



23 00 00 Heating, Ventilating, Air Conditioning (HVAC)

1.0 General

- .1 Mechanical equipment schedules shall appear on the drawings including all performance, sizing and selection data.
- .2 All new construction and major renovations shall include full air conditioning.
- .3 Ground mounted equipment shall not be permitted. Any ground mounted equipment that cannot be avoided shall require Facilities Engineering approval, and if approved, will be



in place to remove major equipment such as chillers and boilers such as roof hatches or removable roof or wall sections.

- .8 Mechanical rooms not located on the lowest level shall have waterproof floors.
- .9 Provide 110v outlets for portable service equipment.
- .10 Provide adequate lighting for servicing.
- .11 Roof mounted equipment, and the path leading to the equipment, must be protected from the roof edge with guardrails when within 3 metres (10 feet) of the edge. Ladders are not permitted to access roof mounted equipment.

3.0 Valving - General

- .1 Sufficient valving should be provided to isolate the services on each level, and each major branch.
- .2 Drain valves shall be provided at the bottom of all building risers, storage tanks, heaters, and system low spots. Drain valves shall consist of a hose bibs with a cap on a chain or shall be piped to drain. Drain valves shall be located to provide maximum effectiveness. Preferred manufacturers: Jenkins, Crane, or Zurn.
- .3 Isolation (shut-off) valves shall be provided for servicing pressure reducing valves, major components of the systems, individual floor mains, risers, and fixtures. Isolation valves 100mm (4") and smaller shall be ball valves. Preferred manufactures: Jenkins, Crane, Victualic, Zurn or Watts.
- .4 Hot water, chilled water, and steam control valves shall be sized for 100%, and not 33% and 66%.
- .5 Kitz valves are not permitted.

4.0 Ventilation

- .1 Outdoor air requirements for ventilation shall comply with ASHRAE Standard 62 "Ventilation for Acceptable Indoor Air Quality", and the Ontario Building Code.
- .2 Operable windows shall not be used to meet fresh air requirements.
- .3 Return air shall be ducted to the return fan. Ceiling return plenums shall not be used.
- .4 Emphasis is drawn to the University's requirement for quiet operation of all mechanical heating and air handling systems. With respect to this requirement careful attention should be given to the selection and design of equipment, in particular: air velocities, fan design and selection, unit ventilators, unit heaters, pumps etc.
- .5 In existing installations with steam coils; Ventilation systems shall use steam preheat coils with integral face and bypass dampers. Where possible, steam coils shall be piped vertically.

5.0 Heating and Cooling

- .1 For new construction and major renovations, geothermal shall be used as the primary source of building heating and cooling unless shown not to be technically feasible. Geothermal system to be sized to meet peak cooling load.



- a. Within the building envelope; shall normally be seamless and schedule eighty (SCH.80) black steel to ASTM A106 Grade B.
 - b. Outside the building envelope; shall normally be seamless and schedule forty (SCH.40) stainless steel to ASTM A312 TP 304L.
- .4 Strainers shall be installed ahead of PRV's, traps, and control valves.
 - .5 Drain valves shall be provided at condensate tanks and shall be located for maximum effectiveness and convenience.
 - .6 Isolation valves shall be provided for pressure reducing valves, major system components and building mains. The main line isolation valve, as it enters the building, shall be double block and bleed. On high pressure lines, a warning line should be installed in parallel with the downstream "double block and bleed" valve to slowly build pressure and prevent water hammer.

9.0 Steam Specialties

- .1 All steam fed tube bundles, coils and heat exchangers shall be equipped with vacuum breakers.
- .2 Steam condensate from steam modulated equipment shall not be lifted by steam pressure.
- .3 Condensate pumps shall not be greater than 1800 RPM.
- .4 Pressure reducing valves shall be sized for 100%, and not 33% and 66%.
- .5 Safety relief valves and condensate tank vents shall be separately piped outside to a safe location. If they terminate on a roof, terminate 2.2m above roofline with a 45 degree angle out on top of the pipe. Vents for condensate tanks shall not be combined with vents for safety relief valves.
- .6 Condensate pumps shall be duplex and equipped with alternating switch.
- .7 Pumped condensate shall be metered, not the steam feed. All condensate tanks to include a condensate meter Flowmec model GNT complete with RT40 flow rate totalizer.
- .8 All steam traps shall have a 12 mm (1/2") or 19 mm (3/4") test valve, located downstream of the trap, to allow maintenance personnel to observe trap operation
- .9 Condensate tanks shall be cast iron or stainless steel and shall not use plastic multi-level float switches.
- .10 Flanged steam pressure reducing valves shall be supported close to each flange to reduce gasket failures.
- .11 All steam traps on steam modulated equipment shall be located 300 mm minimum below the condensate outlet of the equipment. All Packaged Air handling Units shall be mounted at heights that allow for a minimum of 300 mm of head at the inlet to steam traps.
- .12 Steam control valves serving steam converters to be normally closed and fail closed in a power outage to avoid boiling the water side of the system.

