

**SECTION 237413**

**ROOFTOP AIR CONDITIONERS**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. The requirements of Section 230000, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 230500, "Basic Mechanical Materials and Methods" apply to work defined by the Section.

1.2 SUMMARY

- A. This Section includes the following rooftop air conditioners:
  - 1. **Cooling and heating** units **7-1/2 to 20 tons**.
- B. Related Sections include the following:
  - 1. Division 23 "Direct-Fired, Makeup Air Units" for outside units providing 100 percent tempered outside air without heat exchangers.
  - 2. Division 23 "Indirect-Fired, Packaged H&V Units" for outside units providing 100 percent tempered outside air with heat exchangers.

1.3 DEFINITIONS

- A. DDC: Direct-digital controls.

1.4 SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Prepare the following by or under the supervision of a qualified professional engineer:
  - 1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
  3. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that rooftop air conditioners, accessories, and components will withstand seismic forces defined in Division 23 Section "Mechanical Vibration and Seismic Controls." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
    - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For rooftop air conditioners to include in emergency, operation, and maintenance manuals.
- F. Warranties: Special warranties specified in this Section.

## 1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of rooftop air conditioners and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- D. ASHRAE Compliance:
1. Comply with ASHRAE 15 for refrigeration system safety.
  2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
  3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

- F. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- G. UL Compliance: Comply with UL 1995.
- H. Comply with NFPA 54 for gas-fired furnace section.
- I. ARI Certification: Units shall be ARI certified and listed.
- J. ARI Compliance:
  - 1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
  - 2. Comply with ARI 270 for testing and rating sound performance for RTUs.

#### 1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."
- C. Coordinate size, location, and installation of rooftop air-conditioner manufacturer's roof curbs and equipment supports with roof installer.
  - 1. Coordinate installation of restrained vibration isolation roof-curb rails.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of rooftop air conditioners that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than **five** years from date of Substantial Completion.
  - 2. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than **three** years from date of Substantial Completion.
  - 3. Warranty Period for Control Boards: Manufacturer's standard, but not less than **three** years from date of Substantial Completion.
  - 4. Warranty Period for Variable-Speed Fan Motors: Manufacturer's standard, but not less than **three** years from date of Substantial Completion.
  - 5. Warranty Period for Electronic Thermostats: Manufacturer's standard, but not less than **three** years from date of Substantial Completion.

## 1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fan Belts: **One set** for each belt-drive fan.
  2. Filters: **two set** of filters for each unit.

**PART 2 - PRODUCTS**

## 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Rooftop Air Conditioners 7-1/2 Tons to 20 Tons (26 to 70 kW):
    - a. Addison Products Company.
    - b. Carrier Corporation.
    - c. Engineered Air.
    - d. Governair.
    - e. Lennox Industries Inc.
    - f. Mammoth Inc.
    - g. McQuay International.
    - h. Skymark International, Inc.
    - i. Trane; American Standard Companies, Inc.
    - j. YORK International Corporation.
    - k. Tempmaster

## 2.2 ROOFTOP AIR CONDITIONERS 7-1/2 TO 20 TONS

- A. Description: Factory assembled and tested; designed for exterior installation; consisting of compressor, indoor and outside refrigerant coils, indoor fan and outside coil fan, refrigeration and temperature controls, filters, and dampers.
- B. Casing: Galvanized-steel construction with enamel paint finish, removable panels or access doors with neoprene gaskets for inspection and access to internal parts, minimum **1/2-inch** thick thermal insulation, knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs.
- C. Indoor Fan: Forward curved, centrifugal, belt driven with **adjustable** motor sheaves, grease-lubricated ball bearings, and motor.
- D. Outside Coil Fan: Propeller type, directly driven by permanently lubricated motor.

