufficient length of time as directed, so that interiors will be free of foreign matter.

2. Fill, vent and circulate the system with approved solution in accordance with boiler manufacturer's recommendations, allowing it to reach design or operating temperatures. After circulating a few hours, the system should be drained

completely.

3. The entire system installations including apparatus, motors, etc., shall be left in first-class condition including cleaning, oiling and packing.

F. Instruction and Charts: After completion of the installation work called for in this specification, the Contractor and his Subcontractors shall furnish necessary mechanics or engineers for the adjustment and operation of the systems, to the end that the systems may be perfectly adjusted and turned over to the Owner in perfect working order. The Contractor shall further instruct the Owner's authorized representative in the care and operation of the installation, providing all required framed instruction charts, directions, etc.

G. Painting:

1. All exposed ironwork, including steel supports, hangers, etc., shall be painted two (2) coats of machine gray or equal.

2. Painting specifically noted on equipment.

H. Nameplates: Furnish and install DYMO, or approved equal, embossed vinyl-plastic nameplates, with white letters on black background to identify equipment, controls, etc., furnished under this section of the specifications.

END OF SECTION