

SECTION 23 74 13

PACKAGED OUTDOOR ROOFTOP UNTIS

PART 1 GENERAL

1.01 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. Quality Assurance Data:
 - 1. Comply with NFPA 54 for gas-fired furnace section.
 - 2. Gas units AGA-approved specifically for outdoor installation.
 - 3. RTU manufacturer-specific (e.g., Carrier) gas trains and controls are not acceptable.
 - 4. ARI Compliance for Units with Capacities Less Than 135,000 Btuh: Rate rooftop air-conditioner capacity according to ARI 210/240, "Unitary Air-Conditioning and Air-Source Heat Pump Equipment."
 - a) Sound Power Level Ratings: comply with ARI 270, "Sound Rating of Outdoor Unitary Equipment."
 - 5. ARI Compliance for Units with Capacities 135,000 Btuh and More: Rate rooftop air-conditioner capacity according to ARI 340/360, "Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment."
 - a) Sound Power Level Ratings: Comply with ARI 270, "Sound Rating of Outdoor Unitary Equipment."
 - 6. Units UL-listed and carry UL label.
 - 7. International Energy Conservation Code 2015 compliance.
- C. 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.
 - 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. Provide complete selection showing:
 - a) Catalogued capacity rating of packaged unit for standard conditions.
 - b) Correction factors that have been applied to sensible heat capacity for actual entering dry-bulb temperature conditions.
 - c) Actual leaving dry-bulb temperature.
 - d) Indoor fan motor heat has been included.
 - e) De-ration of total unit capacity for 5,400 feet altitude using 105°F temperature for air entering condenser.
- D. Project Record Documents:
 - 1. Shop Drawings:
 - a) Certified elevation and outline drawings with dimensions.
 - b) Certified plan view drawings with dimensions.
- E. Wiring and termination drawings (Operation and Maintenance Data): For rooftop air conditioners to include in emergency, operation, and maintenance manuals.
- F. Warranties: Special warranties specified in this Section.

1.02 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section Roof Accessories.

1.03 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: One set of filters for each unit.

PART 2 PRODUCTS

2.01 SINGLE ZONE PACKAGED ROOFTOP HVAC UNITS 6 TONS AND SMALLER

- A. Acceptable Manufacturers:
 - 1. Aeon
 - 2. ~~Carrier~~
 - 3. McQuay
 - 4. Trane
 - 5. York
 - 6. ~~Engineered Air~~
- B. 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.
- C. Casing: Galvanized-steel construction with enamel paint finish, removable panels or access doors with neoprene gaskets for inspection and access to internal parts, minimum 2" thick double wall foam injected insulation, knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs.
- D. Indoor Fan: Forward curved, centrifugal, belt driven by single-speed motor.
- E. Outside Coil Fan: Propeller type, directly driven by motor.
- F. Refrigerant Coils: Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
- G. Compressor: Hermetic reciprocating compressor with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief, and crankcase heater.
- H. Refrigeration System:
 - 1. Compressor.
 - 2. Outside coil and fan.
 - 3. Indoor coil and fan.
 - 4. Four-way reversing valve and suction line accumulator.
 - 5. Expansion valve with replaceable thermostatic element.
 - 6. Refrigerant dryer.
 - 7. High-pressure switch.
 - 8. Low-pressure switch.
 - 9. Thermostat for coil freeze-up protection during low-ambient temperature operation or loss of air.
 - 10. Low-ambient switch.
 - 11. Brass service valves installed in discharge and liquid lines.
 - 12. Charge of refrigerant.
- I. Filters: In accordance with Division 21-25.

- J. Heat Exchanger: Stainless-steel construction for natural-gas-fired burners with the following controls:
 - 1. Redundant single or dual gas valve with manual shutoff.
 - 2. Direct-spark pilot ignition.
 - 3. Electronic flame sensor.
 - 4. Induced-draft blower.
 - 5. Flame rollout switch.
- K. Outside-Air Damper: Linked damper blades, for 0 to 25 percent outside air, with 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. Damper Performance: Air leakage rate not greater than 4 cfm/ft² of damper surface area at 1.0 inch water gauge and labled by an approved agency when tested in accordance with AMCA 500D for such purpose.
 - 3. Control: Electronic-control system uses mixed-air temperature and selects between outside-air and return-air enthalpy to adjust mixing dampers.
 - 4. 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. Dehumidification control with dehumidistat.
 - 7. Economizer control.
 - 8. Gas valve delay between first- and second-stage firing.
 - 9. Indoor-air quality control with carbon dioxide sensor.
 - 10. Low-ambient control, allowing operation down to -30°F.
 - 11. Minimum run time.
 - 12. Night setback mode.
 - 13. Return-air temperature limit.
 - 14. Smoke alarm with smoke detector installed in supply and return air as required.
 - 15. Low-refrigerant pressure control.
 - 16. Digital display of outside temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters.
 - 17. Economizer Fault Detection and Diagnostics (FDD).
 - a) The following temperature sensors shall be permanently installed to monitor system operation:
 - i) Outside air.
 - ii) Supply air.
 - iii) Return air.
 - b) Temperature sensors shall have an accuracy of $\pm 2^{\circ}\text{F}$ over the range of 40°F to 80°F.

