Part 1 General

1.1 Summary

.1 Unless otherwise indicated, follow the standards below when specifying heating, ventilation and air conditioning (HVAC) work. These standards are not intended to restrict or replace professional judgment.

1.2 Références

.1 Refer to section **00 20 00 Instructions to consultants**.

.2 The equipment identification must respect the standard established by McGill University, Drawing STD-M-001 see section **23 05 53 Identification des Systèmes Mécaniques et des Dessins**.

1.3 Refrigerant Equipment

.1 General

.1 All new refrigerant-based HVAC equipment shall be provided with refrigerant fluids having a GWP of less than 1,500, such as fourth generation Hydrofluoro-olefin & Hydrofluoro-ether (HFO / HFE) synthetic fluids families. These refrigerants have a lower contribution to the global warming. It is the Consultant's responsibility to verify if the new equipment is available with this new family of refrigerants.

.2 Centrifugal chillers are to be preferred over single stage absorption chillers. Stand-alone rooftop glycol units are to be avoided.

.3 Chillers shall use refrigerant fluids with GWP limit of 750 for units above 50 tons. If not available on the market, consider using better ozone friendly refrigerants (see article 1.3.1.1). The new equipment shall have proven service and reliability, parts, services, all-inclusive service contract for five (5) years and a five (5) year renewal clause.

.4 Chilled water coils shall have 25% extra capacity of refrigeration with respect to the design load required by the system.

.5 All multicoil DX shall be provided with interlaced type circuiting. Avoid multicoil DX with single compressor.

.6 The professional in charge of design must select the chiller best adapted to the application. In all cases, the designer must demonstrate that the type of chiller has been selected appropriately for the application and based on a total cost of ownership (TCO) analysis including initial investment, annual operation and maintenance costs.

.7 For heat recovery applications of 200 tons and below, modular multistage chillers (scroll or screw) are to be preferred over centrifugal chillers because they allow for better modulation and the production of hot water at a higher temperature.

.8 The minimum efficiency of chillers must be as good as or better than ASHRAE 90.1-2010.

.9 Design chillers with Delta-T across the evaporator and condenser of 15°F (8.3°C) to reduce pump energy.

.2 Glycol Recirculation Systems

.1 Ethylene glycol should preferably be specified unless the use of propylene glycol is required for the application. However, it is the responsibility of the design engineer to use the appropriate type of glycol for each respective application taking into account applicable laws and regulations.

.2 The following types of glycol should be specified:

.1 Ethylene glycol: premixed DOWTHERM SR1, by the Dow Chemical Company only - no substitutes.

.2 Propylene glycol: premixed DOWFROST by the Dow Chemical Company only - no substitutes.

.3 For glycol recirculation systems, add expansion tanks for glycol replenishing and testing, an automatic glycol feed system to replenish glycol, a pressure transducer at the pump to monitor for low pressure and shutdown the pump, and monitoring sensor connected to the central Building Control Management System.

.4 Install bypass filter on glycol and chill water loops.

1.4 Heating, Ventilation, Air Conditioning Equipment

.1 Design Control for Mechanical Systems

.1 The professionals responsible for system design shall inform the Executive Director Facilities Management and Development in writing whenever budgetary constraints may prevent the performance objectives of this standard from being respected.

.2 Longevity and Performance Criteria for any new system may be introduced if and only if the supplier can provide an obsolescence statement guaranteeing a minimum of ten years serviceability for the system, including the refrigerant gas.

.2 General

.1 Loading docks shall be provided with air curtains or other means to minimize air infiltration and be isolated from the rest of the building. Provide minimum heating at the docks by ducting the building exhaust air to this area. (Use air curtain wall)

.2 Perimeter rooms shall be air-conditioned with sill type grilles and ceiling diffusers (Linear).

.3 All mechanic HVAC equipment shall be housed in a penthouse; rooftop units shall be avoided.

.4 If an equipment is installed on the roof, a 120 V, 20 amps GFI outlet shall be provided for maintenance purpose.

.5 Relative pressures for labs shall be negative with respect to the corridor. Intermediate and high-level radiation labs shall be negative with respect to other labs, and buildings shall be slightly negative to the outside.

.6 If peripheral heating is required, it shall be fed from under the floor. An all-air system with a two supply (hot and cold), one return fan dual duct variable air-column system shall be supplied along exterior walls from under the floor.