- E. Refrigerant Coils: Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
- F. Compressor(s): hermetic compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief
- G. Refrigeration System:
1. Compressor(s).
  2. Outside coil and fan.
  3. Indoor coil and fan.
  4. Four-way reversing valve and suction line accumulator.
  5. Check valves.
  6. Expansion valves with replaceable thermostatic elements.
  7. Refrigerant dryers.
  8. High-pressure switches.
  9. Low-pressure switches.
  10. Thermostats for coil freeze-up protection during low-ambient temperature operation or loss of air.
  11. Independent refrigerant circuits.
  12. Brass service valves installed in discharge and liquid lines.
  13. Charge of refrigerant.
  14. Hot-Gas Bypass: Factory-installed valve.
  15. Timed Off Control: Automatic-reset control shuts compressor off after five minutes.
- H. Filters: **2-inch-** thick, fiberglass, **pleated**, throwaway filters in filter rack.
- I. Heat Exchanger: **Aluminized-steel** or **Stainless-steel** construction for **natural**-gas-fired burners with the following controls:
1. Redundant dual gas valve with manual shutoff.
  2. Direct-spark pilot ignition.
  3. Electronic flame sensor.
  4. Induced-draft blower.
  5. Flame rollout switch.
- J. Electric Heat: Helix-wound, nickel-chrome, electric-resistance elements, factory wired for single-point wiring connection; with time delay for element staging, and overcurrent and overheat protective devices.
- K. Outside-Air Damper: Linked damper blades, for 0 to 25 percent outside air, with **manual slide and fully modulating, spring-return damper motor and hood**.
- L. Economizer: Return- and outside-air dampers with neoprene seals, outside-air filter, and hood.
1. Damper Motor: Fully modulating spring return with adjustable minimum position.
  2. Control: Electronic-control system uses **mixed-air and outside-air temperature** to adjust mixing dampers.
  3. Relief Damper: Gravity actuated with bird screen and hood.

- M. Power Connection: Provide for single connection of power to unit with **unit-mounted disconnect switch accessible from outside unit and** control-circuit transformer with built-in circuit breaker.
- N. Unit Controls: Solid-state control board and components contain at least the following features:
1. Indoor fan on/off delay.
  2. Default control to ensure proper operation after power interruption.
  3. Service relay output.
  4. Unit diagnostics and diagnostic code storage.
  5. Field-adjustable control parameters.
  6. Defrost control.
  7. Dehumidification control with dehumidistat.
  8. Economizer control.
  9. Electric heat staging.
  10. Gas valve delay between first- and second-stage firing.
  11. Indoor-air quality control with carbon dioxide sensor.
  12. Low-ambient control, allowing operation down to **0 deg F**.
  13. Minimum run time.
  14. Night setback mode.
  15. Return-air temperature limit.
  16. Smoke alarm with smoke detector installed in **supply and return air**.
  17. Low-refrigerant pressure control.
  18. Digital display of outside temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters.
- O. DDC Temperature Control: Install stand-alone control module providing link between unit controls and DDC temperature-control system. Control module shall be compatible with temperature-control system specified in Division 23 Section "HVAC Instrumentation and Controls."
- P. Electromechanical Thermostat: Staged heating and cooling on subbase with manual system switch (on-heat-auto-cool) and fan switch (auto-on).
1. Night setback operation with single-stage heating control with **seven-day** time clock with battery backup.
  2. Fan-proving switch to lock out unit if fan fails.
  3. Dirty-filter switch.
- Q. Thermostat: Programmable, electronic; with heating setback and cooling setup with seven-day programming; and the following:
1. Touch sensitive keyboard.
  2. Automatic switching.
  3. **Deg F** readout.
  4. LED indicators.
  5. Hour/day programming.
  6. Manual override capability.
  7. Time and operational mode readout.
  8. Status indicator.
  9. Battery backup.

10. Sub-base with manual system switch (on-heat-auto-cool) and fan switch (auto-on).
11. Fan-proving switch to lock out unit if fan fails.
12. Dirty-filter switch.

R. Optional Accessories:

1. Cold-Weather Kit: Electric heater maintains temperature in gas burner compartment.
2. Service Outlets: Two, 115-V, ground-fault, circuit-interrupter type.
3. condensate drain trap.
4. Dirty-filter switch.
5. **Hail guards of steel, painted to match casing.**
6. **Step-down** diffuser with aluminum grilles, insulated diffuser box with flanges, and interior transition.
7. Power exhaust fan.
8. Vertical vent extension.

S. Roof Curb: Steel with corrosion-protection coating, gasketing, and factory-installed wood nailer; complying with NRCA standards; minimum height of **24 inches**.

