# SECTION 23 80 00 - Terminal HVAC Equipment

## PART 1 GENERAL

1.01 DESCRIPTION

A. Provide Heating, Cooling, and Ventilating Equipment as specified herein and shown on the Drawings.

B. Equipment capacity and size shall be as indicated on the Drawings.

C. Related Work: The requirements of Section 23 05 00, Common HVAC Materials and Methods, also apply to this section.

1.02 QUALITY ASSURANCE

A. Air Handling Equipment: Rated in accordance with AMCA certified rating procedures and AMCA labeled.

B. Air Conditioning and Refrigeration Equipment Rating: Rated in accordance with ARI certified rating procedures and ARI labeled.

C. Gas-fired Equipment: Design certified by American Gas Association.

1.03 SUBMITTALS

A. Submit catalog data, construction details and performance characteristics for each HVAC unit.

B. Submit operating and maintenance data.

## PART 2 PRODUCTS

2.01 terminal heating equipment

A. Wall mounted electric fan forced heaters: UL listed recessed heater with primary and secondary thermal safeties with secondary manual reset, nichrome heating element, recessed wall can, two stage centrifugal blower, and powder coat metal grille. Provide with remote 2-pole thermostat. Cadet C series, Qmark, Markel, King approved.

B. Wall mounted Cove Heaters: UL Listed radiant cove heater. King KCV, or equal.

2.02 ductless split system terminal HVAC equipment

A. Indoor Section: Compact fan coil unit designed for wall, ceiling, recessed ceiling, or low profile concealed ducted mounting. Quantity, style, and capacity as listed on the drawings. Multispeed direct drive fan with air filter. Provide with wired thermostat and condensate pump as indicated.

B. Outdoor Section: Capacity matched with indoor section(s), steel cabinet with hermetically sealed inverter driven compressor(s), accumulator, crankcase heater, high and low pressure switches, restart delay relay, condenser coil, and propeller fans. Low ambient operation to 20 degrees. Single or multiple circuit as indicated. Cooling only or heat pump as indicated on the Drawings. Provide preinsulated lineset for each indoor unit.

C. Acceptable Manufacturers: Mitsubishi, Daikin, Carrier or approved.

2.03 OUTDOOR UNIT-Ducted Fan Coil & Heat Pump

A. General: The outdoor condensing unit is designed specifically for use with matched capacity (e.g. RZR24PVJU8/FBQ24PVJU) SkyAir series indoor evaporator units.

1. The outdoor 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 a Daikin swing compressor, motors, fan, condenser coil, electronic expansion valves, solenoid valves, 4 way valve, distribution headers, capillaries, filters, shut off valves, service ports and suction accumulator.

2. Both liquid and suction lines must be individually insulated between the outdoor and indoor units.

3. The outdoor unit can be wired and piped in the front, lateral or downward directions, accessed from the right side of the unit.

4. The sound pressure level standard shall be that value as listed in the Daikin engineering manual for the specified models at 3 feet from the front of the unit.

5. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for re-programming.

6. The outdoor unit shall be modular in design and should allow for side-by-side installation with minimum spacing.

7. The following safety devices shall be included on the condensing unit; high pressure switch, outdoor fan driver overload protector, Thermal protector for indoor fan motor, Inverter overload protector, fusible plugs, fuse.

B. Unit Cabinet:

1. The outdoor unit model RZR\_\_PVJU8 shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.

2. The outdoor unit will come furnished with four (4) mounting feet, mounted across the base pan, to allow bolting to a cement pad or optionally supplied mounting bracket.

C. Fan:

1. The condensing unit shall consist of one propeller type, direct-drive 70 W fan motor that has multiple speed operation via a DC (digitally commutating) inverter.

|  |  |
| --- | --- |
| **Model Number** | **Fan Motor Output (W) & Quantity** |
| RZR18PVJU8 | 70 x 1 |
| RZR24PVJU8 | 70 x 1 |
| RZR30PVJU8 | 70 x 1 |

2. The fan shall be a horizontal discharge configuration with a nominal airflow maximum of 1,835 cfm.

3. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.