.7 The return air shall supply the hot duct 100%; excess air shall supply the cold duct (with outside air).

.8 See section 23 82 23 for HVAC units design.

.3 Mechanical Preheat, Reheat or Cooling Coils

.1 Whenever possible and applicable, the design engineer shall consider using "dual service" type coils (same coil for heating and cooling - depending on the season) filled with glycol and serviced by heat exchangers if required.

.2 All air handling units' coils shall be provided with glycol, unless a variance request has been accepted by the mechanical engineer of McGill Facility Management and Ancillary Services Department.

.3 Integral Face and Bypass (IFB) or Vertical Integral Face and Bypass (VIFB) preheat or reheat coils shall not be used. Glycol heating coils shall be provided instead.

.4 Coils shall be tested in accordance with A.R.I. standard 410.

.5 Cooling coils air velocities shall not exceed 490 ft/min (2.5 m/s).

.6 Coils construction:

.1 Coil casings shall be 304L stainless steel, 16-gauge minimum.

.2 Headers shall be copper.

.3 Water and DX coils tubes shall be 5/8 inch (16 mm) minimum seamless drawn copper, thickness 0.035" minimum.

.4 Steam coils tubes shall be 1.0 inch (25.4 mm) minimum seamless drawn copper, thickness 0.049" minimum.

.5 Plate type coil fins shall be plate type aluminum 0.010" thickness, maximum spacing of 10 fins per inch. If helical fins are provided for cooling or heat recovery coils, then stainless steel mist eliminators are required in order to avoid water carry-over.

.7 A strainer shall be installed before the control valve on any coil.

.8 All coils shall be equipped with a vacuum breaker at the highest point.

.9 Each hydronic coil shall be provided with isolation valves, balancing valve manometers, thermometers and air vent. The thermometers and manometers shall be installed on the supply and also on the return water sides.

.10 Steam traps shall be installed with recommended slopes for drainage.

.4 Vibration Isolators

.1 Vibration eliminators shall be provided for all moving equipment called for in all projects. Equipment shall be effectively isolated from the building structure to prevent undue vibration and noise transmission to the building.

.5 Humidification

.1 Direct steam humidifiers using steam distribution to be preferred over all other alternatives.

.2 The humidifier dispersion tubes shall be insulated. The tube insulation shall be ceramic or polyvinylidene fluoride (PVDF) – shielded air gap insulation is not accepted.

.3 If steam humidification is not feasible or financially viable, the design engineer must prefer the following sources in the following order:

.1 Natural gas

.2 Electricity.

.4 Humidifiers shall be ARMSTRONG, DRISTEEM or NORTEC or reusable canister. An approved equivalent manufacturer shall be considered if approved in writing by the representative of McGill's Facilities Operations Department (FOD).

1.5 Air Distribution

.1 General

.1 Transformer grilles in doors or transoms are not permitted. Air transfer shall be achieved by duct transfer grilles installed in ceilings, with fire dampers and provision for sound attenuation as required.

.2 Air intakes shall be located away from vehicle circulation areas and exhausts at roof level, not at street level for car fumes. If this cannot be done, then airflow studies shall be considered with respect to the positioning of air intakes and wind.

.3 Air intake velocity shall be 200 feet per minute or less. All basins in air handling units shall be drained with slopes to drains.

.4 Duct insulation shall be installed on the outside of ductwork. Insulation on the inside of ductwork shall be avoided. Acoustical insulation shall be accomplished with silencers.

.5 Transformer rooms shall have their own exhaust and supply with no heating to be provided.

.6 Mechanical room and washroom exhaust fans shall be stop-start programmable.

.7 Air supply to transformer rooms shall be filtered (using 2” deep - Merv 8 filters, combining standard sizes of 24”x24” and 12”x24” only).

.8 Variable air volume (VAV) ventilation systems to be preferred for any space on campus inasmuch as it responds to occupant and functional requirements.

.9 Spaces that do not require continuous ventilation should be supplied by autonomous systems and shut down at unoccupied times.

.10 Space with high internal heat gains due to the presence of equipment (such as electronic equipment, freezers and refrigerators, mechanical equipment, etc.) must preferably be cooled using chilled water fan coils.

