

1 GENERAL

- 1.1 The work of this section includes the provision of all design, labour, materials, equipment and services required to fabricate and install distribution systems as required for a complete project. The work includes, but is not necessarily limited to, the items referenced herein:
- 1.1.1 Air Distribution Systems.
 - 1.1.2 Hydronic Distribution Systems.
 - 1.1.3 Other HVAC Distribution Systems.
- 1.2 Quality Control: Test Air Distribution Ductwork according to SMACNA Duct Leakage Test Manual. Owner to witness tests.

2 DESIGN

- 2.1 Sound Attenuation: Sound attenuation shall be to SMACNA standards. As a general requirement, all occupied areas will be fitted with sound attenuation to meet a minimum standard of NC35.
- 2.2 Vibration Isolation: Vibration isolation shall be as per the equipment manufacturer's recommendations.
- 2.3 Air Distribution System
- 2.3.1 Ducts:
 - 2.3.1.1 Provide waterproof duct upstream and downstream of humidifier units, and for fresh air intakes and dishwasher exhaust.
 - 2.3.1.2 Maximum length for flexible ducts is 2 meters.
 - 2.3.1.3 Provide balancing or splitter damper at all branches.
 - 2.3.1.4 Provide silencers acoustic lining to meet levels recommended by ASHRAE.
 - 2.3.1.5 Provide access doors to all in-duct dampers, etc.
 - 2.3.2 Packaged Air Handling Units (AHU):
 - 2.3.2.1 Provide mixing box sections where applicable with air blenders to achieve uniform mixing. Use insulated dampers when exposed to outside air.
 - 2.3.2.2 Provide fixed sheaves for drives over 5.5 kW. For either type of sheave (fixed or variable pitch), provide a second set as required by the Air Balancing Firm if field testing proves this necessary.
 - 2.3.2.3 Provide constant volume and/or variable volume as required. Provide variable volume operation through use of variable frequency drives on motors. Fans, motors to match variable frequency drive.

- 2.3.2.4 Conform to ANSI/ARI rating for units larger than 40 kW, and bear ARI seal.
- 2.3.2.5 Cabinet, soundproof tested to ARI.
- 2.3.3 Ventilation and Exhaust System
 - 2.3.3.1.1 Provide balancing or splitter dampers at all branches.
 - 2.3.3.2 Fans shall be of one manufacturer and shall be selected to provide 20% excess capacity by changing sheaves.
- 2.4 Hot Water Distribution System
 - 2.4.1 Provide hot water distribution piping from the mechanical room to the terminal units as required.
 - 2.4.2 Insulation as per table in Section 3 - Material.
 - 2.4.3 In the event that steam is the heat source to the mechanical room, a steam to hot water converter must be supplied to provide hot water for building heating purposes.
- 2.5 Glycol Distribution System where applicable:
 - 2.5.1 Provide distribution piping from the mechanical room to the terminal units as required.
 - 2.5.2 Insulation: as per table in Part 3 - Materials.
 - 2.5.3 Provide the required system for mixing glycol and water and for the glycol system.
 - 2.5.4 Chilled Water Distribution System where applicable:
 - 2.5.4.1 Chilled water distribution piping shall follow the same routing as any steam or hot water piping from the source to the mechanical room. Provide distribution piping from the mechanical room to cooling coils as required.
 - 2.5.4.2 Insulation on the chilled water supply and return piping shall be as per the table in Part 3 - Materials.
 - 2.5.5 Terminal Devices
 - 2.5.5.1 Hot water heating convectors or fan coil units shall be used for heating of all areas such as entrances, unoccupied or unventilated spaces, and in all areas where the heat loss exceeds 90 watts per lineal meter of perimeter wall. HVAC systems and associated terminal units shall be designed to maintain the minimum stipulated air circulation rate. For reasons of energy efficiency, reheat systems are unacceptable. For reasons of maintenance cost, fan powered terminal units are not acceptable.

2.5.5.2 Convectors

- 2.5.5.2.1 Convectors shall be of one manufacturer.
- 2.5.5.2.2 Cabinet shall be designed for either below window or wall mounted to suit the application.
- 2.5.5.2.3 Units shall be equipped with a finned heating coil sized to provide the heat output required.

2.5.5.3 Fan Coil Units

- 2.5.5.3.1 Units shall be sized to satisfy heating requirements.
- 2.5.5.3.2 Fan coil units to be the product of one manufacturer.
- 2.5.5.3.3 All water services to have isolation valves and drain valves.
- 2.5.5.3.4 All equipment shall be installed in such a manner as to be easily serviced or replaced.

2.5.5.4 VAV and Constant Volume Terminal Units:

- 2.5.5.4.1 Control: DDC analog.
- 2.5.5.4.2 Pressure independent operation, reset air flow between zero (or minimum flow) and maximum.
- 2.5.5.4.3 Pressure loss: no more than 25 Pa at 10 m/s inlet velocity.
- 2.5.5.4.4 Cavity: internally lined to [UL 181] and [ANSI/NFPA 90A].
- 2.5.5.4.5 Provide sound attenuators on all terminals.
- 2.5.5.4.6 Use units of one manufacturer.
- 2.5.5.4.7 Maximum size of zone: 100 m² for interior spaces except with small offices, 50 m² for exterior zones, 50 m² for small offices, and 50 m² for zones requiring supplementary heat.

