**PRICE AW-I/PMI-IF PACKAGED OUTDOOR HEATING AND COOLING MAKE-UP AIR UNITS**

# Division 23 – Heating, Ventilating, and Air Conditioning

# SECTION 23 74 33 – Dedicated Outdoor-Air Units

**PART 1 – GENERAL**

* 1. **Section Includes:**
     1. Indirect gas fired make-up air heating unit

**1.02 Related Requirements:**

## Section 22 05 13 - Common Motor Requirements for Plumbing Equipment.

* + 1. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
    2. Section 22 10 00 - Plumbing Piping.

## Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

* + 1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
    2. Section 23 09 13 - Instrumentation and Control Devices for HVAC: Control components, time clocks.
    3. Section 23 33 00 - Air Duct Accessories: Flexible duct connections.
    4. Section 23 34 16 - Centrifugal HVAC Fans: Supply fans.
    5. Section 23 40 00 - HVAC Air Cleaning Devices: Filters.
    6. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

# 1.03 Reference Standards

* + 1. All referenced standards and recommended practices in this section pertain to the most recent publication thereof, including all addenda and errata.
    2. AHRI 210/240 - Standard for Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment.
    3. AHRI 270 - Standard for Sound Rating of Outdoor Unitary Equipment.
    4. AHRI 520 - Performance Rating of Positive Displacement Condensing Units.
    5. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices.
    6. ANSI Z83.4/CSA 3.7-2015 - Non-Recirculating Direct Gas-Fired Industrial Air Heaters.
    7. ASHRAE Standard 23.1 - Methods of Testing for Performance Rating Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Temperatures of the Refrigerant.
    8. ASHRAE Standard 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.
    9. ASHRAE Standard 90.2 - Energy Efficient Design of Low-Rise Residential Buildings.
    10. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
    11. NEMA MG 1 - Motors and Generators.
    12. NFPA 54 - National Fuel Gas Code.
    13. NFPA 70 - National Electrical Code.
    14. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
    15. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
    16. UL 207 – Standard for Refrigerant-Containing Components and Accessories, Non-electrical.

# Administrative Requirements

# Pre-installation Meeting: The contractor shall conduct a pre-installation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

# Sequencing: The contractor shall ensure that utility connections are achieved in an orderly and efficient manner.

# Submittals

* + 1. See Section 01 30 00 - Administrative Requirements for submittal procedures.
    2. Product Data:
       1. Provide data indicating dimensions, duct and service connections, accessories, controls, electrical nameplate data, and wiring diagrams.
       2. The performance schedule shall include the following information:
          1. Unit weight
          2. Heating capacity:

1. Delivery temperature
2. Temperature rise
3. Airflow
4. External static pressure.
   * + - 1. Cooling capacity:

Rated cooling output

Evaporator entering temperature (wet bulb and dry bulb)

Condenser ambient air temperature

Minimum efficiency ratio

* + - * 1. Electrical Characteristics:

Horsepower

Voltage

Maximum Overcurrent Protection (MOP) and Minimum Circuit Ampacity (MCA)

* + - * 1. [Optional] Evaporator Coil
    1. Shop Drawings:
       1. Provide general layout drawings with plan and elevation views including relevant dimensions to include duct, piping, and electrical service connection locations for the following items:
          1. Provide roof curb mounting details.
          2. Provide electrical schematics including field wiring connections.
          3. Provide gas piping connection details.
          4. Provide component details including construction method and materials.
    2. Sustainable Design Documentation:
       1. Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements when applicable.

# Quality Assurance

* + 1. Manufacturer Qualifications:
       1. The manufacturer shall be a company specializing in manufacturing the type of products specified in this section, with a minimum of 5 years of documented experience.
    2. The unit shall be ANSI Z83.4 (CSA 3.7) certified and bear certification label by ETL, UL, or CSA.

