

**SECTION 23 74 00**  
**CENTRAL STATION HVAC UNITS**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. Provide Heating, Cooling, and Ventilating Equipment as specified herein and shown on the Drawings.
- B. Equipment capacity and size shall be as indicated on the Drawings.
- C. Related Work: The requirements of Section 23 05 00, Common HVAC Materials and Methods, also apply to this section.

**1.02 REFERENCES**

- A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. AMCA 99 - Standards Handbook.
- C. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- D. AMCA 300 or AHRI 260 - Test Code for Sound Rating Air Moving Devices.
- E. AMCA 500 - Test Methods for Louver, Dampers, and Shutters.
- F. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
- G. AHRI 430 - Central-Station Air-Handling Units.
- H. AHRI 435 - Application of Central-Station Air-Handling Units.
- I. ASTM B117 - Standard Practice for Operating Salt Spray Apparatus.
- J. NEMA MG1 - Motors and Generators.
- K. NFPA 70 - National Electrical Code.
- L. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- M. UL 723 - Test for Surface Burning Characteristics of Building Materials.
- N. UL 900 - Test Performance of Air Filter Units.
- O. UL 1995 - Standard for Heating and Cooling Equipment.
- P. UL 94 - Test for Flammability of Plastic Materials for Parts in Devices and Appliances.
- Q. IBC 2000, 2003 - International Building Code.
- R. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
- S. NFPA 5000 - Building Construction and Safety Code.

- T. ASHRAE 90.1 Energy Code.
- U. AHRI Standard 1060 - Rating Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment.
- V. GSA 2003 Facilities Standard - 5.9 HVAC Systems and Components.

### **1.03 SUBMITTALS**

- A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements. Computer generated fan curves for each air handling unit shall be submitted with specific design operating point noted. A computer generated psychometric chart shall be submitted for each cooling coil with design points and final operating point clearly noted. Sound data for discharge, radiated and return positions shall be submitted by octave band for each unit. Calculations for required baserail heights to satisfy condensate trapping requirements of cooling coil shall be included.
- B. Product Data:
  - 1. Provide literature that indicates dimensions, weights, capacities, ratings, fan performance, finishes of materials, electrical characteristics, and connection requirements.
  - 2. Provide data of filter media, filter performance data, filter assembly, and filter frames.
  - 3. Provide manufacturer's installation instructions.

### **1.04 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing Air Handler products specified in this section must show a minimum five years documented experience and complete catalog data on total product.
- B. For systems with package BACnet controls the manufactures representative shall be required to coordinate with and meet with the control contractor to assist the control contractor in generating a sequence of operations.

## **PART 2 - PRODUCTS**

### **2.01 VAV ROOFTOP UNITS WITH INTEGRAL OR SPLIT DX COOLING**

- A. The unit shall be ETL listed.
- B. Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Units shall be of a modular design with factory installed access sections available to provide maximum design flexibility.
- C. Unit shall be completely factory assembled and shipped in one piece.
- D. Split units to be shipped with a nitrogen holding charge only. The unit shall undergo an operational test prior to shipment. The factory test shall include a refrigeration circuit check test, a unit safety control system operations checkout, and a final unit inspection.
- E. Package units to be shipped fully charged with R410A. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include final balancing of all fan assemblies, a refrigeration circuit runtest, a unit control system operations checkout, a unit refrigerant leak test, and a final unit inspection.

- F. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.
- G. Performance: All scheduled capacities and face areas are the minimum accepted value. All scheduled amps, KW, and HP are maximum accepted values that allow scheduled capacity to be met.
- H. Cabinet
1. Unit cabinet shall be designed to operate at total static pressures up to 5.5 inches w.g.
  2. Unit shall have heavy gauge solid galvanized steel liners provided throughout, allowing no exposed insulation within the air stream. All cabinet insulation, except floor panels, shall be a nominal 2" thick, 1 ½ lb. density, R6.5, glass fiber. Floor panels shall include 1" thick, 3 lb. density, R4.2, glass fiber insulation.
  3. Exterior surfaces shall be constructed of pre-painted galvanized steel for aesthetics and long term durability. Paint finish to include a base primer with a high quality, polyester resin topcoat of a neutral beige color. Finished surface to withstand a minimum 750-hour salt spray test in accordance with ASTM B117 standard for salt spray resistance.
  4. Service doors shall be provided on both sides of each section in order to provide user access to all unit components. Service doors shall be constructed of heavy gauge galvanized steel with galvanized steel interior liners. All service doors shall be mounted on multiple, stainless steel hinges and shall be secured by a stainless steel latch system that is operated by a single handle. The latch system shall feature a staggered engagement for ease of operation and a safety catch shall protect the user from injury in case a positive pressure door is opened while the fan is operating. Removable panels, or doors secured by multiple, mechanical fasteners are not acceptable.
  5. The unit base frame shall be constructed of 15 gauge pre-painted galvanized steel.
  6. The unit base shall overhang the roof curb for positive water runoff and shall have a formed recess that seats on the roof curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base with lifting holes to accept cable or chain hooks.
  7. Lifting brackets shall be provided on the unit base with lifting holes to accept cable or chain hooks.
- I Fans
1. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment. All fan assemblies shall employ solid steel fan shafts. Heavy-duty pillow block type, self-aligning, grease lubricated ball bearings shall be used. Bearings shall be sized to provide an L-50 life at 200,000 hours. The entire fan assembly shall be isolated from the fan bulkhead and mounted on spring isolators. pitch V-belt drives with matching belts shall be provided. V-belt drives shall be selected at the manufacturers standard service factor.
  2. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment. All fan assemblies shall employ solid steel fan shafts. Heavy-duty pillow block type, self-aligning, grease lubricated ball bearings shall be used. Bearings shall be sized to provide an L-50 life at 200,000 hours. The entire fan assembly shall be isolated from the fan bulkhead and mounted on spring isolators with seismic restraints. Pitch V-belt drives with matching belts shall be provided. V-belt drives shall be selected at the manufacturer's standard service factor.
  3. Fan motors shall be heavy-duty 1800 rpm premium efficiency. Fan motors to have grease lubricated ball bearings. Motors shall be mounted on an adjustable base that provides for proper alignment and belt tension adjustment.
  4. Motor shall be Open Dripproof.
  5. Airfoil Supply Fans.