T. Horizontal Discharge Roof Curb: Steel with corrosion-protection coating, **[insulation,]** gasketing, and factory-installed wood nailer, and configured to convert from downflow to horizontal airflow; complying with NRCA standards; minimum height of **26 inches**.

U. Isolation Curb: Rigid upper and lower steel structure with vibration isolation springs having **[2-inch]** static deflection and vertical and horizontal restraints; with elastomeric waterproof membrane.

## 2.3 MOTORS

- A. Comply with requirements in Division 23, Section 230500 Basic Mechanical Materials and Methods, "Motors for Mechanical Equipment."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances. **Install according to ARI Guideline B.**
- B. Curb Support: Install roof curb on roof structure, level and secure, according to NRCA's **"Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts.** Install and secure rooftop air conditioners on curbs and coordinate roof penetrations and flashing with roof construction. **Secure units to curb support with anchor bolts.**
- C. Unit Support: Install unit level on structural **curbs**. Coordinate wall penetrations and flashing with wall construction. **Secure units to structural support with anchor bolts.**

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
  - 1. Gas Piping: Comply with applicable requirements in Division 23 Section "Fuel Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
  - 2. Hot-Water Heating Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.
  - 3. Steam and Condensate Piping: Comply with applicable requirements in Division 23 Section "Steam and Condensate Piping." Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.
- C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
  - 1. Install ducts to termination in roof curb.
  - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
  - 3. Connect supply ducts to rooftop unit with flexible duct connectors specified in Division 23 Section "Duct Accessories."
  - 4. Terminate return-air duct through roof structure and insulate space between roof and bottom of unit with ~~2-inch~~ thick, acoustic duct liner.
  - 5. Install normal-weight, ~~3000 psi~~, compressive strength (28-day) concrete mix inside roof curb, [~~4 inches~~] **<Insert thickness>** thick. Concrete, formwork, and reinforcement are specified in Division 3.
- D. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding."
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, **test, and adjust** field-assembled components and equipment installation, including connections, **and to assist in field testing**. Report results in writing.
- B. Perform the following field quality-control tests and inspections and prepare test reports:
  - 1. After installing rooftop air conditioners and after electrical circuitry has been energized, test units for compliance with requirements.



2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove malfunctioning units, replace with new units, and retest as specified above.

### 3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, air-cooled outside coil, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean outside coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Adjust vibration isolators.
13. Inspect operation of barometric dampers.
14. Lubricate bearings on fan.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.
  - a. Start refrigeration system in summer only.
  - b. Complete startup sheets and attach copy with Contractor's startup report.
18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency. Adjust pilot to stable flame.
  - a. Measure gas pressure on manifold.
  - b. Measure combustion-air temperature at inlet to combustion chamber.
  - c. Measure flue-gas temperature at furnace discharge.
  - d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
  - e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

21. Calibrate thermostats.
22. Adjust and inspect high-temperature limits.
23. Inspect outside-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following:
  - a. Coil leaving-air, dry- and wet-bulb temperatures.
  - b. Coil entering-air, dry- and wet-bulb temperatures.
  - c. Outside-air, dry-bulb temperature.
  - d. Outside-air-coil, discharge-air, dry-bulb temperature.
25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
  - a. Supply-air volume.
  - b. Return-air volume.
  - c. Relief-air volume.
  - d. Outside-air intake volume.
27. Simulate maximum cooling demand and inspect the following:
  - a. Compressor refrigerant suction and hot-gas pressures.
  - b. Short circuiting of air through outside coil or from outside coil to outside-air intake.
28. Verify operation of remote panel, including pilot-light operation and failure modes. Inspect the following:
  - a. High-limit heat exchanger.
  - b. Warm-up for morning cycle.
  - c. Freezestat operation.
  - d. Economizer to limited outside-air changeover.
  - e. Alarms.
29. After startup and performance testing, change filters, vacuum heat exchanger and cooling and outside coils, lubricate bearings, adjust belt tension, and inspect operation of power vents.

### 3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.

## 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain rooftop air conditioners. Refer to Division 1 Section **"Demonstration and Training."**

**END OF SECTION 237413**