

## **SECTION 23 77 30 - VARIABLE REFRIGERANT SYSTEM**

### **PART 1 - GENERAL**

#### **1.1 QUALITY ASSURANCE**

- A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995/CAN/CSA-C22.2 No. 236-05 (R2009) – Heating and Cooling Equipment and bear the Listed Mark.
- B. All wiring shall be in accordance with the National Electric Code (NEC)/Canadian Electrical Code (CEC).
- C. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
- D. The outdoor unit will be factory charged with R-410A.
- E. Mechanical equipment for wind-born debris regions shall be designed in accordance with ASCE 7-2010 and installed to resist the wind pressures on the equipment and the supports.

#### **2.1 WARRANTY**

- A. Manufacturer shall warrant to the customer that products (the “Products”) will be free from defects in material or workmanship. This warranty applies to parts only and is limited in duration to one (1) year from the earlier to occur of (a) the date of original installation, whether or not actual use begins on that date, or (b) eighteen (18) months from the date of shipment. Repaired or replacement parts are warranted for the balance of the warranty period applicable to the original part following the date on which the repaired or replacement part is provided to the Customer.

#### **2.2 EXTENDED WARRANTY**

- A. For its compressors only, manufacturer shall provide the above warranty (which is applicable to parts only) for a seven (7) year period. This extended warranty for compressors is limited in duration to seven (7) years from the earlier to occur of (a) the date of original installation, whether or not actual use begins on that date, or (b) eighteen (18) months from the date of shipment and applies to the compressor and compressor parts only. The effective date of this extended warranty shall be established as above.

#### **2.3 INSTALLATION REQUIREMENTS**

- A. The system must be installed by a factory trained contractor/dealer. The bidders shall be required to submit training certification proof with bid documents. The mechanical contractor's installation price shall be based on the systems installation requirements. The mechanical contractor bids with complete knowledge of the HVAC system requirements. Untrained contractors who wish to bid this project shall contact vendor to arrange training prior to bid day.

## PART 2 – PRODUCTS

### 4.1 CONCEALED CEILING DUCTED UNIT

- A. General: Indoor unit shall be a built-in ceiling concealed fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, direct-drive DC (ECM) type fan with auto CFM adjustment at commissioning, for installation into the ceiling cavity. It is constructed of a galvanized steel casing. It shall be a horizontal discharge air with horizontal return air configuration. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with remote control. Included as standard equipment, a condensate drain pan and drain pump kit that pumps 16" of vertical head minimum. The indoor unit's sound pressure shall be a maximum of 40 dB(A) at low speed measured 5 feet below the ducted unit.
- B. Indoor Unit:
1. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall be equipped with automatically adjusting external static pressure logic that is selectable during commissioning. This adjusts the airflow based on the installed external static pressure.
  2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
  3. Both refrigerant lines shall be insulated from the outdoor unit.
  4. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 16" of lift from the center of the drain outlet and has a built in safety shutoff and alarm.
  5. The indoor units shall be equipped with a return air thermistor.
- C. Unit Cabinet:
1. The cabinet shall be located into the ceiling and ducted to the supply, and return openings if applicable.
  2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

D. Fan:

1. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
2. The unit shall be equipment with automatically adjusting external static pressure logic selectable during commissioning.
3. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a maximum motor output of 0.47 HP.
4. The airflow rate shall be available in three settings.
5. The fan motor shall be thermally protected.
6. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.

E. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall have a maximum of 13 fpi.
3. The refrigerant connections shall be flare connections.
4. A condensate pan shall be located under the coil.
5. A condensate pump with a minimum 16" lift shall be located below the coil in the condensate pan with a built in safety alarm.
6. A thermistor will be located on the liquid and gas line.

F. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

G. Control:

1. Provide remote "in-room" sensor kit. Sensor shall be wall mounted, hard wired remote sensor kit.

H. Provide the following options:

1. A emergency electric heating coil.

2. Condensate pump

**4.2 WALL MOUNTED UNIT**

- A. General: Indoor unit shall be a wall mounted fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, direct-drive DC (ECM) type fan with auto CFM adjustment at commissioning, for installation into the ceiling cavity. It is constructed of a galvanized steel casing. It shall be a horizontal discharge air with horizontal return air configuration. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with remote control. The indoor unit's sound pressure shall be a maximum of 40 dB(A) at low speed measured 5 feet below the ducted unit.
- B. Indoor Unit:
1. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall be equipped with automatically adjusting external static pressure logic that is selectable during commissioning. This adjusts the airflow based on the installed external static pressure.
  2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
  3. Both refrigerant lines shall be insulated from the outdoor unit.
  4. The indoor units shall be equipped with a condensate pan.
  5. The indoor units shall be equipped with a return air thermistor.
- C. Unit Cabinet:
1. The cabinet shall be affixed to a factory supplied wall mounting template and located in the conditioned space.
  2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
- D. Fan:
1. The fan shall be a direct-drive fan, statically and dynamically balanced impeller with high and low fan speeds available.
  2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a maximum motor output 0.07 HP.

3. The airflow rate shall be available in high and low settings.
4. The fan motor shall be thermally protected.

E. Coil:

1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be a copper evaporator coil with a maximum of 14 fpi design completely factory tested.
3. The refrigerant connections shall be flare connections.
4. A thermistor will be located on the liquid and gas line.
5. A condensate pan shall be located in the unit.

F. Electrical:

1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

G. Control:

1. Provide remote "in-room" sensor kit. Sensor shall be wall mounted, hard wired remote sensor kit.

H. Provide the following options:

1. Condensate pump.

4.3 4 WAY CEILING CASSETTE UNIT (2'x2')

- A. General: Indoor unit shall be a ceiling cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity equipped with an air panel grill. It shall be a four-way air distribution type, white, impact resistant with a washable decoration panel. The supply air is distributed via motorized louvers which can be horizontally and vertically adjusted from 0° to 90°. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature. The indoor unit's sound pressure shall be a maximum of 40 dB(A) at low speed measured at 5 feet below the unit.

B. Indoor Unit:

1. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. The 4-way supply air flow can be field modified to 3-way and 2-way airflow to accommodate various installation configurations including corner installations.
5. Return air shall be through the concentric panel, which includes a resin net, mold resistant, antibacterial filter.
6. The indoor units shall be equipped with a condensate pan with antibacterial treatment and condensate pump. The condensate pump shall provide a minimum of 21" of lift and have a built in safety shutoff and alarm.
7. The indoor units shall be equipped with a return air thermistor.
8. All electrical components shall be accessible through the face panel.

C. Unit Cabinet:

1. The airflow of the unit shall have the ability to shut down one or two sides allowing for simpler corner spaces.
2. Fresh air intake shall be possible by way of direct duct installation to the side of the indoor unit cabinet.
3. A branch duct knockout shall exist for branch ducting of supply air.
4. The cabinet shall be constructed with sound absorbing insulation.

D. Fan:

1. The fan shall be direct-drive with statically and dynamically balanced impeller with three fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a maximum motor output of 0.18 HP.
3. The airflow rate shall be available in high and low settings.
4. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.

5. The fan motor shall be thermally protected.
- E. Filter:
1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.
- F. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
  2. The coil shall be a copper evaporator coil with a maximum 17 FPI design completely factory tested.
  3. The refrigerant connections shall be flare connections.
  4. A condensate pan with antibacterial treatment shall be located under the coil.
  5. A condensate pump with a minimum 18 inch lift shall be located below the coil in the condensate pan with a built in safety alarm.
  6. A thermistor will be located on the liquid and gas line.
- G. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
  2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
  3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.
- H. Control:
1. Provide remote "in-room" sensor kit. Sensor shall be wall mounted, hard wired remote sensor kit.

#### **4.4 AIR-COOLED OUTDOOR UNIT**

- A. The variable capacity, heat recovery air conditioning system shall be a variable refrigerant system as specified. The system may consist of multiple evaporators, branch selector boxes, piping, joints, headers, and a three pipe refrigeration distribution system. The condenser shall be a direct expansion (DX), air-cooled heat recovery, multi-zone air-conditioning system with variable speed compressors using R-410A refrigerant. All zones are each capable of operating separately with individual temperature control.

