SECTION 237413 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:

1. Direct-expansion cooling.
2. Electric-heating coils.
3. Gas furnace.
4. Economizer outdoor- and return-air damper section.
5. Integral, space temperature controls.
6. Roof curbs.

1.2 DEFINITIONS

A. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

B. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

C. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

D. Supply-Air Fan: The fan providing supply-air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

E. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

F. VVT: Variable-air volume and temperature.

1.3 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Performance:

1. Basic Wind Speed: <**Insert value**>.
2. Building Classification Category: [**I**] [**II**] [**III**] [**IV**].
3. Minimum 10 lb/sq. ft multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

B. Seismic Performance: RTUs shall withstand the effects of earthquake motions determined according to [**SEI/ASCE 7**] <**Insert requirement**>.

1. 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."

1.4 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. LEED Submittals:

1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.
2. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

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. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

B. Warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

A. 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.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigerant 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."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than [**five**] [**10**] <**Insert number**> years from date of Substantial Completion.
2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than [**five**] [**10**] [**15**] [**20**] <**Insert number**> years from date of Substantial Completion.
3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than [**three**] <**Insert number**> years from date of Substantial Completion.
4. Warranty Period for Control Boards: Manufacturer's standard, but not less than [**three**] <**Insert number**> years from date of Substantial Completion.

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:

C. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or a comparable product by one of the following:

1. AAON, Inc.
2. Addison Products Company.
3. Carrier Corporation.
4. Engineered Air.
5. Lennox Industries Inc.
6. McQuay International.
7. Trane; American Standard Companies, Inc.
8. YORK International Corporation.
9. <**Insert manufacturer's name**>.

2.2 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

1. Exterior Casing Thickness: [**0.052 inch**] [**0.0626 inch**] [**0.079 inch**] <**Insert thickness**> thick.

C. Inner Casing Fabrication Requirements:

1. Inside Casing: Galvanized steel, [**0.034 inch**] [**0.028 inch**] <**Insert thickness**> thick[**, perforated 40 percent free area**].

D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

1. Materials: ASTM C 1071, Type I.
2. Thickness: [**1/2 inch**] [**1 inch**].
3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
4. Liner Adhesive: Comply with ASTM C 916, Type I.

E. Condensate Drain Pans: Formed sections of [**galvanized**] [**stainless**]-steel sheet, a minimum of 2 inches deep[**, and complying with ASHRAE 62.1**].

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Threaded nipple[**both sides of drain pan**].
3. Pan-Top Surface Coating: Corrosion-resistant compound.

F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.3 FANS

A. Direct-Driven Supply-Air Fans: Double width, [**forward curved**] [**backward inclined**], centrifugal; with permanently lubricated, [**multispeed**] [**ECM**] motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

C. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

D. Relief-Air Fan: [**Propeller**] [**Forward curved**] [**Backward inclined**], shaft mounted on permanently lubricated motor.

E. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment" when fan-mounted frame and RTU-mounted frame are anchored to building structure.

F. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.4 COILS

A. Supply-Air Refrigerant Coil:

1. [**Aluminum**] [**Copper**]-plate fin and seamless[**internally grooved**] copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
3. Coil Split: Interlaced.
4. Condensate Drain Pan: [**Galvanized steel with corrosion-resistant coating**] [**Stainless steel**] formed with pitch and drain connections[**complying with ASHRAE 62.1**].

B. Outdoor-Air Refrigerant Coil:

1. [**Aluminum**] [**Copper**]-plate fin and seamless[**internally grooved**] copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

C. Electric-Resistance Heating:

1. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
2. Overtemperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box.
3. Overcurrent Protection: Manual-reset thermal cutouts, factory wired in each heater stage.
4. Control Panel: Unit mounted with disconnecting means and overcurrent protection. Include the following controls:

    a. [**Magnetic**] [**Mercury**] contactors.
    b. Step Controller: Pilot lights and override toggle switch for each step.
    c. SCR Controller: Pilot lights operate on load ratio, a minimum of five steps.
    d. Time-delay relay.
    e. Airflow proving switch.

2.5 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: [**One**] [**Two**] <**Insert number**>.

B. Compressor: [**Hermetic, reciprocating**] [**Semihermetic, reciprocating**] [**Hermetic, scroll**], mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief[**, and crankcase heater**].

