

**FACTORY FABRICATED PACKAGED, 100% OUTDOOR, HEATING AND COOLING
MAKEUP AIR UNITS**

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes packaged heating and cooling units capable of supplying up to 100 percent outdoor air.

1.2 SUBMITTALS

- A. Submit product data in accordance with the requirements of Division 1.

1.3 QUALITY ASSURANCE

- A. All models shall be ETL listed and comply to safety standards UL 1995, the Standard for Safety for Heating and Cooling Equipment.
- B. Units outfitted with indirect fired heaters shall also comply with ANSI Z83.8-2013, and CSA 2.6-2013.
- C. This unit has been tested in accordance to the following standards:
- ANSI/AHRI Standard 340/360
 - ANSI/ASHRAE Standard 37
 - AHRI Standard 270/370

1.4 Warranty

- A. All units shall be provided with the following standard warranties:
1. 5-Year parts warranty covering the entire unit and 2-year factory labor warranty covering the entire unit.
 2. 20-year parts warranty for SS heat exchanger on indirect fired units.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Supply single zone one piece packaged units that are complete as per the following specification, deliver all capacities scheduled, and conform to design indicated herein. Alternate layouts will not be accepted.

2.2 CABINET

- A. Cabinets shall be constructed of heavy gauge galvanized steel and finished with a weather resistant protective coating.
 - 1. Service Access Doors: All door jambs shall be gasketed around their perimeter, and allow for doors to be mounted via removable, spring actuated, stainless steel hinges with stainless steel rivets, and self-compressing latches. Each compartment shall have removable access panels to allow for ease of service and maintainability. Electrical cabinet access doors shall have a door hold installed to prop doors open. All doors shall have stainless steel latches which are pad lockable. Electrical cabinet doors shall be outfitted with schematic/manual pouches formed into the door, along with wiring diagram attached to the interior of the door from the factory.
- B. Entire interior and exterior casing shall be constructed of galvanized steel. Unit shall have undergone a salt spray corrosion test as per ASTM B 117.
- C. Entire unit shall be wind rated up to ± 150 psf per TAS 201, 202 & 203 on any units utilizing a 20" or shorter factory provided roof curb.

2.3 AIRFLOW CONFIGURATIONS

- A. Discharge: Unit shall be configurable for Down (vertical) discharge through the unit's base or Side (horizontal) discharge through the cabinet.
- B. Return: Unit shall also be configurable for No Return, Down (vertical) Return through the unit's base, or Side (horizontal) Return through the cabinet.
- C. Intake Airflow: Unit configuration shall be through use of a fresh/outdoor and return air damper.
 - 1. Damper: Shall exceed AMCA Class 1A standard for low leakage. Damper assembly shall be a single assembly, and outfitted with an integral bird screen and louver/gutter system to divert any drainage through the base of the unit – intake air hood not required.
 - 2. Actuator: A single direct drive damper actuator shall be used with spring return to ensure that the outdoor air section closes when not powered.

2.4 SUPPLY AIR BLOWER AND MOTOR

- A. All supply fans shall be direct drive (belt-drive not acceptable) variable speed plenum fans.
- B. Blower Motor: Motor shall be a premium efficiency motor available as:
 - 1. Open Drip Proof (ODP) or Totally Enclosed Fan Cooled (TEFC) motor driven by a Variable Frequency Drive.
 - 2. Electronically Commutated Motor (ECM) modulated using a Pulse Width Modulating (PWM) signal.
- C. Fans to be selected at or near efficiency peak.
- D. Blower and motor assembly shall be dynamically balanced. The entire blower and motor assembly shall be mounted on rubber vibration isolators. Wheels balanced as per AMCA 204-96, Balance Quality and Vibration Levels for fans.
- E. Unit equipped with total CFM monitoring to measure airflow across supply discharge.