# 1.07 Inspection, Storage, and Rigging

* + 1. Inspection:
       1. The unit shall be inspected immediately upon delivery to ensure there is no apparent physical damage.
       2. Any damage claims should be filed immediately with the carrier.
       3. The manufacturer shall not assume responsibility for damage caused during shipment, handling, storage and rigging.
    2. Storage:
       1. Equipment shall be stored in the original factory shipping packaging away from construction areas where it will be safe from damage and protected from harmful weather conditions.
       2. Factory shipping packaging shall remain in place until unit is ready to be installed.
       3. The make-up air unit is not to be used for temporary heating, cooling or ventilation during construction. Doing so will void the terms of the equipment warranty.
    3. Rigging:
       1. Follow manufacturer’s instructions for rigging and placement of equipment.

# 1.08 Coordination

* + 1. Coordinate all system connections and building penetrations including electrical, gas and duct connections.
    2. Coordinate curb placement, structural and roofing.

# Regulatory Requirements

## The packaged air unit shall conform to NFPA 70, and requirements of authorities having jurisdiction.

# 1.10 Warranty

* + 1. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
    2. The manufacturer will provide a parts only warranty of 12-month from startup or 18-months from shipping, whichever comes first.

# PART 2 PRODUCTS

**2.01 Packaged Outdoor Heating and Cooling Make-up Air Units**

* + 1. Basis of Design: Price Industries
       1. Indirect gas fired make-up air heating unit: AW-I
       2. Indirect gas fired make-up air heating unit: PM-IF
    2. General:
       1. The indirect gas fired make-up air heating unit shall be supplied with an integral or split air cooled DX coil built in accordance with Energy Efficiency Rating (EER), Coefficient of Performance (COP) within the requirements of ASHRAE Standard 90.1 I-P
       2. Units shall be supplied with a single point power [dual point power] connection, and a gas connection.

# 2.02 Cabinet

* + 1. Furnace Section Cabinet Construction:
       1. Outer casing construction shall be (**select one**):
          1. 20 gauge G90 galvanized steel (model size 1-20 or smaller)
          2. 18 gauge G90 galvanized steel
          3. 16 gauge G90 galvanized steel
          4. 20 gauge painted G60 galvanized steel (model size 1-20 or smaller)
          5. 18 gauge painted G60 galvanized steel
          6. 16 gauge painted G60 galvanized steel
          7. 20 gauge 304 stainless steel (model size 1-20 or smaller)
          8. 18 gauge 304 stainless steel
       2. The panel seams shall be turned inward and all seams sealed to provide an air tight casing.
       3. The casing shall include insulation in compliance with NFPA 90A and 90B (**select one**):
          1. [Two-inch] or [one-inch] thickness, [1.5 pound] or [3 pound] density fiberglass insulation.
          2. One inch thick polyurethane injected foam.
       4. Wall and ceiling liner shall be (**select one**):
          1. 20 gauge G60 galvanized steel
          2. 22 gauge G60 galvanized steel
          3. 20 gauge 304 stainless steel
          4. 22 gauge 304 stainless steel
       5. Door Construction:
       6. Doors shall be double wall construction matching the cabinet construction, mounted in a flange frame.
       7. Doors shall include hinges, handles and clasps for tool-free access.
       8. Hinged doors shall be provided for filter, fan, and gas train, and controls sections.
       9. Screwed access panels in these sections are not acceptable.
       10. An optional viewing window with a two inch casing shall be provided on all access doors.
       11. Paint finish:
    2. All exterior galvanized steel shall be coated with a weather resistant paint, capable of withstanding surface degradation and substrate corrosion after at least 1500 hours of salt spray exposure (per ASTM B117).
    3. Floor Construction:
       1. Floors will be [two-inch] or [one-inch] thick double wall construction, in the following material:
          1. Inside panels (**select one**):

18 gauge G90 galvanized steel

18 gauge 304 stainless steel inside panels and

* + - * 1. Outside panels shall be 22 gauge G90 galvanized steel.
      1. The optional floor liner shall be (**select one**):
         1. Floor to have 14 gauge aluminum checker plate liner.
         2. Floor to have 14 gauge 304 stainless steel liner, bent up at walls and welded with drain for a wash down floor.
      2. The floor shall be insulated with [polyurethane foam] or [[1.5] or [3] pound glass fiber insulation].
    1. Base Options:
       1. The unit base shall provide support for the entire unit and shall include lifting points.
       2. The base shall be (**select one**):
          1. Formed and bolted, [six-inch] or [eight-inch] height, using

G90 galvanized steel.

