# SECTION 23 07 60

# AIR HANDLING EQUIPMENT

## PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

D. Refer to Section 230450 for Refrigeration Equipment – HVAC.

1.2 DESCRIPTION OF WORK

A. This Section includes work necessary and/or required and materials and equipment for construction of a complete system. Such work includes, but is not limited to the following:

1. Packaged Rooftop HVAC Unit with Energy Recovery

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. AMCA Standards 210 and 300 for fans.

C. ARI Standard 410, ASHRAE Standard 33 for Heating and Cooling Coils.

D. ASHRAE Standard 52.2 and U.L. Standard 900 for media type air filters.

E. AMCA Standard 511 and 500D for Air Control Dampers.

F. AMCA Standard 611 and 610 for air flow measurement stations.

G. ARI Standard 1060 and ASHRAE Standard 84 for Air-to-Air Energy Recovery Equipment.

H. ARI Standard 260 and 430 for Air Handling Units.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

B. Whenever a variable frequency PWM drive is installed to control an AC motor, a maintenance-free, circumferential, conductive micro fiber shaft grounding ring shall be installed on the AC

motor drive end to discharge shaft currents to ground. Recommended part: AEGIS SGR™ Bearing Protection Ring, as made by Electro Static Technology. Install in accordance with the manufacturer's written instructions.

1.5 SUBMITTALS

A. Submit shop drawings in accordance with Section 230200.

B. Submit shop drawings and descriptive date for all equipment specified in this section.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items provided by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements. In addition, the following special guarantee applies:

1. Each compressor unit shall be provided with manufacturer's five (5) year parts and labor warranty.

**PART 2 – PRODUCTS**

2.1 PACKAGED ROOFTOP HVAC UNIT WITH ENERGY

A. Factory fabricated and assembled unit consisting of constant volume fans, motors, and drive assemblies, coils, plenum casing, filters, energy recovery wheel (with motor and drive), natural gas heating section, access doors and operating controls, motor starters and disconnect switches.

1. Unit cooling capacities shall be in accordance with and tested to ARI standard 210/240-84 & 360-85.

2. Units shall be safety certified in accordance with UL standard UL465, UL559 and/or ANSI Standard Z21.47. Unit shall be safety certified by an accredited testing laboratory. Unit nameplate shall carry the sticker of the certification agency.

3. Unit shall be shipped completely assembled by the manufacturer including all standard items and optional items. Unit shall be 100% run tested by the manufacturer with a copy of the run test report shipped with the unit.

4. Unit shall have decals and tags to indicate unit lifting - rigging, service areas and caution areas. Wiring diagrams, installation and maintenance manuals shall be supplied with each unit.

B. Unit Construction:

1. Unit shall be completely factory assembled, piped and wired, and shipped in one piece, specifically designed for outdoor application with a fully weatherproof cabinet with dedicated bottom supply/return air style system for mounting on an insulated curb. Cabinet shall be constructed entirely of G90 galvanized metal with the exterior constructed of 18 gauge or heavier material. The unit roof shall be cross broken and sloped to assure drainage.

2. Access to compressor(s), controls, filters, blower, heating section, and other items shall be through hinged access doors with a quarter turn latch (door fastening screws are not acceptable). Air side service access doors shall be fully gasketed with rain break overhangs. Filter access door will have an internal metal liner to protect the doors insulation.

3. Unit exterior shall be painted with corrosion resistant polyurethane paint over a wash primer and a paint lock type galvanized steel. Paint shall be manufacturer's standard color and withstand a 2,500 hour salt spray test. The interior air side of the cabinet shall be entirely insulated on all exterior panels with 1" thick, three quarter pound density, neoprene coated, fiberglass insulation.

4. To guarantee no leakage of conditioned air from the cabinet all of the cabinet under positive pressure, downstream from the supply air blower, shall have a separate internal cabinet contained within, and separate from, the exterior cabinet by an air gap. The internal cabinet shall be guaranteed to hold a static pressure of up to 12 inches water column.

5. All openings through the base pan of the unit shall have turned flanges of at least 1/2" in height around the opening through the base pan.

6. Condenser coils and fan discharge shall be protected by heavy duty wire guards.

C. Fans:

1. Blower(s) shall be entirely self contained on a slide deck for service and removal from the cabinet. Adjustable V-belt drive shall be provided with a minimum rating of 140% of the motor nameplate brake horsepower. Blowers, drives and motors shall be statically and dynamically balanced. Blower shall be single width, single inlet airfoil design.

   a. Blower shall be controlled by a factory mounted VFD where indicated.

2. Shafts shall be AISI hot rolled steel accurately turned, ground, polished, and ring gauged for accuracy. Shafts shall be sized for first critical speed of at least 1.43 times the maximum speed for the class.

