

SECTION 238119

PACKAGED HEAT PUMP AND AIR CONDITIONING ROOFTOP UNITS

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included in This Section: Materials, equipment, fabrication, installation and tests in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Mini-split system single zone air conditioning units
 - 2. Packaged variable air volume air conditioning units

1.2 REFERENCE STANDARDS

- A. AMCA Standard 300 Reverberant Room Method for Sound Testing of Fans
- B. AMCA Standard 301 Method for Calculating Fan Sound Ratings from Laboratory Test Data
- C. AMCA 500 Test Methods for Louver, Dampers, and Shutters
- D. ARI 340/360 Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
- E. ARI Standard 210 Laboratory Methods of Testing Fans for Rating Purposes
- F. ARI 410 Forced-Circulation Air-Cooling and Air-Heating Coils
- G. ARI 430 Central-Station Air-Handling Units
- H. ARI 435 Application of Central-Station Air-Handling Units
- I. ASME B31.5 – Refrigeration Piping

1.3 QUALITY ASSURANCE

- A. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.
- B. Each air conditioning unit shall be UL or ETL listed and labeled as a complete assembly.
- C. Supply all equipment and accessories new and free from defects.
- D. Supply all equipment and accessories in compliance with the applicable state and local codes.
- E. All items of a given type shall be the products of the same manufacturer.
- F. Scheduled equipment performance is minimum capacity required, rated in accordance with ARI Standards 210 (up to 10 tons) and ARI Standard 360 (others).
- G. Unit sound ratings shall be in accordance with ARI Standards 270 or 370.
- H. Scheduled electrical capacity shall be considered as maximum available.
- I. Unit casing shall be capable of withstanding minimum 500-hour salt spray exposure per ASTM B117 (scribed specimen).
- J. Each unit shall be completely factory assembled and shipped in one piece, except for split systems. Single packaged units shall be shipped fully charged with refrigerant. Split systems and all units split between the evaporator and the condensing section shall be shipped with a nitrogen holding charge.

- K. Each unit shall undergo a complete factory run test prior to shipment. The factory test shall include final balancing of fan assemblies, a refrigeration circuit run test, a unit control system operations checkout, test and adjustment of gas furnace where applicable, coil pressure tests, and a unit refrigerant leak test.

1.4 Submittals

- A. See Section 230501 Basic Mechanical Materials and Methods.
- B. Submit product data, O&M data, and samples and show item on shop drawings (where shop drawings are required) according to the following table.
1. "R" means required.
 2. "R2" means required only for products and equipment differing for the specified manufacturer and model and for "or equals" where specified.

Item	Product Data	O&M Manual	Shop Drawing
Packaged rooftop units	R	R	R
Accessories	R	R	R
Roof curbs	R		R

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Packaged Heat Pump and Air Conditioning Rooftop Units
1. Daikin Industries
 2. Trane Company
 3. Aeon
 4. Johnson Controls Inc. (York)
 5. Carrier Corporation
 6. Or equal

2.2 MINIMUM ACOUSTICAL PERFORMANCE (ALL UNITS)

- A. All new units must meet or exceed the sound power levels in the table below

Condition	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
MAX DISCHARGE	88	84	85	83	82	81	80	79
MAX INLET	80	85	81	81	80	79	78	76

2.3 ROOFTOP PACKAGED SINGLE ZONE HEAT PUMP UNIT – VARIABLE VOLUME (AC-1 – AC-3)

- A. Applies to units required to be variable volume per Title 24 and those scheduled as variable volume.
- B. Unit Cabinet
1. Panel construction shall be double-wall construction for all panels including the floor panels. Equipment shall have an under floor liner. 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.
 2. 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.

3. 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.
4. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weather tight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment. Fork lift slots shall be provided in the unit base.

C. Fans

1. Supply Fan

- a. Supply fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan or plenum fan array.
- b. The fan wheel shall be Class II construction with aluminum 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. Rubber or spring isolators
- c. Fan assembly shall be a slide out assembly for servicing and maintenance.
- d. Motors shall comply with Section 230513 Motors and Controllers.
 - 1) Provide electrically commutated motors (ECM) or variable speed drive for continuous or staged air volume control.