Painted G60 galvanized steel.

304 stainless steel

* + - * 1. Welded and painted structural steel of [four-inch] or [six-inch] height.
    1. Damper Construction:
       1. Dampers shall be constructed as follows (**select one**):
       2. Unit dampers shall have a galvanized steel hat channel frame with staked corners.

Blades shall be 16-18 gauge triple-vee roll formed galvanized steel.

Damper linkages shall be installed in the frame.

* + - 1. All dampers shall have an extruded heavy gauge 6063 aluminum frame that includes jamb seals.
         1. Blades shall be airfoil shaped extruded aluminum and include rubber blade seals.
         2. Damper linkages shall be installed in the frame.
      2. All dampers shall have extruded heavy gauge 6063 aluminum frame that includes jamb seals.
         1. Blades shall be airfoil shaped extruded aluminum and include rubber blade seals.
         2. Damper blades shall be insulated with expanded polyurethane foam providing R-2.29 and include a thermal break.
         3. Damper linkages shall be installed in the frame.
    1. Outdoor Installation:
       1. The casing shall be weatherproofed for outdoor installation with an optional intake louver or hood (select all that apply).
          1. The outdoor air section shall include a motorized two position damper which closes when the unit is not in operation.
          2. The unit shall be provided with an air hood constructed of 18 gauge galvanized steel and shall be coated with a weather resistant paint, capable of withstanding surface degradation and substrate corrosion after at least 1500 hours of salt spray exposure (per ASTM B117).
          3. The air hood shall include a half inch expanded metal bird screen.
          4. The unit shall be provided with an outdoor air louver.
          5. The inlet louver frame and blades shall be mill finished extruded aluminum.
          6. The inlet louver shall include a ½ inch expanded metal bird screen.
          7. Louver blades shall be designed to channel rain to the side to avoid entrainment.
          8. The louvers shall be tested in accordance with AMCA 511.
       2. Roof Construction:
          1. The roof shall have three break standing seams.
    2. Mixing Box Installation (optional):
       1. The unit shall be provided with a mixing box that includes return air and outdoor air connections.
       2. The mixing box shall have matching cabinet construction.
       3. The return and outdoor air dampers shall be linked so as one damper opens, the other closes.
       4. The dampers shall be operated by factory supplied electric modulating damper actuators with a [CO2 sensor and control] or [temperature sensor and control].
       5. Outdoor dampers shall close when the unit is not operating.
    3. Economizer Installation (optional):
       1. The unit shall be provided with an economizer box that includes return air, outdoor air, and exhaust air connections.
       2. The outside and return air dampers shall each be sized for 100 percent of the supply air volume.
       3. Control of the dampers shall be by factory installed modulating, spring return-type actuators.
       4. An optional 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.
       5. An optional 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.
       6. The outdoor air dampers shall modulate in response to the unit’s temperature control system when the outdoor air is suitable for free-cooling.
       7. A [barometric exhaust damper] or [a two position motorized damper] shall be provided.
    4. Outdoor Installation:
       1. The weather-proofed casing shall be supplied with the following options (**select all that apply**):
          1. The outdoor air section shall include a motorized two position damper which closes when the unit is not in operation.
          2. The unit shall be provided with an outdoor air hood constructed of 18 gauge galvanized steel.
          3. The outdoor air hood shall be provided with the following options (**select all that apply**):

The outdoor air hood shall be coated with a weather resistant paint, capable of withstanding surface degradation and substrate corrosion after at least 1500 hours of salt spray exposure (per ASTM B117).