- a. Supply fan shall be a double width, double inlet (DWDI) airfoil centrifugal fan. All fans shall be mounted using shafts and hubs with mating keyways. Fans shall be Class II type and fabricated from heavy-gauge aluminum. Fan blades shall be continuously welded to the back plate and end rim.
  - 6. Airfoil Return Fans.
    - a. A single width, single inlet (SWSI) airfoil centrifugal return air fan shall be provided. The fan shall be Class II construction. The fan wheel shall be Class II construction and fabricated from heavy-gauge aluminum with fan blades continuously welded to the back plate and end rim. The fan shall be mounted using shafts and hubs with mating keyways. Exhaust fans are not acceptable
- J. Variable Air Volume Control
- 1. Separate electronic variable frequency drives shall be provided for each fan. Drives shall be independent. Drives shall be cooled by the filtered mixed air stream. The completed unit assembly shall be listed by a recognized safety agency, such as ETL. Drives are to be accessible through a hinged door assembly complete with a single handle latch mechanism. Mounting arrangements that expose drives to high temperature, unfiltered ambient air are not acceptable. The unit manufacturer shall install all power and control wiring.
  - 2. The drive output shall be controlled by the factory installed main unit control system and drive status and operating speed shall be monitored and displayed at the main unit control panel. The supply and return/exhaust fan drive outputs shall be independently controlled in order to provide the control needed to maintain building pressure control. Supply and return/exhaust air fan drives that are slaved off a common control output are not acceptable.
  - 3. All drives shall be factory run tested prior to unit shipment.
- K. Electrical
- 1. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with unit shall be number and color coded and labeled according to the electrical diagram provided for easy identification.
  - 2. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch circuit short circuit protection, 115 volt control circuit transformer and fuse, system switches, and a high temperature sensor. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply and return fan motors shall have contactors and external overload protection. Knockouts shall be provided in the of the main control panels for field wiring entrance.
  - 3. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch circuit short circuit protection, 115 volt control circuit transformer and fuse, system switches, and a high temperature sensor. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Knockouts shall be provided in the side of the main control panels for field wiring entrance.
  - 4. Where unit is a single package combine B and C to a single point connection.
  - 5. All 115-600 volt internal and external wiring between control boxes and components shall be protected from damage by raceways or liquid tight conduit.
  - 6. The receptacle shall be powered by a field supplied 115V source.
  - 7. Single non-fused disconnect switch shall be provided for connecting electrical power at the unit. Disconnect switches shall be mounted internal to the control panel and operated by an externally mounted handle. Externally mounted handle is designed to prohibit opening of the control panel door without the use of a service tool.

8. Unit SCCR rating to be 10 kAIC.
9. Unit shall be provided with a 24 volt transformer and terminal strip for field supplied controls where factory controls are not specified.

L. Heating and Cooling Sections

1. The cooling coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with factory piped cooling coil and sloped drain pan. Hinged access doors on both sides of the section shall provide convenient access to the cooling coil and drain pan for inspection and cleaning.
2. Submittals must demonstrate that scheduled unit leaving air temperature (LAT) is met, that fan and motor heat temperature rise (TR) have been considered, and scheduled entering air temperature (EAT) equals mixed air temperature (MAT). Draw-thru cooling - Scheduled EAT equals cooling coil EAT and scheduled unit LAT equals cooling coil LAT plus TR.
3. Direct expansion (DX) cooling coils shall be fabricated of seamless 1/2" diameter high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design. All units shall have two independent refrigerant circuits and shall use an interlaced coil circuiting that keeps the full coil face active at all load conditions.
4. All coils shall be factory leak tested with high pressure air under water.
5. A painted galvanized steel, positively sloped drain pan shall be provided with the cooling coil. The drain pan shall extend beyond the leaving side of the coil and underneath the cooling coil connections. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall be connected to a threaded drain connection extending through the unit base. Units with stacked cooling coils shall be provided with a secondary drain pan piped to the primary drain pan.
6. A stainless steel, positively sloped drain pan shall be provided with the cooling coil. The drain pan shall extend beyond the leaving side of the coil and underneath the cooling coil connections. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall be connected to a threaded drain connection extending through the unit base. Units with stacked cooling coils shall be provided with a secondary drain pan piped to the primary drain pan.
7. A 2 row hot water heating coil shall be factory installed in the unit heat section. Coils shall be fabricated of seamless 5/8" diameter copper tubing that is mechanically expanded into high efficiency HI-F rippled and corrugated aluminum plate fins. All coil vents and drains shall be factory installed. The hot water heat section shall be installed downstream of the supply air fan. A factory-tested diffuser shall be used in order to provide air distribution across the coil. Hinged access doors on both sides of the unit shall provide convenient access to the coil and valve for inspection and cleaning.
8. Coils shall be factory leak tested with high pressure air under water.

M. Filters

1. Unit shall be provided with a draw-through filter section. The filter section shall be supplied complete with the filter rack as an integral part of the unit. The draw-through filter section shall be provided with panel filters. See other Sections for filter media.