2. Condenser Fans

- a. Motors shall be totally enclosed, thermally protected, electrically commutated motors (ECM)
- b. 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.
- c. Either shaft down design or shaft-up with rain shield

3. All fans dynamically balanced in factory

D. Compressors and Refrigeration System

1. Multiple stage (3 minimum) or variable capacity as required by ASHRAE Standard 90.1 and Title 24.
2. Fully hermetic, scroll type with on demand crankcase heaters, internal high-pressure and temperature protection.
3. Refrigerant shall be non-ozone depleting type, such as R-407C or 410A.
4. Mounted on rubber grommets and internally spring mounted for vibration isolation.
5. Compressor motors shall be cooled by refrigerant gas passing through motor windings and shall have line break thermal and current overload protection.
6. Each refrigerant circuit shall include:
 - a. Balanced port thermostatic expansion valve (TXV) with removable power element.
 - b. Solid core refrigerant filter driers with pressure ports.
7. Refrigerant pressure gage ports and connections on suction, discharge, and liquid lines.
8. The evaporator coil, condenser coil, compressors and refrigerant circuit shall be designed for heat pump operation. The refrigerant circuit shall contain a 4 way reversing valve for the heat pump 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.

E. Evaporator and Condenser Coils

1. Seamless internally grooved copper tubes with all joints brazed.

2. Single slab, single pass design to facilitate easy coil cleaning. Composite coils or coils that require unit top panels removed are not acceptable.
 3. Dual circuit models shall have face-split type evaporator coil.
 4. Coils shall at minimum be leak tested at 150 psig, pressure tested at 450 psi, and qualified to UL 1995 burst test at 1775 psig.
 5. Evaporator Fins: Aluminum lanced plate fins mechanically bonded to copper tubes.
 6. Condenser Fins: Aluminum-fins pre-coated with a durable epoxy-phenolic coating. Coating shall be applied to the aluminum fin stock prior to the fin stamping process to create an inert barrier between the aluminum fin and copper tube. Epoxy-phenolic barrier shall minimize galvanic action between dissimilar metals.
- F. Drain Pan
1. 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.
- G. Filter Section
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 (or 4" final filter section only). The unit design shall have a hinged access door for the filter section. The manufacturer shall ship the rooftop unit with 2" construction filters. The contractor shall furnish and install, at building occupancy, the final set of filters per the contract documents.
 2. Filters shall be MERV 13A.
- H. Controls and Safeties
1. Safeties
 - a. Unit shall incorporate a solid-state compressor lockout that provides optional reset capability at the space thermostat, if any of the following safety devices trip and shut off compressor:
 - 1) Compressor lockout protection provided for either internal or external overload
 - 2) Low-pressure protection
 - 3) Freeze protection (evaporator coil)
 - 4) High-pressure protection (high pressure switch or internal)
 - 5) Loss of charge protection
 - 6) Start assist on single-phase units
 - b. Supply-air sensor shall be located in the unit and detect both heating and cooling operation.
 - c. Unit must have ability to disable compressor operation below an adjustable setpoint temperature based on outdoor air temperature.
- I. Roof Curb Adapters
1. Units must be capable of using a roof curb adapter. No re-roofing of existing curb adapter allowed.
- J. Integrated Economizer
1. Low-leakage, gear-driven galvanized steel opposing parallel blade dampers with UL approved gears.
 2. Capable of introducing up to 100% outdoor air
 3. Minimum outdoor airflow shall be maintained by adjustable minimum positions based on supply fan speed.
 4. Damper actuator shall be electronic fully modulating direct-coupled design. Exposed linkage or jackshafts not acceptable.