4. The fan motor shall be provided with a fan guard to prevent contact with moving parts.

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 coil shall be of a waffle louver fin and rifled bore tube design to ensure highly efficient performance.

3. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design.

4. The fins are to be covered with an anti-corrosion acrylic resin and hydrophilic film type E1 rated for up to 1000 hours salt spray.

5. The pipe plates shall be treated with powdered polyester resin for corrosion prevention. The thickness of the coating must be between 2.0 to 3.0 microns.

E. Compressor:

1. The Daikin swing compressor shall be variable speed (PAM inverter) controlled which is capable of changing the speed to follow the variations in total cooling load as determined by the suction gas pressure as measured in the condensing unit. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity shall be controlled to eliminate deviation from target value.

2. The inverter driven compressor shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed swing type.

3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.

4. The capacity control range shall be as shown below:

|  |  |
| --- | --- |
| **Model Number** | **Capacity Control Range** |
| RZR18PVJU8 | 35-100% |
| RZR24PVJU8 | 30-100% |
| RZR30PVJU8 | 25-100% |

5. The compressor shall be equipped with a crankcase heater, high pressure safety switch and internal thermal overload protector.

6. The compressor shall be mounted to avoid the transmission of vibration.

F. Electrical:

1. The power supply to the outdoor unit shall be 208-230 volts, 1 phase, 60 hertz +/- 10%.

|  |  |
| --- | --- |
| **Power Supply Voltage** | **Voltage Range** |
| 208-230V/1/60 | 187V-253V |

|  |  |  |
| --- | --- | --- |
| **Model** | **MCA** | **MOP** |
| RZR18PVJU8 | 16.5 | 20 |
| RZR24PVJU8 | 16.5 | 20 |
| RZR30PVJU8 | 16.5 | 20 |

2. The control voltage between the indoor and outdoor unit shall be 16VDC.

3. The control wiring shall be a two-wire multiplex transmission system, thus simplifying the wiring operation.

4. The control wiring lengths shall be as shown below:

|  |  |  |
| --- | --- | --- |
|  | **Outdoor to Indoor Unit** | **Indoor Unit to Remote Control** |
| **Control Wiring Length** | 3,280 | 1,640 |
| **Wire Type** | 18 AWG, 2 wire, non-polarity, non-shielded, stranded | |

2.04 FBQ INDOOR UNIT – DUCTED CONCEALED UNIT

A. General: Daikin indoor unit model FBQ shall be a ducted concealed fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, for installation in the ceiling. It shall be available in capacities from 18,000 Btu/h to 30,000 Btu/h. Model numbers are FBQ18PVJU, FBQ24PVJU, and FBQ30PVJU to be connected to the corresponding SkyAir series outdoor condensing unit model RZR18PVJU8, RZR24PVJU8, and RZR30PVJU8. It shall be a horizontal discharge air with horizontal return air configuration. All models feature a low height cabinet making them applicable to ceiling pockets that tend to be shallow. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. Included as standard equipment, a condensate drain pan and drain pump kit that pumps to 18-3/8” from the drain pipe opening. The indoor units sound pressure shall range from 37 dB(A) to 39 dB(A) at low speed measured 5 feet below the ducted unit with 6.6 ft of discharge ductwork and 3.3 ft of suction ductwork.

B. Performance: Each units performance is based on nominal operating conditions:

|  |  |
| --- | --- |
| **Model Number** | **Cooling**  (Indoor 80°F DB / 67°F WB,  Outdoor 95°F DB, 25 ft pipe length) |
| FBQ18PVJU | 18,000 |
| FBQ24PVJU | 24,000 |
| FBQ30PVJU | 30,000 |

C. Indoor Unit:

1. The Daikin indoor unit FBQ 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, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall be equipment 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 individually 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 18-3/8” of lift from the center of the drain outlet.

5. The indoor units shall be equipped with a return air thermistor.

6. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.

7. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:

1. The cabinet shall be located into the ceiling and ducted to the supply and return air openings.

2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

E. 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 an 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 motor output range of 350 Watts.

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.

