# SECTION 15782 - ROOFTOP HEATING AND COOLING UNITS

## PART 1 - GENERAL

### 1.1 DESCRIPTION OF WORK:

A. Extent of packaged rooftop heating and cooling units work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Refer to other Division 15 sections for metal ductwork, air devices, automatic temperature controls not factory-installed, and required for conjunction with packaged heating and cooling units; not work of this section.

C. Electrical Work: Refer to Division 15 section "Electrical Provisions of Mechanical Work" for requirements.

### 1.2 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings:

1. Submit shop drawings detailing the manufacturer's electrical requirements for power supply wiring for rooftop heating and cooling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

2. Submit shop drawings detailing the mounting, securing, and flashing of the roof curb to the roof structure. Indicate coordinating requirements with roof membrane system.

C. Record Drawings: At project closeout, submit record drawings of installed systems products in accordance with requirements of Division 15.

D. Maintenance Data: Submit maintenance data and parts list for each rooftop heating and cooling unit, control, and accessory, including "trouble- shooting" maintenance guide. Include this data in maintenance manual; in accordance with requirements of Division 15.

### 1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of rooftop heating and cooling units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Gas-fired furnace section construction shall be in accordance with AGA safety standards. Furnace section shall bear the AGA label.

2. Testing and rating of rooftop units of 135,000 btu/hr capacity or over shall be in accordance with ARI 360 "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment".

3. Testing and rating of rooftop units under 135,000 btu/hr capacity shall be in accordance with ARI 210 "Standard for Unitary Air-Conditioning Equipment", and provide Certified

Rating Seal. Sound testing and rating of units shall be in accordance with ARI 270 "Standard for Sound Rating of Outdoor Unitary Equipment". Units shall bear Certified Rating Seal.

4. Refrigerating system construction of rooftop units shall be in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".

5. Energy Efficiency Ratio (EER) of rooftop units shall be equal to or greater than prescribed by ASHRAE 90A "Energy Conservation in New Building Design".

6. Provide rooftop units which are UL listed and labeled.

7. Rooftop units shall be designed, manufactured, and tested in accordance with UL requirements.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Handle rooftop units and components carefully to prevent damage. Replace damaged rooftop units or components with new.

B. Store rooftop units and components in clean dry place, off the ground, and protect from weather, water, and physical damage.

C. Rig rooftop units to comply with manufacturer's rigging and installation instructions for unloading rooftop units, and moving them to final location.

1.5 SCHEDULING AND SEQUENCING:

A. Coordinate installation of roof mounting curb with roof structure.

B. Coordinate roof opening locations and for mechanical and electrical connections.

1.6 SPECIAL WARRANTY:

A. Warranty on Compressor and Heat Exchanger: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, compressors and heat exchangers with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.

1. Warranty Period: 5 years from date of substantial completion.

1.7 MAINTENANCE:

A. Extra Materials: Furnish to Owner, with receipt, the following spare parts for each rooftop heating and cooling unit:

1. One set of matched fan belts for each belt-driven fan.

2. One set filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Rooftop Units:

a. McQuay Air Conditioning Group; McQuay Inc.
b. Trane (The) Co; Div of American Standard Inc.
c. York; Div of York International.
d. Lennox Industries

2. Make Up Air Units:

a. Captive Aire
b. Reznor
c. Sterling
d. Trane
e. Aaon

2.2 ROOFTOP UNITS (3 TO 50 TONS):

ENGINEER NOTE: Written around a Trane Voyager unit, 3 to 50 tons. Units 27-1/2 tons and greater can be delivered with VAV, hydronic coils, and other special options. These options are not covered by this specification.

A. General Description: Units shall be factory-assembled and tested, designed for roof or slab installation, and consisting of compressors, condensers, evaporator coils, condenser and evaporator fans, refrigeration and temperature controls, filters, condenser coil guards and dampers. Capacities and electrical characteristics are scheduled on the Drawings.

B. Casing: Manufacturer's standard casing construction, having corrosion protection coating, and exterior finish. Casings shall have removable panels or access doors for inspection and access to internal parts, a minimum of 1/2" thick thermal insulation, knockouts for electrical and piping connections and an exterior condensate drain connection and lifting lugs.

C. Roof Curbs: Manufacturer's standard construction, insulated and having corrosive protective coating, complete with factory-installed wood nailer and drain nipple. Construction shall be in accordance with NRCA Standards.

1. Provide ¾” rubber waffle vibration isolation and around full curb perimeter.

OR

Provide full perimeter spring isolation rail.

OR

Provide rubber gasket around full curb perimeter.