5. Economizer outdoor hood shall be pre-painted and fully assembled
 6. Fixed outdoor air drybulb temperature lockout set to setpoint mandated by Title 24 for this climate zone.
- K. Barometric Relief
1. Package shall include damper, seals, hardware, and hoods to relieve excess internal pressure.
 2. Damper shall close due to gravity upon unit shutdown.
- L. Thermostatic Control
1. BACnet MSTP interface.
- 2.4 ROOFTOP PACKAGED SINGLE ZONE AC UNIT – CONSTANT VOLUME (AC-4)
- A. Applies only to units allowed to be constant volume per Title 24 and scheduled as constant volume.
- B. Unit Cabinet:
1. Galvanized steel coated with a pre-painted baked enamel finish on all externally exposed surfaces. Internal surfaces shall be of a primer coated finish.
 2. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standards 340/360 minimum exterior sweat criteria. All airstream interior surfaces shall be insulated with a minimum ½ inch thick, 1 lb./ft³ density foil-faced cleanable insulation that meets the NFPA 90 flame retardance requirements and has an R-value of 3.70.
 3. Cabinet panels shall be hinged with integrated non-corrosive hinges. Large area hinged access panels for the filter, compressors, evaporator fan, and control box and heat section areas. Each panel shall use multiple quarter-turn latches and handles. Each major external hinged access panel shall be double-wall construction and permanently attached to the rooftop unit. Panels shall also include tiebacks.
 4. Unit shall have a factory-installed internally sloped condensate drain pan to prevent standing water from accumulating, with a minimum ¾ inch NPT connection. Pan shall be fabricated of high impact polycarbonate material epoxy powder coated steel and shall slide out or otherwise be fully accessible for cleaning and or maintenance. Drain pans shall conform to ASHRAE Standard 62.1 self-draining provisions.
 5. Provide horizontal or vertical supply air and return air connections as indicated on drawings.
 6. Unit shall have single-point thru-the-bottom and thru-the-side power and control wiring connection capability.
 7. Provide thru-the-bottom gas connection where gas service is shown from below on drawings.
- C. Fans
1. Supply fan
 - a. Centrifugal fan with forward curved blades of steel with a corrosion resistant finish
 - b. Rubber or spring isolators
 - c. Cartridge type or pillow-block ball bearings
 - d. Adjustable belt drive. Drive option shall be selected based on scheduled fan airflow rate and static pressure duty.
 - e. Blower assembly (blower wheels, motors, belts, and both bearings) shall slide out for easy access.
 - f. Motors shall comply with Section 230513 Motors and Controllers.
 - 1) Provide electrically commutated motors (ECM) where scheduled on drawings.
 2. Condenser fans shall be of the direct-driven propeller type, with corrosion-resistant aluminum blades riveted to corrosion-resistant steel supports. Condenser-fan motors shall

be totally enclosed, thermally protected, and be of a shaft down design to protect from direct contact from harsh environments.

3. All fans dynamically balanced in factory

D. Compressors and Refrigeration System

1. Fully hermetic, scroll type with on demand crankcase heaters, internal high-pressure and temperature protection.
2. Refrigerant shall be non-ozone depleting type, such as R-407C or 410A.
3. Mounted on rubber grommets and internally spring mounted for vibration isolation.
4. Compressor motors shall be cooled by refrigerant gas passing through motor windings and shall have line break thermal and current overload protection.
5. Each refrigerant circuit shall include:
 - a. Balanced port thermostatic expansion valve (TXV) with removable power element.
 - b. Solid core refrigerant filter driers with pressure ports.
6. Refrigerant pressure gage ports and connections on suction, discharge, and liquid lines.

E. Evaporator and Condenser Coils

1. Seamless internally grooved copper tubes with all joints brazed.
2. Single slab, single pass design to facilitate easy coil cleaning. Composite coils or coils that require unit top panels removed are not acceptable.
3. Dual circuit models shall have face-split type evaporator coil.
4. Coils shall at minimum be leak tested at 150 psig, pressure tested at 450 psi, and qualified to UL 1995 burst test at 1775 psig.
5. Evaporator Fins: Aluminum lanced plate fins mechanically bonded to copper tubes.
6. Condenser Fins: Aluminum lanced plate fins mechanically bonded to copper tubes.
7. Alternate Condenser Fins: Aluminum-fins pre-coated with a durable epoxy-phenolic coating. Coating shall be applied to the aluminum fin stock prior to the fin stamping process to create an inert barrier between the aluminum fin and copper tube. Epoxy-phenolic barrier shall minimize galvanic action between dissimilar metals.

F. Filter Section

1. Filter rack shall be capable of housing 2 inch or 4 inch filters (field convertible to 4 inch is acceptable)
2. Filter section shall use standard size filters and be of common sizes within cabinet sizes.
3. Filters shall be accessible through a hinged access panel and be on a slide-out track.
4. Filter shall be MERV 13A

G. Controls and Safeties

1. Safeties:
 - a. Unit shall incorporate a solid-state compressor lockout that provides optional reset capability at the space thermostat, if any of the following safety devices trip and shut off compressor:
 - 1) Compressor lockout protection provided for either internal or external overload
 - 2) Low-pressure protection
 - 3) Freeze protection (evaporator coil)
 - 4) High-pressure protection (high pressure switch or internal)
 - 5) Loss of charge protection
 - 6) Start assist on single-phase units
 - b. Supply-air sensor shall be located in the unit