.2 Ductwork

.1 Ductwork shall be as per the latest SMACNA and ASHRAE standards.

.2 If the ductwork needs to be insulated, then the insulation shall be placed on the outer wall of the ventilation ducts (i.e. no insulation allowed in the air tunnel). If required, acoustic silencers shall be provided. In addition, all airstream surfaces should be resistant to mould growth and resist erosion, according to the requirements of ASHRAE Standard 62.1 (ASHRAE 2010a).

.3 The following ductwork shall be insulated to a minimum of R-6:

.1 All supply air ductwork.

.2 All return air ductwork located above the ceiling and below the roof.

.3 All OA ductwork.

.4 All exhaust and relief air ductwork between the motor-operated damper and penetration of the building exterior.

.4 Flexible conduits:

.1 Flexible conduits as per NFPA-90, NFPA-90B, ULC.

.2 Maximum length of 1500 mm (60”).

.3 Acceptable models:

- Boflex, model types AS and AI.
- Équipement Trans Continental, model AI-U-Flex.

- Flexmaster Co Ltd., model Triple lock.

.5 All new ductwork for chemical fume hood exhaust systems shall be 316 stainless steel, low carbon, round, with annealed welds; or fibreglass reinforced plastics depending on the application.

.6 All existing conduits that will be reused need to be sealed:

.1 Repair all major leaks as per SMACNA recommendations using products that are UL 181 compliant.

.2 Seal the existing conduits from the inside using an automatized system such as Aeroseal or approved equal. The application shall be done by an authorized distributor.

.3 Diffusers

.1 All new and replacement ceiling diffusers shall be selected in order to achieve an efficient air distribution. Shape and colour to be coordinated with the project architect. Provide balancing dampers for each diffuser.

.2 Induction type diffusers shall be used for variable air volume ventilation systems.

.3 Fabric faced terminal diffusion devices are not accepted at McGill, unless a variance request has been accepted by the mechanical engineer of McGill Facility Management and Ancillary Services Department.

.4 Terminal boxes (mixing boxes and VAV boxes)

.1 For each new project, verify that the terminal boxes serving the designated area are still functional and have not exceeded their life expectancy, in which case they would need to be replaced.

.2 All new mixing or variable air volume (VAV) terminal boxes shall be Direct Digital Control (DDC) type and be connected to McGill University's Building Automation System (BAS). This shall be done even when the existing terminal boxes are pneumatic type.

.3 Each box shall serve a designated zone and be controlled by its dedicated DDC thermostat connected to the BAS system.

.5 Air Filters

.1 For general applications pre-filters shall be MERV 8 2 "(50mm) and final filters shall be MERV 13 - 12" (300mm) rigid box type with header for side-access or front access applications.

.2 Always use standard filter sizes 24"x24" and 12"x24". Other filters sizes shall be used when it is impossible to use standard size or when the standard size is not available for a given application. When this is the case, notify in writing the maintenance mechanical engineer of McGill University Facilities Management and Ancillary Services.

.3 Filter frames and fasteners

.1 Frames and fasteners shall be from a recognizable filter manufacturer, with a minimum of 5 years in existence. They need to be easily available locally.

.2 The fasteners shall allow for an easy installation or removal of filters, without having to use any tools. In addition, no tool should be required in order to replace any of the filter fasteners.

.3 Preferred fastener type, specific to the installed filter combination: C-78 series by Camfil or Filter clip series by Filtration Lab or approved equivalent.

.6 Dampers and louvres

.1 See section 23 82 23 for a complete description.

.7 Fire dampers

.1 Install fire dampers where required. For dampers installed behind or incorporated into the grilles, these will serve as access. Elsewhere, at each damper, install access doors of sufficient size to allow inspection, adjustment and refitting of the damper, link and fuse.

.8 Fans

.1 Whenever available, fans shall be direct driven type rather than belt driven.

.9 Access Doors

.1 Access doors shall be provided at locations in the duct systems where access to manual or automatic fire dampers, coils, thermostats or any other apparatus requires inspection.

.2 Doors shall be constructed with an external built-up metal frame for stiffening. Doors on insulated ductwork shall be of double panel construction provided with glass fibreboard filler.

.3 Access doors shall be provided ahead of all fan inlets and on both sides of all coils to allow for cleaning and inspection.