- c) Refrigerant pressure sensors, where used, shall have an accuracy of ± 3 percent of full scale.
 - d) The unit controller shall be capable of providing system status by indicating the following:
 - i) Free cooling available.
 - ii) Economizer enabled.
 - iii) Compressor enabled.
 - iv) Heating enabled.
 - v) Mixed air low limit cycle active.
 - vi) The current value of each sensor.
 - e) The unit controller shall be capable of manually initiating each operating mode so that the operation of compressors, economizers, fans and the heating system can be independently tested and verified.
 - f) The unit shall be capable of reporting faults to a fault management application accessible by day-to-day operating or service personnel, or annunciated locally on zone thermostats.
 - g) The FDD system shall be capable of detecting the following faults:
 - i) Air temperature sensor failure/fault.
 - ii) Not economizing when the unit should be economizing.
 - iii) Economizing when the unit should not be economizing.
 - iv) Damper not modulating.
 - v) Excess outdoor air.
- O. DDC Temperature Control: Install stand-alone controls compatible with controls specified in section 25 90 00 providing link between unit controls and DDC temperature-control systems in section 25 90 00 and Section 25 50 00 – Intelligent Building Automation System (IBAS).
- P. 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. Subbase 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.
- Q. 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. Power exhaust fan.
 7. Demand control ventilation.
- R. Roof Curb: Steel with corrosion-protection coating, gasketing, and factory-installed wood nailer; complying with NRCA standards; minimum height of 14 inches.

2.02 ROOFTOP AIR CONDITIONERS 7-1/2 TO 20 TONS

- A. Acceptable Manufacturers:
1. AAON, Inc.
 2. ~~Carrier Corp.~~
 3. ~~Engineered Air~~
 4. Mammoth Inc.
 5. McQuay International
 6. Trane Company (The); North American Commercial Group
 7. YORK International Corporation
- B. 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.
- C. Casing: Galvanized-steel, double wall construction with enamel paint finish, hinged panels or access doors with neoprene gaskets for inspection and access to internal parts, minimum 2-inch-thick foam-injected insulation, knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs.
- D. Indoor Fan: Forward curved, centrifugal, belt driven with adjustable motor sheaves, grease-lubricated ball bearings, and motor.
- E. Outside Coil Fan: Propeller type, directly driven by permanently lubricated motor.
- F. Refrigerant Coils: Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.[Provide phenolic epoxy corrosion-protection coating to both coils.]
- G. Compressor(s): Hermetic reciprocating compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief , and crankcase heater(s).
- H. 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 (no greater than 50% of total capacity)
 15. Timed Off Control: Automatic-reset control shuts compressor off after five minutes

- I. Filters: In accordance with Section 23 40 00 HVAC Air Cleaning Devices.
- J. Heat Exchanger: 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.
- K. Outside-Air Damper: Linked damper blades, for 0 to 25 percent outside air, with 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. Damper Performance: Air leakage rate not greater than 4 cfm/ft² of damper surface area at 1.0 inch water gauge and labled by an approved agency when tested in accordance with AMCA 500D for such purpose.
 - 3. Control: electronic-control system uses mixed-air temperature and selects between outside-air and return-air enthalpy to adjust mixing dampers.
 - 4. 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. Economizer control.
 - 7. Electric heat staging.
 - 8. Gas valve delay between first- and second-stage firing.
 - 9. Indoor-air quality control with carbon dioxide sensor.
 - 10. Low-ambient control, allowing operation down to 0°F.
 - 11. Minimum run time.
 - 12. Night setback mode.
 - 13. Return-air temperature limit.
 - 14. Smoke alarm with smoke detector installed in supply and return air as required.
 - 15. Low-refrigerant pressure control.
 - 16. Digital display of outside temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters.
 - 17. Variable-Air-Volume Control: variable-frequency drive controls supply-air static pressure. Supply-air, static-pressure limit shuts unit down on high pressure.
 - 18. Economizer Fault Detection and Diagnostics (FDD):
 - a) The following temperature sensors shall be permanently installed to monitor system operation:
 - i) Outside air.