10.0 Pumps - Heating and Cooling



- .1 Circulating pumps shall have gauges to indicate both low and high side pressures. Pressure gauges should be provided with pressure snubbers to protect gauges from pulsations in pressure.
 - .2 Heating and cooling pumps shall be duplex type and equipped with automatic pump change over controls.
 - .3 Vertical in-line pumps 1 HP (0.75 KW) and larger should have a split type spacer coupling and have seal flushing connections complete with filter, sight flow indicator, and quarter-turn shut-off valves.
 - .4 When size & pressure permit, in-line pumps with mechanical seals are preferred. Mechanical seals should be of the outside type and should be Durametalllic or equal.
 - .5 Circulating pumps should have flexible connections to limit the transfer of vibrations to the piping system.
 - .6 All 0.5 HP and larger pumps shall be provided with auxiliary contacts for monitoring of run times by the BAS.
 - .7 All pumps should run at 1800 RPM or less.
 - .8 Approved Pump Manufacturers: Armstrong, Grundfos, Bell and Gossett, Xylem.
 - .9 All circulating pumps shall have air vents.
 - .10 Flo-Trex suction guides and check/balancing/shut-off combined valves shall be installed on circulating pump inlets and outlets, respectively. As part of commissioning, ensure all three-way valves are balanced to achieve a minimum of a 20 degree difference between the discharge and return flow.
 - .11 Pressure gauges shall be properly sized and installed such that all pump inlet and outlet pressures can be measured quickly and accurately.
 - .12 With multiple pumps, provide mounts (either anchors or a monorail system) to service the pumps.
 - .13 VFDs are not to be integral to pump.
- 11.0 Testing, Adjusting and Balancing for HVAC
- .1 Prior to startup of any pump, or fan, all construction debris shall be removed from the system.
 - .2 Pipe systems shall be thoroughly flushed prior to the startup of circulating pumps.
 - .3 The locations of Pitot tube test ports in ducts should be specified by the designer and not left to the contractor.
 - .4 Pumps shall not be started without a strainer on the suction line.
 - .5 All ducting shall be inspected to confirm that they are sufficiently clean for operation.
 - .6 Air distribution systems shall be balanced to design volumes $\pm 5\%$.
 - .7 Liquid handling systems shall be balanced to design volumes $\pm 15\%$.
 - .8 The functionality of all systems shall be verified and confirmed to Queen's University before final acceptance of the work will be considered.



12.0 Pneumatic Control System for HVAC

- .1 A refrigerant dryer is required for control air. The dryer should be mounted in a cool place and should not be mounted above the compressor(s). The preferred supplier is Hankison
- .2 Control air and laboratory air systems shall be separate.
- .3 Control air compressors are required to be duplexed and should be sized to provide a run-time ratio of 0.3:1 to 0.5:1. Two separate electrical feeds from different sources shall be furnished for each compressor.
- .4 Control air compressors shall be provided with auxiliary contacts for monitoring of run times by the BAS.
- .5 Control air compressors shall be provided with auxiliary contacts for monitoring low air pressures by the BAS.
- .6 Control air compressors shall have air-cooled intercoolers and aftercoolers. Coolers shall not use once-thru water.
- .7 Control air piping shall be Type "L" hard copper. All common pipe shall be copper. Plastic pipe shall only be used for short runs from the main copper pipe to the equipment. Any tee in a chase should be accessible in case it needs to be repaired.
- .8 Compressed air receivers shall be equipped with automatic blow down.
- .9 Control air compressors shall be on emergency power.
- .10 Control air is to be used in main mechanical rooms only. Control air is not to leave mechanical room that houses the compressor. Electrical controls are to be used outside the mechanical rooms.
- .11 Preferred manufacturers: Gardner Denver, Quincy, Ingersoll Rand, Omega.

13.0 Refrigerant Piping

- .1 All installations require best refrigeration practices.
- .2 All piping system must be pressure tested to 1 ½ times operating pressure.
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.12 Vessels shall be provided for the storage of the full refrigerant charge of the largest chiller.