.10 Flexible Connections and Isolating Connections

.1 Flexible connections shall be provided on joints between ducts and air-handling equipment. They shall be 150 mm (6 inch) wide Ventglass type flexible connections. Two 13 mm (1/2 inch) wide heavy flexible braised copper conductors with clamps shall be installed to ground all systems.

.2 Flanges shall be provided on the ducts to make proper connections. Connections shall have a minimum of 100 mm (4 inch) between the flanges and shall be airtight. Similar connections shall be supplied for the joints between dissimilar metals in the ductwork. Flexible conductors shall be used to bridge all flexible connections in ductwork.

1.6 Duct sealing

.1 If required and/or it has been decided that the ductwork needs to be sealed for a particular project: repair any major leaks larger than 12 mm (0.5 in.) in diameter with sealant and fibreglass tape as recommended by SMACNA. The product used must meet the requirements of UL 181.

.2 Seal the existing ducts from the inside using an automated aerosol system.

.1 Similar to Aeroseal.

.2 An authorized distributor of the sealer manufacturer must make the application.

.3 The sealant must comply with UL Outline Scope 1381.

.4 The sealant must cure in no more than two hours and shall not release any residual gas from volatile organic compounds (VOCs) thereafter.

.5 The sealant must remain flexible after drying.

.6 The sealant should only deposit itself where leaks are located.

.7 Provide status reports before and after the work, as well as a sealing profile, for each section of sealed ductwork. The report must indicate the percent reduction in leaks for the supply and return air ducts.

1.7 Testing, Adjusting, and Balancing

.1 General

.1 Before renovations, all HVAC systems affected by the change shall be checked and airflow readings shall be recorded.

.2 After renovations, all HVAC systems affected by the change shall be checked and balanced.

.3 Commissioning of new HVAC systems shall wait until all construction work is complete and all dust and dust sources have been cleaned up and eliminated.

LEED .4 Air handling units shall not be turned on during construction.

LEED .5 Filters on the return air shall be changed after construction is finished and before final balancing.

.6 Final inspections shall be made to ensure after start-up that filter frames are not damaged, ducts are clean, balancing is correct.

.7 The project contractor has the responsibility to document the test.

.8 The project engineer has the responsibility to conclude on the passage of the test.

.2 Balancing and Testing

.1 All air handling units and their respective distribution networks shall be balanced for air quantities as shown on the engineering drawings.

.2 Trades shall provide all belts and pulleys required for balancing all fan systems.

.3 Trades shall submit all testing and balancing results on 8.5 x 11 inch sheets with cross-referenced drawing showing diffuser location and air quantities removed.

.4 Fan test shall be submitted. The entire document shall be bound in a title binder with hard fibreboard cover. The document shall also be provided in electronic format (PDF is preferred).

1.8 Cooling Towers

.1 Cooling towers and all interior surfaces and components shall be made of 304L stainless steel. The unit's floor shall be complete with heavy duty 304L stainless steel grating.

.2 The fans shall be direct driven type. If direct driven is not available, provide gearbox driven motor. Belt driven fans shall be avoided.

.3 The motors must be controlled by variable frequency drives – see VFD section 23 09 33.

LEED .4 Cooling towers shall be complete with efficient drift eliminators that reduce drift to a maximum of 0.002% of recirculated water volume for counter-flow towers and 0.005% of recirculated water flow for cross-flow towers.

.5 Provide basin sweeper piping in order to limit debris build up.

.6 Cooling towers shall be complete with 304L stainless steel ladder and railing.

.7 Depending on the cooling tower location and its surroundings there might be a risk that contaminants (dust, pollen, etc.) get into the cooling tower causing clogging and premature stoppage of the unit. Removable stainless steel mesh screens shall be provided at the air intake in order to ensure proper operation.

.8 Cooling tower performance (in US gpm per HP) must follow the latest version of ASHRAE 90.1.

1.9 Heating

.1 General

.1 In all projects and all buildings, the professional in charge of design shall select heating sources in the following order:

.1 Heat recovery from internal gains thanks to a heat recovery chiller or a heat pump **or** using existing local heat recovery loops;

.2 Central steam distribution via steam to hot water heat exchangers or central hot water distribution;

.3 Geoexchange (i.e., ground sourced heat pump system) energy, especially for new construction or full-building renovation projects;

.4 Natural gas hot water condensing boilers in isolated cases where central steam and hot water distribution networks are not available;

.5 Electric boards or coils when none of the above-mentioned energy sources is available.