N. Outdoor/Return Air Section

1. Unit shall be provided with an outdoor air economizer section. The 0 to 100% outside air economizer section shall include outdoor, return, and exhaust air dampers. Outdoor air shall enter from both sides of the economizer section through horizontal, louvered intake panels complete with rain lip and bird screen. The floor of the outdoor air intakes shall provide for water drainage. The economizer section shall allow return air to enter from the bottom of the unit. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be opposed sets of parallel blades, arranged vertically to converge the return air and outdoor air streams in multiple, circular mixing patterns.
  2. Low leak dampers shall be provided on outdoor or return dampers. Damper blades shall be fully gasketed and side sealed and arranged horizontally in the hood. Damper leakage shall be less than 1.5 CFM/Sq. Ft. of damper area at 1.0 inch static pressure differential. Leakage rate to be tested in accordance with AMCA Standard 500. Damper blades shall be operated from multiple sets of linkages mounted on the leaving face of the dampers.
  3. A barometric exhaust damper shall be provided to exhaust air out of the back of the unit. A bird screen shall be provided to prevent infiltration of foreign materials. Exhaust damper blades shall be lined with urethane gasketing on contact edges.
  4. Control of the outdoor or return dampers shall be by a factory installed actuator. Damper actuator shall be of the modulating, spring return type. If outdoor air is suitable for "free" cooling, the outdoor air dampers shall modulate in response to the unit's temperature control system. An adjustable enthalpy control shall be provided to sense the dry-bulb temperature and relative humidity of the outdoor air stream to determine if outdoor air is suitable for "free" cooling
- O. Discharge and Return Plenum Options
1. A supply air discharge plenum shall be provided. The plenum section shall have a bottom discharge opening.
- P. Condensing Section
1. Air Cooled Condenser
    - a. The condensing section shall be open on the sides and bottom to provide access and to allow airflow through the coils. Condenser coils shall be multi-row and fabricated from cast aluminum micro-channel coils. Each condenser coil shall be factory leak tested with high-pressure air under water. Coils are to be recessed so that the cabinet provides built in hail protection.
    - b. Condenser fans shall be direct drive, propeller type designed for low tip speed, vertical air discharge, and include service guards. Fan blades shall be constructed of steel and riveted to a steel center hub. Condenser fan motors shall be heavy-duty, inherently protected, three-phase, non-reversing type with permanently lubricated ball bearing and integral rain shield.
    - c. Units shall have at least one head pressure sensing condenser fan controlled to maintain positive head pressure. An ambient thermostat shall prevent the refrigeration system from operating below 45° F ambient.
    - d. Units shall have at least one condenser fan controlled to maintain positive head pressure. SpeedTrol™ condenser fan speed control shall be added to the last fan off on each refrigeration circuit to provide cooling operation to ambient temperatures down to 0° F. Fan speed control shall be field adjustable.
  2. Scroll Compressors

- a. Each unit shall have a variable speed inverter compressor or digital compressor as lead compressor on each circuit and fixed speed scroll compressor(s) on the others. If there is only 2 compressors with 2 circuit machine a variable capacity compressor is only required on one circuit. All compressors shall be isolated with resilient rubber isolators to decrease noise transmission. The lead compressor shall be driven by variable frequency drive or digital designed for digital operation to control compressor speed. The VFD (if used) will be mounted in a weather protected panel complete with ventilation fans. The compressor speed shall dynamically vary to match the space load. Inverter driven compressor shall be able to modulate from 25 Hertz to a maximum of 100 Hz. Digital shall vary between 25% and 100%. The minimum unit capacity shall be 13% of full load. The variable speed inverter compressor motor shall be a brushless permanent magnet type, to provide higher efficiency at all speeds. Oil injection system shall be provided to ensure optimal efficiencies. Gearotor oil pump shall be provided for bearing lubrication at all compressor speed. Oil Strainer shall be provided to control the risk of system debris in the oil injection circuit. Each variable speed inverter compressor shall be engineered with an appropriate sized VFD to control compressor motor speed and to provide compressor protection functions. Crankcase heating shall be provided to prevent refrigerant migration and mixing with crankcase oil when the compressor is not in operation. Each variable speed compressor shall include a crankcase heater (done via a DC holding current through the motor windings) sight-glass, current sensing and motor temperature sensing, excessive refrigerant discharge temperature sensing protection, low oil level sensing protection, motor overload protection and a time delay to prevent short cycling and simultaneous starting of compressors following a power failure . Each digital or fixed speed compressor shall include crankcase heater, sight-glass, anti-slug protection, current sensing and motor temperature sensing, motor overload protection. Include a time delay to prevent short cycling and simultaneous starting of compressors following a power failure.
  - b. Each compressor shall be complete with gauge ports, crankcase heater, sight-glass, anti-slug protection, motor overload protection and a 5 minute time anti-cycling time delay.
  - c. Refrigeration capacity control shall be accomplished by modulating& staging of the unit's multiple compressors. To maintain desired temperature control, the unit shall have one variable capacity compressor plus a minimum of steps of capacity control for fixed speed compressor(s). The unit shall modulate the variable capacity compressor and stage the fixed compressors to deliver the desired setpoint temperature with the minimum amount of energy. All compressor capacity control modulating & staging shall be controlled by the factory installed main unit control system.
3. Refrigeration Circuit
    - a. Each package unit shall have two independent refrigeration circuits. Each circuit shall be complete with low pressure control, pumpdown switch, liquid line solenoid valve, filter drier, liquid moisture indicator/sight-glass, thermal expansion valve, liquid line charging valve with a 3/8" charging port, a manual reset high pressure safety switch. The thermal expansion valve shall be capable of modulation from 100% to 25% of its rated capacity. Sight-glasses shall be accessible for viewing without disrupting unit operation. Each circuit shall be dehydrated and factory charged with 410-A Refrigerant and oil.
    - b. Each split unit shall have two independent refrigeration circuits. Each circuit shall be complete with low pressure control, liquid line charging valve with a 3/8" charging port, a manual reset high pressure safety switch. Each Circuit shall be dehydrated, leak tested, and shipped with a Nitrogen holding charge. Unit shall have discharge and suction line shutoff valves.