C. Refrigeration Specialties:

1. Refrigerant: [**R-22**] [**R-407C**] [**R-410A**] <**Insert type**>.
2. Refrigerant: R-407C or R-410A.
3. Expansion valve with replaceable thermostatic element.
4. Refrigerant filter/dryer.
5. Manual-reset high-pressure safety switch.
6. Automatic-reset low-pressure safety switch.
7. Minimum off-time relay.
8. Automatic-reset compressor motor thermal overload.
9. Brass service valves installed in compressor suction and liquid lines.

2.6 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Glass Fiber: Minimum [**80**] <**Insert number**> percent arrestance, and [**MERV 5**] <**Insert value**>.
2. Pleated: Minimum [**90**] <**Insert number**> percent arrestance, and [**MERV 7**] <**Insert value**>.

2.7 GAS FURNACE

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.

1. CSA Approval: Designed and certified by and bearing label of CSA.

B. Burners: Stainless steel.

1. Fuel: [**Natural**] [**Propane**] gas.
2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.

3. High-Altitude [**Model**] [**Kit**]: For Project elevations more than 2000 feet above sea level.

C. Heat-Exchanger and Drain Pan: Stainless steel.

D. Venting: Gravity vented[**with vertical extension**].

E. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve[**with vertical extension**].

F. Safety Controls:

1. Gas Control Valve: [**Single stage**] [**Two stage**] [**Modulating**].
2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.8 DAMPERS

A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with [**manual**] [**motorized**] damper filter.

B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

1. Damper Motor: Modulating with adjustable minimum position.
2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

2.9 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with[**unit-mounted disconnect switch accessible from outside unit and**] control-circuit transformer with built-in overcurrent protection.

2.10 CONTROLS

A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC."

B. Basic Unit Controls:

1. Control-voltage transformer.
2. Wall-mounted thermostat or sensor with the following features:

a. Heat-cool-off switch.
b. Fan on-auto switch.
c. Fan-speed switch.
d. [**Manual**] [**Automatic**] changeover.
e. Adjustable deadband.
f. [**Concealed**] [**Exposed**] set point.
g. [**Concealed**] [**Exposed**] indication.
h. [**Degree F**] [**Degree C**] indication.
i. Unoccupied-period-override push button.
j. Data entry and access port to input temperature set points, occupied and unoccupied periods, and output room temperature, supply-air temperature, operating mode, and status.

3. [**Remote Wall**] [**Unit**]-Mounted Annunciator Panel for Each Unit:

    a. Lights to indicate power on, cooling, heating, fan running, filter dirty, and unit alarm or failure.
    b. DDC controller or programmable timer and interface with HVAC instrumentation and control system.
    c. Digital display of outdoor-air temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters.

C. [**Electronic**] [**DDC**] Controller:

1. Controller shall have volatile-memory backup.
2. Safety Control Operation:

    a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
    b. Firestats: Stop fan and close outdoor-air damper if air greater than [**130 deg F**] <**Insert temperature**> enters unit. Provide additional contacts for alarm interface to fire alarm control panel.
    c. Fire Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence described in Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System."

3. Scheduled Operation: Occupied and unoccupied periods on [**seven**] [**365**]-day clock with a minimum of [**two**] [**four**] programmable periods per day.
4. Unoccupied Period:

    a. Heating Setback: [**10 deg F**] <**Insert temperature**>.
    b. Cooling Setback: System off.
    c. Override Operation: [**Two**] <**Insert number**> hours.

5. Supply Fan Operation:

    a. Occupied Periods: Run fan continuously.
    b. Unoccupied Periods: Cycle fan to maintain setback temperature.

6. Refrigerant Circuit Operation:

    a. Occupied Periods: Cycle or stage compressors to match compressor output to cooling load to maintain [**room**] [**discharge**] temperature. Cycle condenser fans to maintain maximum hot-gas pressure.
    b. Unoccupied Periods: Compressors off.

7. Gas Furnace Operation:

    a. Occupied Periods: [**Cycle**] [**Stage**] [**Modulate**] burner to maintain [**room**] [**discharge**] temperature.
    b. Unoccupied Periods: Cycle burner to maintain setback temperature.

