SECTION 15720

Mechanical Specification

Packaged Unitary Make-up and Ventilation Air

\*\* NOTE TO SPECIFIER \*\* REZNOR; industrial and commercial heating products. This section is based on the products of REZNOR

Toll Free Tel: (800) 695-1901

Web: http://www.ReznorHVAC.com

\*\* Remove all notes shown in red with \*\* before use/publishing.

Part 1 General

1. SECTION INCLUDES Unit

\*\* NOTE TO SPECIFIER \*\* Delete items below not required for project.

* 1. Heating/cooling makeup air systems.
	2. Ventilation Systems.
1. RELATED SECTIONS

\*\* NOTE TO SPECIFIER \*\* Delete any sections below not relevant to this project; add others as required.

* 1. Section 15050 – Basic Mechanical Materials and Methods: Rough-in and service requirements for materials and installation.
	2. Section 16050 – Basic Electrical Materials and Methods: Rough-in and service requirements for materials and installation.
1. SUBMITTALS
	1. Submit under provisions of Section 01300.
	2. Product Data: Manufacturer's data sheets on each product to be used, including:
		1. Preparation instructions and recommendations.
		2. Storage and handling requirements and recommendations.
		3. Installation methods.
	3. Shop Drawings: Submit manufacturer/installer's shop drawings, including plans, elevations, sections, and details, indicating location of equipment, operating characteristics, loads, dimensions, tolerances, materials, components, fabrication, fasteners, hardware, finish, options, and accessories.
2. QUALITY ASSURANCE
	1. Manufacturer Qualifications: Single source for design, engineering, production and warranty.
	2. Manufacturer shall have at least 40 years experience in manufacturing makeup air or ventilation equipment.
	3. Installer Qualifications: Licensed and experienced with mechanical equipment installation, testing and start-up. Familiar with local and national code requirements and restrictions.
3. DELIVERY, STORAGE, AND HANDLING
	1. Store products in manufacturer's unopened packaging until ready for installation.
4. PROJECT CONDITIONS
	1. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

Part 2 PRODUCTS

1. MANUFACTURERS
	1. Acceptable Manufacturer: REZNOR. Toll Free Tel: (800) 695-1901. Fax: (901) 252-1305.
		1.
		2.
		3.

*\*\* NOTE TO SPECIFIER \*\* Delete one of the following two paragraphs; coordinate with requirements of Division 1 section on product options and substitutions.*

* 1. Substitutions: Not permitted.
	2. Requests for substitutions will be considered in accordance with provisions of Section 01600.

*\*\* NOTE TO SPECIFIER \*\* The YDMA packaged rooftop units are designed to cool and heat high volumes of outside air year round for makeup air and ventilation applications. In addition, YDMA can provide significant capacities of space conditioning.*