.2 Heating networks: heating networks must be designed using low temperature set points for compatibility with existing or upcoming low-temperature heat recovery networks. Design temperature set point must be less than or equal 120°F with a 20°F to 40°F temperature differential.

.3 When using natural gas or electricity for heating purposes, the professional in charge of design must use existing service entrances in order to avoid the addition of energy meters from utility companies.

.2 Building Envelope Heating

.1 Geoexchange to be preferred in new buildings.

.2 For new buildings, the professional in charge of design must prefer the use of low-temperature radiators or the use of hot ventilation air.

.3 The use of steam radiators or convectors is forbidden for building envelope heating and the professional in charge of design must consider converting such equipment to hot water when it is included in the scope of the project.

.4 Use of electric baseboard heaters, electric convectors or electric hot air curtains must only be considered in remote areas far from any hot water or steam distribution. Electric equipment must be equipped with triac relays for applications of less than 1 kW and with SCR controllers for applications greater than or equal 1 kW.

.5 Loading docks, indoor garages, warehouses and other space equipped with garage doors must be equipped with hot water unit heaters. In case there is a risk of freezing, other means shall be considered and approved by Variance Request Form.

.3 Terminal Heating

.1 In any upgrade or installation of an HVAC system comprising terminal heating, the professional in charge of design must prefer the use of low-temperature hot water (120°F and below) with a 20°F to 40°F temperature differential.

.2 The use of electric terminal heating can be acceptable but the professional in charge of design must demonstrate that this is the best option based on a total cost of ownership (TCO) analysis including installation, energy, and maintenance costs.

.4 Heat Recovery and Free Cooling

.1 Consider the use of heat recovery systems when the winter cooling load of a building is greater than 30 tons.

.2 Estimation of a building's winter cooling load shall include the following internal gains: IT cabinets and server rooms, air exhausts greater than 5,000 CFM, HVAC systems requiring cooling in the winter, all cooling loads 5 tons and over.

.3 Lab air exhausts 5,000 cfm and over must be equipped with heat recovery. Heat recovery systems must prevent cross contamination.

.4 All HVAC systems with air supply 2,360 L/s (5,000 CFM) and over and whose fresh air ratio is greater than 70% must be equipped with a heat recovery system with a total efficiency ratio (sensible and latent) greater than 50%.

.5 Heat recovery is to be preferred over free cooling when possible. In other cases, free cooling must be considered for all systems with a cooling load 10 tons and over.

.6 The professional in charge of design must evaluate whether free cooling or mechanical cooling is the best option for HVAC systems requiring cooling in the winter. The justification of using mechanical cooling must be based on an evaluation of the minimum fresh air requirements based on applicable standards.

.7 Bearing in mind that the chillers designed for summer usage are often oversized for winter applications, the professional in charge of design must consider the use of heat recovery chillers adapted to the minimum cooling load of the building in the winter.

1.10 High Dilution Mixed Flow Exhaust Fans

.1 General

.1 Fans will conform to AMCA standards 210 and 300. Fans must be tested to these same standards at an AMCA accredited laboratory. Fans may carry the AMCA seal; for performance (AMCA 210) and sound levels (AMCA 300).

.2 Fans shall be UL and CUL Listed to UL 705 Safety Standard.

.3 Compliant with NFPA 45.

.4 Classification for non-sparking construction shall be in accordance with AMCA 99.

.2 Products

.1 Induction and high Dilution Mixed Flow Impeller Fans.

.2 Impeller shall be mounted directly to the motor shaft providing a type 4 direct drive arrangement without couplings. The motor shall be isolated from the primary exhaust

air stream and must be visible and accessible from outside the fan for inspection and service.

.3 Each fan motor will be supplied with a variable frequency drive.

.4 Mixed flow impeller shall consist of a combination of backward curved axial/centrifugal vanes of welded steel construction unless AMCA Schedule B. Fans shall have no-overload, no-dead-point type performance characteristics with stable operation at all points of their curve.

.5 Each fan, together with all drive components, must have a combined bearing life of a minimum of L10 150,000 hours.