- ii) Supply air.
 - iii) Return air.
 - b) Temperature sensors shall have an accuracy of $\pm 2^{\circ}\text{F}$ over the range of 40°F to 80°F .
 - c) Refrigerant pressure sensors, where used, shall have an accuracy of ± 3 percent of full scale.
 - d) The unit controller shall be capable of providing system status by indicating the following:
 - i) Free cooling available.
 - ii) Economizer enabled.
 - iii) Compressor enabled.
 - iv) Heating enabled.
 - v) Mixed air low limit cycle active.
 - vi) The current value of each sensor.
 - e) The unit controller shall be capable of manually initiating each operating mode so that the operation of compressors, economizers, fans and the heating system can be independently tested and verified.
 - f) The unit shall be capable of reporting faults to a fault management application accessible by day-to-day operating or service personnel, or annunciated locally on zone thermostats.
 - g) The FDD system shall be capable of detecting the following faults:
 - i) Air temperature sensor failure/fault.
 - ii) Not economizing when the unit should be economizing.
 - iii) Economizing when the unit should not be economizing.
 - iv) Damper not modulating.
 - v) Excess outdoor air.
- O. DDC Temperature Control: Install stand-alone controls compatible with controls specified in section 15950 providing link between unit controls and DDC temperature-control systems in section 15950 and Section 15975 Integrated Building Automation System (IBAS).
- P. 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. Subbase 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.
- Q. 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. PVC condensate drain trap.
 4. Dirty-filter switch.
 5. Hail guards of steel, painted to match casing.
 6. Power exhaust fan centrifugal type.
 7. Vertical vent extension.
 8. Demand control ventilation.
- R. Roof Curb: Steel with corrosion-protection coating, gasketing, and factory-installed wood nailer; complying with NRCA standards; minimum height of 14 inches.