1. DX Cooling
	* 1. Unit: High Capacity DX Cooling Makeup Air Units utilizing R410-A Refrigerant:
		2. Furnish and install model YDMA for treatment of up to 100% constant outside air per plans and specifications. Unit shall be completely factory assembled, tested, internally wired, fully charged with Refrigerant R410A, and shipped as one piece. Unit shall consist of foam insulated weather-tight casing with optional field installed outdoor intake hood, compressors, air-cooled condenser coils, condenser fans, evaporator coils, supply fan, motors and drives, and unit controls. Packaged Cooling and Heating Units shall carry an ETL listing. Refrigerant System:
		3. DX systems shall be designed to provide 10% to 100% incremental capacity control for treatment of up to 100% outside air with up to 80 degree F (27 degree C) dewpoint entering the unit. Unit shall have hermetic compressors with a scroll design with internal pressure relief and motor temperature winding protection. Compressor shall be equipped with reversal rotation protection. Refrigeration protection shall include low and high pressure switches, refrigerant circuit frost protection, liquid line filters/dryers and service gage ports. The unit shall have a factory installed refrigerant charges to provide unit performance as shown in the schedule. Low pressure switch shall operate at 35 psi or lower pressure. The auto reset low pressure switch shall not reset until the pressure rises about 50 psi. The manual reset high pressure switch shall operate above 600 psi with ± 15 psi. The unit will not reset without a user manually pushing the reset button and the refrigerant line pressure is below 400 psi. Refrigeration control shall include thermal expansion valves, external equalizers and distributors for each compressor circuit.
			1. The refrigerant system shall have a non user adjustable 5 minute minimum ON and minimum OFF timer circuit protection. The refrigerant circuit shall have an anti-cycle timer in addition to the minimum ON/OFF timer that prevents the compressor(s) from cycle on the minimum timer circuit.
			2. The refrigerant system shall include evaporator coil. The copper tube-aluminum plate fin evaporator coil shall be 4 rows with 14 fins per inch to meet leaving air performance as shown on the unit schedule. The multi-circuit evaporator coils shall be interlaced configuration. The entire coil face area shall be active with a single circuit or multiple circuit activation such that the entire coil face shall provide air cooling and dehumidification in part load operation. Split coil face design not acceptable because it does not allow full active face area for dehumidification in the part load operation. The evaporator coils shall be protected from frosting by a low temperature cutout. The factory installed froststat on each circuit shall interrupt power to the associated compressor when the temperature drops below 35°F. The frost stat shall not deactivate until the circuit temperature rises to 50°F. The coils shall be leak tested at the factory to ensure pressure integrity. The unit shall include air cooled condenser coils sized to provide the unit performance as shown in the mechanical schedule. The condenser coil shall be light weight 5/16 copper tubing with aluminum fins. The condenser shall be compact 2 row coil design with low refrigerant volume. The condenser coils shall NOT be aluminum micro-channel type design.
			3. The condensate drain pan shall be rust proof or high corrosion resistant 316 stainless steel. The drain outlet shall be attached to a double sloped drain pan with a minimum 1/8 inch per foot (10 mm per meter) slope. The drain pain shall collect potential condensate from all evaporator/condenser coils and distributor area in the air stream to prevent blow-off condensate reaching unprotected bottom unit surfaces. The unit shall have field supplied and installed P trap, in accordance with all local and area codes and Best Practices.

*\*\* NOTE TO SPECIFIER \*\* Delete one – Standard vs High Efficiency Condenser Fan*

* + - 1. The unit shall be supplied with standard efficiency condenser fan motor(s) rated for the necessary condenser coil airflows. The condenser fans shall be accessible for servicing. The condenser fan system shall be dynamically balanced at the factory and installed with vibration dampening to reduce ambient noise.
			2. The unit shall be supplied with high efficiency electronically commutated motors (ECM) for the condenser fans. The motors shall be rated for the necessary condenser coil airflows. The motors shall have an efficiency 89% or higher. The condenser fans shall be accessible for servicing. The condenser fan system shall be dynamically balanced at the factory and installed with vibration dampening to reduce ambient noise. The motor shall accept a 0-10v control signal and modulate based upon a command from the unit’s control systems. The motor shall provide the following diagnostics and safety features: Lockrotor/jam fault, over/under current protection, over temperature protection and under/over voltage protection.

\*\* NOTE TO SPECIFIER \*\* Delete Hot Gas By Pass if not required. Recommended for all fixed capacity circuits

* + - 1. Factory installed hot gas bypass options shall be available on all fixed capacity refrigerant stages in addition to multiple steps of capacity modulation to supplement discharge air control. The hot gas bypass valve shall have a range of 95 -115 psi with a factory setting of 105. (SST 33.7F) The valve shall be rated to handle 30% of the associated compressor capacity. The HGBP circuit shall be equipped to prevent reverse flow through the valve.

\*\* NOTE TO SPECIFIER \*\* Delete Low ambient if not required. Not recommended for Make-up air systems due to the fact that the outdoor air is already cooled.

* + - 1. DX system shall have low ambient kit. The unit shall cycle or modulate the condenser fans based upon system temperature to maintain operation down to 32°F ambient with 65°F evaporator coil entering temperature.

\*\* NOTE TO SPECIFIER \*\* Delete Hail Guard if not required. Recommended for all applications

* + - 1. The unit shall have a factory installed removable condenser coil hail guard providing protection from large debris and hail that can cause significant damage to the condenser coils. The hail guard shall not obstruct condenser airflow or add significant condenser fan static pressure. The hail guard shall prevent half-inch diameter debri from hitting the condenser coil.
			2. The condenser coils shall be copper tube and aluminum fin design. The coils shall be light weight and low refrigerant volume with the use of 5/16 copper tubing. The condenser coils shall NOT be aluminum micro-channel type design.
			3. The evaporator coil(s) shall be copper tube and aluminum fin design. The evaporator coils shall be interlaced, 4 row design maximizing latent performance as shown on the unit’s mechanical schedule.