- B. Operation of the system shall permit either individual cooling or heating of each indoor unit simultaneously or all of the indoor units associated with each branch of the cool/heat selector box.
- C. Defrost Heating – Each system shall maintain continuous heating during defrost operation.
- D. Oil Return Heating – Each system shall maintain continuous heating during oil return operation.
- E. Low Ambient Cooling – Each system shall be capable of low ambient cooling operation to -4°F DB.
- F. Operating Range
  - 1. The operating range in cooling will be (-4°F) 23°F DB ~ 122°F DB.
  - 2. Each system as standard shall be capable of onsite reprogramming to allow low ambient cooling operation to -4°F DB.
  - 3. The operating range in heating will be -14°F DB – 77°F DB / -14°F WB – 60°F WB. Simultaneous cooling/heating operating range will be (-4°F) 23°F WB ~ 60°F WB.
  - 4. Cooling mode indoor room temperature range will be 57°F-77°F WB.
  - 5. Heating mode indoor room temperature range will be 59°F-80°F DB.
- G. General:
  - 1. The condensing unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator. High/low pressure gas line, liquid and suction lines must be individually insulated between the condensing and indoor units.
  - 2. The condensing unit shall be capable of operating automatically at reduced noise during night time.
  - 3. The system will automatically restart operation after a power failure and will not cause any settings to be lost.
  - 4. The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
  - 5. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload

protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.

6. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.
7. Oil recovery cycle shall be automatic. Each system shall maintain continuous heating during oil return operation.
8. The condensing unit shall be capable of heating operation at -14°F dry bulb ambient temperature without additional low ambient controls or an auxiliary heat source.
9. The system shall continue to provide heat to the indoor units in heating operation while in the defrost mode.

B. Unit Cabinet:

1. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.

C. Fan:

1. The condensing unit shall consist of one or more propeller type, direct-drive fan motors that have multiple speed operation via a DC (digitally commutating) inverter.
2. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type.
3. The fan motor shall be provided with a fan guard to prevent contact with moving parts.
4. Night setback control of the fan motor for low noise operation by way of automatically limiting the maximum speed shall be a standard feature.

D. Condenser Coil:

1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The heat exchanger on the condensing units shall be manufactured from seamless copper tube.

E. Compressor:

1. The inverter scroll compressors shall be variable speed controlled.
2. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.

3. Oil separators shall be standard with the equipment together with an intelligent oil management system.
4. The compressor shall be spring mounted to avoid the transmission of vibration.

#### **4.2 BRANCH SELECTOR BOX FOR HEAT RECOVERY SYSTEM**

A. General:

1. The selector boxes shall be factory assembled, wired, and piped.

B. Unit Cabinet:

1. The units shall have a galvanized steel plate casing.
2. Each cabinet shall house multiple electronic expansion valves for refrigerant control per branch.
3. The cabinet shall contain one subcooling heat exchanger per branch.
4. The unit shall have sound absorption thermal insulation.

C. Refrigerant Valves:

1. The unit shall be furnished with multiple electronic expansion valves per branch to control the direction of refrigerant flow.
2. The refrigerant connections shall be brazed.
3. Multiple indoor units may be connected to a branch selector box provided they are within the capacity range of the branch selector.

D. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
2. The unit shall be capable of operation within the limits of 187 volts to 255 volts.
3. The minimum circuit amps (MCA) shall be 0.1 and the maximum overcurrent protection amps (MOP) shall be 15.
4. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded 2 conductor cable.

#### **4.5 I-TOUCH CONTROLLER:**

- A. Provide head end I-Touch controller for integration of the entire VRF system and the roof mounted heat recovery unit.

#### **4.6 DESIGN EQUIPMENT**

- A. Daikin

#### **4.7 ACCEPTABLE MAKE**

- A. Daikin, LG, Samsung, Hitachi

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