SECTION 23 81 40
AIR-COOLED UNITARY EQUIPMENT

PART 1 – GENERAL

1. DESCRIPTION

A. This section includes design, performance, refrigerants, controls, and installation requirements for air-cooled packaged HVAC units.

2. DEFINITIONS:

A. Coefficient of Performance (COP) - Cooling: The ratio of the rate of heat removed to the rate of energy input in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.

B. Energy Efficiency Ratio (EER): The ratio of net cooling capacity is Btu/h to total rate of electricity input in watts under designated operating conditions.

C. Heating Seasonal Performance Factor (HSPF) - Total heating output of heat pump during its normal annual usage period for heating in Btu/h divided by total electric energy input in watts during the same period.

D. Seasonal Energy Efficiency Ratio (SEER) - Total cooling output of an air conditioner during its normal annual usage period for cooling in Btu/h divided by total electric energy input in watts during the same period.

E. Air-Source Unitary Heat Pump: One or more factory made assemblies that normally include an indoor conditioning coil, compressor(s) and an outdoor refrigerant-to-air coil. These units provide both heating and cooling functions.

3. QUALITY ASSURANCE:

A. Comply with ASHRAE Standard 90.1-2010, Energy Standard for Buildings except Low-Rise Residential Buildings for cooling and heating performance requirements when tested in accordance with AHRI Standards.

B. Heating Performance shall conform to ASHRAE requirements when tested in accordance with AHRI Standards.

C. Comply with specification requirements for seismic restraints if applicable.

D. Scheduled performance represents the minimum acceptable level of performance.

E. Manufacturer shall provide for design of all refrigerant piping systems to include line sizing and refrigerant pressure requirements. Manufacturer shall provide all components as required for reliable operation in long line length applications. It shall be the responsibility of the manufacturer to identify if the maximum distance, both vertical and total distance exceeds the listed limits of the equipment and to provide equipment and

components and equipment as required for reliable operation given the length of the refrigerant line runs.

4. SUBMITTALS

A. Submit in accordance with specifications.

B. Manufacturer's Literature and Data:
   1. Air-Source Unitary Equipment:
      a. Packaged units
      b. Split system

C. Certification: Submit, simultaneously with shop drawings, a proof of certification that this product has been certified by AHRI.

D. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required cooling and heating capacities EER and COP values as applicable.

E. Performance information indicated in the equipment schedules shall represent the minimum level of acceptable performance. All submitted equipment shall meet or exceed the stated performance.

F. Submit wind load pressure calculations for exterior components to demonstrate compliance with the prevailing codes at the time of permit. This shall include unit casing calculations, unit to curb attachment calculations and curb to roof calculations.

PART 2- PRODUCTS

1. UNITARY EQUIPMENT (PACKAGED AND SPLIT DX SYSTEMS)

A. Units shall have factory assembled refrigerant circuits and shall be provided with filter/dryers, shut-off valves, gage ports, charge port, thermostatic expansion valves, integral disconnect switch, thermostat or controls interface as applicable, overcurrent protection for individual components, phase loss protection with automatic restart, refrigerant pressure safeties with automatic reset and factory start-up service.

B. Casing: Indoor unit shall be constructed of zinc coated, heavy-gage galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Standard factory unit coatings shall be tested 500 hours in a salt spray test in compliance with ASTM B117. Cabinet panels shall have lifting handles and shall be water- and air-tight seal. All exposed vertical, top covers and base pan shall be insulated with 1-inch matt-faced, fire-resistant, odorless, glass fiber material. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1. The base of the unit shall have provisions for forklift and crane lifting if required. Unit casings shall be designed to withstand the wind load ratings as required by the prevailing codes at time of permit. All packaged units and condensing units shall be securely attached to the mounting pad, frame or structure and such attachments shall be designed to resist the wind loading requirements of the prevailing code at the time of permit.

C. Filters: Two inch, MERV 8, throwaway filters shall be factory supplied on all units. Unit submittals shall indicate that unit was selected utilizing a 2" MERV 8 filters at medium life and that static pressure capability has taken this into account. For LEED certified projects, provide filters in accordance with the proposed credits. 3 sets of filters shall be provided during the construction process. New filters shall be installed prior to the test and balance process and new filters shall be installed at final completion. 1 complete set of filters shall be left with the owner after final completion. It shall be the contractor's responsibility to maintain construction filters on all units and duct systems if units are to be operated during the construction process.

D. Compressors: Compressors shall be direct-drive, hermetic scroll type with centrifugal type oil pumps. Motor shall be suction gas-cooled. Internal overloads and crankcase heaters shall be utilized with all compressors. Heat pumps shall be provided with extended range operation and automatic reversing valve.