7. Fan motor external static pressure range for nominal airflow:

|  |  |
| --- | --- |
| **Model Number** | **Fan ESP (in. WG)** |
| FBQ18PVJU | 0.80 – 0.20 |
| FBQ24PVJU | 0.80 – 0.20 |
| FBQ30PVJU | 0.80 – 0.20 |

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 of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.

3. The coil shall be a 3 row cross fin copper evaporator coil with 15 fpi design completely factory tested.

4. The refrigerant connections shall be flare connections and the condensate will be 1-1/4” outside diameter PVC.

5. A condensate pan shall be located under the coil.

6. A condensate pump with a 18-3/8” lift shall be located below the coil in the condensate pan with a built in safety alarm.

7. 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. The unit shall be compatible with a Wired or Wireless I/R controller to perform input functions necessary to operate the system.

2. A full array of fault diagnostics shall be accessible via the remote controller.

3. The unit shall be compatible with interfacing with connection to BACnet and LonWorks networks or interfacing with connection to BMS system. Consult with Daikin prior to applying controls.

I. Optional Accessories Available:

1. Remote “in-room” sensor kit KRCS01-4B.

a. The Daikin wall mounted, hard wired remote sensor kit is recommended for applications where there could be a difference between set temperature and actual temperature. The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit).

2. Navigation Remote Controller (BRC1E73).

3. Coordinate with Owner for option of using Smart Phone app/wireless adapter as well as wired wall mounted T stat.

2.05 Multi Split Ductless Heat Pump - INDOOR UNIT – CTXS/FTXS

General: The indoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. Both liquid and suction lines must be individually insulated between the outdoor and indoor units.

A. Unit Cabinet:

1. The indoor unit shall have a white, “wipe-clean” finish.

2. The drain and refrigerant piping shall be accessible from six (6) positions for flexible installation (right side, right back, and right bottom; and left side, left back, and left bottom.

3. The cabinet shall be supplied with a mounting plate to be installed onto a wall for securely mounting the cabinet.

4. The cabinet includes:

a. Indoor unit ON/OFF switch, capable of being used when the remote controller is missing. When switch is used, the default setting is AUTO mode, 77°F temperature setting, and AUTO airflow rate.

b. “Intelligent Eye” motion sensor capable of setting back the set point temperature for energy savings. This feature may be disengaged on the I/R remote controller.

c. OPERATION lamp that turns green when activated.

c. TIMER lamp that turns orange when activated.

d. A Signal Receiver that receives signals from the remote controller at a maximum distance of 23 ft. When the unit receives a signal, you will hear the following: 2 beeps – operation start, 1 beep – Setting changed, 1 long beep – Operation stop.

B. Fan:

1. The evaporator fan shall be an assembly consisting of a direct-driven fan by a single motor.

2. The fan shall be statically and dynamically balanced and operate on a motor with permanent lubricated bearings.

3. An auto-swing louver for adjustable air flow (both vertically and horizontally) is standard via the wireless remote control furnished with each system.

4. The indoor fan shall offer a choice of five speeds, plus quiet and auto settings.

5. The fan shall have a delayed start when initially put into HEAT operation, giving time for the evaporator coil to heat up and preventing a cold draft from entering the room.

C. Filter:

1. The return air filter provided will be a mildew resistant, removable and washable filter. Two titanium apatite photocatalytic air purifying filters are included for additional air filtration.

D. Coil:

1. The evaporator coil shall be a nonferrous, aluminum fin on copper tube heat exchanger.

2. All tube joints shall be brazed with silver alloy or phoscopper.

3. All coils will be factory pressure tested.

4. A condensate pan shall be provided under the coil with a drain connection.

E. Electrical:

1. The outdoor unit shall be powered with 208-230 volts, 1 phase, and 60 hertz power. The indoor unit shall receive 208-230 volt, 1 phase, 60 hertz power from the outdoor unit.

2. The allowable voltage range shall be 187 volts to 253 volts.

F. Control:

1. The unit shall have a backlit, wireless remote infra-red controller capable to operate the system. It shall have Cooling Operation, Heating Operation, Automatic Operation, Dry Operation and Fan Only Operation.

