

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute (ANSI/AHRI)
  - .1 ANSI/AHRI 210/240-08, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
- .2 CSA Group
  - .1 CSA B52-05, Mechanical Refrigeration Code.
  - .2 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for specified equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 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 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 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .6 Manufacturer's Field Reports:
  - .1 Submit manufacturer's field reports specified.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for specified equipment for incorporation into manual.
  - .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 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 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 and protect outdoor HVAC equipment from nicks, scratches, and blemishes.
  - .2 Replace defective or damaged materials with new.

**1.5 WARRANTY**

- .1 For Work of this Section 23 74 00- Packaged Outdoor HVAC Equipment, 12 months warranty period is extended to 60 months for heat exchangers, compressors, controllers, motors, dampers, and actuators. All other components shall have a warranty period of 24 months.
- .2 Contractor hereby warrants that packaged rooftop HVAC units and refrigeration compressors will function and operate in accordance with CCDC 2 GC 24, but for 60 months.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Roof mounted, self-contained single zone or multizone unit as scheduled with gas burner and DX refrigeration and bear label of CSA and CGA.
- .2 Units to consist of cabinet and frame, supply fan, return fan where specified, burner with integral induced draft fan, air filter, refrigerant cooling coil, compressor(s), condenser coil and fans, motorized outside air damper, return damper, hot and cold decks, and zone control dampers where specified (multi-zone units). Zone control damper actuators shall be supplied by Controls Contractor. Air handling unit manufacturer shall coordinate torque requirements with Controls Contractor to allow for properly sized actuators. All other unit actuators supplied by unit manufacturer.
- .3 Unit shall re-use existing roof curb where replacing existing unit. Contractor shall verify exact dimensions prior to order to determine if transitional curb component is required. For new units not replacing an existing unit, it shall be supplied with a prefabricated roof curb to conform to the requirements of National Roofing Contractors Association (NRCA), minimum height of 450mm.
- .4 Conform to ANSI/AHRI 210/240, rating for unit larger than 40 kW nominal.
- .5 Units must conform to regulations set out in the Canadian Energy Efficiency Act for large air conditioners, as applicable. Packaged units shall be tested to CSA Standard C746-98 and must bear an energy efficiency verification label provided by CSA.

### **2.2 CABINET**

- .1 Air handling units shall be weatherproofed and equipped for installation outdoors. This shall generally include for the prevention of infiltration of rain and snow into the unit. Air intakes and discharges shall come complete with 25mm x 25mm galvanized screens. Rain gutters or diverters shall be installed above all access doors. Caulk all joints with a water resistant sealant.
- .2 Framing and supports: 2 mm thick welded steel, galvanized after manufacture, with lifting lugs.
- .3 Outer casing: weathertight 18 gauge thick galvanized steel with baked enamel finish. All unprotected metal and welds shall be factory coated.
- .4 Access: gasketed hinged doors with locking door handle type fasteners. Access doors shall be fully lined.
- .5 Units shall come equipped with access doors to the following components where applicable: fans and motors, dampers and operators, electrical control panels, burner compressor compartments, filters, cooling coils. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.
- .6 Insulation: internal, 50mm thick, 48kg/cu.m. density acoustic insulation. Insulation to be secured with steel angles. All longitudinal insulation joints and butt ends

shall be covered by sheet metal to prevent erosion of exposed edges. Drain pans and all floor areas shall be insulated on the underside.

- .7 24 gauge perforated liner (40% free area) shall be installed over insulation in following areas (where applicable): fan sections, filter sections, access sections. 22 gauge solid liner shall be installed over insulation in following areas (where applicable): coil sections, underside of unit.

### **2.3 FANS**

- .1 Centrifugal, forward curved impellers, statically and dynamically balanced. 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 Fan motors shall be open drip proof, super-E high efficiency.
- .3 All forward curved fan assemblies shall be equipped with greaseable pillowblock bearings, supported on a rigid structural steel frame.