.6 Each assembly shall include discharge guide vanes to increase fan efficiency.

.7 The assembly will be designed for direct mounting on a conventional roof curb without the use of guy wires anchored to the roof.

.8 A fiberglass reinforced plastic twin nozzle discharge allowing external air suction shall be provided. The nozzle shall be resistant to chemicals and ultraviolet rays.

.9 A wind drive crown providing secondary induction of outside air shall be provided. Induction shall occur downstream of the impeller and shall not influence fan BHP or static pressure requirements. The discharge flow from the crown may reach a minimum of 197% of the design flow. The manufacturer shall publish complete documentation to this effect for all primary flows.

.10 Fans shall be built to AMCA "C" standard (per AMCA 99) with a non-ferrous metal intake bell to prevent sparks in the event of motor bearing failure.

.11 The fans shall be modular so that they can be assembled on site.

.12 All attachment bolts shall be 316 stainless steel.

.13 A bolted impeller inspection access door shall be provided on each fan.

.14 The fan and accessories shall be equipped with a drain to prevent water infiltration into the building.

.15 Motors shall be TEFC Mill & Chemical electric with service factor of 1.15, L10 bearings 150,000 hours and equipped with thermistors. The motors shall be of the high efficiency type operating at a maximum of 1800 rpm and designed to operate with variable frequency drive.

.16 A NEMA 3R non-fusible disconnect switch shall be provided mounted on the fan and wired to the motor.

.17 Provide lubrication lines for motor bearings – they shall be Teflon coated with braided stainless steel. These lines shall be supplied with extensions to facilitate maintenance.

.18 Corrosion Coating: All steel and aluminum parts in contact with the air flow that are not SS or fiberglass will be prepared by treatment with Iron Phosphate. The coating will exceed a 700 hour resistance to the ASTM B117 salt resistance test. The coating will have passed the ISO 12944-6 test to ensure adequate resistance to ultraviolet rays, corrosion and low temperatures.

.19 2.1.29 Start-up shall be supervised by a specialized technician. Training will be given at the installation site by the fan representative. Fans shall conform to AMCA standards 210 and 300. Fans must be tested to these same standards at an AMCA accredited laboratory. Fans may carry the AMCA seal; for performance (AMCA 210) and sound levels (AMCA 300).

.3 Accessories

.1 Mixing Plenum

.1 A mixing plenum for installation at the fan inlet will be supplied by the manufacturer. Each plenum will be designed to support the weight of the fan and provide the performance of the specified fans. Plenums for systems with multiple fans or with an energy recovery section will be constructed of double walls insulated on all sides of the plenum including the floor with structural reinforcements. Plenums for a single fan will be constructed of thick plates of continuously welded steel. Double-walled plenums, except for motors under 3 HP, will have an average wall thickness of 1.5 in. and the insulation will have an Rmin value of 4.34. All plenums will be able to support fans without guy wires or overhead structures. The plenums will be equipped with hinged access doors and protective grilles on the primary air intake vents. The primary air intake vents will be located on the underside or on the sides of the plenum according to the indications on the drawings. The anti-corrosion coating will be the same as that of the fans. Unless otherwise specified, the plenums will be designed for mounting on a roof base. Safety grilles will be provided over the fan inlet. All mixing plenums will be supplied with a jib crane fixture as well as a jib crane to perform motor maintenance on the fan system.

.2 Bypass dampers will be provided on all mixing plenums to adjust the mixture of primary and outdoor air to maintain the static pressure set point. The dampers shall be of the aluminum opposed blade type, of aerodynamic shape with low leakage rate, and equipped with an elongated shaft for connection to an actuator. Rain canopies with protective mesh will be provided for each damper. The dampers will be equipped with electric actuators supplied and installed by the fan manufacturer but connected by the control contractor.

.3 Low leakage, aerodynamically shaped, parallel louvered isolation dampers shall be provided with each plenum. They will be constructed of extruded aluminum and coated with an epoxy coating against corrosion. The actuators will be of the on/offspring return type and will be supplied and installed by the fan manufacturer. The actuators shall be factory wired and electrically interlocked (via a transformer when required) with the fan disconnect switch so that they open when the fan is started and close by spring return action when the fan is off.