2. The controller shall consist of an On/Off Power switch, Mode Selector, Quiet Button (for outdoor unit), Fan Setting, Swing Louver, On/Off Timer Setting, Temperature Adjustment, °C or °F Temperature Display, Intelligent Eye Sensor, Weekly Timer, Night Set Mode, Comfort Mode, Econo Mode, and Powerful Operation.

a. On/Off switch powers the system on or off.

b. Mode selector shall operate the system in auto, cool, heat, fan, or dry operation.

c. Quiet button for outdoor unit lowers the noise level by changing frequency and fan speed of the outdoor unit.

d. Fan setting shall provide five fan speeds, plus quiet and auto settings.

e. Swing louver shall adjust the airflow (horizontal and vertical) blades.

1) Vertical & horizontal positions can be manually adjusted, or placed into auto swing or 3-D airflow settings.

f. On/Off timer is used for automatically switching the unit on or off.

1) Night Set mode automatically engaged with Off Timer is set. This setting automatically adjusts the temperature setting 0.9°F (0.5°C) up in COOL, 3.6°F (2.0°C) down in HEAT to prevent excessive cooling or heating during sleeping hours.

g. Temperature adjustment allows for the increase or decrease of the desired temperature.

h. The Intelligent Eye sensor detects human movement. If no movement is detected in the room for more than 20 minutes, the operation automatically changes up or down 3.6°F to an energy saving operation.

i. Weekly timer allows for programming the temperature setting and on/off times of up to four settings per day for each day of the week.

j. Comfort Mode directs the airflow upwards while in COOL operation and downward while in HEAT operation. This function prevents air from blowing directly on the occupants in the room.

k. Econo operation is a function which enables efficient operation by limiting the maximum power consumption value. This function will also prevent the circuit breaker from tripping when the unit operates alongside other appliances on the same circuit.

l. Powerful operation allows quick cool down or heating up in the desired space to achieve maximum desired temperature in the shortest allowable time period.

3. The controller shall be able to display two-digit fault codes extracted from the indoor unit to aid in troubleshooting.

4. Temperature range on the remote control shall be 64°F to 90°F in COOL mode, 50°F to 86°F in HEAT mode, and 64°F to 86°F in AUTO mode. The temperature shall be controlled in 1° increments.

5. The indoor unit microprocessor has the capability to receive and process commands via return air temperature and indoor coil temperature sensors enabled by commands from the remote control.

6. The unit shall also have the capability to connect to a smart-device app via wireless adapter – coordinate with owner for adding this feature.

G. Sound:

1. Indoor unit sound levels shall not exceed:

|  |  |  |
| --- | --- | --- |
| **Indoor Daikin Model** | **Cooling Mode Sound Level (H/M/L/SL) dB(A)** | **Heating Mode Sound Level (H/M/L/SL) dB(A)** |
| CTXS07LVJU | 38 / 32 / 25 / 22 | 38 / 33 / 28 / 25 |
| FTXS09LVJU | 41 / 33 / 25 / 22 | 42 / 35 / 28 / 25 |
| FTXS12LVJU | 45 / 37 / 29 / 23 | 45 / 39 / 29 / 26 |
| FTXS15LVJU | 45 / 40 / 35 / 32 | 43 / 38 / 33 / 30 |

\*values are measured approximately 3 feet away with JIS standard operating conditions.

2.06 OUTDOOR UNIT

General: The outdoor unit shall be specifically matched to corresponding indoor units while not exceeding maximum connected capacity. The outdoor unit shall be completely factory assembled and pre-wired with all necessary electronic and refrigerant controls. The outdoor unit shall be controlled by a microprocessor and dedicated EEV’s shall be provided for capacity control during part load of the indoor unit.

A. Unit Cabinet:

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

2. The outdoor unit will come furnished with four (4) mounting feet, mounted across the base pan, to allow bolting to a cement pad or optionally supplied mounting bracket.

3. The assembly will be able to withstand a maximum rated wind pressure of 193psf Lateral, 93psf Uplift. See document TER-16-3088.