**Q.—Roof Curbs**

1. ~~A prefabricated seismically rated 12-gauge galvanized steel, mounting curb, designed and manufactured by the unit manufacturer, shall be provided for field assembly on the roof decking prior to unit shipment. The roof curb shall be a full perimeter type with complete perimeter support of the air handling section and rail support of the condensing section. Supply and return opening duct frames shall be provided as part of the curb structure allowing duct connections to be made directly to the curb prior to unit arrival. The curb shall be a minimum of 16" high and include a nominal 2" x 4" wood nailing strip. Gasket shall be provided for field mounting between the unit base and roof curb.~~

**Q. Roof Curbs: Provide with seismically rated non-plenum isolation curb approved by manufacturer for all units.**

**1. Curb Mounted Spring Isolation Base:**

- a. Rooftop equipment shall be mounted on an integrated spring and weather seal curb arrangement that fits under the equipment to be isolated and over the curb. Top and bottom members shall be of extruded aluminum and shall be connected by a flexible, water-proof neoprene membrane with counter flashing protection/cover. The aluminum members shall seal against the equipment and against the curb with continuous closed cell neoprene sponge.
  - b. Springs shall be cadmium plated and shall have a deflection as required by drawings with 50% additional travel to solid. Spring diameters shall be no less than 0.8 of the spring height at rated load. Wind resistance shall be provided by means of resilient snubbers in the corners with a minimum clearance of 1/4" so as not to interfere with the spring action except in high winds.
  - c. Curb shall be seismically rated for seismic zone where building is located.
  - d. Submittals shall include spring deflections, spring diameters, compressed spring height and solid spring height, seal material details and the design configuration of the entire base arrangement.
  - e. Vibrex, Thycurb, Amber Booth, Mason, Kinetics Noise Control.
2. Where required, provide perimeter angle and cross members to support two layers of 5/8" sheet rock. Install two layers of 5/8" weatherproof sheet rock with staggered joints on the perimeter angle and cross members provided with the vibration isolator bases. Apply sheet rock around all ductwork above the roof and caulk all joints and seams. Provide additional acoustical materials as recommended by acoustical engineer.

**R. Package Unit Controls**

1. Each package control unit shall be equipped with a microprocessor based control system. The unit control system shall include all required temperature and pressure sensors, input/output boards, main microprocessor and operator interface. All boards shall be individually replaceable for ease of service. All microprocessors, boards, and sensors shall be factory mounted, wired and tested. **System shall be BACnet compatible and integrate to BACnet BAS.**
2. The microprocessor shall be a stand-alone DDC controller not dependent on communications with any on-site or remote PC or master control panel. The microprocessor shall maintain existing set points and operate stand alone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.
3. The main microprocessor shall support an RS-232 direct connection to a product service tool or a modem. A communications module shall be provided for direct communication into the BAS network.
4. All digital inputs and outputs shall be protected against damage from transients or wrong voltages. Each digital input and digital output shall be equipped with an LED for ease of service. All field wiring shall be terminated at a separate, clearly marked terminal strip.



5. The microprocessor memory shall be protected from all voltage fluctuations as well as any extended power failures. The microprocessor shall support an RS-232 direct connect from an IBM PC or 100% true compatible using MicroTech software. The microprocessor shall maintain existing set points and operate stand alone if the rooftop loses either direct connect or network communications.
6. The microprocessor shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to insure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.
7. If the unit is to be programmed with a night setback or setup function, an optional space sensor shall be provided. Space sensors shall be available to support field selectable features. Sensor options shall include Zone sensor with tenant override switch, or Zone sensor with tenant override switch and heating/cooling set point adjustment.
8. User Interface (UI)
  - a. The keypad/display character format shall be 20 characters x 4 lines. The character font shall be a 5 x 8 dot matrix. The display shall be a super twist liquid crystal display (LCD) with black characters on yellow background providing high visibility. The display form shall be in plain English coded formats. Lookup tables are not acceptable.
  - b. The keypad shall be equipped with 8 individual touch-sensitive membrane key switches. All control settings shall be password protected from changes by unauthorized personnel.
  - c. Both a unit-mounted and remote-mounted UI shall be provided. One remote UI can communicate with up to 8 separate units. Both the unit-mounted and remote-mounted UI are always active. The control contractor is responsible for wiring between the unit and the remote UI. The maximum wiring distance to the remote UI is 2100 feet. The remote UI shall have an 8 line x 30 character display. The remote UI shall be provided with the same "push and roll" navigational tool and have identical functionality to the unit-mounted UI.
9. The display shall provide the following information:
  - a. Supply, return, outdoor and space air temperature.
  - b. Duct and building static pressure- the control contractor is responsible for providing and installing sensing tubes.
  - c. Fan status and airflow verification.
  - d. Fan VFD speed.
  - e. Outside air damper position and economizer mode.
  - f. Cooling, heating and changeover status.
  - g. Occupied, unoccupied, and dirty filter status.
  - h. Date and time schedules.
  - i. Up to 4 current alarms and 8 previous alarms with time and date.
10. The keypad shall provide the following set points as a minimum:
  - a. Six control modes including off manual, auto, heat/cool, cool only, heat only and fan only.
  - b. Four occupancy modes including auto, occupied, unoccupied and bypass (tenant override with adjustable duration).
  - c. Control changeover based on return air temperature, outdoor air temperature, or space temperature.
  - d. Primary cooling and heating set point temperature based on supply or space temperature.
  - e. Night setback and setup space temp.
  - f. Cooling and heating control differential (or dead band).

- g. Cooling and heating supply temperature reset options based on one of the following: Return air temperature, outdoor air temperature, space temperature, Airflow, or external (1-5VDC) signal.
  - h. Reset schedule temperature.
  - i. High supply, low supply and high return air temperature alarm limits.
  - j. Ambient compressor and heat lockout temperatures.
  - k. Auto or manual lead lag method on compressors.
  - l. Compressor interstage timers duration.
  - m. Duct and Building static pressure
  - n. Minimum outdoor airflow reset based on external reset (1-5 VDC), percent of CFM capacity, and fixed outdoor damper position.
  - o. Economizer changeover based on enthalpy, dry bulb or network signal.
  - p. Current time and date.
  - q. Occupied/unoccupied time schedules with allowances for holiday/ event dates and duration.
  - r. Three types of service modes including timers normal (all time delays,) timers fast (all time delays 20 seconds,) and normal.
11. Refrigeration capacity control shall be accomplished by staging of the unit's multiple compressors. Unit shall be equipped with a 120V terminal strip for field supplied and installed controls

S. Warranty

- 1. The manufacturer shall provide 12 month parts only warranty. Defective parts will be repaired or replaced during the warranty period at no charge. The warranty period shall commence at start up, or 6 months after shipment, whichever occurs first.
- 2. The manufacturer will provide extended 48 month parts only warranty on the compressor.