8. Electric-Heating-Coil Operation:

    a. Occupied Periods: [**Cycle**] [**Stage**] [**Modulate**] coil to maintain [**room**] [**discharge**] temperature.
    b. Unoccupied Periods: Energize coil to maintain setback temperature.
    c. Operate supplemental electric heating coil with compressor for heating with outdoor temperature below [**25 deg F**] <**Insert temperature**>.

9. Fixed Minimum Outdoor-Air Damper Operation:

    a. Occupied Periods: Open to [**25**] <**Insert percent**> percent.
    b. Unoccupied Periods: Close the outdoor-air damper.

10. Economizer Outdoor-Air Damper Operation:

    a. Occupied Periods: Open to [**10**] [**25**] <**Insert percent**> percent fixed minimum intake, and maximum 100 percent of the fan capacity to comply with ASHRAE Cycle II. Controller shall permit air-side economizer operation when outdoor air is less than [**60 deg F**] <**Insert temperature**>. Use [**outdoor-air temperature**] [**mixed-air and outdoor-air temperature**] [**outdoor-air enthalpy**] [**mixed-air temperature and select between outdoor-air and return-air enthalpy**] to adjust mixing dampers.[**Start relief-air fan with end switch on outdoor-air damper.**] During economizer cycle operation, lock out cooling.
    b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.
    c. Outdoor-Airflow Monitor: Accuracy maximum plus or minus 5 percent within 15 and 100 percent of total outdoor air. Monitor microprocessor shall adjust for temperature, and output shall range from [**2- to 10-V dc**] [**4 to 20 mA**] <**Insert value**>.

11. VVT Relays:

    a. Provide heating- and cooling-mode changeover relays compatible with VVT terminal control system required in Section 233600 "Air Terminal Units" and Section 230900 "Instrumentation and Control for HVAC."

D. Interface Requirements for HVAC Instrumentation and Control System:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide [**BACnet**] [**or**] [**LonWorks**] compatible interface for central HVAC control workstation for the following:

    a. Adjusting set points.
    b. Monitoring supply fan start, stop, and operation.
    c. Inquiring data to include[**outdoor-air damper position,**] supply- and room-air temperature[**and humidity**].
    d. Monitoring occupied and unoccupied operations.

2.11 ACCESSORIES

A. Electric heater with integral thermostat maintains minimum 50 deg F temperature in gas burner compartment.

B. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required.[**Outlet shall be energized even if the unit main disconnect is open.**]

C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

D. Coil guards of painted, galvanized-steel wire.

E. Hail guards of galvanized steel, painted to match casing.

F. Concentric diffuser with white louvers and polished aluminum return grilles, insulated diffuser box with mounting flanges, and interior transition.

2.12 ROOF CURBS

A. Roof curbs with vibration isolators and wind or seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

a. Materials: ASTM C 1071, Type I or II.
b. Thickness: [**1 inch**] [**1-1/2 inches**] [**2 inches**] <**Insert thickness**>.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

a. Liner Adhesive: Comply with ASTM C 916, Type I.
b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
d. Liner Adhesive: Comply with ASTM C 916, Type I.

C. Curb Height: [**14 inches**] [**24 inches**] [**36 inches**] <Insert height>.

D. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment" for wind-load requirements.

2.13 CAPACITIES AND CHARACTERISTICS

A. Supply-Air Fan:

1. Airflow: <**Insert cfm**>.
2. External Static Pressure: <**Insert inches wg**>.
3. Fan Speed: <**Insert rpm**>.
4. Motor Horsepower: <**Insert value**>.
5. Motor Speed: <**Insert rpm**>.

B. Relief-Air Fan:

1. Airflow: <**Insert cfm**>.
2. External Static Pressure: <**Insert inches wg**>.
3. Fan Speed: <**Insert rpm**>.
4. Motor Horsepower: <**Insert value**>.
5. Motor Speed: <**Insert rpm**>.

C. Outdoor-Air-Intake Relief-Air Fan:

1. Airflow: <**Insert cfm**>.
2. Static Pressure: <**Insert inches wg**>.
3. Fan Speed: <**Insert rpm**>.
4. Motor Horsepower: <**Insert value**>.
5. Motor Speed: <**Insert rpm**>.