2.5 REFRIGERATION SYSTEM

- A. Unit shall utilize a variable speed inverter duty scroll compressor with the following features:
1. Modulation: Compressor speed shall be capable of modulation from 25%-100%.
 2. Refrigerant: Unit shall be factory charged with R410A refrigerant.
 3. Vibration Isolation: Compressor as well as blower assembly shall each be mounted on rubber vibration isolators to reduce transmission of vibration to the building structure.
 4. Internal Overload Protection: Compressor shall include internal thermal overload protection to protect against excessive motor temperatures.
 1. Crankcase Heater: Compressor shall include a crankcase heater to protect against liquid flood-back and elimination of oil foaming on startup. The crankcase heater must remain powered when the compressor is not in operation.
 2. Defrost mode in units specified as Heat Pumps in the equipment schedule: When outdoor coils are deemed at risk of freezing, the unit shall simultaneously turn on auxiliary heat while running the heat pump in "cooling" mode to help defrost outdoor coils as needed while still maintaining desired leaving air temperatures.
- B. The unit shall be outfitted with the following:
1. Indoor Coil: Indoor coil shall be a high efficiency 4-7 row coil design with aluminum fins mechanically bonded to copper tubes. Includes sensor/(s) to read average coil face temperature.
 2. Electronic Expansion Valve: Each refrigeration circuit will be outfitted with an electronic expansion valve metering device which can be throttled from 0-100% open to allow for precise superheat control.
 3. Indoor Coil Drain Pan: The indoor coil shall be outfitted with a sloped stainless steel drain pan. This pan shall be outfitted with a safety overflow switch which will automatically shut down cooling operation prior to water overflowing the drain pan in the event of a drain clog. The entire drain pan shall be minimum 20 GA Stainless Steel construction and wrap beneath the entire coil with flashing on entering side of coil to ensure capture of all condensate. Drain pan discharge pipe shall also be stainless steel construction. Drain pan shall be pitched to meet or exceed ASHRAE 62.1 standard.
 4. Hot Gas Reheat Coil, if specified on schedule: The unit shall include an optional copper tube and aluminum fin hot gas reheat coil mounted downstream of the indoor coil. This coil shall be controlled via fully modulating hot gas reheat valve to provide precise reheat temperature control. This coil shall include the addition of an evaporative coil leaving condition sensor to maintain a coil dew point.
 5. Outdoor (Condenser) Coil: Outdoor coil shall be a high efficiency coil design with aluminum fins mechanically bonded to copper tubes. The coil shall be downward sloped to protect coil from hail damage. Optional hail guards may also be outfitted to the outdoor coil for added protection.

6. Outdoor Fans: The outdoor coil shall have a vertical discharge outfitted with fully modulating Electronically Commutated Motor (ECM) condensing fans.

2.6 HEATING SYSTEM

- A. The gas burner shall be an indirect-fired, push-through type, using natural gas or liquid propane gas. The inlet-supply pressure to the unit for natural gas must be 7" w.c. minimum. For liquid propane gas, the minimum must be 11" w.c.
- B. All furnaces shall be controlled by an electronic Vernier-type fully modulating control system capable of achieving 80% combustion efficiency over the entire gas firing range of the unit.
- C. Each furnace shall have:
 1. A minimum turndown ratio of 6:1 for natural gas and 5:1 for LP gas while maintaining a constant 80% efficiency (90% for high efficiency furnace option).
 2. Each furnace heat exchanger shall be a tube style design made entirely of stainless steel.
 3. Factory piped condensate drain to exterior of cabinet.
- D. Each electric heater shall have:
 1. Electric coils are controlled using SCR controls. SCR is a time proportioning type controller that modulates the heater and supplies the exact amount of power to match the heat demand with a 10:1 turndown per stage with full modulation between minimum turndown and max output.

2.7 FILTERS

- A. Provide filters as part of unit. All filters shall be furnished and installed to meet the performance requirements set forth in the schedule.
- B. Provide manufacturer's bird screen on outdoor air intake.
- C. All filters shall be installed on tracks for easy removal from the unit.
- D. Up to 3 layers of outdoor air filtration installed. Unit shall ship with a 2" washable metal mesh outdoor air filter. Mixed air shall be provided with optional 2" MERV-8, optional MERV-13, optional 4" MERV-15, or optional 4" HEPA filter banks factory installed as indicated on the equipment schedule.

2.8 ELECTRICAL

- A. All controls shall be pre-wired and housed in an insulated electrical cabinet within the unit to protect against risk of condensation.
- B. Units shall be provided with single point electrical connection.
- C. Unit shall be provided with a door safety switch that de-energizes the supply fan when the door is opened.

- D. Unit shall be provided with a factory mounted averaging supply air temperature sensor to allow for accurate discharge temperature readings within unit when a downstream sensor is not installed. Field mounted and wired discharge air sensors will not be accepted.
- E. Unit shall be provided with a factory mounted averaging intake air temperature sensor to allow for accurate intake temperature reading regardless of how the OA/RA dampers are positioned.
- F. The electrical cabinet shall be outfitted with the following:
 - 1. LED electrical cabinet service light with automatic activation upon door switch.
 - 2. Color wiring schematics, laminated to the interior wall of the cabinet doors.
 - 3. Factory mounted disconnect with unit bottom knockouts.
 - 4. A LED backlit, LCD Human-Machine Interface (HMI) shall be mounted within the unit's control cabinet to allow for all set points configuration and refrigeration system monitoring at the unit.
 - 5. Optional 120V, 15A unit powered or unpowered convenience outlet.