The outdoor air hood shall include a half inch expanded metal bird screen.

* + - * 1. The unit shall be provided with an outdoor air louver, tested in accordance with AMCA 511.

The inlet louver frame and blades shall be mill finish extruded aluminum.

Louver blades shall be designed to channel rain to the side to avoid entrainment.

The outdoor air louver shall include a half inch expanded mesh bird screen.

* + 1. Filters:
       1. Filter type and filter rack:
          1. Filters shall be supplied in filter racks, and shall be accessible through a hinged filter access door.
          2. [Optional] The manufacturer shall provide one extra set of filters of each size and type, or a quantity as specified in the plans.
          3. [Optional] A filter rack shall be supplied and factory installed with (**select one**):

Filter differential pressure switch;

Magnahelic pressure gauge;

Digihelic pressure gauge;

Photohelic pressure gauge.

* + - * 1. Filter rack shall be supplied as follows (**select one**):

Unit shall include a two-inch filter rack made of G90 steel.

The Filters shall be accessed through hinged filter access door.

[Supply one set of [MERV 8], [MERV 11], [MERV 13] pleated filters]; or [Supply one set of high temperature pleated filters]; or [Supply one set of washable filters.]

Unit shall include 4 inch filter rack made of G90 steel.

Filters shall be accessed through hinged filter access door.

Supply one set of [MERV 14] or [MERV 13] pleated filters.

Unit shall include 12 inch filter rack made of galvanized steel.

Filters will be [front] or [side] mounted and accessed through hinged access door.

Supply one set of [HEPA], [MERV 13], [MERV14] or [MERV 16] filters.

# 2.05 Furnace and Gas Train (Burners)

* + 1. Construction (**Price Model AW-I only**):
       1. The heat exchanger shall be indirect fired type with a [three] or [four] pass drum and turbulator style tubes for increased heat transfer.
       2. Both primary and secondary heat exchangers shall be constructed of [409] or [304] stainless steel.
       3. The heat exchanger shall include condensate connections for a field installed trap.
       4. The gas burner shall be a modulating, blow-through type mounted outside of the airstream, and shall include:
          1. Flame safe guard;
          2. Timed pre-purge;
          3. Flame sensing.
       5. The gas train shall include the following equipment:
          1. Manual main shut off valve;
          2. Main line appliance regulator;
          3. Motorized electric main gas valve;
          4. Modulating gas valve;
          5. Manual pilot gas shut-off valve;
          6. Manual pilot gas pressure regulator;
          7. Pilot gas valve.
       6. The gas unit controls shall include:
          1. Intermittent pilot ignition;
          2. [Flame rod sensor] or [UV scanner] (**select one**);
          3. High temperature limit;
          4. Air proving sensor;
          5. Modulating temperature control system.
          6. Induced draft (ID) fan (optional on AW-I units only)
       7. The unit shall include an observation port for inspecting the pilot and main flame.
       8. The gas train shall include:
          1. Main manual shut off valve;
          2. Main line appliance regulator;
          3. Motorized electric main gas valve;
          4. Modulating gas valve;
          5. Manual pilot gas shut off valve;
          6. Manual pilot gas pressure regulator;
          7. Pilot gas valve, designed to operate to -40°F (-40°C).
       9. [Optional] Burner profile dampers and actuators shall be provided for VAV operation.
          1. Dampers shall be controlled for [2-speed] or [continuous modulation] from 50 – 100 percent of design airflow.
          2. The damper actuator shall have an end switch to prove position before the blower will start.
       10. A regulator shall be required for initial gas pressure as specified in the plans and drawings.
       11. The pilot shall be electrically ignited by spark rod through a high voltage ignition transformer.
    2. Construction (**Price Model PM-IF 80% and 90% efficient only**):
       1. The heat exchanger shall be 409 stainless steel construction, convoluted style tubes with in shot [80 percent] or [90 percent] efficient burners.
       2. The heat exchanger shall be power vented with negative pressure with respect to the supply airstream.
       3. The heat exchanger shall include condensate connections for a field installed trap.
       4. The gas burner shall be a modulating type mounted outside of the airstream.
       5. Units with multiple heat exchangers shall have on/off type for all subsequent (second, third, etc) heat exchangers.
       6. Furnace controls shall include:
          1. Spark ignition system with flam rod sensor;
          2. Preset high temperature limit switch;
          3. Air proving switch.
       7. Ninety percent (90%) efficient burners shall include:
          1. Factory provided condensate lines with heat trace from the burner to the pipe chase;
          2. Heat trace, field wired to dedicated 120 volt circuit;
          3. Field provided and installed condensate drains from the unit condensate drains into the conditioned building space;
          4. Factory provided condensate neutralizer kits for field installation inside the conditioned building space.
       8. The gas train shall include:
          1. Main manual shut off valve;
          2. Main line appliance regulator;
          3. Motorized electric main gas valve;
          4. Modulating gas valve;
          5. Manual pilot gas shut off valve;
          6. Manual pilot gas pressure regulator;
          7. Pilot gas valve designed to operate to -40°F (-40°C).

