

**AIR HANDLING**

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**1. GENERAL**

**1.1 References**

- .1 The following is a list of standards which may be referenced in this section:
  - .1 ARI: 410 Forced-Circulation Air-Cooling and Air-Heating Coils.
  - .2 AMCA:
    - .1 Bulletin 300, Setup No. 1.
    - .2 Standard 99, Standards Handbook, Reverberant Room Method for Sound Testing of Fans.
    - .3 Standard 210, Laboratory Methods of Testing Fans for Rating.
  - .3 ASHRAE:
    - .1 52, Method of Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
  - .4 ASTM: D4157, Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method), Test Method for.
  - .5 CSA: C22.1, Canadian Electrical Code
  - .6 IEEE: 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
  - .7 NEMA: MG 1-12.53a, Motors and Generators.
  - .8 NFPA:
    - .1 70, NEC.
    - .2 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
    - .3 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
  - .9 OSHA.
  - .10 UL/ULC: Product Directories.

**AIR HANDLING**

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**1.2 Submittals**

- .1 Action Submittals:
  - .1 Complete specifications, descriptive drawings, catalog cuts, and descriptive literature, which shall include make, model, dimensions, weight of equipment, and electrical schematics for products specified.
- .2 Informational Submittals:
  - .1 Manufacturer's Test Reports for the following:
    - .1 Hydronic heating coils
    - .2 Direct Expansion (DX) coils
    - .3 Heat recovery plates
    - .4 Noise test results.
  - .2 Equipment Installation Certificates:
    - .1 Certificate of Equipment Delivery, Form 100.
    - .2 Certificate of Readiness to Install, Form 101.
    - .3 Certificate of Satisfactory Installation, Form 102.
    - .4 Certificate of Equipment Satisfactory Performance, Form 103.
  - .3 Recommended procedures for protection and handling of products prior to installation.
  - .4 O&M Data: As specified in Section 01730, Operation Maintenance Manuals.

**1.3 Extra Materials**

- .1 Provide tag and box for shipment and storage the following spare parts:

<u>Item</u>	<u>Quantity</u>
Filters	Four complete sets per unit
High Efficiency Filters	Two complete sets per unit
Fan Belts	One complete set per unit

- .2 Delivery: In accordance with Section 01600 – Materials and Equipment.

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**AIR HANDLING**

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**2. PRODUCTS**

**2.1 General**

- .1 Supply and install non-fused disconnects on each air handling system.
- .2 Coat interior surfaces and fan wheel in contact with the air stream with 6-mil minimum thickness of chemical-resistant epoxy coating.
- .3 Where spark-proof construction requirements are noted, supply and install equipment in accordance with AMCA Standard 99-0401 for Type B spark-proof construction.
- .4 Shafts and Drive Belts:
  - .1 Provide multiple drive belts where motor horsepower is 1.5 kW or larger.
  - .2 Belt Guards: Meet federal and Provincial of Manitoba OSHA requirements for safety protection, and be easily removable by one person.
  - .3 Tachometer Access Holes: Large enough to accept standard tachometer drive shaft.
  - .4 Center punch fan shaft to accommodate tachometer readings.
- .5 Fan Equipment: Rated and tested in accordance with AMCA 210 and AMCA 2401 for Class I service, unless otherwise specified.
- .6 Ball Bearings:
  - .1 For Forward-Curved Fans: Size for minimum life L-10 of over 80,000 hours.
  - .2 For Airfoil and Backward Inclined Fans: Size for minimum life L-10 of over 40,000 hours, with an average life L-50 of over 200,000 hours.
- .7 Drives for Belt-Driven Fans:
  - .1 Sheaves shall be capable of providing 150% of motor horsepower.
  - .2 Mount motors on adjustable motor brackets.
  - .3 Provide motors 75 kW and under with adjustable speed sheaves that allow for 20% speed variation.
  - .4 Provide belt-driven fans with cast iron or flanged steel sheaves.
- .8 Air Filters, Fans, Air Handlers, and Air Conditioners: Meet requirements of NFPA 90A and NFPA 90B.

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**AIR HANDLING**

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.9 Acoustical Levels:

- .1 Maximum allowable break-out sound pressure measured at 1.2 m away from the air handling equipment shall be limited to 80 dBA
- .2 Maximum allowable discharge sound pressure measured at 2.0 m downstream of the unit discharge shall be limited to 85 dBA

**2.2 Air Handling Equipment, MAU, AHU**

.1 Additional Requirements

- .1 Refer to Equipment schedules supplement to this section, Schematic drawings and specification Section 15900 – HVAC Instrumentation and Controls – General, for additional requirement for each Air Handling System.