D. Evaporator Fans: Forward-curved, centrifugal, belt-driven fans with adjustable sheaves or direct-driven fans; and permanently lubricated motor bearings.

E. Condenser Fans: Propeller-type, direct-driven fans with permanently lubricated bearings.

F. Coils:

1. General: Aluminum plate fin and seamless copper tube type. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall have a galvanized steel casing. Coils shall be mounted in the coil casing with same end connections accessible for service. Coils shall be removable from the unit through the roof or through the piping enclosure. Coil section shall be completely insulated.

ENGINEER NOTE: Steam/water coils not a factory option on smaller packaged units. Call representative for exact cutoff.

2. Steam Heating Coils: Non-freeze steam coils, pitched in unit casing for proper drainage. Coils shall be double tube type having accurately sized steam distributor tubes and evenly spaced orifices. Orifices shall discharge steam in the direction of condensate flow to ensure even distribution of steam over full length of each tube. Coils shall be proof (150 psig) and leak (100 psig) tested with air pressure under water.

OR

3. Water Heating Coils: Pitched in the unit casing for proper drainage. Coils shall have metering orifices and a supply header to ensure distribution of hot water to each tube. Coils shall be proof (300 psig) and leak (200 psig) tested with air pressure under water continuous tube type, and proof (300 psig) and leak (200 psig) tested with air pressure under water.

4. Refrigerant Cooling Coils: Have an equalizing type vertical distributor to ensure each coil circuit receives the same amount of refrigerant. Coils shall be proof (450 psig) and leak (300 psig) tested with air pressure under water, then cleaned, dehydrated, and sealed with a holding charge of nitrogen.

G. Compressors: Serviceable, semi-hermetic, or fully hermetic compressors, complete with integral vibration isolators and crankcase heaters.

H. Safety Controls: Manual reset type for:

1. Low pressure cutout;
2. High pressure cutout;
3. Compressor motor overload protection.

I. Heat Exchangers: Manufacturer's standard construction for gas-fired heat exchangers and burners.

1. Controls:

a. Redundant gas valve;
b. Intermittent pilot ignition;
c. Electronic spark ignition system;
d. High limit cutout;
e. Forced draft proving switch.
f. Dampers to accept 0-10 m/a signal
g. Low voltage control

J. Economizer Control: Return and outside air dampers, outside air filter, fully modulating electric control system with enthalpy control, and adjustable mixed-air thermostat. System shall have 100 percent outside air capability. Provide automatic changeover through adjustable enthalpy control device.

ENGINEER NOTE: For Trane, VAV only at and above 27-1/2 tons.

M. Variable Air Volume Control: Discharge air step controller, and electric control system with enthalpy control.

N. Electric Heat Sections: Electric heat coils, of manufacturer's standard construction, factory-wired for single point wiring connection, complete with over-current and over-heat protection devices.

O. Accessories: Units shall include the following accessories as indicated or scheduled:

1. See schedules on drawings for additional requirements.

ENGINEER NOTE: Low ambient control not needed with 100% economizer.

2. Low ambient control: Furnish low ambient control for head pressure control, designed to operate at temperatures down to 0 deg F (-18 deg C).

3. Thermostat: Assembly shall provide for staged heating and cooling with manual or automatic changeover on standard sub-base.

4. Anti-Recycling Control: Furnish anti-recycling control to automatically prevent compressor restart for 5-minutes after shutdown.

5. Provide hail guards.

2.3 ROOFTOP UNITS (20 TONS TO 130 TONS):

ENGINEER NOTE: Written around Trane Intellipak.

A. General Description: Rooftop unit shall be factory- assembled and tested, designed for roof or slab installation and, consisting of compressors, condensers, evaporator coils, condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers. Capacities and electrical characteristics are scheduled on the Drawings.

B. Casing manufacturer's standard casing construction, having corrosion protection coating, and exterior finish. Casings shall have removable panels or access doors for inspection and access to internal parts, a minimum of 1" thick thermal insulation on double wall and ½" thick on single wall. Provide knockouts for electrical and piping connections, and an exterior condensate drain connection, and lifting lugs.

C. Roof curbs: Manufacturer's standard construction, insulated and having corrosive protective coating, complete with factory-installed wood nailer and drain nipple. Construction shall be in accordance with NRCA Standards.

1. Pedestal curbs are not acceptable for [Denver] jurisdiction, provide full perimeter curb.

OR

Provide full perimeter curb with pedestal beam for DX air cooled condensing unit.

2. Provide ¾" rubber waffle vibration isolation pad around full curb perimeter, to fully isolate unit from curb.

OR

Provide full curb perimeter spring isolation rail.

