

Part 1 General**1.1 SUMMARY**

- .1 Section Includes:
 - .1 Materials and installation for self-contained, hot water and refrigeration packaged rooftop HVAC units.
- .2 Related Requirements
 - .1 Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
 - .2 Section 23 05 93 – Testing Adjusting and Balancing.
 - .3 Section 23 33 00 – Air Duct Accessories.
 - .4 Section 23 44 00 – HVAC Air Filtration
 - .5 Section 25 90 01 – EMCS: Site Requirements, Applications and Systems Sequences of Operations
 - .6 Section 26 29 09 – Variable Frequency Drives

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Air Conditioning and Refrigeration Institute (ARI)
 - .1 ANSI/ARI 210/240-2008, Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - .2 ARI 270-2009, Sound Rating of Outdoor Unitary Equipment.
 - .3 ANSI/UL 1995 B-1998, Standard for Heating and Cooling Equipment.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B52-13, Mechanical Refrigeration Code.
 - .2 CSA C22.1 HB-12, Canadian Electrical Code Handbook.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 National Fire Protection Association
 - .1 NFPA 90A-15, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .5 Environment Canada, (EC)/Environmental Protection Services (EPS)
 - .1 Environmental Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems SOR/2003-289.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 00 10 – General Instructions.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for packaged rooftop HVAC units.

- .3 Shop Drawings:
 - .1 Submit shop drawings to indicate project layout and dimensions; indicate:
 - .1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.
 - .2 Piping, valves, fitting shipped loose showing final location in assembly.
 - .3 Control equipment shipped loose, showing final location in assembly.
 - .4 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.
 - .5 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.
 - .6 Pump and fan performance curves.
 - .7 Details of vibration isolation.
 - .8 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.
 - .9 Type of refrigerant used.
 - .4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .6 Instructions: submit manufacturer's installation instructions.
 - .7 Manufacturer's Field Reports: manufacturer's field reports specified.
 - .8 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 00 10 – General Instructions include data as follows:
 - .1 Indicate: brief description of unit, indexed, with details of function, operation, control, and service for components.
 - .2 Provide for units, manufacturer's name, type, year, number of units, and capacity.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials outdoors and in accordance with manufacturer's recommendations in clean area.
 - .2 Store and protect RTUs from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse of pallets, crates, padding, packaging materials as specified in Section 01 00 10 - General Instructions.

1.6 WARRANTY

- .1 For the work of this Section 23 74 00 - Packaged Outdoor HVAC Equipment, the 12 months warranty period is extended to 24 months.

1.7 DESIGNATED CONTRACTOR

- .1 Controller Replacement RTU-3
 - .1 Hire the services of Aeon (through their local agent) for the services of this section pertaining to the one rooftop unit that will be retained (RTU-3) .

Part 2 Products

2.1 GENERAL

- .1 Roof mounted, self-contained unit with glycol heating coil, DX refrigeration, and bearing label of CSA, ARI, ULC.
- .2 Units to consist of cabinet and frame, supply fan, return fan (RTU-1), air filter, refrigerant cooling coil, compressor, condenser coil and fans, motorized outside air damper, motorized relief air damper, return damper, motorized mixing damper, gravity relief damper (RTU-2). RTU-1 shall have a return fan economizer. RTU-2 shall have a barometric relief economizer.
- .3 Prefabricated roof curb to conform to requirements of National Roofing Contractors Association (NRCA), minimum height 450 mm.
- .4 Conform to ANSI/ARI 210/240, rating for unit larger than 40 kW nominal.

2.2 CONTROLLER (RTU-3)

- .1 There is an existing proprietary Aeon controller presently installed in RTU-3, that is indicated to be replaced. All materials must be selected to ensure compatibility with the existing Aeon rooftop unit..

2.3 CABINET

- .1 Cabinets: weatherproofing tested and certified to AGA rain test standards and soundproofing tested to ARI 270, dbA at 3 m free field.
- .2 Air handling units shall be weatherproofed and equipped for installation outdoors. This shall include prevention of infiltration of rain and snow into the unit, louvers or hoods on air intakes and exhaust openings with 25mm galvanized inlet screens; rain gutters or diverters over all access doors; all joints caulked with a water resistant sealant, roof joints turned up 51 mm with three break interlocking design; outer wall panels extend a minimum of 6mm below the floor panel; drain traps connections for field supply and installation of drain traps.