14.0 HVAC Water Treatment

.1 Water treatment shall be provided for all closed water systems. Systems shall include water filters. Queen's University currently engages SUEZ with contact information given below:

SUEZ
Sebastian Ratzinger, E.I.T.
Account Manager
Mobile: 613-267



- .1 For building perimeter heaters, hot water heating shall be used rather than direct steam heating.
- .2 All water lines into and out of heat exchangers shall have thermometers located in a convenient position for reading from the floor
- .3 Hot water heating systems to be designed for 120 F supply water temperature.
- .4 Steam/hot water heating converters do not require a backup or standby. However, 100% backup capability is preferred and a minimum of two converters are required to meet peak demand.
- .5 Sufficient clearance shall be provided in mechanical rooms for the removal of tube bundles.
- .6 Building entrances shall be heated with electric heaters.
- .7 Tube bundle baffles in shell and tube heat exchangers shall be constructed of brass, stainless steel or other corrosion resistant metals. Carbon steel baffles are not acceptable.
- .8 For steam feed heat exchangers the steam shall enter the shell clear of the tube bundle. Increase the length of the shell to suit.

16.0 Water Chillers

- .1 Approved Chiller Manufacturers;
 - a. Air or Water Cooled: Carrier, York, Daikin
 - b. Modular Chillers (Must receive Queen's approval): Multistack, Aermec
- .2 For loads of 200 ton and larger; Multiple compressors are required to meet peak demand.

17.0 Condensers, Coolers and Cooling Towers

- .1 Towers are to be stainless steel construction or composite material.
- .2 Motors are to be variable frequency driven.
- .3 Float / level sensors are to be electronic.
- .4 Towers will include sump heaters for shoulders season operation.
- .5 Towers to include vibration sensors and seismic isolation springs.
- .6 Towers to include factory approved access ladders and platforms where required.
- .7 If a tower is only available in Galvanized material pre cleaning and Passivation is to be performed according to the manufactures specification complete with documentation of the process and verification upon completion.
- .8 Approved manufacturers: BAC, Evapco.
- .9 Open loop cooling towers are not permitted.

18.0 Air-To-Air Energy Recovery Equipment



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- .6 Belt guards should be provided on fans with walk in sections. The front face of guards should be constructed of expanded metal to allow for visual inspection and cooling.
- .7 Fan-motor assemblies should be provided with vibration isolators.
- .8 All fan motors should be of energy efficient design.
- .9 Fan scrolls should have drain plugs or access doors.
- .10 One set of spare drive belts should be provided.
- .11 Fans are frequently specified with excessive rotational speeds. Emphasis is drawn to the University's requirement for quiet operation of all air handling systems. Therefore, speed and type of fan must be given careful consideration.
- .12 Fume hood and fume exhaust fans shall be roof mounted. All fume exhaust ductwork must be under negative pressure within the building envelope. Basis of design to be direct-drive Strobic with sealed motor bearings. All fume exhaust to include a glycol run around loop for energy recovery. Fume exhaust systems to include a minimum of two (2) fans on a common plenum to provide some level of exhaust air flow in the event of a fan failure. Plenum to include a blank for a future fan and ductwork is to be sized to accommodate a minimum of 50% additional air flow for future expansion. Motorized dampers to be included under each fan to allow service to individual fans while others remain in operation. Critical exhaust systems, such as animal care applications, must include N+1 redundancy.
- .13 All exhaust fans shall have backdraft dampers.
- .14 All 0.5 HP and larger fans shall be provided with auxiliary contacts for monitoring of run times by the BAS.
- .15 Use centrifugal fans or silencers on axial fans where exterior noise is a problem.
- .16 In-line fans are difficult to service and should not be used, unless with the permission of Facilities Trades and Engineers.
- .17 Fans with either A, B, or C belts are preferred.

20.4 Coils

- .1 Coils should have a galvanized steel casing.
- .2 Where subject to freezing temperatures, hot water heating coils should be glycol-water coils. Only propylene glycol shall be used. Steam heating coils to be face and bypass (Retrofit coils only, new coils to be hot water or glycol.).
- .3 Coils should be removable from the unit. Piping unions or flanges should be provided to facilitate coil removal.
- .4 Refrigerant coils with multiple compressors should be alternate tube circuited to distribute the cooling effect over the entire coil face at reduced load conditions.
- .5 Heating coils should have double pole discharge air low limit thermostats