T. Split System Controls

- 1. See "R" for air handler and condensing unit control.
- 2. For Condensing Unit only provide controls to accept remote 0-10V input signal for modifications and remote enable/disable.

U. Aaon, Daikin, Carrier or Trane.

**2.02 INDOOR AIR HANDLERS**

A. Unit Construction

- 1. Configuration: Fabricate as detailed on drawings.
- 2. Performance: Conform to AHRI 430. See schedules on prints.
- 3. Acoustics: Sound power levels (dB) for the unit shall not exceed the specified levels shown on the unit schedule. The manufacturer shall provide the necessary sound treatment to meet these levels if required.
- 4. Fabricate unit with heavy gauge channel posts and panels secured with mechanical fasteners. All panels, access doors, and ship sections shall be sealed with permanently applied bulb-type gasket. Shipped loose gasketing is not allowed.
- 5. Panels and access doors shall be constructed as a 2-inch nominal thick; thermal broke double wall assembly, injected with foam insulation with an R-value of not less than R-13 or equal fiberglass.
  - a. The inner liner shall be constructed of G90 galvanized steel.
  - b. The outer panel shall be constructed of G90 galvanized steel.
  - c. The floor plate shall be constructed as specified for the inner liner.
  - d. Unit will be furnished with solid inner liners at coil panels. Perforated at all others.
- 6. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, maximum 5 inches of positive or 6 inches of negative static pressure. Deflection shall be measured at the panel midpoint.

7. The casing leakage rate shall not exceed .5 cfm per square foot of cabinet area at 5 inches of positive static pressure or 6 inches of negative static pressure.
8. Module to module field assembly shall be accomplished with an overlapping, full perimeter internal splice joint that is sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.
9. Access doors shall be flush mounted to cabinetry, with minimum of two six inch long stainless steel piano-type hinges, latch and full size handle assembly. Access doors shall swing outward for unit sections under negative pressure. Access doors on positive pressure sections, shall have a secondary latch to relieve pressure and prevent injury upon access.
10. A formed G60 galvanized steel base rail shall be provided by the unit manufacturer for structural rigidity and condensate trapping.

B. Fan Assemblies

1. Where housed fans are noted, acceptable fan assembly shall be a double width, double inlet, class II, belt-drive type housed forward curved fan dynamically balanced as an assembly, as shown in schedule. Maximum fan RPM shall be below first critical fan speed. Fan assemblies shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports. Copper lubrication lines shall be provided and extend from the bearings and attached with grease fittings to the fan base assembly near access door. If not supplied at the factory, contractor shall mount copper lube lines in the field. Fan and motor shall be mounted internally on a steel base. Provide access to motor, drive, and bearings through hinged access door.
2. Acceptable fan assembly shall be a single width, single inlet, class II, direct-drive type plenum fan dynamically balanced as an assembly, as shown in schedule. Maximum fan RPM shall be below first critical fan speed. Fan assemblies shall be dynamically balanced by the manufacturer on all three planes. Provide access to motor and fan assembly through hinged access door. Selections shall not result in fan speeds greater than 70 Hz at design conditions.
3. Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of the unit if removal is required. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on 2" deflection spring vibration type isolators inside cabinetry. Seismic snubbers shall be provided.

C. Bearings, Shafts, and Drives

1. Bearings: Basic load rating computed in accordance with AFBMA - ANSI Standards. The bearings shall be designed for service with an L-50 life of 200,000 hours and shall be a heavy duty pillow block, self-aligning, grease-lubricated ball or spherical roller bearing type.
2. Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.
3. V-Belt drives shall be cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Fixed sheaves, matched belts, and drive rated based on motor horsepower. Minimum of 2 belts shall be provided on all fans with 10 HP motors and above. Standard drive service factor minimum shall be 1.1 S.F. for 1/4 HP – 7.5 HP, 1.3 S.F. for 10 HP and larger, calculated based on fan brake horsepower.

D. Electrical

1. Fan motors shall be manufacturer provided and installed, Open Drip Proof, premium efficiency (meets or exceeds EPA requirements), 1750 RPM, single speed VFD compatible. Complete electrical characteristics for each fan motor shall be as shown in schedule. Provide with shaft grounding on all motors 5 HP and larger with VFD, Aegis Inc., SGR series or equal.
2. The air handler(s) shall be ETL listed.
3. Unit shall be factory wired from single disconnect to individual fan motors.