.2 Unit Construction:

- .1 Unit casing shall be of minimum 16 gauge satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Finish shall be a 2 part epoxy with polyurethane topcoat, to all exposed surfaces. All unprotected metal and welds shall be factory coated.
- .2 Unit shall come complete with 22 gauge solid galvanized metal liner over all insulated areas of sidewalls and roof. Finish side of the liner that is in contact with the airstream shall be a two-part epoxy applied in the same fashion as that on the unit casing.
- .3 All units shall be internally insulated with 48 kg per cubic metre density acoustic insulation. Insulation thickness shall match wall thickness of 50mm. Insulation shall be secured with steel angles. All longitudinal insulation joints and butt ends shall be covered by a sheet metal break to prevent erosion of exposed edges. Drain pans and all floor areas shall be insulated on the underside.
- .4 All walls, roofs and floors shall be of formed construction; with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water-resistant sealant.
- .5 Units shall come complete with access doors to all components within the unit. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.
  - .1 Access doors shall be fully lined, with stainless steel piano hinges and brass pins, in welded steel frames. Doors shall be fully lined with automotive bulb gasket and nylon 6/PA6 lever type handles, operable from both sides for all units over 1.2 m high. Units 1.5 m and above in height to have three handles per door.

**AIR HANDLING**

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- .2 Whenever possible, hinged access doors to areas of negative pressure shall open out, and to areas of positive pressure shall open in. Where space constrictions require the use of outward opening doors to an area of positive pressure, a clear warning label must be affixed.
  - .3 Hinged access doors shall come complete with tie back clips.
  - .4 Door directly upstream of cooling coil and all doors downstream of cooling coil shall have thermal breaks to minimize sweating.
  - .6 Casings shall be supported on structural channel supports, designed and welded for low deflections. Integral lifting lugs shall be provided for hoisting.
  - .7 Drain pans, where required, shall be an integral part of the floor paneling, a minimum of 50 mm deep, with welded corners. Drain pans shall extend a minimum of 150 mm downstream of coil face and shall come complete with a 40 mm male NPT drain connection. Drain pans must be sloped and pitched such that there is no standing water. Intermediate drain pans shall be provided between cooling coils above 1.6 m. Drain pans shall be Type 316 stainless steel.
- .3 Fans:
- .1 Fans shall be backward inclined or airfoil design and rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall have a rust inhibiting coating. Fans shall be equipped with greaseable, self-aligning ball or roller type pillow block bearings, supported on a rigid structural steel frame. Fan scroll and wheel shall be aluminum.
  - .2 Motor, fan bearings and drive assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly, where required. Motor mounting shall be adjustable to allow for variations in belt tension.
  - .3 Belt guards on all units shall be epoxy coated.
  - .4 Fan-motor assemblies shall come complete with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor, which is welded to the structural frame of the unit. The isolators shall be vertical spring type with leveling bolts, bridge bearing waffled pads with minimum 1 in static deflection designed to achieve high isolation efficiency. Fans shall be attached to the discharge panel by a PVC coated polyester woven fabric, with a sealed double locking fabric to metal connection.
  - .5 Fan motors shall be TEFC high efficiency type, inverter duty where indicated.

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**AIR HANDLING**

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.4 Filters:

- .1 Filter sections shall come complete with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as shown on the drawings.
- .2 Filter media shall meet UL Class 2 standards.
- .3 Each filter bank shall come complete with a flush-mounted Magnahelic air filter gauge with adjustable signal flag (Dwyer Series 2000, or approved equal).
- .4 Winter-Filters, Summer Filters, Pre-Filters: 50 mm pleated panel disposable filters, non-woven reinforced cotton/poly fabric media with a metal support grid and heavy duty beverage board-enclosing frame. Permanent re-usable metal enclosing frame. The filter media shall have a MERV rating of 6 to ASHRAE Standard 52.1.
- .5 Final Filters: Rigid self-supporting extended surface disposable filters consisting of high density synthetic media, media support grid, metal contour stabilizers, metal diagonal support bracing and enclosing frame. Media shall be 3 ply, dual stage synthetic. Pre-filter layer of coarse 7 to 10  $\mu$  synthetic fibers; secondary ply of progressively structured spun bonded polypropylene fibers blended with filaments from 1 to 6.7 microns; and final ply of spun bonded polypropylene backing with strength to support filtering stages. The media shall withstand 100 percent humidity and be non-shedding. Media shall have a MERV rating of 13 to ASHRAE 52.1. Media shall be quality certified by ISO-9002.

.5 Motorized Dampers:

- .1 Supply and install motorized dampers indicated on drawings and herein described. Motorized dampers shall be of High Performance type as specified under Section 15901 - HVAC Control, Field components, and Instruments.
- .2 Motorized damper actuators shall be supplied and field mounted by the HVAC Controls Subcontractor.