2.9 CONTROLS

- A. Unit shall be outfitted with a control board to allow for full control of the entire unit.
- B. Provide air flow switch on the supply fan system to sense air flow with available set of contacts for connection to BMS for airflow alerts.
- C. All unit controls shall be compatible with BACnet based building management systems.
- D. Temperature Control System
 - 1. **Low-Ambient Cooling:** Unit is factory outfitted with logic allowing for low-ambient operation of the DX system
 - a. Standard low-ambient operation: Unit(s) with a DX system may operate down to 0°F outdoor temperatures purely through software utilizing the standard factory modulating components.
 - b. Extreme low-ambient operation: Unit(s) with a DX system may operate to extreme low-ambient conditions, down to -25°F outdoor temperatures, are factory fitted with a bypass solenoid.
 - 2. **Discharge Temp Control (Heating)**
Unit modulates the burner flame (current supply in the case of electric heating) to accurately maintain the desired discharge temperature set point and compensate for fluctuations in entering air temperature, air volume and % of OA using heating PID controls designed specifically for the DOAS.
 - 3. **Discharge Temp Control (Cooling)**
Unit modulates the compressor frequency to accurately maintain the desired discharge temperature set point and compensate for fluctuations in entering air temperature, air volume and % of OA using proprietary cooling PID controls designed specifically for the

DOAS.

4. Discharge Temp Control (Heat Pump)

Unit modulates the compressor frequency to accurately maintain the desired discharge temperature set point and compensate for fluctuations in entering air temperature, air volume and % of OA using heating PID controls designed specifically for the DOAS. Minimum and maximum discharge set points can be set to limit the temperature entering the space. When ambient temperatures drop below a user configurable minimum outdoor air temperature set point, or the unit is not able to maintain a user configurable minimum discharge temp for 5 minutes time, the heat pump will initiate its backup heat source. Initiation of backup heater operation shall ensure discharge temps are maintained prior to disabling heat pump to make sure discharge temps are never impacted during changeover. An optional additional HMI or room thermostat can be used to determine the space temperature. In the case that no temperature sensor is available in the space, the unit will use an internal return temperature sensor.

5. Discharge Humidity Control (Dehumidification)

Unit modulates the compressor frequency to accurately maintain a desired evaporative coil dew point measured via a coil mounted temperature sensor between the evaporative and hot gas reheat coils. A fully modulating hot gas reheat valve shall utilize excess waste heat from the condensing section feeding the hot gas reheat coil with the precise amount of heat needed to accurately reheat the airstream in order to maintain a desired discharge temperature compensating for fluctuations in entering air temperature, air volume and % of OA using proprietary dehumidification PID controls designed specifically for DOAS.

6. Space Temp Control (Heating)

Unit modulates the burner flame (current supply in the case of electric heating) to accurately maintain the desired space temperature set point and compensate for fluctuations in entering air temperature, air volume and % of OA using heating PID controls designed specifically for the DOAS. Minimum and maximum discharge set points can be set to limit the temperature entering the space. An optional additional HMI or room thermostat can be used to determine the space temperature. In the case that no temperature sensor is available in the space, the unit will use an internal return temperature sensor.

7. Space Temp Control (Cooling)

Unit modulates the compressor frequency to accurately maintain the desired space temperature set point and compensate for fluctuations in entering air temperature, air volume and % of OA using cooling (heating when in heat pump mode) PID controls designed specifically for the DOAS. Minimum and maximum discharge set points can be set to limit the temperature entering the space. An optional additional HMI or room thermostat can be used to determine the space temperature. In the case that no temperature sensor is available in the space, the unit will use an internal return temperature sensor.

8. Space Temp Control (Heat Pump)

Unit modulates the compressor frequency to accurately maintain the desired space temperature set point and compensate for fluctuations in entering air temperature, air volume and % of OA using heating PID controls designed specifically for the DOAS. Minimum and maximum discharge set points can be set to limit the temperature entering the space. When ambient temperatures drop below a user configurable minimum outdoor air temperature set point, or the unit is not able to maintain a user

configurable minimum discharge temp for 5 minutes time, the heat pump will initiate its backup heat source. Initiation of backup heater operation shall ensure discharge temps are maintained prior to disabling heat pump to make sure discharge temps are never impacted during changeover. An optional additional HMI or room thermostat can be used to determine the space temperature. In the case that no temperature sensor is available in the space, the unit will use an internal return temperature sensor.