- a. See Section 23 05 00 for VFD requirements.
  - b. Disconnect requirements:
    - 1) Motor circuit protectors or UL 489 circuit breakers. All disconnects shall include a lock-out mechanism when in the off position.
    - 2) The Motor Circuit protector shall be a UL listed 508 current limiting manual motor starter with magnetic trip elements only. The breaker shall carry a UL 508F rating (up to 100A frame size) which provides for coordinated short circuit rating for use with the motor contactor and provides a minimum interrupting rating of 30,000 AIC for the combination starter.
    - 3) Disconnect shall be UL 98 suitable for service entrance protection.
    - 4) UL 489 breaker shall include thermal and magnetic trip mechanisms.
  - c. Provide all conduit and conductors. Install per NEC.
- 4. Provide with smoke detector in return air stream path. Detector shall be factory wired to disable fans on smoke sensed at device. Provide device with AUX contacts that allow connection of addressable fire alarm relay. Relay by Division 26.
  - 5. All electrical connection components shall be field provided and mounted as shown on project schedule.
- E. Filters
- 1. Furnish angled or flat filter section as shown on drawings that will accommodate either 2" or 4" filters.
  - 2. See filter media specification section for filters.
- F. Plenum / Access Sections
- 1. Plenum section shall be provided and properly sized for inlet and/or discharge air flow (between 600 and 1500 feet per minute). The plenum shall provide single or multiple openings as shown on drawings and project schedule.
  - 2. Access section shall be provided for access between hot water coil and cooling coil section, between future cooling section and fan inlet for servicing of fan and backdraft dampers of fan array., and where shown on drawings for servicing components. All access doors on the discharge side of supply air stream shall be inward opening against pressure.
- G. Economizer Sections
- 1. Dampers shall be provided with opposed blade low leak airfoil damper blades. Dampers shall be hollow core galvanized steel airfoil blades, fully gasketed and have continuous vinyl seals between damper blades in a galvanized steel frame. Dampers shall have stainless steel jamb seals along end of dampers. Linkage and ABS plastic end caps shall be provided when return and outside air dampers sized for full airflow. Return and outside air dampers of different sizes or very large dampers and exhaust dampers must be driven separately. Damper Leakage: Leakage rate shall be less than two tenths of one percent leakage at 2 inches static pressure differential or 4 CFM/sq. ft at 1"wc whichever is more restrictive. Leakage rate tested in accordance with AMCA Standard 500. Openings shall be configured as shown on drawings.
- H. Direct Expansion Cooling Coil: Non-ferrous extended surface, counterflow serpentine type with heavy gauge galvanized steel casing with double sloped, non-ferrous drain pan suitable for mounting required. Assembled with 5/8" OD x 0.020" thick copper tubes brazed to copper headers with one complete circuit distributor for each capacity step of the compressor. Provide interlaced coils for 2 circuit condensing units. Aluminum fins mechanically bonded to tube and spaced a maximum of 12 fins per inch. Construction shall allow for expansion and contraction without developing leaks. Permanently label each coil in accessible location with all operating parameters.
- I. Heating Coils: See Section 23 57 00.

- J. Provide Drain pan for cooling coil. Construct drain pans from stainless steel with cross break and double sloping pitch to drain connection. Provide drain pans under cooling coil section. Drain connection centerline shall be a minimum of 3" above the base rail to aid in proper condensate trapping. Drain connections that protrude from the base rail are not acceptable. There must be a full 2" thickness of insulation under drain pan.
- K. Acceptable Manufacturers: Aeon, Daikin, Carrier, or Trane. Dimensions of approved manufacturers shall not exceed those noted on drawings.

### **2.03 ROOFTOP GAS FIRED UNIT WITH AND WITHOUT COOLING**

- A. The complete unit shall be cETLus listed.
- B. The unit shall be ASHRAE 90.1-2016 compliant and labeled.
- C. Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Each unit shall be completely factory assembled and shipped in one piece.
- D. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.
- E. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.
- F. Performance: All scheduled EER, IEER, capacities and face areas are minimum accepted values. All scheduled amps, kW, and HP are maximum accepted values that allow scheduled capacity to be met.
- G. Warranty: The manufacturer shall provide 12-month parts only warranty. Defective parts shall be repaired or replaced during the warranty period at no charge. The warranty period shall commence at startup or six months after shipment, whichever occurs first.
- H. Cabinet, Casing and Frame
  1. Panel construction shall be double-wall construction for all panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Insulation shall be a minimum of 1" thick with an R-value of 7.0, and shall be 2 part injected foam. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g.
  2. Panel construction shall be double-wall construction for all panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Insulation shall be a minimum of 2" thick with an R-value of 13.0, and shall be 2 part injected foam. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g.
  3. Exterior surfaces shall be constructed of pre-painted galvanized steel for aesthetics and long term durability. Paint finish to include a base primer with a high quality, polyester resin topcoat of a neutral beige color. Finished panel surfaces to withstand a minimum 750-hour salt spray test in accordance with ASTM B117 standard for salt spray resistance.

4. Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.
  5. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.
- I. Outdoor/Return Air Section
1. Unit shall be provided with an outdoor air economizer section. The economizer section shall include outdoor, return, and exhaust air dampers. The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be parallel blade design. Damper blades shall be gasketed with side seals to provide an air leakage rate of 1.5 cfm / square foot of damper area at 1" differential pressure in according with testing defined in AMCA 500. A barometric exhaust damper shall be provided to exhaust air out of the back of the unit. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges. Control of the dampers shall be by a factory installed direct coupled actuator. Damper actuator shall be of the modulating, spring return type. A comparative enthalpy control shall be provided to sense and compare enthalpy in both the outdoor and return air streams to determine if outdoor air is suitable for "free" cooling. If outdoor air is suitable for "free" cooling, the outdoor air dampers shall modulate in response to the unit's temperature control system.
  2. **Provide with power exhaust or return fan per schedule. Fan shall be operated by VFD or EC motor to allow modulation for space pressure control.**
- J. Filters
1. Unit shall be provided with a draw-through filter section. The filter rack shall be designed to accept a 2" filter. See other section for media.
- K. Cooling Coil
1. The indoor coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and an ASHRAE 62.1 compliant double sloped drain pan.
  2. The direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 3 rows. All cooling coils shall have an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.
  3. The cooling coil shall have an electronic controlled expansion valve. The unit controller shall control the expansion valve to maintain liquid subcooling and the superheat of the refrigerant system.
  4. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.
  5. The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.

6. Acceptable coils are to have ARI Standard 410 certification and bear the ARI symbol. Coils exceeding the scope of the manufacturer's certification and/or the range of ARI's standard rating conditions will be considered provided the manufacturer is a current member of the ARI Air- Cooling certification program and the coils have been rated in accordance to ARI Standard 410.
7. Coils shall be designed to withstand 250 psi maximum operating pressures and a maximum fluid temperature of 300 °F for standard duty copper tube coils.
8. Coils shall be submerged in water and tested with a minimum 315 psi air pressure for standard copper tube coils. Coils must display tag with the inspector's identification as proof of testing.
9. Coils shall be of plate fin type construction providing uniform support for all coil tubes. Coils are to be manufactured with die-formed aluminum fins with self-spacing collars which completely cover the entire tube surface. The fin thickness shall be 0.0075 +/- 5%. Manufacturer must be capable of providing self-spacing die-formed fins 4 through 14 fins/inch with a tolerance of +/- 4%.
10. Tubing and return bends shall be constructed from UNS 12200 seamless copper conforming to ASTM B75 and ASTM B251. Copper tube temper shall be light annealed with a maximum grain size of 0.040 mm and a maximum hardness of Rockwell 65 on the 15T scale. Tubes are to be mechanically expanded to form an interference fit with the fin collars. Coil tube size and wall thickness are 1/2"x0.016. Coil tube size and wall thickness are 5/8"x0.020 and 1/2"x0.016.
11. Headers shall be constructed from UNS 12200 seamless copper conforming to ASTM B75 and ASTM B251. Coil field piping connections are 3/4 in. male NPT.
12. Coil casings shall be a formed channel frame of galvanized steel.
13. The chilled water lines shall be fully insulated to the field piping connections internal to the cabinet.
14. The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall be provided with a threaded drain connection extending through the side of the unit.
15. **Provide dual circuit interfaced coils for systems with dual circuit condensing units.**