.6 Coils:

- .1 Coils shall be constructed of copper tube and aluminum fin with copper headers. Fins constructed of aluminum or copper shall be rippled for maximum heat transfer and shall be mechanically bonded to the tubes by mechanical expansion of the tubes. The coils shall have a Type 316 stainless steel casing. All coils shall be factory tested with air at 2068 kPa while immersed in an illuminated water tank.
- .2 Coils shall be ARI 410 performance rated.
- .3 Headers shall be located inside of the air handler unit and arranged for counterflow between air and water. Locate supply and return connections on same side.
- .4 Coils shall be removable from the unit at the header end, unless shown otherwise on the drawings. All water coils shall be equipped with a capped vent tapping at the top of the

**AIR HANDLING**

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- return header, and a capped drain tapping at the bottom of the supply header. Coils shall be completely drainable.
- .5 Water coils shall be circuited to provide adequate tube velocities to meet design requirements. Internal turbulators are not acceptable.
  - .6 Refrigerant Superfin evaporator type coils shall be equipped with distributors connected to the coil by copper tubes. Hot gas bypass inlet shall be at the refrigerant distributor.
  - .7 Refrigerant coils shall be alternate tube circuited in order to distribute the cooling effect over the entire coil face at reduced load conditions.
  - .8 Electric resistance coils shall come complete with silicon controlled rectifier (SCR)
    - .1 SCR to have one touch self-calibration, single source connection for thermostat, dual colour LED indication lights for correct calibration and epoxy coated for dust and corrosion protection.
    - .2 SCR to be mounted in local control panel pertinent to the air handling unit.
    - .3 SCR shall supply 575v/3ph/60Hz output to the electric coil and utilize a 4-20mA signal input
    - .4 Acceptable manufacturers: P.M. Wright
- .7 Economizer Mixing Section, where applicable:
- .1 Include provisions for mixing dampers on return and outside air inlets.
  - .2 Position opposed-blade dampers across the long dimension of each air opening, with linkage arranged so corresponding outside and return air dampers move together.
  - .3 Supply and install either the combination style box, or a two-piece assembly with a vee filter box and high efficiency mixing box bolted together.
  - .4 Install damper linkage at the factory to provide minimum and maximum damper segments proportional to quantities of minimum and maximum outside air requirements.
- .8 Heat Recovery Section, where applicable:
- .1 Supply and install an air-to-air plate heat exchanger with minimum performance as shown in the schedule.
  - .2 Heat exchanger core shall be aluminum. Core shall include flow separators whenever vapour and condensate streams interact limiting the heat transfer capacity.
  - .3 Where indicated provide supply air side opposed blade face and bypass dampers with accompanying linkage and operating controls. Dampers and actuators shall be High

**AIR HANDLING**

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Performance type as specified under Section 15901 - HVAC Controls, Field Components and Instruments.

- .4 Where indicated provide factory mounted frost control system.
- .5 Frost control shall be sized such that the total air flow is unchanged in defrost mode.
- .6 HVAC Controls Subcontractor to supply and install a dedicated solid state controller complete with a control actuator that will effectively modulate the face and bypass damper to achieve the following:
  - .1 Accurate supply air temperature control
  - .2 Summer/Winter operation changeover
  - .3 Exhaust air side frost control
- .7 In conditions when the exhaust air could provide more heat than is required, the bypass damper is varied by the controller to limit heat transfer and maintain supply air set point.
- .9 DX Cooling Section, where applicable
  - .1 The DX-Cooling section shall be supplied and installed as an integral part of the air handling unit.
  - .2 All refrigerant specialties to be supplied, factory installed and tested by the manufacturer.
  - .3 Free-cooling shall be the first priority before DX-Cooling.
  - .4 Refer to Section 15730 – Unitary Air Conditioning Equipment.
- .10 Factory-Mounted Pre-Wired Controls and Field-Mounted Controls:
  - .1 Factory-mounted controls shall be pre-wired and certified by CETL. Supply and Install a single-point power connection for entire unit. Refer to Division 16 for Supply and Install of power to unit.
  - .2 All electrical circuits shall undergo a dielectric strength test, and shall be factory tested and checked as to proper function.
  - .3 Unit shall bear an ETL label with all the necessary identification marks, electrical data, and any necessary cautions as required by the National Electrical Code.
  - .4 Where indicated, Supply and Install a system of motor speed control, including all necessary terminal blocks, motor starters, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external