E. Refrigerant Circuit: A minimum of two circuits is required for each unit if available from the manufacturer. Otherwise, units shall have the capability to reduce capacity either through varying the speed of the compressor or staging the compressor. Capacity control valves (Rawal) shall be an acceptable alternative only if variable capacity is not available. Each refrigerant circuit shall have independent thermostatic expansion devices, service pressure ports, and refrigerant line filter driers factory installed as standard. An area shall be provided for replacement suction line driers.

F. Evaporator and Condenser Coils: Internally finned, copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. The evaporated coil and condenser coil shall be leak tested at the factory to 3 times design operating pressure. All dual compressor units shall have intermingled evaporator coils. IAQ rated stainless steel condensate drain pans shall be provided. For units with outdoor air flow rates exceeding 15% of the total supply air volume and located within 15 miles of the sea coast, a sea coast rated coating shall be applied to the evaporator coil.

G. All split system air handling units shall be provided with galvanized secondary drain pans with water sensing float switch. Float switch shall be hard wired to interrupt operation of the unit in the event water is sensed in the secondary drain pan.

H. Outdoor fans: Direct driven, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motors shall be permanently lubricated and shall have built-in thermal overload protection.

I. All condensing units or packaged units shall be provided with louvered hail guards for protection of the condenser coils.

J. For roof mounted units, provide a factory pre-fabricated roof curb and mounting details to indicate that unit mounting to curb and curb mounting to roof is capable of withstanding the design wind loading.

K. Unit casing shall be capable of withstanding the design wind loading without separation from curb and must remain intact in accordance with prevailing codes.

L. Indoor Fan: Forward-Curved, Centrifugal Fan. Provide direct drive if available or provide V-belt driven with adjustable motor sheaves. Motors shall be thermally protected.

Provide oversized motors for high static application. Motors shall meet the U.S. Energy Policy Act of 2005 (EPACT). Provide variable speed ECM motors if available from unit manufacturer.

M. For all split system and packaged DX systems with outdoor air quantities exceeding 15% of the total supply air quantity for that unit, a modulating hot gas reheat coil shall be provided to ensure humidity control under all unit operating conditions. As an alternative, the unit manufacturer may provide another means to control humidity as long as the proposed means is equal in performance and ability to dehumidify as the hot gas reheat coil system. Dehumidification means must be compliant with the prevailing energy code in effect at the time of permitting.

N. All units shall be provided with a unitary controller capable of controlling all unit functions to include; start/stop, temperature control, humidity control, etc.

O. Defrost Controls (heat pump units): A time initiated, temperature terminated defrost system shall ship with a setting of 70-minute cycle, with a choice of 50- or 90-minute cycle. Timed override limits defrost cycle to 10 minutes shall be available on units from 10 to 20 tons. Adaptive demand defrost shall be provided on units below 10 Tons.

P. Unit Electrical:
1. Provide single point unit power connection and unit mounted disconnect switch.
2. Unit control box shall be located within the unit and shall contain controls for compressor, reversing valve and fan motor operation and shall have a 50 VA 24-volt control circuit transformer and a terminal block for low voltage field wiring connections.
3. Safety Controls - High pressure, low temperature, and low pressure safety switches shall be wired through a latching lockout circuit to hold the conditioner off until it is reset electrically be interrupting the power supply to the conditioner. All safety switches shall be normally closed, opening upon fault detection.
4. Provide all packaged units with a step down transformer and a 120 volt, 20 amp convenience outlet mounted in a weatherproof enclosure. Convenience outlet shall be wired so that when main power disconnect is in the off position, outlet is still energized.

2. PACKAGED TERMINAL AIR CONDITIONERS

A. PTAC units shall be provided where indicated on the drawings. PTAC efficiencies shall be in accordance with the requirements of the prevailing energy code in effect at the time of permit.

B. All PTAC units shall be provided with wall sleeve, decorative anodized aluminum exterior grille, electrical sub-base suitable for hard wiring units, thermostat interface, condensate drain connection, integral air filter, refrigerant filter/drier, extended range heating, automatic supplemental heat, freeze protection, refrigerant pressure limit switches, leveling legs and power disconnect switch.

C. Maximum PTAC STC level shall not exceed 28.

D. For PTAC units mounted within 15 miles of the sea coast or mounted in corrosive environments, the PTAC wall sleeve, exterior wall grille, unit casing and condenser coil

shall be coated with a corrosion resistant coating in accordance with the requirements as listed in the corrosion protection section of this specification.