OR

Provide rubber gasket around full curb perimeter.

D. Exhaust and Supply Air Fans: Forward-curved or airfoil, centrifugal, belt-driven fans with adjustable sheaves; and permanently lubricated motor bearings.

E. Condenser fans: Propeller-type, direct-driven fans with permanently lubricated bearings.

F. Coils:

1. General: Aluminum plate fin and seamless copper tube type. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall have a galvanized steel casing. Coils shall be mounted in the coil casing with same end connections accessible for service. Coils shall be removable from the unit through the roof or through the piping enclosure. Coil section shall be completely insulated.

2. Steam Heating Coils: Non-freeze steam coils, pitched in unit casing for proper drainage. Coils shall be double tube type having accurately sized steam distributor tubes and evenly spaced orifices. Orifices shall discharge steam in the direction of condensate flow to ensure even distribution of steam over full length of each tube. Coils shall be proof (150 psig) and leak (100 psig) tested with air pressure under water.

OR

Water Heating Coils: Pitched in the unit casing for proper drainage. Coils shall have metering orifices and a supply header to ensure distribution of hot water to each tube. Coils shall be proof (300 psig) and leak (200 psig) tested with air pressure under water. Continuous tube type, and proof (300 psig) and leak (200 psig) tested with air pressure under water.

3. Refrigerant Cooling Coils: Have an equalizing type vertical distributor to ensure each coil circuit receives the same amount of refrigerant. Coils shall be proof (450 psig) and leak (300 psig) tested with air pressure under water, then cleaned, dehydrated, and sealed with a holding charge of nitrogen.

4. Electric heat sections: Manufacturer's standard construction electric heat coils, factory-wire for single point wiring connection. Complete with over-current and over-heat protection devices.

G. Compressors: Scroll type, serviceable, semi-hermetic, or hermetic compressors with integral vibration isolators, and crankcase heaters which de-energize during compressor operation. Units shall also have:

a. Hot-gas bypass valve and piping on one compressor.

b. Thermal expansion valves, filter dryers, sight glasses, compressor service valves, liquid line service valves; minimum of 2 refrigerant circuits for units having 2 or more compressors; and fan-cycling control for low ambient control to 35 deg F (2 deg C).

ENGINEER NOTE: Low ambient only when no economizer.

H. Safety Controls:

1. Low pressure cutout, manual reset;
2. High pressure cutout, manual reset;
3. Compressor motor overload protection, manual reset;
4. Anti-recycling timing device;
5. Adjustable low-ambient lockout;
6. Oil pressure switch.
7. Supply duct over-pressurization

I. Heat Exchangers: Manufacturer's [standard] [stainless steel] construction for gas-fired heat exchangers and burners, designed for minimum of [2-stage operation] [3:1 modulation] [4:1 modulation]. Provide single gas connection.

ENGINEER NOTE: Trane 4:1 very expensive.

1. Controls:

a. redundant gas valves;
b. intermittent pilot ignition;
c. electronic spark ignition system;
d. high limit cutout;
e. forced draft proving switch;
f. flame roll-out switch.

J. Economizer Control: Return and outside air dampers, outside air filter, fully modulating electric control system with enthalpy control, and adjustable mixed-air thermostat. System shall have 100 percent outside air capability. Provide automatic changeover through adjustable enthalpy control device.

K. Variable Air Volume Control: Discharge air step controller, electric control system with enthalpy control, and 7-day programmable time clock.

L. Filters Section: 2" thick fiberglass throwaway filters in filter rack, with maximum face velocity of 300 fpm.

M. Electrical: Units shall have a 115 VAC convenience outlet, separately fused, for unit service. Unit power connection shall be either through unit cabinet or within roof curb perimeter. Provide UL listed disconnect switch.

N. Temperature Control: Factory-installed, demand-oriented solid-state control system with minimum of 2 cooling steps and 2 heating steps. Controls shall include solid-state thermostats with dead-band, and sub-base with system and fan switches. Other control features include:

1. Discharge temperature reset capability with space temperature override;

2. 7-day programmable time clock, with power failure carryover, for remote mounting;

3. Warm-up cycle.

4. Provide [outdoor air damper compensation control package] [IAQ dampers and flow monitoring station] for minimum outside air volume control during VAV modulation.

O. Accessories: Units shall include the following accessories as indicated or scheduled:

1. Remote Control Panel: Furnish panel for remote mounting containing control of heating, cooling, evaporator fan, and outdoor damper; and indicator lights for up to 6 unit functions.

2. Anti-Recycling Control: Furnish anti-recycling control to automatically prevent compressor restart for 5-minutes after shutdown.