H. Roof Curb Adapters

1. Units must be capable of using a roof curb adapter. No re-roofing of existing curb adapter allowed.

- I. Integrated Economizer
 - 1. Include only for units scheduled to have economizer on drawings
 - 2. Title 24 compliant
 - 3. Low-leakage, opposing, gear-driven dampers with UL approved gears.
 - 4. Capable of introducing up to 100% outdoor air
 - 5. Damper actuator shall be electronic fully modulating design
 - 6. Economizer outdoor hood shall be pre-painted and fully assembled
 - 7. Fixed outdoor air drybulb temperature lockout set to setpoint mandated by Title 24 for this climate zone.
- J. Barometric Relief
 - 1. Include only for units scheduled to have barometric relief on drawings
 - 2. Package shall include damper, seals, hardware, and hoods to relieve excess internal pressure.
 - 3. Damper shall close due to gravity upon unit shutdown.
- K. Thermostatic Control
 - 1. BACnet MSTP interface.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General
 - 1. Maintain all recommended clearances.
 - 2. Comply with all manufacturers' recommendation.
- B. Rooftop Units
 - 1. Coordinate roof penetration, concrete pads, and other structural supports with others.
 - 2. For sloped roofs sloped ¼" per foot or less, install wood shims under curb to provide a level unit installation. For steeper slopes, provide a custom curb in place of standard manufacturer's curb to provide a level unit installation.
 - 3. Furnish 2-inch thick, 2 pcf density insulation alongside of curb.
 - 4. Per acoustical consultant recommendation, install the unit on ½" to 1" thick closed-cell elastomeric vibration isolation foam, Getzner Sylodyn, between the unit and curb.
 - a. Elastomeric foam isolators are produced using engineered materials including mixed-cell polyurethane foam and should be selected based on the weight loading along the support surface strip (psi) based on equipment weight.
 - b. Contact: Alexander Born, Getzner USA, alexander.born@getzner.com, 704-966-2085
- C. Split Systems
 - 1. See Section 232113 HVAC Piping for refrigerant piping.
 - 2. See Section 230700 Mechanical Insulation for piping insulation. Insulate both lines where specified and where recommended by manufacturer.
 - 3. Purge and charge refrigeration system as recommended by the manufacturer.
- D. Condensate Drains
 - 1. Provide condensate pump where scheduled. See Section 233300 Duct Accessories.
 - 2. See Section 220000 Plumbing
 - 3. Test cooling coil drain pans. See Section 233300 Duct Accessories

3.2 ISOLATION AND SEISMIC RESTRAINTS

- A. See Section 230548 Vibration and Seismic Control

- B. Contractor or AC unit vendor shall be responsible for anchorage details of units including all structural calculations stamped and signed by a registered engineer.
- C. Make duct connections to unit with flexible connections.

3.3 CONTROLS

- A. See Division 25 Building Automation Systems for control system integration and field wiring requirements.
- B. For VAV units, extend duct static pressure tube and flow tip to a minimum of 2/3 of the way down the duct system, but not downstream of any fire/smoke dampers, unless otherwise indicated in Division 25 Building Automation Systems.
- C. For units with economizer relief building pressure sensors, extend building static pressure sensing tube to a plate sensor located in an interior zone, unless otherwise indicated in Division 25 Building Automation Systems.

3.4 INSPECTION

- A. Verify that adequate clearance between fans and adjacent walls or equipment is available to permit maintenance and repairs.

3.5 PRE-OPERATING CHECKS

- A. Before operating fans
 - 1. See Section 230800 Mechanical Commissioning
- B. Do not operate fans for any purpose, temporary or permanent until
 - 1. Ductwork is clean
 - 2. Temporary of final air filters in place. See Section 234000 Air Cleaning Devices
 - 3. Bearings lubricated

3.6 START-UP, TESTING, AND ADJUSTING

- A. Start-Up
 - 1. General: Comply with manufacturer's instructions
 - 2. Start-up of VAV AC units shall be provided under the direct supervision of each manufacturer's representative with factory trained personnel.
- B. See Section 230593 Testing, Adjusting, and Balancing
- C. Commissioning: See Section 230800 Mechanical Commissioning

3.7 TRAINING

- A. See Section 230800 Mechanical Commissioning

END OF SECTION 238119