2.6 Heat Recovery Equipment

- 2.6.1 Consider the use of heat recovery equipment controlled by BAS.
- 2.6.2 Carry out Life Cycle Cost Analysis and abide by the rules of [ASHRAE 90.1].

2.7 Auxiliary Equipment

- 2.7.1 Secondary Pumps:
 - 2.7.1.1 Pumps shall be of the centrifugal design.
 - 2.7.1.2 Pump motors shall be TEFC and selected to conform to the latest requirements for energy efficient motors.

- 2.7.1.3 Duplicate pumps shall be provided such that, as the failure of one pump, the second pump is totally capable of performing the function automatically.
- 2.7.1.4 Select pumps of one manufacturer.
- 2.7.1.5 Pumps shall be selected such that their operating point is at the point of highest efficiency on the pump curve. Pumps may be variable speed and controlled by BAS.
- 2.7.2 Heat Exchangers:
 - 2.7.2.1 Heat exchangers shall be of the brazed plate design where possible.
 - 2.7.2.2 Heat exchangers shall be selected so that their actual rating is equal to 125% of the design load.
 - 2.7.2.3 Select heat exchangers of one manufacturer.

2.8 Duct Accessories

- 2.8.1 Dampers - Fire:
 - 2.8.1.1 Use only type B or C, gravity or spring type.
 - 2.8.1.2 Air leakage of closed damper not to exceed 2% of nominal catalogue rating at 750 Pa differential pressure as rated by *[ANSI/ARI 880]*.
 - 2.8.1.3 Provide access doors for all fire dampers.
- 2.8.2 Registers, Grilles and Diffusers:
 - 2.8.2.1 Use equipment from manufacturers with published test data certified in accordance with All Diffuser Council Codes and ISO standards.

2.9 Piping

- 2.9.1 Steam and Condensate Piping for humidification systems:
 - 2.9.1.1 For pressure over 205 kPa: comply with requirements of Provincial Codes and *[ANSI B31.1]*.
 - 2.9.1.2 Calculate flexibility of piping. Clearly show location of anchors, guides and supports/hangers.
 - 2.9.1.3 Minimum slope for steam pipe in direction of slope, 5% if slope is against flow. Provide drip traps at low points.
 - 2.9.1.4 Cast steel valves over 1000 kPa. Sizes NPS 2 and larger. Do not use butterfly valves.
 - 2.9.1.5 Insulate as per table in *[ASHRAE 90.1]*. Use insulation protection saddles and rollers for hangers.

- 2.9.1.6 Restrain piping against seismic activity in seismic zones 3 and above.
- 2.9.2 Hydronic System:
 - 2.9.2.1 Steel piping, (hot water heating, glycol, condenser and chilled water 5-120°C and max. 860 kPa)
 - 2.9.2.2 Standards to be most stringent of local, Provincial or *[ASHRAE 90.1]*.
 - 2.9.2.3 For heating system provide reverse return piping.
 - 2.9.2.4 Drain low points, provide auto vents for high points.
 - 2.9.2.5 Provide isolating valves at branches and at connection to equipment, and flow control balancing valves as required.
 - 2.9.2.6 Provide flexible connections and vibration isolating supports and hangers at connection to equipment. Do not support piping from equipment.
 - 2.9.2.7 Provide protection against freezing.
 - 2.9.2.8 Provide for chemical cleaning of piping.
 - 2.9.2.9 Owner will approve glycol used and witness mixing and filling of system.
 - 2.9.2.10 Use dielectric unions at connection to different material.
 - 2.9.2.11 Provide stand-by pumps for secondary building distribution systems.
 - 2.9.2.12 Provide means to add chemicals and glycol to systems in operation.
 - 2.9.2.13 Insulate as per table in *[ASHRAE 90.1]*.
 - 2.9.2.14 Restrain piping larger than NPS 4 against seismic activity in seismic zones 3 and above.

3 MATERIALS

3.1 Air Distribution System

- 3.1.1 Ducts; in accordance with SMACNA HVAC Duct Construction, Standards, Metal and Flexible.
- 3.1.2 Packaged Air Handling Units (AHU)
 - 3.1.2.1 Fabricate units of welded steel, galvanized, with hinged gasketed access doors, internally acoustically lined casing with perforated metal inner wall.
 - 3.1.2.2 Fans: statically and dynamically balanced, centrifugal type with shafts operating less than 80% of first critical speed. Bearings selected for average life of 150,000 hours and provided with lubrication fittings extended to the side of the unit where there is sufficient space for convenient servicing. Fans: internally vibration isolated.