3. Low Ambient Control: Furnish anti-recycling control for head pressure control, designed to operate at temperatures down to 0 deg F (-18 deg C).

ENGINEERS NOTE: Not needed with economizer.

4. Thermostat: Assembly shall provide for staged heating and cooling with manual or automatic changeover on standard sub-base.

5. High duct temperature shutdown.

6. Provide hail guards.

7. See schedules and drawings for additional required accessories.

2.5 MAKE-UP AIR UNITS:

ENGINEER NOTE: Written around Reznor unit

A. General: Provide factory-fabricated and factory-tested air handling units as indicated, or sizes and capacities as scheduled, and as specified herein.

B. Components:

1. [Evaporative Cooling Section] [Chilled Water Coil Section]
2. Filters
3. Supply Fan, Motors & Drive
4. [Furnace Section] [Heating Water Coil Section]
5. Controls

C. Cabinet:

1. Factory painted enamel finish
2. Insulate walls and roof of cabinet
3. Include lifting lugs welded or bolted to the base of unit
4. Hinged and latched fan access door
5. Fan cabinet shall be [horizontal duct outlet] [down discharge plenum outlet]

D. Fan:

1. Centrifugal fans with forward curved or backward inclined blades, AMCA certified
2. Motors shall be high efficiency, meeting criteria of Section 15040.
3. Motor sheaves and drive belts shall be sized to eliminate belt squeal on start-up.
4. Filter rack with 2" 30% efficient pleated filters, factory installed.

E. Furnace Sections:

1. [Direct fired gravity vented] [Indirect fired power vented]
2. Heat exchanger shall be 409 stainless steel
3. Burners shall be 409 stainless steel
4. Furnace sections shall be equipped with the following safety and limit controls:

    a. Redundant gas valve
    b. Intermittent spark safety pilot
    c. Differential air pressure switch
    d. Electronic modulating gas control valves
    e. Fire stat
    f. Gas pressure safety switch
    g. Air flow proving switch
    h. The packaged make-up air system shall be certified and bear the label of AGA.

F. Direct Evaporative Cooling Section:

1. Evaporative cooling section which shall have a saturation effectiveness of 90%. Utilize 12" CELDEK or equal.
2. Stainless steel sump
3. Make-up water float valve
4. Centrifugal type spray pump, thermally protected
5. Type L copper piping header
6. Automatic fill and drain kit.
7. Sumpless water spray evaporative coolers with media moisture sensors are also acceptable.

G. Controls:

1. Provide factory control module to provide the start/stop function of the unit, interlocks to kitchen hoods and meet the Sequence of Operation.
2. Provide supply water and sump drain down kits for freeze protection. This includes all required piping, control valves and control wiring.

H. Options:

1. Factory roof curb with [full perimeter rubber gasket] [full perimeter ¾" waffle vibration isolation]
2. Inlet dampers, with two position control actuator.
3. 2" thick 30% filters.
4. Fresh air inlet hood with birdscreen.
5. See schedules for additional accessories

2.6 MAKE-UP AIR UNITS (DX COOLING):

ENGINEER NOTE: Written around Aaon unit.

A. Unit Performance:

1. Unit cooling capacities shall be in accordance with and tested to ARI standard 210/240-89 or 360-85.
2. Units shall carry the ARI compliance label.
3. Units shall be safety certified in accordance with UL Standard UL 1995, and ANSI Standard Z21.47.
4. Unit shall be 100% run tested by the manufacturer with a copy of the run test report shipped with the unit.

B. Unit Construction:

1. Unit design shall be dedicated bottom supply/return air style system for mounting on a roof curb.
2. Cabinet shall be constructed entirely of G90 galvanized metal with the exterior constructed of 18 gauge or heavier material.
3. Access to compressor(s), controls, filter, blower, heating section and other items needing periodic checking or maintenance shall be through hinged access doors with a quarter turn latch (door fastening screws are not acceptable). Air side service access doors shall be fully gasketed with rain break overhangs.
4. Unit exterior shall be painted with polyurethane paint over a primer and a G90 type galvanized steel.
5. The interior air side of the cabinet shall be entirely insulated on all exterior panels with 1” thick, 1.5 pound density, neoprene coated, fiberglass insulation.

C. Blowers:

1. Blower(s) shall be entirely self contained on a slide deck for service and removal from the cabinet.
2. All belt drive blower(s) shall have backward inclined airfoil blades.
3. Blower, drives and motors shall be dynamically balanced.