### **2.4 AIR FILTERS**

- .1 50mm thick, MERV 13, replaceable media.
- .2 To meet NFPA 90A, air filter requirements type Class 2.
- .3 Where filters are provided in air handling units for make-up air applications and where hoar frost may occur, only steel frame filters are acceptable.
- .4 Provide filters bank with air filter gauge capable of remote alarming. Provide complete with static pressure taps and aluminum tubing, all factory installed. Mount inside of a weatherproof enclosure with viewing window.

### **2.5 HEAT EXCHANGERS AND BURNERS**

- .1 Natural gas fired, multiple flue passes, with primary heating surface of titanium stainless steel.
  - .1 Gas burner: factory mounted, wired and fire tested complete with operating and safety controls.
  - .2 Blow through positive pressure.
  - .3 Spark ignited pilot with interrupted pilot flame safety shut-off.
- .2 Units with heat exchangers shall be tested and certified to ANSI/CSA standards to provide a minimum of 80% efficiency throughout entire operating range as required by ASHRAE 90.1.
- .3 Gas fired multi-zone sections shall incorporate the high efficiency heat exchanger and high turndown burner design. The multi-zone head shall be constructed of hot and cold decks arranged in a blow-through configuration. The use of draw-through cooling with re-heating of cooled air to meet zone heat demands is not acceptable.
- .4 The heat exchanger/burner assembly shall include 15:1 turndown for input ranges form 100-1400 MBH.

- .5 Combustion air motor speed shall vary proportionally in response to the modulation of gas flow to provide optimum fuel/air mixture and efficiency at all conditions. Two speed or step speed combustion air blowers are not acceptable.

## **2.6 REFRIGERATION**

- .1 Conform to CSA B52 and UL 1995 requirements, along with Environment Canada Federal Halocarbon Regulations (2003).
- .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: direct driven propeller type arranged for vertical draw-through airflow. Motors shall be weather resistant type.
  - .3 Condenser to form integral part of unit.
  - .4 Electrical system: complete with operating controls, oil and refrigerant pressure protection, motor overload protection, weatherproof electrical wiring with weatherproof disconnect.
  - .5 A minimum of three compressors shall be used for all VAV or multi-zone air handling units.
  - .6 Include refrigerant piping with automatic hot gas bypass, sight glass, filter and valves.
  - .7 Refrigerant: R-410A.
- .3 Evaporator:
  - .1 Rated to ANSI/AHRI 210/240.
  - .2 Thermostatic expansion valve, with external equalizer.
  - .3 Coil: staggered seamless copper tubes expanded into aluminum fins, sized appropriately for design load.
  - .4 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.

## **2.7 CONTROLS**

- .1 Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors, and terminals for the connection of external control devices or relays. Gas fired units shall also include high limit and combustion airflow switch.
- .2 Factory installed and wired non-fused disconnect switch.
- .3 Automatic controls shall be housed in a control panel mounted in or on the air handling unit.

- .4 Provide a discharge air low limit equipped with an automatic bypass time delay to allow for cold weather start-up. On a heating system failure, this device will shut down the fan and close the outdoor air damper.
- .5 Air handling unit controller must be capable of controlling cooling and economizing on the cold deck while simultaneously controlling heating on the hot deck.
- .6 Air handling units are replacing existing units. As such, it is expected that the new units will operate in the same manner as the existing units. The following control sequencing shall be confirmed to suit the existing system.
- .7 Multi-Zone Heat-Cool Unit:
  - .1 Remote solid state electronic control panel containing "on-off" "summer-winter" selector switches with "heat" "cool" "fan" indicating lights. Selector switch control by DDC at BMS.
  - .2 Hot deck temperature: maintained by modulating, outdoor reset controller such that hot deck temperature increases as outdoor air temperature decreases.
  - .3 Cold deck temperature: at "summer" position, maintained by cold deck thermostat operating liquid line solenoid valves as required, with compressor lockout at 14 degrees C, restart 17 degrees C.
  - .4 Freeze protection control: wired in cold deck control circuit to guard against coil frosting and low air flow, with shut off by differential pressure switch or low temperature.
  - .5 Cooling capacity control: provided by hot gas bypass valve modulating to maintain constant suction temperature.
  - .6 Existing modulating zone thermostats controlling modulating zone damper operators shall maintain zone temperatures.
- .8 Single Zone Heat-Cool Unit:
  - .1 Existing low voltage, adjustable room thermostat controls heater stages in sequence with delay between stages, or compressor, to maintain room temperature setting.
- .9 Night mode: unit cycles as unit heater with 100% recirculation on winter or summer cycles.