- .3 Framing and supports: 2 mm thick welded steel, galvanized after manufacture, with lifting lugs at top of unit.
- .4 Outer casing: weathertight 1.6 mm thick galvanized steel primed with a two-part acid based etching primer. Finish coat shall be an electrostatically applied enamel, to all exposed surfaces. All unprotected metal and welds shall be factory coated, complete with flashing.
- .5 Access: gasketted hinged doors with quick lever handle type fasteners.
- .6 Insulation: neoprene coated glass fiber on surfaces 51 mm thick, 24 kg/m³ density.

2.4 ARRANGEMENT

- .1 RTU-2 to be arranged with side discharge and side return to match existing ductwork connections. The use of a side discharge/return through a curb will not be acceptable.
- .2 RTU-1 to be arranged with bottom supply and return.

2.5 FANS

- .1 Centrifugal, forward curved impellers, statically and dynamically balanced. V-belt drive with adjustable variable pitch motor pulley, fan and motor integrally mounted on isolation base, separated from unit casing with flexible connections and spring isolators. Vibration isolators: 95% efficiency.
- .2 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 be provided with a rust inhibiting coating.
- .3 Forward curved fan assemblies shall be equipped with greaseable pillow block bearings, supported on a rigid structural steel frame. Provide single extended grease line from far side to access side bearing.
- .4 RTU-2 shall have a FC SWSI fan arrangement.
- .5 Provide return air fans as scheduled. The use of power exhaust fan arrangements will not be considered for RTU-1.
- .6 Provide compliant belt guards on all units with walk in sections over 60" (1524 mm) high.
- .7 Fans shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.

2.6 VARIABLE VOLUME DEVICES

- .1 Variable speed drives to be provided:
 - .1 RTU-1:
 - .1 On supply fan
 - .2 On return fan
 - .3 Include with line and load side reactors
 - .4 Include TVSS
 - .5 Include bypass

- .2 RTU-2:
 - .1 On supply fan
 - .2 Include with line and load side reactors
 - .3 Include TVSS
 - .4 Include bypass
- .2 To Section 26 29 09 – Variable Frequency Drives.

2.7 **FILTER BOX**

- .1 Material to match casing. For flat type filter arrangement.
 - .1 Provide access to filter through hinged door with suitable hardware.
 - .2 Provide blank-off plates and gaskets to prevent air bypass.

2.8 **AIR FILTERS**

- .1 In accordance with Section 23 44 00 - HVAC Air Filtration.
- .2 Pre filter: MERV 8.
- .3 Final Filter: MERV 14.

2.9 **MULTI-LEAF DAMPERS**

- .1 Opposed blade type for relief and outdoor air, parallel blade type for mixing.
- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Actuator: factory installed by RTU manufacturer, factory wired to a terminal strip within the RTU, signal 4-20 mA or 0-10 VDC, weather-proof enclosure.
- .6 Performance:
 - .1 Leakage: in closed position less than 2% of rated air flow at 250 Pa differential across damper.
 - .2 Pressure drop: at full open position less than 20 Pa differential across damper at 150 m/s.
- .7 Insulated aluminum dampers:
 - .1 Outdoor air and relief dampers: thermally insulated.
 - .2 Frames: insulated with extruded polystyrene foam with RSI 0.88.
 - .3 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.
 - .4 General: single unit consisting of dampers, blender, mixing section, with provision for floor mounting.
 - .5 Construction: steel, with duct connection flanges, reinforced for rigidity, finished with zinc coating.