D. Outside Air:

1. Shall be a modulating enthalpy controlled 100% economizer with multi-stage integrated economizer and compressor operation for maximum benefit. The economizer shall consist of a motor operated outdoor air damper and return air damper constructed of extruded aluminum, hollow core, air foil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 25 CFM of leakage per square foot of damper area when subjected to 2” WG air pressure differential across the damper. Damper motor shall be spring return to ensure closing of outdoor air damper during periods of unit shut down or power failure. A pressure relief damper sized for 100% relief air shall be provided as part of the economizer.

E. Power Exhaust:

1. The control shall be on-off and all controls shall be factory installed.

F. Evaporator Coil:

1. Evaporator coil(s) shall be copper tube with aluminum fins mechanically bonded to the tubes.
2. Evaporator coils to have galvanized steel end casings.
3. Evaporator coils for multi-compressor units shall be circuited with one circuit and expansion valve per compressor.

G. Condenser Coil:

1. Condenser coil(s) shall be copper tube with aluminum fins mechanically bonded to the tubes.
2. Provide hail guards.

H. Refrigeration System:

1. Compressor(s) shall be of the hermetic scroll type with internal thermal overload protection and mounted on the compressor manufacturer's recommended rubber vibration isolators.
2. All units over 7 tons shall be multiple stage and shall have a minimum of 2 stages of capacity control.
3. System shall be equipped with automatic re-set low pressure and manual reset high pressure refrigerant controls.
4. Unit shall be equipped with Schrader type service fittings on both the high side and low pressure sides of the system.
5. Unit shall be equipped with refrigerant liquid line driers.
6. Lead circuit(s) shall be provided with hot gas bypass.
7. See schedules for additional controls and requirements.

I. Gas Heating Section:

1. Unit shall be provided with a gas heating furnace consisting of an [aluminized steel] [stainless steel] heat exchanger with multiple concavities, and induced draft blower and an electric pressure switch to lockout the gas valve until the combustion chamber is purged and combustion air flow is established.
2. Unit shall be provided with a gas ignition system consisting of an electronic ignitor to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.
3. Units tubular gas heat exchanger will carry a 15 year non pro-rated warranty.
4. Unit shall heat using natural gas and be equipped with a modulating gas valve, adjustable speed combustion blower and tubular heat exchanger. The completely factory mounted gas heating assembly shall be capable of operating at any firing rate between 100% and 30% of rated capacity. The combustion air and gas firing rate shall both be capable of modulation. A discharge air sensor shall be provided for field installation in the supply air ductwork to sense the discharge air temperature. The discharge air setpoint shall be adjusted at the electronic controller within the rooftop unit control compartment. Heating control shall be capable of operation initiated by a call for heat from a thermostat.
5. See schedules for additional controls.

J. Power Option:

1. Unit shall be provided with a factory installed and wired internal disconnect switch with fusing.

K. Filters:

1. Unit to be furnished with 2" pleated throw away 30% efficient supply air filters.

L. Temperature Control:

1. Unit shall be equipped with a discharge air temperature controller. Controller to be multi-compressor units. Controller to include compressor anti-short cycle protection for each compressor.

a. Unit shall be equipped with hot gas by-pass control on lead refrigeration stage to protect against evaporator frosting at low air flows and suction pressures.
b. Unit to be equipped with an electronic supply air discharge temperature controller. Controller to be multi-stage on multi-compressor units. Controller to include compressor anti-short cycle protection for each compressor.

M. Roof Curbs:

1. Roof curbs shall be constructed of galvanized steel.

2. Provide ¾" rubber waffle vibration isolation around full curb perimeter.

OR

Provide full perimeter spring isolation rail.

OR

Provide rubber gasket around full curb perimeter.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine areas and conditions under which rooftop units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION:

A. General: Install rooftop units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Install and secure roof curb to roof structure, in accordance with National Roofing Contractor's Association (NRCA) installation recommendations and shop drawings. Install and secure rooftop units on curbs and coordinate roof penetrations and flashing.

C. Electrical Connections: Refer to Section 16142 - Electrical Connections for Equipment for final connections to equipment and installation of loose shipped electrical components.

3.3 DEMONSTRATION:

A. Start-Up Services:

1. Provide the services of a factory-authorized service representative to start-up rooftop units, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Operating and Maintenance Training:

1. Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of rooftop units. Training shall include start-up and shut-down, servicing and preventative maintenance schedule and procedures, and troubleshooting procedures plus procedures for obtaining repair parts and technical

assistance. Review operating and maintenance data contained in the Operating and Maintenance Manuals specified in Division One.

2. Schedule training with Owner, provide at least 7-day prior notice to the Architect/Engineer.

END OF SECTION 15782