## **2.8 REMOTE PANEL**

- .1 Provide remote readout panel for each unit containing:
  - .1 Signal lights indicating system status, heating system failure cooling system failure and dirty filters.
  - .2 Check switches proving signal light operation.
  - .3 System on-off switch cooling system on-off switch.
- .2 Provide gauges in remote panel indicating outside air, mixed air, return air and discharge air temperatures for each deck before heat exchangers.

## **2.9 TRANSITION CURB**

- .1 Where required, provide full perimeter roof mounting curb of heavy gauge sheet metal, minimum of 450mm 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. Contractor shall provide and install external insulation and flashing on the transition curb on site.

## **2.10 CAPACITY**

- .1 As indicated.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for outdoor HVAC equipment installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### **3.2 INSTALLATION**

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

### **3.3 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 Upon completion of work, after cleaning is carried out.
- .2 Obtain reports within 3 days of review and submit to Departmental Representative.
- .3 Performance Verification:
  - .1 Rooftop Air Handling Units:
    - .1 Set zone mixing dampers for full cooling, except that where diversity factor forms part of design set that percentage of zone dampers to full heating.
    - .2 Set outside air and return air dampers for minimum outside air.
    - .3 Set face and bypass dampers so face dampers are fully open and bypass dampers are fully closed.
    - .4 Check for smooth, vibration-less correct rotation of supply fan impeller.
    - .5 Measure supply fan capacity.
    - .6 Adjust impeller speed as necessary and repeat measurement of fan capacity.
    - .7 Measure pressure drop each component of air handling unit.
    - .8 Set outside air and return air dampers for the percentage of outside air required by design and repeat measurements of fan capacity.
    - .9 Reduce differences between fan capacity at minimum and maximum outside air less than 5%.
    - .10 Set face and bypass dampers to full bypass and repeat measurement of fan capacity.
    - .11 Reduce difference between fan capacity with F&BPD fully closed to bypass and fully open to bypass to less than 5%.
    - .12 Reduce difference between fan capacity at full cooling and fan capacity at full heating to less than 5%.
    - .13 OAD: verify for proper stroking, interlock with RAD.
    - .14 Measure DBT, WBT of SA, RA, EA.
    - .15 Measure air cooled condenser discharge DBT.
    - .16 Measure flow rates (minimum and maximum) of SA, RA, EA, relief air.
    - .17 Simulate maximum cooling load and measure refrigerant hot gas and suction temperatures and pressures.
    - .18 Use smoke test to verify no short-circuiting of EA, relief air to outside air intake or to condenser intake.
    - .19 Simulate maximum heating load and:
      - .1 Verify temperature rise across heat exchanger.
      - .2 Perform flue gas analysis. Adjust for peak efficiency.
      - .3 Verify combustion air flow to heat exchanger.
      - .4 Simulate minimum heating load and repeat measurements.

- .20 Verify operating control strategies, including:
  - .1 Heat exchanger operating and high limit.
  - .2 Early morning warm-up cycle.
  - .3 Freeze protection.
  - .4 Economizer cycle operation, temperature of change-over.
  - .5 Alarms.
  - .6 Voltage drop across thermostat wiring.
  - .7 Operation of remote panel including pilot lights, failure modes.
- .21 Measure leakage past zone mixing dampers by taking temperature measurements. Reduce leakage to less than 5%.
- .22 Measure return fan capacity.
- .23 Adjust impeller speed as necessary and repeat measurement of return fan capacity.
- .24 Check capacity of heating unit.
- .25 Refer to other sections of these specifications for PV procedures for other components.
- .2 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.
- .3 Verify accessibility, clean ability, drainage of drain pans for coils, humidifiers.
- .4 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.

### 3.4 DEMONSTRATION

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

### 3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.
  - .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 74 11- Cleaning.
- .3 Perform cleaning operations in accordance with manufacturer's recommendations.

**END OF SECTION**