B. Fan:

1. The fan shall be a direct drive, propeller type fan.

2. The motor shall be inverter driven, permanently lubricated type bearings, inherent.

3. The fan shall be capable of operating in “Quiet Operation” which lowers the outdoor fan speed in either COOL, HEAT, or AUTO modes.

4. A fan guard is provided on the outdoor unit to prevent contact with fan operation.

5. Airflow shall be horizontal discharge.

C. Coil:

1. The outdoor coil shall be nonferrous construction with corrugated fin tube.

2. The fins are to be covered with an anti-corrosion acrylic resin and hydrophilic film type E1, rated for up to 1000 hours salt spray.

3. Refrigerant flow from the condenser will be controlled via a metering device.

4. Automatic defrost will remove any frost from the outdoor unit allowing the system to maintain heating capacity.

D. Compressor:

1. The outdoor compressor shall be a patented, variable speed Daikin swing inverter-driven compressor. The one piece action reduces noise, extends life, boasts higher efficiency and reduces energy consumption.

2. The outdoor unit shall have an accumulator and four-way reversing valve.

3. PVE Refrigerant Oil shall be used to provide improved lubrication & better chemical stability, and no hydrolysis, leading to higher product reliability.

4. The compressor shall have an internal thermal overload.

5. The outdoor unit can operate with a maximum refrigerant piping of 164 feet (maximum 82 feet per indoor unit), with 49 feet maximum vertical difference between indoor unit and outdoor unit (maximum 24 feet between indoor units), without any oil traps, BP boxes, or additional components.

6. The compressor shall have a quick-warming function to prevent pumping liquid refrigerant in low-ambient conditions.

E. Electrical:

1. The electrical power requirement is 208-230 volt, 1-phase, and 60 Hz power.

2. The voltage range limitations shall be a minimum of 187 volts and a maximum of 253 volts.

F. Sound:

1. Outdoor unit sound levels shall not exceed:

|  |  |  |
| --- | --- | --- |
| **Outdoor Daikin Model** | **Cooling Mode Sound Level dB(A)** | **Heating Mode Sound Level dB(A)** |
| 2MXL18QMVJU | 50 | 51 |

\* values are measured approximately 3 feet away with JIS standard operating conditions.

2. Outdoor unit shall be equipped with optional Night Quiet Mode for COOL operation. Night Quiet reduces the operation noise during night-time hours and is engaged via dipswitch setting during installation.

a. Night Quiet mode shall be activated when temperature drops 10.8°F or more below the highest temperature recorded that day. Function will be cancelled when the temperature difference between the current outdoor temperature and the maximum outdoor temperature becomes less than 7.2°F.

2.07 SYSTEM DIAGNOSTICS

General: The system shall be capable of producing 2-digit fault codes:

A. Controls – compatibility varies by indoor unit model.

1. I/R controller

2. Wired Controller

3. Wi-fi module

B. D-Checker software: The D-Checker software has the ability to display error codes and values for every sensor on the system through the outdoor unit. The sensor data points shall be graphed or recorded for export to a spreadsheet. The spreadsheet can then be analyzed to troubleshoot operational issues or acknowledge proper operation.

## PART 3 EXECUTION

3.01 INSTALLATION

A. Install and arrange equipment as shown on the Drawings and as recommended by the equipment manufacturer.

3.02 AIR HANDLING INSTALLATION

A. Installation and Arrangement: Air handling equipment shall be instal­led and arranged as shown on the Drawings. Comply with the manufacturer's recommendations for installation connection and start-up.

B. Lubrication: All moving and rotating parts shall be lubricated in accordance with the manufacturer's recommendations prior to start-up.

3.03 Condensate drainage

A. Provide complete condensate drainage system for cooling and heat pump equipment. Route condensate to approved interior receptor. Discharging condensate to the exterior is not permitted. See Division 22 for piping materials and methods.

3.04 CONTROLS

A. Wiring: All wiring shall be in accordance with the National Electrical Code and local electrical codes. All thermostat wire shall be minimum 18 gauge, 6 conductor.

B. Mounting: All controls intended to be operable by the occupant shall be mounted with the operating portion no more than 46” above the floor or as otherwise required by applicable codes.

END OF SECTION

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