L. Supply Fan

1. Supply fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with fan blades that are continuously welded to the hub plate and end rim. The supply fan shall be a direct drive fan mounted to the motor shaft.
2. All fan assemblies shall employ solid steel fan shafts. Heavy-duty pillow block type, self-aligning, grease lubricated ball bearings shall be used. Bearings shall be sized to provide a L-50 life at 250,000 hours. The entire fan assembly shall be isolated from the fan bulkhead with a flexible collar and mounted on 1" spring isolators.
3. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment.
4. Supply fan and motor assembly combinations larger than 8 hp or 22" diameter shall be internally isolated on 1" deflection, spring isolators and include removable shipping tie downs.
5. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.
6. The motor shall be T Frame and open drip proof. Overload protection and speed control is provided by the factory installed VFD and rooftop unit controller. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

7. The supply fan shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range.

M. Heating Section

1. The rooftop unit shall include a natural gas heating section. The gas furnace design shall be one natural gas fired heating module factory installed downstream of the supply air fan in the heat section. The heating module shall be a tubular design with in-shot gas burners.
2. The module shall be complete with furnace controller and control valve capable of 5:1 modulating operation.
3. The heat exchanger tubes shall be constructed of stainless steel.
4. The module shall have an induced draft fan that will maintain a negative pressure in the heat exchanger tubes for the removal of the flue gases.
5. Each burner module shall have two flame roll-out safety protection switches and a high temperature limit switch that will shut the gas valve off upon detection of improper burner manifold operation. The induced draft fan shall have an airflow safety switch that will prevent the heating module from turning on in the event of no airflow in the flue chamber.
6. The factory-installed DDC unit control system shall control the gas heat module. Field installed heating modules shall require a field ETL certification. The manufacturer's rooftop unit ETL certification shall cover the complete unit including the gas heating modules.
7. The control valve shall be field supplied and installed in the heating vestibule. The control valve shall be capable of receiving a 2 – 10 Vdc signal. The wire harness from the unit controller to the control valve shall be factory installed.

N. Electrical

1. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be provided with the unit. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.
2. A single non-fused disconnect switch shall be provided for disconnecting electrical power at the unit. Disconnect switches shall be mounted internally to the control panel and operated by an externally mounted handle.

O. Controls

1. Unit shall be wired for field supplied temperature controls.
2. **Provide factory mounted smoke detector with auxiliary relay for addressable fire alarm system.**

P. Roof Curb

1. A prefabricated heavy gauge seismically rated galvanized steel, mounting curb shall be provided for field assembly on the roof decking prior to unit shipment. The roof curb shall be a full perimeter type with complete perimeter support of the air handling section and condensing section. The curb shall be a minimum of 14" high and include a nominal 2" x 4" wood nailing strip. Gasket shall be provided for field mounting between the unit base and roof curb.



Q. Approved manufacture's: Trane, Carrier, Aeon, Daikin.

## **2.04 SPLIT CONDENSING UNIT**

- A. Air Cooled Condenser
  - 1. The condensing section shall be open on the sides and bottom to provide access and to allow airflow through the coils. Condenser coils shall be constructed with 3/8" copper tubing mechanically bonded to aluminum fins for maximum heat transfer. Each condenser coil shall be factory leak tested with high-pressure air under water.
  - 2. Condenser fans shall be direct drive, propeller type designed for low tip speed, vertical air discharge, and include service guards. Fan blades shall be constructed of steel and riveted to a steel center hub. Condenser fan motor shall be direct drive, single phase, permanently lubricated "PSC" motors with inherent thermal overload.
  - 3. Unit shall have standard pressure controls that cycle the condenser fan motors to maintain condensing pressures for operation down to 0°F ambient.
  - 4. Condenser fan motor shall be direct drive, single phase permanently lubricated "PSC" motors with inherent thermal overload.
  - 5. Unit shall be complete with liquid and suction line isolation valves.
  
- B. Scroll Compressors
  - 1. Unit shall have heavy-duty Copeland scroll compressor(s).
  - 2. Compressors shall be isolated with resilient rubber isolators to decrease noise transmission.
  - 3. **Lead compressor on each circuit shall be variable capacity with digital operation or with VFD operation.**
  - 4. **Units shall contain a minimum of 2 refrigerant circuits.**
  
- C. Capped connections shall be external to the unit providing for field connection of refrigerant piping.
  
- D. Unit shall have a liquid and suction line service valve.
  
- E. Match manufacture of air handler, see Article 2.03.

## **2.05 GAS FURNACE**

- A. Galvanized blower wheel shall be centrifugal type, statically and dynamically balanced. Blower motor of PSC ECM type shall be permanently lubricated with sleeve bearings. Motor shall have multiple speeds from 500-1150 RPM operating only when 115-VAC motor inputs are provided. Blower motor shall be direct drive and soft mounted to the blower housing to reduce vibration transmission.
  - 1. Casing
  - 2. Casing shall be of .030 in. thickness minimum, prepainted steel.
  - 3. Draft Inducer Motor
  - 4. Draft inducer motor shall be single speed PSC design.
  