3. OPERATING CONTROLS

E. Low voltage, adjustable room thermostat to control heating and cooling in sequence with delay between stages, compressor and supply fan to maintain temperature setting. Include system selector switch (off-heat-auto-cool) and fan control switch (auto-on). Thermostats are to be provided with adaptive recovery for all heat pump based systems. Thermostats shall be equal to the Honeywell VisionPRO IAQ series with integral 7 day programming and humidistat. System shall be capable of operating in dehumidification mode regardless of space temperature when humidity levels exceed setpoints.

F. Unit DDC Controller (for projects with DDC based control systems)

1. Unit controller shall include input, output and self-contained programming as needed for complete control of unit.
2. Unit controller shall be BACnet/Lon Works compliant and utilize the same communications protocol as the main DDC based control system.
3. All program sequences shall be stored on board in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executted by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices.
4. Programming of logic controller shall be completely modifiable in temperature control system interface: Points shall be available from the unit controller for service access and display and/or control in the field over installed LAN.
5. Refer to control system specification for additional information.

4. ACCESSORIES:

A. Electric Heater: Constructed of heavy-duty nickel chromium elements. Staging shall be achieved through the unit control processor. Each heater shall have automatically reset high limit control. Heaters shall be individually fused from the factory and shall comply with NEC requirements. Power assemblies shall provide single point connection. Electric heat modules shall be listed and labeled by a national recognized testing laboratory acceptable to authorities having jurisdiction. Electric heater controls shall confirm the supply fan is operating before electric elements are energized. Operate electric heater in stages when outdoor ambient is too low to maintain space thermostat setting with compressor operation.

5. CORROSION PROTECTION (WITHIN 15 MILES OF THE SEA COAST OR IN CORROSIVE ENVIRONMENTS)

A. Outdoor Condenser Coils and Indoor Evaporator Coils:

1. This coating requirement applies to all condenser coils and all evaporator coils with a total outdoor air flow rate in excess of 15% of the total air flow rate.

2. As an alternative to the immersion coating, a factory applied corrosion resistance coating shall be acceptable as long as the performance requirements indicated below are met or exceeded.

3. Epoxy Immersion Coating – Electrically Deposited: The multi-stage corrosion-resistant coating application comprises of cleaning (heated alkaline immersion bath) and reverse-osmosis immersion rinse prior to the start of the coating process. The coating thickness shall be maintained between 0.6-mil and 1.2-mil. Before the coils are subjected to high-temperature oven cure, they are treated to permeate immersion rinse and spray. Where the coils are subject to UV exposure, UV protection spray treatment comprising of UV-resistant urethane mastic topcoat shall be applied. Provide complete coating process traceability for each coil and minimum five years of limited warranty. The coating process shall be such that uniform coating thickness is maintained at the fin edges. The quality control shall be maintained by ensuring compliance to the applicable ASTM Standards for the following:
   a. Salt Spray Resistance (Minimum 6,000 Hours)
   b. Humidity Resistance (Minimum 1,000 Hours)
   c. Water Immersion (Minimum 260 Hours)
   d. Cross-Hatch Adhesion (Minimum 4B-5B Rating)
   e. Impact Resistance (Up to 160 Inch/Pound)

B. Exposed Outdoor Cabinet:
   1. Casing Surfaces (Exterior and Interior): All exposed and accessible metal surfaces shall be protected with a water-reducible acrylic with stainless steel pigment spray-applied over the manufacturer's standard finish. The spray coating thickness shall be 2-4 mils and provide minimum salt-spray resistance of 1,000 hours (ASTM B117) AND 500 hours UV resistance (ASTM D4587).

PART 3- EXECUTION

1. INSTALLATION

A. Install split systems and packaged systems according to manufacturers printed instructions.

B. Manufacturer shall provide for design of all refrigerant piping systems to include line sizing and refrigerant pressure requirements. Manufacturer shall provide all components as required for reliable operation in long line length applications. It shall be the responsibility of the manufacturer to identify if the maximum distance, both vertical and total distance exceeds the listed limits of the equipment and to provide equipment and components and equipment as required for reliable operation given the length of the refrigerant line runs.

C. Install electrical and control devices furnished by the manufacturer but not specified to be factory mounted. All electrical work shall comply with the electrical specifications

D. Perform startup checks according to manufacturer's written instructions.

E. Provide factory start-up for all units. Provide Project Engineer and Commissioning Agent with copies of the factory start-up sheets.

F. Test controls and demonstrate its compliance with project requirements. Replace damaged or malfunctioning controls and equipment and retest the equipment to the satisfaction of the Project Engineer and Commissioning Agent.

G. Provide services of manufacturer's technical representative for four hours to instruct owner personnel in operation and maintenance of units.

END OF SECTION 23 81 40