**AIR HANDLING**

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- control devices or relays. Supply and Install a main non-fused NEMA 4 disconnect switch for each Air Handler System.
- .5 Supply and Install a NEMA 4 control cabinet mounted on the outside of the unit casing, which shall be adequately sized to include an allocated 600mm x 600mm space for mounting the Networked DDC controller.
  - .6 All input and output interfacing points with the Networked DDC controller shall be factory terminalized with proper identification on a control strip mounted adjacent to the space allocated for the Networked DDC controls
  - .7 Where air-cooled DX-cooling section is required, the field-mounted electronic temperature control system shall have the capability of providing multiple stages of cooling control to maintain supply air temperature. The minimum run and off time for compressors shall be four (4) minutes at full load startup, and may range up to eight (8) minutes under part load conditions. The controller shall incorporate a proportional, integral control algorithm that reduces temperature drop by resetting to the set-point after each stage is cycled on.
  - .8 Where an Economizer Mixing section is required, upon an Economizer Mode enable signal from the BAS, the Factory-mounted controller shall modulate the mixing dampers to maintain supply air temperature set-point. Additional mechanical cooling shall be enable should the mixing damper is not able to satisfy the supply air temperature set-point.
  - .9 Where a hydronic heating section is required, a Field-mounted controller shall modulate the control valve output capacity, utilizing proportional and integral control algorithm to maintain supply air temperature set-point with 4 to 20 mA or 0-10 Vdc reset supplied and installed by the Building Automation System (BAS).
  - .10 Field-mounted controller shall be capable of interfacing with the BAS, all the input/output points and alarms as shown on system schematic drawings and as described in Section 15900 – HVAC Instrumentation and Controls – General.
  - .11 Supply and Install factory-mounted contacts for emergency shutdown of unit upon activation of fire alarm.
  - .12 Refer to specification Section 15901 – HVAC Control, Field Components and Instruments for specific requirements of control devices.
  - .13 Ensure that all interfacing control signals from devices and sensors are compatible with the BAS system.
  - .14 Supply and Install factory-mounted Hand-Off-Auto (HOA) switch for single speed system, Slow-Off-Fast-Auto (SOFA) switch for two-speed systems.
  - .15 Coordinate factory and field mounted controls with the HVAC Controls Subcontractor.

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**AIR HANDLING**

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.16 Supply and install factory mounted in return air stream of air handling units, smoke detector. Wire to local control panel for connection by Division 16. Refer to schedule 15999 for applicable units.

.11 Marine Lights

.1 Provide marine type lights in all sections having an access doors on all units. Lights shall be factory installed and wired to a single lighted switch located outside the supply fan access door.

.2 Wire power connection for all lights to one point for connection by Division 16.

.3 Light to be fed from a separate source so that the lights are operative even when the unit is off.

.12 Acceptable Manufacturers:

.1 Makeup Air Units: Cicul-Aire

.2 Air Handling Units: McQuay

**2.3 Accessories**

.1 Equipment Identification Plates: Provide 1.6 mm (16-gauge) stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear 9.5 mm high engraved block type black enamel filled equipment identification number and letters indicated in this Specification and as shown.

.2 Lifting Lugs: Suitably attached for equipment assemblies and components weighing over 45 kg.

**2.4 Source Quality Control**

.1 Manufacturer's Tests:

.1 Direct expansion cooling coil leak tested underwater with 2068 kPa (300 psi) air.

**3. EXECUTION**

**3.1 Installation**

.1 Pipe drain pan connection through a running trap to floor drain.

.2 Isolate sheet metal duct connections from all non-internally spring-isolated fan units or other rotating equipment.

.3 Locate units to provide access spaces required for filter changing; motor, drive, and bearing servicing; and fan shaft and coil removal.

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**AIR HANDLING**

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- .4 Inspect internal casing insulation, seal all exposed edges, and butt joints with mastic to ensure insulation will not be loosened during operation.

**3.2 Adjusting and Cleaning**

- .1 Air and Water System Balancing: as specified in Section 15950 – HVAC Systems Testing, Adjusting, and Balancing.
- .2 Lubricate nonsealed bearings prior to startup.
- .3 Do not operate units until filters are installed. If operated without filters, completely clean coils and interior of units.
- .4 Vibration:
  - .1 Statically and dynamically balance all rotating equipment.
  - .2 Perform field testing on rotating equipment to ensure there is no excessive vibration.
  - .3 If excessive vibration is experienced, rebalance equipment in-place to the satisfaction of the Contract Administrator.

**3.3 Manufacturer's Services**

- .1 Provide Manufacturer's services in conformance with the requirements of Section 01650, Equipment Installation. Manufacturers Representative shall provide support of equipment installations and field inspection of equipment before startup.
- .2 Duration of Training: The training of City's personnel shall be carried out as per Section 01664 - Training.

**3.4 Extended Warranty**

- .1 Provide Manufacturer's extended guarantee or warranty, with the City named as beneficiary, in writing for a period of two (2) years after the date of Total Performance. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General and Supplemental Conditions.

**3.5 Schedules**

- .1 Refer to Makeup Air and Air Handling Unit schedules in Section 15999 – List of Schedules for further details.

**END OF SECTION**