# 2.06 Fans

* + 1. Fan Construction:
       1. Fan shall be centrifugal type (**select one**):
          1. The fans shall be [AMCA certified] DWDI forward curved type centrifugal fans with a belt driven motor, and matching motor sheaves and belts.
          2. The fans shall be statically and dynamically balanced.
          3. The fans shall be [mounted on a solid steel shaft with heavy duty self-aligning pre-lubricated ball bearings.
          4. Fan bearings shall be greasable, self-aligning pillow block type with L-10 life of 60,000 hours.
          5. Motor mounts shall be on an adjustable base for belt tensioning.
          6. Belts shall be rated for with service factor of 1.2.
          7. [Optional] Manufacturer shall supply one extra set of belts per fan motor.
          8. The fan and motor assembly shall be mounted on common base with (**select one**):

Rubber in shear (RIS) isolation;

[One-inch] or [two-inch] deflection spring isolation;

[One-inch] or [two-inch] deflection seismic rated spring isolation

* + - * 1. The fan shall be connected to fan bulkhead by a canvas type flex connector.
        2. [Optional] The fan shall be provided with [OSHA style] belt guard.
        3. The fans shall be AMCA certified SWSI unhoused plenum type:
        4. The fan shall be [belt driven] or [directly coupled to the motor].
        5. For belt driven assemblies, the fan bearings shall be greasable, self-aligning pillow block type with L-10 life of 60,000 hours.
        6. Belts shall be rated for with service factor of 1.2, and shall be supplied with a [OSHA style] belt guard.
        7. The fan and motor assembly shall be mounted on an [adjustable – belt drive only], common base complete with (select one):

Rubber in shear (RIS) isolation;

One inch deflection [seismic rated] spring isolation;

Two inch deflection [seismic rated] spring isolation.

* + - * 1. Manufacturer shall optionally supply one extra set of belts per fan motor.
    1. Fan Motor:
       1. Fan motors shall be (**select one**):
          1. NEMA rated [high] or [premium] efficiency Open Drip Proof (OPD) type.
          2. NEMA rated [high] or [premium] efficiency Totally Enclosed Fan Cooled (TEFC) type.
       2. Motors equal to or less than five horsepower shall include motor sheaves that are adjustable plus/minus 10 percent.
       3. For motors greater than five horsepower, the motor sheaves shall be fixed.
       4. The motor electrical requirement shall be as specified in the plans and drawings.
       5. [Optional] Motors shall include extended lubrication lines piped for access from the side of the unit.
       6. [Optional] The motor shall be provided with a shaft grounding ring.

