# SECTION 23 74 00 - packaged hvac units

## PART 1 - GENERAL

1.1 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.

1.2 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.

1.3 SUBMITTALS

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

B. Submit operating and maintenance data.

## PART 2 - PRODUCTS

2.1 ROOF MOUNTED Duel Fuel/high efficiency ERV HVAC EQUIPMENT

A. Manufacturers

1. Basis of Design: Daikin Applied

a. [Deducts for alternative equipment will be considered.]

B. General Description

1. Furnish as shown on plans, Daikin Applied Rebel Heating and Cooling Unit(s) model DPS. Unit performance and electrical characteristics shall be per the job schedule.

2. Configuration: Fabricate as detailed on prints and drawings:

a. Return plenum / economizer section

b. Filter section

c. Cooling coil section

d. Supply fan section

e. Gas heating section.

f. Condensing unit section

3. The complete unit shall be cETLus listed.

4. The unit shall be ASHRAE 90.1-2013 compliant and labeled.

5. Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Each unit shall be completely factory assembled and shipped in one piece. Packaged units shall be shipped fully charged with R-410 Refrigerant and oil.

6. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.

7. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.

8. Performance: All scheduled EER, IEER, capacities and face areas are minimum accepted values. All scheduled amps, kW, and HP are maximum accepted values that allow scheduled capacity to be met.

9. Warranty: The manufacturer shall provide 12-month parts only warranty. Defective parts shall be repaired or replaced during the warranty period at no charge. The warranty period shall commence at startup or six months after shipment, whichever occurs first.

C. Cabinet, Casing, and Frame

1. Panel construction shall be double-wall construction for all panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Insulation shall be a minimum of 2" thick with an R-value of 13.0, and shall be 2 part injected foam. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g.

2. Panel construction shall be double-wall construction for all panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Insulation shall be a minimum of 1" thick with an R-value of 7.0, and shall be 2 part injected foam. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g.

3. Exterior surfaces shall be constructed of pre-painted galvanized steel for aesthetics and long term durability. Paint finish to include a base primer with a high quality, polyester resin topcoat of a neutral beige color. Finished panel surfaces to withstand a minimum 750-hour salt spray test in accordance with ASTM B117 standard for salt spray resistance.

4. Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.

5. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.

D. Economizer Section

1. Unit shall be provided with an outdoor air economizer section. The economizer section shall include outdoor, return, and exhaust air dampers. The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be parallel blade design. Damper blades shall be gasketed with side seals to provide an air leakage rate of 1.5 cfm / square foot of damper area at 1” differential pressure in according with testing defined in AMCA 500. A barometric exhaust damper shall be provided to exhaust air out of the back of the unit. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges. Control of the dampers shall be by a factory installed direct coupled actuator. Damper actuator shall be of the modulating, spring return type. A comparative enthalpy control shall be provided to sense and compare enthalpy in both the outdoor and return air streams to determine if outdoor air is suitable for “free” cooling. If outdoor air is suitable for “free” cooling, the outdoor air dampers shall modulate in response to the unit’s temperature control system.

E. Exhaust Fan

1. Exhaust fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim. The exhaust fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.

2. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

3. The unit DDC controller shall provide building static pressure control. The unit controller shall provide proportional control of the exhaust fans from 25% to 100% of the supply air fan designed airflow to maintain the adjustable building pressure setpoint. The field shall mount the required sensing tubing from the building to the factory mounted building static pressure sensor.

F. Filters

1. Unit shall be provided with a draw-through filter section. The filter rack shall be designed to accept a 2” prefilter and a 4” final filter. The unit design shall have a hinged access door for the filter section. The manufacturer shall ship the rooftop unit with 2” MERV 8 construction filters. The contractor shall furnish and install, at building occupancy, the final set of filters per the contract documents.

G. Cooling Coil

1. The indoor coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and an ASHRAE 62.1 compliant double sloped drain pan.

2. The direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 3 rows. All cooling coils shall have an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.

3. The cooling coil shall have an electronic controlled expansion valve. The unit controller shall control the expansion valve to maintain liquid subcooling and the superheat of the refrigerant system.

4. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.

5. The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.

H. Supply Fan

1. Supply fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with fan blades that are continuously welded to the hub plate and end rim. The supply fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.

2. All fan assemblies shall employ solid steel fan shafts. Heavy-duty pillow block type, self-aligning, grease lubricated ball bearings shall be used. Bearings shall be sized to provide a L-50 life at 250,000 hours. The entire fan assembly shall be isolated from the fan bulkhead with a flexible collar and mounted on 1” spring isolators.

3. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment.

4. Supply fan and motor assembly combinations larger than 8 hp or 22” diameter shall be internally isolated on 1” deflection, spring isolators and include removable shipping tie downs.

5. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

6. The motor shall be T Frame and open drip proof. Ovrload protection and speed control is provided by the factory installed VFD and rooftop unit controller. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

7. The supply fan shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range.

I. Variable Air Volume Control

1. The unit controller shall proportionally control the Electronically Commutated Motors (ECM) on the supply and exhaust fans. The supply fan shall be controlled to maintain an adjustable duct pressure setpoint. A duct static pressure sensor shall be factory mounted in the control panel. The field shall furnish and install the pneumatic tubing for the duct static pressure sensor and the building pressure sensor. The field shall furnish and install the outdoor air pressure sensor.

2. The unit controller shall proportional control the ECM motors on the supply fan based on space temperature. The unit controller shall increase/decrease the speed of the supply fan in order to maintain the space temperature within its setpoint and deadband. The unit controller shall provide discharge air temperature control with the compressor modulation.

3. An electronic variable frequency drive shall be provided for the supply air fan. Each drive shall be factory installed out of the air stream in a conditioned cabinet. Drives shall meet UL Standard 95-5V. The completed unit assembly shall be listed by a recognized safety agency, such as ETL. Drives are to be accessible through a hinged door assembly. Mounting arrangements that expose drives to high temperature unfiltered ambient air are not acceptable.

4. The unit manufacturer shall install all power and control wiring.

5. The supply air fan drive output shall be controlled by the factory installed main unit control system and drive status and operating speed shall be monitored and displayed at the main unit control panel.

J. Heating Section

1. The rooftop unit shall include a natural gas heating section. The gas furnace design shall be one natural gas fired heating module factory installed downstream of the supply air fan in the heat section. The heating module shall be a tubular design with in-shot gas burners.

2. Each module shall have two stages of heating control.

3. Each module shall have two stages of heating control. The module shall be complete with furnace controller and control valve capable of 12:1 modulating operation.

4. Each module shall have two stages of heating control. The module shall be complete with furnace controller and control valve capable of 5:1 modulating operation.

5. The heat exchanger tubes shall be constructed of stainless steel.

6. The module shall have an induced draft fan that will maintain a negative pressure in the heat exchanger tubes for the removal of the flue gases.

7. Each burner module shall have two flame roll-out safety protection switches and a high temperature limit switch that will shut the gas valve off upon detection of improper burner manifold operation. The induced draft fan shall have an airflow safety switch that will prevent the heating module from turning on in the event of no airflow in the flue chamber.

8. The factory-installed DDC unit control system shall control the gas heat module. Field installed heating modules shall require a field ETL certification. The manufacturer’s rooftop unit ETL certification shall cover the complete unit including the gas heating modules.

K. Heat Pump Heating

1. The evaporator coil, condenser coil, compressors and refrigerant circuit shall be designed for heatpump operation. The refrigerant circuit shall contain a 4 way reversing valve for the heatpump operation. The outdoor coil shall have an electronic expansion valve to control the refrigerant flow. The unit controller shall modulate the expansion valve to maintain compressor operation within the compressor operational envelope.

2. The refrigerant system shall have a pump-down cycle.

3. The unit shall have a natural gas furnace for hybrid heating. When the heatpump operation cannot maintain the discharge air temperature setpoint the natural gas furnace shall temper the airstream to the discharge air temperature setpoint.

L. Heat Recovery Wheel

 1. Total energy wheel, with means for by-pass during economizer operation.

M. Condensing Section

1. Outdoor coils shall have seamless copper tubes, mechanically bonded into aluminum plate-type fins. The fins shall have full drawn collars to completely cover the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.

2. Outdoor coils shall be cast aluminum, micro-channel coils. Plate fins shall be protected and brazed between adjoining flat tubes such that they shall not extend outside the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.

3. Fan motors shall be an ECM type motor for proportional control. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 0~120°F. Mechanical cooling shall be provided to 25º F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.

4. The condenser fan shall be low noise blade design. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be of a composite material.

5. The unit shall have scroll compressors. One of the compressors shall be an inverter compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature. The inverter compressor shall have a separate oil pump and low oil safety protection.

6. The unit shall have scroll compressors. One of the compressors shall be an inverter compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature. The inverter compressor shall have a separate oil pump and an oil separator for each compressor that routes oil back to the compressor instead of through the discharge line.

7. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.

8. Refrigerant circuit shall have a bypass valve between the suction and discharge refrigerant lines for low head pressure compressor starting and increased compressor reliability. When there is a call for mechanical cooling the bypass valve shall open to equalizing the suction and discharge pressures. When pressures are equalized the bypass valve shall close and the compressor shall be allowed to start.

9. Each circuit shall be dehydrated and factory charged with R-410A Refrigerant and oil.

N. Electrical

1. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be provided with the unit. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.

2. A single non-fused disconnect switch shall be provided for disconnecting electrical power at the unit. Disconnect switches shall be mounted internally to the control panel and operated by an externally mounted handle.

O. Controls

1. Provide a complete integrated microprocessor based Direct Digital Control (DDC) system to control all unit functions including temperature control, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times, and diagnostics. This system shall consist of all required temperature sensors, pressure sensors, controller and keypad/display operator interface. All MCBs and sensors shall be factory mounted, wired and tested.