2.10 CONTROLS

- .1 Include factory-mounted discharge air temperature controller with the following features as a minimum:
 - .1 Ability to control discharge air temperature in three modes:
 - .1 Heating
 - .2 Cooling
 - .3 Economizer
 - .2 Ability to automatically transition between these modes using logic based on prevailing and preceding conditions.
 - .3 Ability to provide dehumidification control.
 - .4 Ability to reset discharge air temperature in either heating or cooling based on an externally applied analog signal (0-10 VDC).
 - .5 Mechanical cooling shall be disabled below an adjustable low ambient temperature set point.
 - .6 Ability to disable cooling by a remote binary input contact.
 - .7 Heating shall be disabled above an adjustable ambient temperature set point.
 - .8 Ability to disable heating by a remote binary input contact.
- .2 Damper actuators (as described previously), factory mounted and pre-wired to a terminal strip (RTU-1, RTU-2).
- .3 Air flow measuring station (RTU-1 return fan):
 - .1 Fan inlet airflow measuring probe:
 - .1 Wetted Materials: aluminum with clear anodized finish.
 - .2 Accuracy: $\pm 2\%$.
 - .3 Max. Temperature: 400°F (204°C).
 - .4 Minimum Design Flow: 2.03 m/sec.
 - .5 Maximum Design Flow: 60.96 m/sec.
 - .6 Process Connections: 1/4 NPT female.
 - .7 Factory-mounted on fan inlet bell.
 - .2 Differential pressure transmitter:
 - .1 4-20 mA output.
 - .2 Selectable range pre-configured for fan and probe.
 - .3 Panel mount, with LCD read-out
 - .4 Factory mounted and pre-wired to a terminal strip.
- .4 Freeze-stat (RTU-1, RTU-2):
 - .1 Adjustable, set to 5 C.
 - .2 Dry contact output, NC contact for BMS alarm connection
 - .3 Locate bulb downstream of glycol coil
- .5 Mixing plenum differential pressure transmitter (RTU-1):
 - .1 4-20 mA output.
 - .2 0-25 Pa.
 - .3 Panel mount, with LCD read-out
 - .4 Factory mounted and pre-wired to a terminal strip.

- .5 Sensing lines to be run in copper, securely fastened in place, with the positive pressure sensing leg terminated in the return fan discharge side of the mixing box, and the negative pressure sensing leg terminated in the supply fan suction side of the mixing box.

2.11 HOT WATER COIL

- .1 Coils shall be constructed of copper tube, aluminum fin, and copper headers with schedule 40 steel pipe connectors.
- .2 The coils shall have a galvanized steel casing. All coils shall be factory tested with air at 2070 kPa while immersed in an illuminated water tank.
- .3 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 return header or connection, and a capped drain tapping at the bottom of the supply header or connection.
- .4 Outdoor units with glycol coils shall be provided with a fully insulated and weatherproofed piping vestibule to allow for the entry of piping from the building into the air-handling unit, and for connection to the coil.

2.12 REFRIGERATION

- .1 Conform to CSA B52 and ANSI/UL 1995 requirements.
- .2 Compressor/Condenser Section:
 - .1 Hermetic compressors, vibration isolated with flexible suction and discharge connections, oil sight glass, oil pressure switch, crankcase heater, and automatic pump down system with control to liquid line solenoid valve.
 - .2 Fans: propeller type with single piece spun venturi outlets and zinc plated guards. Motors: sequenced for head pressure control.
 - .3 Electrical system: complete with operating controls, oil and refrigerant pressure protection, motor overload protection, weatherproof electrical wiring with weatherproof, rain tight disconnect.
 - .4 Include refrigerant piping with automatic hot gas bypass, sight glass, filter and valves.
 - .5 Condenser: staggered copper tube aluminum fin coil assembly with sub-cooling rows to provide 8 degrees C sub-cooling.
 - .6 Capacity reduction: hot gas bypass. Provide fan control for head control for low ambient operation down to 10 degrees C ambient temperature.
 - .7 Refrigerant: R-410.
- .3 Evaporator:
 - .1 Rated to ANSI/ARI 210/240.
 - .2 Coil: seamless copper tubes expanded into aluminum fins, 4 rows with 12 fins per 25 mm, and insulated condensation pan.
 - .3 Cooling coil condensate drain pans: designed to avoid standing water, easily cleaned or removable for cleaning. Drain connection: deep seal trap complete with trap seal primer.