.4 Vortex Breakers must be provided on all side entrances and plenums having more than one fan in operation.

.2 Silencer

.1 Include a silencer in the form of an acoustic nozzle which must be designed as an integral part of the fan exhaust nozzle without increasing the height of the overall assembly.

.2 This integrated acoustic nozzle must not increase the overall height of the assembly while providing an attenuation of a minimum of 13 dBA per fan. The acoustic nozzle shall provide attenuation per model according to the following table. Published values shall be obtained using AMCA 300 methods with the silencer installed on the fan in question. The acoustic nozzle shall be constructed with an outer shell of fiberglass reinforced plastic with a minimum thickness of 3/16”. The internal lining shall be made of corrosion resistant perforated steel. The silencer must be supplied in the same color as the fans. The fiberglass acoustic media shall be isolated from the exhaust air by a non-fibrous acoustic media film.

.3 Inline silencer

.1 An in-line acoustic silencer, four (4) feet high, shall be supplied and factory installed between the acoustic nozzle discharge and the engine. The acoustic silencer shall be constructed with a fiber reinforced plastic outer casing with a minimum thickness of 3/16". The internal lining will be made of corrosion resistant perforated steel. The silencer must be supplied in the same color as those of the fans. The fiberglass acoustic media will be isolated from the exhaust air by a non-fibrous acoustic media film. This in-line acoustic silencer will reduce the sound level by approximately 3 dB more than the nozzle-shaped acoustic silencer at each of the prescribed distances when used in combination with it.

.4 Silencer on bypass dampers

.1 In-line acoustic silencers 4 inches thick will be supplied and factory installed on the outside of the bypass dampers. The acoustic silencers shall be made of a 16-gauge galvanized steel housing and the acoustic breaker blades will be made of 18 gauge galvanized steel on the exterior face and 22 gauge perforated galvanized steel on the interior face. A bird screen is also included.

.3 Roof curb or a seismic base

.1 If required, a minimum 14-gauge galvanized steel roof curb or a seismic base shall be provided for the fan assembly.

.4 Intelligent control system

.1 An intelligent control system will be supplied with the fan unit. This control system shall be designed to maintain the static pressure of the network at all times at a predetermined level regardless of the activity in the exhaust air network. (Ex: variation in flow demands from fume hoods). This will be accomplished without any user intervention.

.2 The air outlet speed of each fan shall be maintained at a minimum of 3000 feet per minute at all times. The system will also control the opening and closing of bypass dampers and isolation dampers as a secondary mode of control. Additionally, fans running simultaneously will run at the same speed and frequency to eliminate any possibility of exhaust airflow imbalance.

.3 The static pressure at which the network/system is to be maintained must be manually adjustable on the control panel touch screen. The system also offers the possibility of changing/modifying this set point remotely via the communication/building control network "BMS". A BACnet card will be the communication link between the unit and the BMS. This will allow the transfer of information to the user. The information transmitted is:

.1 Static pressure measured in the plenum

.2 Frequency of motor VFDs in use

.3 The energy consumption of each fan

.4 The status of each fan

.5 Alarms which shall be programmed as required by McGill

.4 The control system will establish a sequence so that no fan is inactive for a period of more than 30 days (adjustable according to the user's needs). This will extend fan life by evenly distributing their usage.

.5 In the event of a failure of one of the fans in operation, the controller will start the stand-by fan (in redundancy) and stop the operation of the one in trouble. An alarm will be sent to the BMS to notify the user.

.6 Pressure sensors shall be supplied and factory installed in the ventilation unit mixing plenum at the inlet of each fan.

.7 The panel must be powered with 120V/1/60. Everything will be tested and pre-wired in the factory and the connection on site will be the responsibility of the control contractor.

.8 The wiring and connection of control to the VFDs, the programming of the VFDs, the supply and installation of the pressure sensor in the ventilation duct, will be by others.

.4 Guarantee

.1 The fan manufacturer shall provide a seven (7) year warranty on all fan components including the motor.

.5 Preventive maintenance program

.1 A 5-year preventive maintenance contract shall be included for the fans. The maintenance program will come complete with a detailed annual report which is to be presented to the University.

.6 Acceptable product

.1 Acceptable Product: Tri-Stack Generation III from Strobic Air Corporation or approved equal.

END OF SECTION