2. The stand-alone DDC controllers shall not be dependent on communications with any on-site or remote PC or master control panel for proper unit operation. The microprocessor shall maintain existing set points and operate standalone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.

3. The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.

4. All digital inputs and outputs shall be protected against damage from transients or incorrect voltages. All field wiring shall be terminated at a separate, clearly marked terminal strip.

5. The DDC controller shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to insure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.

6. The keypad interface shall allow convenient navigation and access to all control functions. The unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted. The user interaction with the display shall provide the following information as a minimum:

a. Return air temperature.

b. Discharge air temperature.

c. Outdoor air temperature.

d. Space air temperature.

e. Outdoor enthalpy, high/low.

f. Compressor suction temperature and pressure

g. Compressor head pressure and temperature

h. Expansion valve position

i. Condenser fan speed

j. Inverter compressor speed

k. Dirty filter indication.

l. Airflow verification.

m. Cooling status.

n. Control temperature (Changeover).

o. VAV box output status.

p. Cooling status/capacity.

q. Unit status.

r. All time schedules.

s. Active alarms with time and date.

t. Previous alarms with time and date.

u. Optimal start

v. Supply fan and exhaust fan speed.

w. System operating hours.

x. Fan

y. Exhaust fan

z. Cooling

aa. Individual compressor

bb Heating

cc Economizer

dd. Tenant override

7. The user interaction with the keypad shall provide the following:

a. Controls mode

1) Off manual

2) Auto

3) Heat/Cool

4) Cool only

5) Heat only

6) Fan only

b. Occupancy mode

1) Auto

2) Occupied

3) Unoccupied

4) Tenant override

c. Unit operation changeover control

1) Return air temperature

2) Space temperature

3) Network signal

d. Cooling and heating change-over temperature with deadband

e. Cooling discharge air temperature (DAT)

f. Supply reset options

1) Return air temperature

2) Outdoor air temperature

3) Space temperature

4) Airflow (VAV)

5) Network signal

6) External (0-10 vdc)

7) External (0-20 mA)

g. Temperature alarm limits

1) High supply air temperature

2) Low supply air temperature

3) High return air temperature

h. Lockout control for compressors.

i. Compressor interstage timers

j. Night setback and setup space temperature.

k. Building static pressure.

l. Economizer changeover

1) Enthalpy

2) Drybulb temperature

m. Currently time and date

n. Tenant override time

o. Occupied/unoccupied time schedule

p. One event schedule

q. Holiday dates and duration

r. Adjustable set points

s. Service mode

1) Timers normal (all time delays normal)

2) Timers fast (all time delays 20 sec)

8. If the unit is to be programmed with a night setback or setup function, an optional space sensor shall be provided. Space sensors shall be available to support field selectable features. Sensor options shall include:

a. Zone sensor with tenant override switch

b. Zone sensor with tenant override switch plus heating and cooling set point adjustment. (Space Comfort Control systems only)

9. To increase the efficiency of the cooling system the DDC controller shall include a discharge air temperature reset program for part load operating conditions. The discharge air temperature shall be controlled between a minimum and a maximum discharge air temperature (DAT) based on one of the following inputs:

a. Airflow

b. Outside air temperature

c. Space temperature

d. Return air temperature

e. External signal of 1-5 vdc

f. External signal of 0-20 mA

g. Network signal

P. Roof Curb

1. A prefabricated heavy gauge galvanized steel, mounting curb shall be provided for field assembly on the roof decking prior to unit shipment. The roof curb shall be a full perimeter type with complete perimeter support of the air handling section and condensing section. The curb shall be a minimum of 14" high and include a nominal 2" x 4" wood nailing strip. Gasket shall be provided for field mounting between the unit base and roof curb.

## PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Refer to applicable sections for piping, ductwork, insulation, painting, etc.

3.2 ROOF MOUNTED EQUIPMENT INSTALLATION

A. All roof mounted mechanical equipment shall be supported and seismically anchored on leveled, flashed and counterflashed curbs anchored to resist seismic forces and suitable for the roof construction. Minimum curb height shall be 12" above the roof unless indicated otherwise on the Drawings. Flashing into the roof is specified in another Section.

B. Make all piping, electrical and duct penetrations for each piece of equipment within the curb unless shown otherwise on the Drawings. Piping and electrical conduit shall not be routed across the roof.

3.3 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.

C. Filters: Specified filters or approved temporary construction filters shall be installed in supply units prior to start-up or used for drying and/or temporary heat.

3.4 SMOKE DETECTOR INSTALLATION

A. Provide unit or duct-mounted smoke detectors at air handling units in accordance with Code requirements.

B. Where detectors are mounted in a concealed location, provide remote indicating panel located as directed.

C. Automatic Smoke Detector Fan Shutdown: Arrange controls to shut down respective air handling system upon detection of smoke.

3.5 CONTROLS

A. Wiring: All wiring shall be in accordance with the National Electrical Code and local electrical codes.

END OF SECTION 23 74 00