3. Bearings shall be heavy duty, grease lubricated, anti-friction ball or roller, self-aligning, pillow block type and selected for minimum average bearing life (AFBMA L-50) in excess of 200,000 hours at the maximum class RPM.

4. Fans shall be mounted on vibration bases with adjustable motor bases, V-belt drives, spring isolators, and flexible connections. Belts shall be designed for a minimum 1.4 service factor. Drives for motors shall be variable pitch.

5. Motors shall be standard NEMA frame, high efficiency, with 1.15 service factor and open drip-proof enclosures. Motor selections shall be non-overloading over the fan curve from 0 to 150% of design flow, and the design BHP shall not be above 90% of motor horsepower at design condition.

6. Fans' ratings shall be based on AMCA Standards 210 and 300. Fans shall bear the AMCA seal.

D. Outside Air Economizer

1. 100% O/A Option: Unit shall be equipped with a 2-position motorized outside air damper. The damper shall consist of extruded aluminum, hollow core, air foil blades with rubber edge and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 25 CFM of leakage per square foot of damper area when subjected to 2" WG air pressure differential across the damper. Damper motor shall be spring return to ensure closing of outdoor air damper during periods of unit shutdown or power failure.

E. Energy Recovery Wheel:

1. Units shall be furnished with a factory mounted and tested energy wheel. The wheel shall be mounted in a rigid frame containing the wheel drive motor, drive belt, wheel seals and bearings. These components will form a cassette which shall be removable from the unit without the use of tools.

2. The energy recovery cassette shall contain a total energy recovery heat wheel constructed of a light weight polymer material with permanently bonded desiccant coating. The energy recovery wheel media shall be capable of removal from the cassette and replacement without the use of tools. Wheel media shall be cleanable using hot water or light detergent without degrading the latent efficiency.

3. The exhaust fan shall be forward curved or backward inclined DWDI with an adjustable V-belt drive. A backdraft damper shall be included with the exhaust fan.

4. The energy wheel section shall include a through-matrix purge section factory installed onto the energy wheel. The purge section shall include dampers, actuators and casing components.

5. The energy recovery wheel shall include wheel rotation detection sensor and speed switch output module with contacts wired to the low voltage terminal block for wheel rotation indication.

F. Condenser Section

1. The condensing section shall be equipped with direct drive, vertical discharge condenser fan(s). The condenser coil shall be sloped at least 30° from horizontal to protect the coil from damage.

2. Condenser coil(s) shall be copper tube with aluminum fins mechanically bonded to the tubes.

3. Condenser coil(s) to be sized for a minimum of 10° sub-cooling.

G. Evaporator Coil

1. Evaporator coil shall be multi-row minimum ½" copper tube with aluminum fins mechanically bonded to the tubes, with galvanized steel end casings, and equalizing type vertical tube distributors.

2. Evaporator coils for multi-compressor units shall be circuited with one circuit and expansion valve per compressor.

3. Unit shall be equipped with a double sloped, mastic coated drain pan, and outlets on either side of unit.

H. Refrigeration System

1. Compressor(s) shall be of the scroll type with crankcase heater(s), internal thermal overload protection, internal spring isolators and mounted on the compressor manufacturer recommended rubber vibration isolators.

2. All units over 7 tons shall be multiple stage and shall have a minimum of 2 stages of capacity control.

3. Compressor(s) shall be mounted in an isolated compartment to permit operation of the unit without affecting air flow when the compressor compartment is open.

4. Compressor(s) shall be isolated from the base pan and supply air to avoid any transmission of noise from the compressor into the building.

5. System shall be equipped with thermostatic expansion valve(s) type refrigerant flow control, automatic re-set low pressure and manual reset high pressure refrigerant controls, Schrader type service fittings on both the high side and low pressure sides of the system, refrigerant liquid line driers, and factory charged with refrigerant.

6. Unit shall be equipped with five minute time delay and twenty second staging relays, and hot gas bypass no-load valves and piping for each refrigerant circuit.

I. Hot Gas Reheat Coil – Modulating:

1. Unit shall be equipped with a two row 5/8" copper tube, hot refrigerant gas reheat coil.

2. Coil shall be copper tube with aluminum fins mechanically bonded to the tubes.

3. Hot gas distribution shall be accomplished with a factory installed solenoid and modulating thermal expansion valve piped into the lead refrigerant circuit.

4. Unit shall have a control circuit and logic to operate the modulating hot gas valve.

5. Unit control block shall have terminals to control the hot gas reheat function.

J. Gas Heating Section:

1. Unit shall be equipped with a fully modulating heating section using natural gas fuel, minimum 4 to 1 turndown.

2. Unit shall be provided with a gas heating furnace consisting of an aluminized steel or stainless steel tubular heat exchanger, an induced draft blower, and an electric pressure switch to lock out the gas valve until the combustion chamber is purged and combustion air flow is established.