- 3.1.2.3 Filters: ULC Class 2, 100 mm thick, pleated type, disposable, with minimum 30% efficiency and 90-92% arrestance to [ASHRAE 52], in slide-out permanent metal frames. Maximum Face Velocity: 2.5 m/sec. Provide prefilters and/or after filters if required in order to maintain air cleanliness suitable for users and equipment. Provide local filter gauges.
- 3.1.2.4 Coils: ARI rated. Max face velocity for cooling coils: 2.5 m/sec.
- 3.1.2.5 Water coils shall have freeze plug protection. Drain pans: stainless steel or nonferrous. Externally insulated to prevent condensation. Pan to slope to drain at low point. Install deep seal P trap on drain line.
- 3.1.2.6 Drives complete with motors, adjustable motor slide rail base, adjustable sheaves, belts and belt guards.
- 3.1.2.7 Acceptable Materials: *[Trane; Carrier; McQuay; York; Sheldons; Dunham Bush; Engineered Air; Temprite]*.

3.2 Fluid Distribution System

- 3.2.1 Steam and Hot Water Underground Distribution System
 - 3.2.1.1 Steam or hot water piping: Schedule 40
 - 3.2.1.2 Condensate piping: Schedule 80.
- 3.2.2 Glycol Distribution System: Distribution piping: Schedule 40.
- 3.2.3 Chilled Water Distribution System: Supply and return piping: Schedule 40.

3.3 Terminal Devices

- 3.3.1 Convectors: Convectors shall consist of a coil unit complete with items inside a baked enamel, sheet metal cabinet. Units shall be equipped with sheet metal enclosures.
- 3.3.2 Fan Coil Units
 - 3.3.2.1 Fan coil units shall contain a galvanized steel, centrifugal forward curved, statically and dynamically balanced fan in a galvanized steel housing.
 - 3.3.2.2 Cabinet shall be steel, complete with baked enamel finish and hinged access door.
 - 3.3.2.3 Units shall be acoustically insulated.
 - 3.3.2.4 Unit shall be equipped with an externally insulated galvanized steel drain pan complete with a minimum 75 mm drain connection.
 - 3.3.2.5 Units to be equipped with a minimum 25 mm thick replaceable filter.

3.4 Duct Accessories

- 3.4.1 Dampers - Operating:

- 3.4.1.1 Thermally insulated, low leakage. Manufacture to SMACNA standards.
- 3.4.1.2 Blade type to suit service, complete with extruded vinyl seals, spring stainless steel side seals.
- 3.4.1.3 Bearings: pressure fit self-lubricating bronze.
- 3.4.1.4 Linkage plated steel rods, brackets with brass pivots.
- 3.4.2 Dampers - Fire:
 - 3.4.2.1 Units shall be ULC labelled and listed.
- 3.5 Steam and Condensate Piping: Piping: to [ASTM A-53], Grade B, seamless or EW or [ASTM A-106], Grade B. Schedule 40.
- 3.6 Ventilation and Exhaust Systems: In accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- 3.7 Insulation Thicknesses
 - 3.7.1 Steam and hot water piping

40	mm	
100° to 150°C	50	mm
150° to 200°C	75	mm
200° to 250°C	100	mm
 - 3.7.2 Condensate Piping: 50 mm
 - 3.7.3 Chilled Water Piping

40	mm	
0° to 40°C	50	mm
40° to 60°C	50	mm

4 INSTALLATION

- 4.1 Air Distribution System
 - 4.1.1 In accordance with SMACNA HVAC Duct Construction, Standards, Metal and Flexible.
 - 4.1.2 Insulate all fresh air intakes and exhaust ducts 3m from exhaust louvre.
 - 4.1.3 Insulate all supply air ducts on AC systems, or where duct is used for heating.
- 4.2 Ventilation and Exhaust System
 - 4.2.1 During testing and balancing be prepared to change sheaves to provide the required airflow as per the Room Data Sheets.
 - 4.2.2 In accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.

- 4.2.3 Insulate all fresh air intake and exhaust ducts 3 metres from exhaust louvres.
- 4.3 Duct Accessories
 - 4.3.1 Dampers - Fire: Install to the requirements of local authorities.
- 4.4 Piping
 - 4.4.1 Piping shall be installed so as to conserve space in buildings and to keep furring to a minimum.
 - 4.4.2 Slope piping in the direction of flow. Provide drain spouts at low points in the system.
 - 4.4.3 On steam systems install steam traps to remove condensate at a maximum of 50 metres and at all low points.
 - 4.4.4 Install steam traps ahead of all pressure reducing valves.
 - 4.4.5 Install pressure relief valves downstream of every pressure reducing station unless the piping and fittings are fully rated for the higher pressure.
 - 4.4.6 Install strainers on the impact side of all pressure reducing valves.
- 4.5 General
 - 4.5.1 Install equipment as per manufacturer's instructions.
 - 4.5.2 Vibration Isolation: Install vibration isolation at all connections between piping and pumps. Install vibration isolation devices as recommended by the equipment manufacturer.

End of Section