9. **Space Humidity Control (Dehumidification)**

Unit modulates the compressor frequency to accurately maintain a desired evaporative coil dew point measured via a coil mounted temperature sensor between the evaporative and hot gas reheat coils. A fully modulating hot gas reheat valve shall utilize excess waste heat from the condensing section feed the hot gas reheat coil with the precise amount of heat needed to accurately reheat the airstream in order to maintain a desired space temperature compensating for fluctuations in entering air temperature, air volume and % of OA using proprietary dehumidification PID controls designed specifically for the DOAS.

10. **Advanced Total Unit Economizer:** The control system is outfitted standard, without need for any additional hardware, with an Advanced Total Unit Economizer which will take maximum advantage of as much energy available in the outdoor air conditions in order to run the compressor the minimum amount required at any given incoming air conditions. If the outdoor enthalpy (temperature and relative humidity) permits, the unit will be capable of completely modulating and shutting off compressor to provide “free” cooling and dehumidification as the outdoor air conditions allow.

E. Activation Controls:

1. **Activate Based on Intake (Heating)**

Unit will activate heating when the intake temperature drops below the desired set point.

2. **Activate Based on Intake (Cooling)**

Unit will activate cooling when the intake temperature rises above the desired set point.

3. **Activate Based on Intake (Dehumidification)**

Unit will activate dehumidification when the intake conditions rise above the desired intake set point, with activation set points configured to a Dew Point, Relative Humidity or a combination of Dew Point/Relative Humidity.

4. **Activate Based on Space (Heating)**

Unit will activate heating when the space temperature drops below the desired set point.

5. **Activate Based on Space (Cooling)**

Unit will activate cooling when the space temperature rises above the desired set point.

6. **Activate Based on Space (Dehumidification)**

Unit will activate dehumidification when the space set point rises above the desired space set point, with activation set points configured to a Dew Point, Relative Humidity or a combination of Dew Point/Relative Humidity.

7. **Activate Based on Both (Heating)**

Unit will activate heating when the space AND intake temperature drop below the desired set point.

8. **Activate Based on Both (Cooling)**
Unit will activate cooling when the space AND intake temperature rise above the desired set point.
9. **Activate Based on Both (Dehumidification)**
Unit will activate dehumidification when the space and intake set point rise above the desired space and intake set point, with activation set points configured to a Dew Point, Relative Humidity or a combination of Dew Point/Relative Humidity.
10. **Activate Based on Either (Heating)**
Unit will activate heating when the space OR intake temperature drops below the desired set point.
11. **Activate Based on Either (Cooling)**
Unit will activate cooling when the space OR intake temperature rises above the desired set point.
12. **Activate Based on Either (Dehumidification)**
Unit will activate dehumidification when the space or intake set point rises above the desired space or intake set point, with activation set points configured to a Dew Point, Relative Humidity or a combination of Dew Point/Relative Humidity.
13. **Activate Based on Stat (Heating)**
Unit will activate heating when the space thermostat sends a 24V signal to W and G on the main control board. Unit will modulate to maintain a constant discharge heat set point.
14. **Activate Based on Stat (Cooling)**
Unit will activate cooling when the space thermostat sends a 24V signal to Y and G on the main control board. Unit will modulate to maintain a constant discharge cool set point.

2.10 ROOF CURB

- A. Unit shall be factory assembled, and constructed of minimum 18GA galvanized steel.

2.11 VARIABLE FREQUENCY DRIVES

- A. Provide Variable Frequency Drive for the compressor as part of the unit. VFD shall be furnished and installed to meet the performance set forth in the schedule and as specified under another section of this work.
 1. Accessories to be furnished and mounted by the drive manufacturer and contained in a single enclosure. (The use of more than one enclosure is not acceptable).
- B. Provide Variable Frequency Drive for speed control on all non-ECM direct drive supply fans.
- C. All VFDs shall provide the following inherent protections:
 1. Phase protection.
 2. Brownout protection.
 3. Overload/Overheat protection.
 4. Soft starts to protect bearings/hardware.

5. Low & High voltage & over-torque protections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which packaged 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. Install in accordance with manufacturer's instructions, drawings, written specifications, manufacturer's installation manual and all applicable building codes.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties. Install piping to allow service and maintenance.
- B. Duct installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of ducts.
- C. Electrical: Conform to applicable requirements in Division 16 Sections.

3.4 SYSTEM START-UP

- A. System start-up is performed by a factory trained Service Technician.

END OF SECTION