3. Unit shall be provided with a gas ignition system consisting of an electronic ignitor to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.

4. Unit shall have gas supply piping entrances in the unit base for through the curb gas piping and in the outside cabinet wall for across the roof gas piping.

5. Units tubular heat exchanger shall carry a twenty-five (25) year warranty.

K. Power/Electrical Section

1. Unit shall be equipped with a single point electrical connection with motor starters, relays, voltage transformer and terminal block for controls interface, factory mounted disconnect switch.

2. Unit shall include a laminated, color coded electrical wiring diagram attached to the door of the unit. Damper actuators shall be wired to the units low voltage terminal block. All components are UL listed, approved, or classified.

L. Filters

1. Unit shall be furnished with 2", MERV 8 per ASHRAE Standard 52.2-99, pleated throw away supply air filters, U.L. Class 2.

2. Units with energy recovery wheels shall have outside air and mixed air filter sections.

M. Roof Curbs

1. Curb shall be constructed of 14 gauge galvanized steel with a wood nailer strip. Curbs are to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit.

N. Manufacturers: Basis of design Modine. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work are limited to one of the following:

1. Modine
2. AAON
3. Addison
4. McQuay

O. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements as indicated on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

**PART 3 – EXECUTION**

3.1 INSTALLATION

A. Verify that coils, filters, motors, drives and other components are matched with the proper unit.

B. Assemble unit components following manufacturer's instructions for handling, testing and operation. Repair damaged galvanized areas, and paint in accordance with manufacturer's written recommendations.

C. Vacuum clean interior of units prior to operation.

D. Repair air leaks from or into casing that can be heard or felt during normal operation.

E. Install rooftop units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

F. Support: Install and secure roof curb to roof structure, in accordance with National Roofing Contractor's Association (NRCA) installation recommendations and shop drawings. Install and secure rooftop units on curbs and coordinate roof penetrations and flashing.

G. Perform field mechanical balancing in accordance with Section 230950: TESTING AND BALANCING OF MECHANICAL SYSTEMS.

H. The Mechanical Contractor shall own as part of his work, the following:
Provide one (1) additional drive set, if necessary, to obtain final design balancing requirements. The Mechanical Contractor shall coordinate with Balancing Firm and equipment manufacturer for drive selection, including belts and pulleys.

3.2 AUTOMATIC TEMPERATURE CONTROLS

A. Coordination of control work with the BAS shall include, but not be limited to, the following items as described in Section 230900: ATC.

B. Rooftop Energy Recovery Units:

1. The following items shall be provided by the equipment manufacturer:

   a. Motor starters and overload protection.
   b. Control transformers.
   c. Energy wheel motor, speed controller, defrost controller and rotation failure contact.
   d. Dampers and damper motors.
   e. Terminal blocks for all wiring connections between equipment and control devices.
   f. Analog air filter differential pressure sensor, each filter bank.
   g. Manual reset freeze stat.

2. The following items will be furnished by the BAS Contractor and installed by the equipment manufacturer:

   a. DDC Controller.
   b. Unit discharge air temperature sensor.
   c. Heating and cooling coil discharge air temperature sensors.
   d. Discharge humidity sensor.
   e. Return air temperature sensor.
   f. Return air humidity sensor.
   g. Temperature sensor at exhaust air outlet.
   h. Current sensor for one phase of power feeding the supply and exhaust fans.

3. The following items shall be field mounted and wired by the BAS Contractor:

   a. Discharge air temperature sensor.
   b. Discharge humidity sensor.
   c. Heating coil discharge air temperature sensor.
   d. Manual reset freezestat (supplied by ATC).

C. The factory mounted DDC controllers shall be fully programmed with factory approved applications. Any modifications to these programs shall be done by factory trained personal or as approved by the DDC controls and unit equipment manufacturer.

The unit equipment manufacturer shall provide coordination for start-up, check-out, and test of the factory mounted DDC controllers and network devices including the protocol translator. Any hardware and software necessary including labor shall be provided by the unit equipment manufacturer.

The unit DDC controllers shall be networked to a standard protocol translator or gateway so system points shall be available for communications and control from the Building Automation System (BAS)/Automatic Temperature Controls (ATC) System. The protocols available from the protocol translator to the BAS/ATC System shall be BACNET (MSTP), LON or N2.

System points shall be configured to the BAS/ATC System by the BAS/ATC System Contractor. The mapping of points to the BAS/ATC front-end/PC shall be done by the BAS/ATC Contractor. Any software or hardware necessary including labor to accomplish this work shall be provided by the BAS/ATC System Contractor.

**END OF SECTION 23 07 60**