- .4 Minimum Staging Required:
 - .1 RTU-1:
 - .1 4 independently circuited compressors, hot gas bypass on lead compressor. Tandem-circuited compressors are unacceptable.
 - .2 RTU-2:
 - .1 3 independently circuited compressors, hot gas bypass on lead compressor. Tandem-circuited compressors are unacceptable.

2.13 CAPACITY

- .1 As indicated.

2.14 ROOF CURB

- .1 Provide full perimeter seismic roof mounting curb of heavy gauge sheet metal, minimum of 305mm high, and complete with wood nailer, neoprene sealing strip, and fully welded "Z" bar with 25mm upturn on inner perimeter, to provide a complete seal against the elements.
- .2 New roof curb must match the bearing dimensions of existing roof curb. No alteration of the roof framing will be allowed.
- .3 New roof curb must match the main duct riser dimensions of existing ducts. No alteration of the roof framing and duct openings not offsetting of main duct connections will be allowed.
- .4 The piping vestibule shall also be part of the unit curb.

Part 3 Execution

3.1 COMPLIANCE

- .1 Environmental Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems SOR/2003-289.

3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.3 INSTALLATION

- .1 Install as per manufacturers' instructions on roof curbs provided by manufacturer as indicated.
- .2 Manufacturer to certify installation, supervise start-up and commission unit.
- .3 Run drain line from cooling coil condensate drain pan to discharge over roof drain.

3.4 ROOF CURB

- .1 Fasten curb to steel deck to meet seismic requirements of the NBC.
- .2 Curb to cover existing roof openings. External insulation and flashing of the roof-mounting curb shall be provided by the Roofing Subcontractor.

3.5 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.
 - .2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.
 - .3 Schedule site visits to review work at stages listed:
 - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of work at 25% and 60% complete.
 - .3 Upon completion of work, after cleaning is carried out.
- .2 Obtain reports within 3 days of review and submit immediately to Departmental Representative.
- .3 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.
- .4 Verify accessibility, cleanability, drainage of drain pans for coils, humidifiers.
- .5 Performance Verification:
 - .1 General:
 - .1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems, supplemented as specified herein.
 - .2 Rooftop Air Handling Units:
 - .1 Set zone mixing dampers for full cooling, except that where diversity factor forms part of design set that % of zone dampers to full heating.
 - .2 Set outside air and return air dampers for minimum outside air.
 - .3 Check for smooth, vibration less correct rotation of supply fan impeller.
 - .4 Measure supply fan capacity.
 - .5 Adjust impeller speed as necessary and repeat measurement of fan capacity.
 - .6 Measure pressure drop of each component of air handling unit.
 - .7 Set outside air and return air dampers for the % of outside air required by design and repeat measurements of fan capacity.
 - .8 OAD: verify for proper stroking, interlock with RAD.
 - .9 Measure DBT, WBT of SA, RA, EA.
 - .10 Measure air cooled condenser discharge DBT.
 - .11 Measure flow rates (minimum and maximum) of SA, RA, EA, relief air.
 - .12 Simulate maximum cooling load and measure refrigerant hot gas and suction temperatures and pressures.
 - .13 Measure radiated and discharge sound power levels under maximum heating demand and under maximum cooling demand with compressors running.

- .14 Verify operating control strategies, including:
 - .1 Freeze protection.
 - .2 Economizer cycle operation, temperature of change-over.
 - .3 Alarms.
- .15 Measure return fan capacity.
- .16 Adjust impeller speed as necessary and repeat measurement of return fan capacity.
- .3 Start-Up:
 - .1 General: in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .4 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.
- .5 Verify accessibility, cleaning ability, drainage of drain pans for coils, humidifiers.
- .6 Commissioning Reports:
 - .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports supplemented as specified herein. Include:
 - .1 Report forms as specified Section 01 91 13 - General Commissioning (Cx) Requirements: Report Forms and Schematics.

3.6 DEMONSTRATION

- .1 Training: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O M Personnel, supplemented as specified.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 00 10 – General Instructions.
 - .1 Leave work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 00 10 – General Instructions.

END OF SECTION