# 2.07 Electrical

* + 1. Disconnect:
       1. The unit shall be supplied with a disconnect (**select all that apply**):
          1. [Through-the-door] or [external] type switch;
          2. [Non-fused] or [fused];
          3. [NEMA 3R] or [NEMA 4X] or [NEMA 12] rated;
          4. Disconnect to be field supplied and installed by others.
    2. Electrical Panel:
       1. The unit electrical panel shall contain the following components:
          1. Motor starters/protectors;
          2. Motor contactors;
          3. Control transformers;
          4. Control circuit fuses;
          5. Terminal block for factory mounted controls.
       2. Low temperature cabinet heater(s) shall be provided for each panel containing unit mounted controls and/or variable frequency drive(s).
       3. The wiring and controls shall be factory tested prior to shipment.
       4. The unit electrical panel shall include (**optional**):
          1. Industrial control wiring with numbered and color-coded wiring run in Panduit.
          2. High and low voltage wiring shall be provided on separate panels.

# 2.08 Controls

* + 1. Factory Installed Controls:
       1. The factory installed controls shall be located in the integral controls cabinet with a hinged access door.
       2. All controls shall operate off a transformer from the main power supply for single point power connection.
       3. The unit controller shall operate all unit components.
    2. Control Enclosure:
       1. All electrical components shall be enclosed within a [NEMA 3R] or [NEMA 4X] enclosure.
    3. Air Temperature Sensor:
       1. The unit shall be provided with a factory mounted supply air temperature sensor in the discharge of the supply air fan.
       2. [Optional] Provide room reset via a remote temperature sensor that is factory supplied for field installation.
       3. [Optional] A remote control panel shall be supplied for field installation and shall include (**select all that apply**):
          1. On-off switch;
          2. Summer-winter switch;
          3. Heat-Off-Cool switch;
          4. Indicating lights for (**select all that apply**):

Supply fan;

Exhaust fan;

Heat operation;

Blower operation;

Heat fail;

Pilot operation;

Burner operation;

Lockout indication;

Clogged filter indication.

* + 1. Variable Frequency Drive:
       1. The fan motor shall be provided with a variable frequency drive (VFD) control complete with (**select all that apply**):
          1. VFD control shall be provided [with] or [without] manual bypass;
          2. VFD control shall be [with] or [without] [input; or output] line reactors;
          3. VFD(s) to be provided for (**select one**):

VAV control;

Building static control;

CAV control;

Final balancing;

Filter-loading-offset.

* + 1. Control Accessories (**select all that apply**):
       1. Interlocks:
          1. [The unit shall start when the exhaust fan is running] or [The unit will start and allow a 3 minute delay for the exhaust fan to turn on].
          2. The burner shall operate when the flow switch located in exhaust duct proves flow.
       2. Timer.
       3. Carbon Monoxide (CO) Monitoring System
       4. Manual Reset Low and High Limit Controls:
          1. The manual reset controls shall shut down the fan if supply air temperatures exceed the high or low limit set points.
       5. Door kill switches shall be provided on [fan access doors] or [all access doors].
       6. Marine service lights shall be provided in each accessible section.
       7. Service outlet [GFI type] or [duplex type] shall be provided.
       8. Power supply for service lights and/or outlets shall be provided [by others] or [from the factory installed transformer].
       9. Phase monitor.