D. Supply-Air Refrigerant Coil:

1. Total Cooling Capacity: <**Insert Btu/h**>.
2. Sensible Cooling Capacity: <**Insert Btu/h**>.
3. Entering-Air Dry-Bulb Temperature: <**Insert deg F**>.
4. Entering-Air Wet-Bulb Temperature: <**Insert deg F**>.
5. Coating: [**Baked phenolic**] [**Cathodic epoxy**].

E. Outdoor-Air Refrigerant Coil:

1. Ambient-Air Temperature: <**Insert deg F**>.
2. Coating: [**Baked phenolic**] [**Cathodic epoxy**].
3. Fan Motor: <**Insert value**>.
4. Number of Fans: <**Insert number**>.

F. Electric-Resistance Heating Coil:

1. Capacity: <**Insert kilowatts**>.
2. Number of Steps: <**Insert number**>.

G. Compressors:

1. Suction Temperature: <**Insert deg F**>.
2. Power Input: <**Insert kilowatts**>.
3. Energy-Efficiency Ratio (EER): <**Insert value**>.
4. Seasonal Energy-Efficiency Ratio (SEER): <**Insert value**>.
5. Coefficient of Performance (COP): <**Insert value**>.

H. Gas Furnace:

1. Airflow: <**Insert cfm**>.
2. Minimum AFUE: <**Insert value**> percent.
3. Minimum Thermal Efficiency: <**Insert value**> percent.
4. Minimum Combustion Efficiency: <**Insert value**> percent.
5. Input: <**Insert Btu/h**>.
6. Output: <**Insert Btu/h**>.
7. Entering-Air Temperature: <**Insert deg F**>.
8. Air-Temperature Rise: <**Insert deg F**>.

I. Recirculating-Air Filters:

1. Minimum Face Area: <**Insert sq. ft.**>.
2. Thickness: [**1 inch**] [**2 inches**] <**Insert thickness**>.
3. Initial Resistance: <**Insert inches wg**>.
4. Final Resistance: <**Insert inches wg**>.

J. Outdoor-Air Filters:

1. Minimum Face Area: <**Insert sq. ft.**>.
2. Thickness: [**1 inch**] [**2 inches**] <**Insert thickness**>.
3. Initial Resistance: <**Insert inches wg**>.
4. Final Resistance: <**Insert inches wg**>.

K. Electrical Characteristics for Single-Point Connection:

1. Voltage: <**Insert value**>.
2. Phase: <**Insert value**>.
3. Hertz: <**Insert value**>.

4. Full-Load Amperes: <**Insert value**>.
5. Minimum Circuit Ampacity: <**Insert value**>.
6. Maximum Overcurrent Protection: <**Insert amperage**>.

L. Sound Power: Radiated from condenser casing.

1. 1st Octave: <**Insert value**> dB.
2. 2nd Octave: <**Insert value**> dB.
3. 3rd Octave: <**Insert value**> dB.
4. 4th Octave: <**Insert value**> dB.
5. 5th Octave: <**Insert value**> dB.
6. 6th Octave: <**Insert value**> dB.
7. 7th Octave: <**Insert value**> dB.
8. 8th Octave: <**Insert value**> dB.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting: Install RTUs on concrete base using [**elastomeric pads**] [**elastomeric mounts**] [**restrained spring isolators**] <**Insert device**>. Comply with requirements for concrete base specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]

1. Minimum Deflection: [**1/4 inch**] [**1 inch**] <**Insert dimension**>.

B. Roof Curb: Install on roof structure or concrete base, 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."] [ARI Guideline B.] Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

C. Unit Support: Install unit level on structural [**curbs**] [**pilings**]. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

D. Install wind and seismic restraints according to manufacturer's written instructions.[Wind and seismically restrained vibration isolation roof-curb rails are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."]

E. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

F. Install piping adjacent to RTUs to allow service and maintenance.

1. Gas Piping: Comply with applicable requirements in [**Section 231123 "Facility Natural-Gas Piping."**] [**Section 231126 "Facility Liquefied-Petroleum 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.

G. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination at top of 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 RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."

4. Install return-air duct continuously through roof structure.
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 with concrete.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. After installing RTUs 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.

D. Remove and replace malfunctioning units and retest as specified above.

3.3 CLEANING AND ADJUSTING

A. 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**] <**Insert number**> visits to site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

END OF SECTION