2.03 ROOFTOP AIR CONDITIONERS LARGER THAN 20 TONS

- A. Acceptable Manufacturers:
1. AAON, Inc.
 2. ~~Carrier Corp.~~
 3. ~~Engineered Air~~
 4. Mammoth Inc.
 5. McQuay International
 6. Trane Company (The); North American Commercial Group
 7. YORK International Corporation
- B. 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.
- C. Casing: Manufacturer's standard double-wall galvanized sheet metal construction with exterior enamel paint finish, hinged access doors with neoprene gaskets for inspection and access to internal parts, minimum 2" thick foam-injected thermal insulation, knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs.
- D. Indoor Fan: Forward curved or Airfoil, centrifugal, belt driven with adjustable motor sheaves, grease-lubricated ball bearings, and motor Mount fan and motor assembly on base with spring isolators having 2-inch deflection.
- E. Return-Air Fan: Forward curved or Airfoil, centrifugal, belt driven with adjustable motor sheaves, grease-lubricated ball bearings, and motor Mount fan and motor assembly on base with spring isolators having 2-inch deflection.
- F. Outside Coil Fan: Propeller type, directly driven by permanently lubricated motor.
- G. Refrigerant Coils: Aluminum-plate fin and seamless copper tube in galvanized-steel casing with equalizing-type vertical distributor and thermal expansion valve; tested to 450 psig and leak tested to 300 psig with air under water. Insulate coil section. Provide phenolic epoxy corrosion-protection coating to both coils. Provide stainless-steel drain pan under indoor coil.
- H. Compressor(s): Semihermetic reciprocating compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief, and crankcase heater(s).
- I. 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. Timed Off Control: Automatic-reset control shuts compressor off after five minutes
 15. Refrigerant Circuits: Interlaced refrigerant-coil circuiting with circuit for each compressor
 16. Capacity Control: Cylinder unloaders with steps as scheduled
 17. Capacity Control: Hot-gas bypass valve and piping on one compressor (not greater than 25% of total capacity)
 18. Compressor Motor Overload Protection: Manual reset
 19. Antirecycling Timing Device: Prevents compressor restart for five minutes after shutdown
 20. Adjustable, Low-Ambient, Head-Pressure Control: designed to operate at temperatures as low as 0 deg F by cycling outside coil fans and controlling speed of last fan of each circuit
 21. Oil-Pressure Switch: Designed to shut down compressors on low oil pressure
- J. Filters: In accordance with Section 23 40 00 HVAC Air Cleaning Devices.
- K. Heat Exchanger: Stainless-steel construction for natural-gas-fired burners with the following controls:
1. Redundant dual gas valve with manual shutoff.
 2. Limited modulating gas valve with turn-down ratio of at least 3:1.
 3. Direct-spark pilot ignition.
 4. Electronic flame sensor.
 5. Induced-draft blower.
 6. Flame rollout switch.
- L. Water Heating Coils: Aluminum-plate fin and seamless copper tube in galvanized-steel casing, tested to 300 psig and leak tested to 200 psig with air under water; with modulating control valve and actuator. Insulate coil section.
- M. Outside-Air Damper: Linked damper blades, for 0 to 25 percent outside air, with fully modulating, spring-return damper motor and hood.
- N. Economizer: Return- and outside-air dampers with neoprene seals, outside-air filter, and hood.
1. Relief Damper: Gravity actuated with bird screen and hood.
 2. Damper Performance: Air leakage rate not greater than 4 cfm/ft² of damper surface area at 1.0 inch water gauge and labled by an approved agency when tested in accordance with AMCA 500D for such purpose.
- O. 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.
- P. 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. Economizer control Electric heat staging.
8. Gas valve delay between first- and second-stage firing.
9. Low-ambient control, allowing operation down to 0°F.
10. Minimum run time.
11. Night setback mode.
12. Return-air temperature limit.
13. Smoke alarm with smoke detector installed in supply and return air.
14. Low-refrigerant pressure control.
15. Digital display of outside temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters
16. Variable-Air-Volume Control: Variable-frequency drive controls supply-air static pressure. Supply-air, static-pressure limit shuts unit down on high pressure
17. DDC Temperature Control Provided and installed by section 25 00 00 Integrated Automation (Refer to Section 25 50 00 Integrated Building Automation System (IBAS)) for interface requirements.
18. Economizer Fault Detection and Diagnostics (FDD)
 - a) The following temperature sensors shall be permanently installed to monitor system operation:
 - i) Outside air.
 - ii) Supply air.
 - iii) Return air.
 - b) Temperature sensors shall have an accuracy of $\pm 2^{\circ}\text{F}$ over the range of 40°F to 80°F.
 - c) Refrigerant pressure sensors, where used, shall have an accuracy of ± 3 percent of full scale.
 - d) The unit controller shall be capable of providing system status by indicating the following:
 - i) Free cooling available.
 - ii) Economizer enabled.
 - iii) Compressor enabled.
 - iv) Heating enabled.
 - v) Mixed air low limit cycle active.
 - vi) The current value of each sensor.
 - e) The unit controller shall be capable of manually initiating each operating mode so that the operation of compressors, economizers, fans and the heating system can be independently tested and verified.
 - f) The unit shall be capable of reporting faults to a fault management application accessible by day-to-day operating or service personnel, or annunciated locally on zone thermostats.
 - g) The FDD system shall be capable of detecting the following faults:
 - i) Air temperature sensor failure/fault.
 - ii) Not economizing when the unit should be economizing.
 - iii) Economizing when the unit should not be economizing.
 - iv) Damper not modulating.
 - v) Excess outdoor air.

Q. 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. PVC condensate drain trap
 4. Dirty-filter switch
 5. Hail guards of steel, painted to match casing
 6. Power exhaust fan, forward curved, centrifugal, belt driven with adjustable sheaves
 7. Vertical vent extension
 8. Demand control ventilation
- R. Roof Curb: Steel with corrosion-protection coating, gasketing, and factory-installed wood nailer; complying with NRCA standards; minimum height of 14 inches.

2.04 MOTORS

- A. General requirements for motors are specified in Division 23.
- B. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances
- B. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other Division 21-25 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Gas Piping: Comply with applicable requirements in Specification Section 23 11 23 Natural Gas Systems. 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.
 1. Gas lines and electrical conduit over 2" shall be fastened to Unistrut stands. Stands shall be mechanically fastened to 2'x2'x2" concrete paver. Pavers shall be set on modified rolled roofing pads. One stand for every ten foot (10') of gas line and no more than one paver per stand.
 2. Hot-Water Heating Piping: comply with applicable requirements Specification Section 23 11 13 Hydronic Piping. Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.
- D. Duct installation requirements are specified in Specification Section 23 31 00 HVAC Duct and Casing. 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. Terminate return-air duct through roof structure and insulate space between roof and bottom of unit with 2" thick, acoustic duct liner.
- E. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.
- F. Rooftop conduits shall be fastened to sheet metal triangle stands. Stands shall be mechanically fastened to 2'x2'x2" concrete pavers. Pavers shall be set on modified rolled roofing pads. One stand for every ten foot (10') of conduit and no more than one paver per stand. Supports shall not penetrate the roof membrane.

3.03 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 and deliver to DPS.

- 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.

3.04 ADJUSTING

- A. Adjust initial temperature 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.

END OF SECTION 23 74 13