# 2.09 Refrigeration Package

* + 1. Chilled Water Coil:
       1. The unit shall include aluminum fin copper tube type chilled water coil where indicated on the plans.
       2. The chilled water coils shall be certified per AHRI 410.
       3. The chilled water coil shall be mounted in a rack over a stainless steel double sloped condensate pan.
       4. [Optional] The chilled water coil shall include a piping vestibule.
    2. DX Coil:
       1. The unit shall include aluminum fin copper tube type DX coils where indicated on the plans.
       2. The DX coils shall be mounted in a rack over a stainless steel double sloped condensate pan.
       3. The coil shall contain a nitrogen holding charge to prevent atmospheric contamination.
    3. Integral DX Cooling System:
       1. The unit shall include an integral DX cooling system including cooling coil and condensing section where indicated on the plans.
       2. Evaporator coils shall be copper tube aluminum fin coil type.
       3. Cooling coils shall be mounted in a rack over a stainless steel double sloped condensate drain pan.
       4. The condensing section shall include:
          1. R410A scroll compressors;
          2. Filter driers;
          3. Sight glass;
          4. Thermostatic expansion valves;
          5. Direct drive type condensing fan motors.
       5. Unit shall be factory charged with refrigerant and include all necessary controls and safeties for standalone operation.
       6. The condensing section shall be open on the sides and bottom to provide access and to allow airflow through the coils.
       7. The condenser coils shall be (select one):
          1. Multi-row and fabricated from cast aluminum micro-channel coils for units 20 tons and higher;
          2. Aluminum fin copper tube type for units less than 20 tons.
       8. Each unit shall have multiple heavy-duty scroll compressors.
          1. The compressors shall be isolated with resilient neoprene rubber isolators to decrease noise transmission.
          2. Each compressor shall be supplied complete with:

Sight glass;

Anti-slug protection;

High and low pressure control;

Brown-out protection;

Current sensing and motor temperature sensing;

Motor overload protection;

Short cycle protection;

[Optional] Hot gas bypass on one compressor circuit;

[Optional] Crankcase heater

* + - 1. Refrigeration capacity control shall be accomplished by (**select one**):
         1. Staging of the unit’s multiple compressors;
         2. Staging of the unit’s multiple compressors and modulation of the digital scroll compressor and electronic expansion valve.
      2. To maintain desired temperature control, the unit shall have [a minimum of [[two]; [four]; [six]], or continuous] steps of capacity control.
      3. All compressor capacity control staging shall be controlled by the factory installed main unit control system.
      4. Options (**select all that apply**):
         1. The hot gas bypass control shall be factory installed on [the lead] or [both] refrigerant circuits.
         2. Hot gas bypass control shall include a modulating hot gas bypass control valve, all associated piping, and shall be automatically operated by the units’ control.
         3. The modulating hot gas reheat shall be provided on the lead circuit complete with modulating valves, reheat coil, and dehumidification control.
    1. Refrigerant:
       1. The unit shall use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.
    2. Evaporator Coil:
       1. The evaporator copper tube aluminum fin coil assembly shall be supplied with alternate row circuiting, a galvanized drain pan, and a thermostatic expansion valve.

# 2.10 Roof Curb (optional)

* + 1. A roof curb shall be supplied knocked down with the following construction (**select one**):
       1. Galvanized steel with no insulation.
       2. Galvanized steel with 1.5 lb. glass fiber insulation pinned and glued.
       3. The roof curb shall include a wood nailer strip and intermediate bracing as required.
       4. Cross braces shall be provided to support field supplied duct collar sleeves.

# PART 3 EXECUTION

**3.01 Installation**

* + 1. The make-up air unit shall be installed in accordance with the manufacturer's installation instructions, all applicable building codes, and in accordance with NFPA 90A; NFPA 90B; ANSI Z83.4 (CSA 3.7).
    2. A fuel gas system connection shall be provided in accordance with NFPA 54. Refer to Section 22 10 00
    3. Refer to Section 22 05 48 for information regarding the installation of the make-up air unit with vibration isolators.
    4. Refer to Section 23 33 00 for information regarding flexible duct connections on the make-up air unit.

# Start-up Service

* + 1. Engage factory authorized service technician to start up and commission units.
    2. Provide start up report to owner.

# 3.03 Maintenance

* + 1. Refer to Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
    2. A separate maintenance contract shall be provided for specified maintenance service.
    3. Service and maintenance of units shall be provided for one year from Date of Substantial Completion.
    4. Maintenance Materials:
       1. Furnish the following for the Owner's use for project maintenance:
          1. See Section 01 60 00 - Product Requirements for additional provisions.
          2. Extra filters of each type and size.
          3. Extra belts of each type and size.