- B. Primary Heat Exchangers: Primary heat exchangers shall be 3 Pass corrosion resistant aluminized steel of fold and crimp sectional design and applied operating under negative pressure.
  
- C. Secondary Heat Exchangers: Secondary heat exchangers shall be of a stainless steel flow through of fin and tube design and applied operating under negative pressure.
  
- D. Controls: See other section for field installed controls
  
- E. Unit shall have rated efficiency of 92% min.

- F. Approved Manufactures: Trane, Carrier, Daikin, Aeon, or approved.

## **2.06 CASED COIL**

- A. Cooling coil shall consist of heavy gauge steel cabinet with baked-on enamel finish to match air furnace.
1. Coil shall have aluminum fins bonded to seamless copper tubing.
  2. Comply with ANSI/AHRI Standard 210/240. Provide drain pans with connections at one end.
  3. Use thermal expansion valve with brazed joints in place of capillary tube metering device.
  4. Match manufacture of condensing unit.

## **2.07 CONDENSING UNIT 5 TONS OR LESS**

- A. General:
1. Units shall be operable down to at least 40° F outdoor temperature.
  2. Use R-410a refrigerant.
  3. Only one liquid line, one suction line, and one power connection shall be made to each compressor. Provide charging valves with brass caps. Plastic will not be allowed.
- B. Condenser Coils:
1. Aluminum plate fins mechanically bonded to seamless copper tubes or 'Spine Fin' trade mark system which has aluminum fins epoxy bonded to aluminum tubes or micro-channel.
  2. Provide stamped louver coil guard for unit.
- C. Fans:
1. Direct driven propeller type.
  2. Fan motor shall be single or two speed, thermostatically controlled, permanently lubricated, and designed with permanent protection.
  3. Motors shall be resiliently mounted.
  4. Each fan shall have a safety guard.
- D. Compressor:
1. Each condenser unit shall have only one compressor.
  2. Design with following features:
    - a. Externally mounted brass service valves with charging connections.
    - b. Crankcase heater.
    - c. Resilient rubber mounts.
    - d. Compressor motor-overload protection.
- E. Controls:
1. Factory wired and located in separate enclosure.
  2. Provide field installed safety devices:
    - a. High and low pressure cutout.
    - b. Condenser fan motor-overload devices.
    - c. Anti-cycle timers to prevent units from starting up again for five minutes after any power interruption.
    - d. Head pressure type low ambient kit.
- F. Casing:
1. Fully weatherproof for outdoor installation. Finish shall be weather resistant.
  2. Panels shall be removable for servicing.
  3. Openings shall be provided for power and refrigerant connections.
- G. Unit shall have rated efficiency of no less than SEER=13.0.

- H. Approved manufactures: Carrier, Daikin, Trane, Aeon.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Install and arrange equipment as shown on the Drawings and as recommended by the equipment manufacturer.
- B. Piping: Refer to applicable sections for piping, ductwork, insulation, painting, etc.

#### **3.02 ROOF MOUNTED EQUIPMENT INSTALLATION**

- A. All roof mounted mechanical equipment shall be supported and seismically anchored on leveled, flashed and counterflashed vibration isolated curbs anchored to resist seismic forces and suitable for the roof construction. Minimum curb height shall be 12" above the roof unless indicated otherwise on the Drawings. Flashing into the roof is specified in another Section.
- B. Make all piping, electrical and duct penetrations for each piece of equipment within the curb unless shown otherwise on the Drawings. Piping and electrical conduit routed above and across the roof shall be supported on flashed and counterflashed curbs with pipe guides anchored to the curbs in "pitch pockets." Submit shop drawings on other arrangements for approval.
- C. Acoustical Protection: Install two layers of 5/8" weatherproof sheet rock with staggered joints on **the roof deck**. ~~the perimeter angle and cross members provided with the vibration isolator bases.~~ Apply sheet rock around all ductwork above the roof and caulk all joints and seams. ~~Provide additional acoustical materials as recommended by acoustical engineer.~~
- D. Install on vibration isolation curbs where noted on drawings.
- E. **All curbs shall be elevated such that no termination or hole in the roof membrane on the vertical surface is less than 12" above the horizontal.**

#### **3.03 AIR HANDLING INSTALLATION**

- A. Installation and Arrangement: Air handling equipment shall be installed and arranged as shown on the Drawings. Comply with the manufacturer's recommendations for installation, connection, and start-up.
- B. Lubrication: All moving and rotating parts shall be lubricated in accordance with the manufacturer's recommendations prior to start-up.
- C. Filters: Specified filters or approved temporary construction filters shall be installed in supply units prior to start-up or used for drying and/or temporary heat. See specifications related to ensuring ducts remain clean during construction for more information.

#### **3.04 SMOKE DETECTOR INSTALLATION**

- A. Provide duct-mounted smoke detectors at air handling units in accordance with Code requirements.
- B. Where detectors are mounted in a concealed location, provide remote indicating panel located as directed.

- C. Automatic Smoke Detector Fan Shutdown: Coordinate with Automatic Temperature Controls specified elsewhere in these specifications.

### **3.05 CONTROLS**

- A. Wiring: All wiring shall be in accordance with the National Electrical Code and local electrical codes.
- B. For integrated systems the manufacture shall provide a trained representative to renew the sequence of operations with the control contractor. The factory control system point integration document shall be annotated by factory representative and control contractor at each instance where the BAS and integrated controller share information.**

### **3.06 START-UP**

- A. Manufacturer's Field Service: Once Control Contractor has installed DDC at each unit engage a factory authorized service representative to inspect field assembled components and equipment installation to include electrical and piping connections. Report results to A/E in writing. Inspection must include a complete startup checklist to include (as a minimum) the Completed Start-Up Checklists as found in manufacturer's IOM. Do not start unit until both factory technician and DDC technician have approved installation.
- B. Engage a factory authorized service representative to perform startup service. Start-up shall be scheduled so DDC Contractor is present. Clean entire unit, comb coil fins as necessary, and install clean filters. Verify water source for compliance with manufacturer's requirements for flow and temperature. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.
- C. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

**END OF SECTION 23 74 00**