\*\* NOTE TO SPECIFIER \*\* Delete coil coating if not required. Recommended if the coils can be exposed to sea salt, chlorine or other corrosion substance. Remove coils not needing the coating.

* + - 1. Coils shall have coating to prevent premature deterioration caused by salt or other environmental chemicals. The coat shall provide an ASTM B117-97 salt spray of 6048 hours. The coat shall provide dip & baked onto the coil insure even coating with no reducing of thermal performance. Spray on coat is not acceptable. The coat shall pass ASTM G21 mold growth standard. The following coils shall be coated:
				1. All DX Evaporator Coil(s)
				2. All DX Condenser Coil(s)
				3. Reheat Coil(s)

\*\* NOTE TO SPECIFIER \*\* Delete compressor sound blankets if not required. Always recommended for urban or other high density environments.

* + - 1. Unit compressors shall have sound blankets. The sound blanks shall reduce ambient noise as demonstrated by sound performance sheets provided by manfacturer. Sound blankets shall come factory installed. Blankets shall be rated for outdoor use.

\*\* NOTE TO SPECIFIER \*\* Delete reheat if not required. Recommended if the space can be significantly over cooled by the entering air; process cannot handle a constant 52-55 leaving air temperature; the air has a net Air change over greater than 6 or every 10 minutes. We also recommend some type of discharge air control.

* + 1. Unit shall include DX based reheat. The method of reheat shall comply with ASHRAE 90.1 requirements. Unit shall include a dedicated compressor and refrigeration circuit using full condenser reheat or total heat of rejection to the supply airstream. The reheat coil position shall include a minimum separation of 10 inches (102 mm) from the cooling coil to eliminate re-evaporation of cooling coil condensate. The circuit shall be capable of delivering a nominal 13°F to 17°F temperature rise from the main evaporator temperature without the need for modulating the capacity for all entering outside air conditions. The reheat system shall modulate to maintain the user adjustable unit leaving air temperature setpoint while also maintaining a constant evaporator temperature setpoint. The reheat coil shall operate down to 50°F ambient temperature without the need of low ambient kit. The reheat coil shall provide greater than 7 COP efficiency at 65°Fdb/64°Fwb entering air temperature. Manufacturer shall show unit performance at above condition. The refrigerant circuits shall include thermal expansion valves with external equalizers. Service gage ports and refrigerant line filter dryers are factory installed as standard. Pre-cooling coils shall be two row depth with 6 fin per inch to minimize air pressure drop.

\*\* NOTE TO SPECIFIER \*\* Delete whole section if Gas heat not required.

* 1. Gas Heating
		1. The system shall be provided with gas heat with the capacity shown the mechanical schedule. Gas heating system shall be factory install consisting of heat exchanger, venter fan, spark ignition system, control valves and all necessary safeties to provide a fully operational heating system ready for operation from the factory. The heat exchanger shall be constructed of 409 stainless steel for make-up air applications. The heat exchanger shall properly drain condensate or other water during the heating and cooling season. The system shall modulate both the gas and combustion air to maintain temperature setpoint(s) and thermal efficiency. The heat exchanger shall be capable of 100 degree (F) temperature rise for 100% outside air treatment. The heating system shall be certified to ANSI Standard Z83.8/CSA 2.6. The heat exchanger shall be 4 pass serpentine, non welded, constructed of 409 stainless steel. Safety Features shall consist but not limited to:
			+ - Automatic discharge air limit control.
				- Air proving pressure switch.
				- Color coded wiring and matching terminal blocks.
				- Circuit breaker protected transformers

\*\* NOTE TO SPECIFIER \*\* Delete one fuel type.

* + 1. The gas heating shall utilize natural gas.
		2. The gas heating system shall utilize propane gas.

\*\* NOTE TO SPECIFIER \*\* Delete one Efficiency type. High efficiency system gas is always recommended for high volume of outside air because of the significant savings.

* + 1. Heating system shall have a minimum thermal efficiency of 91%. The thermal efficiency shall not fall below 90% through the modulated operational range. The Heat exchanger shall have condensate drain to remove and/or prevent water build up in the unit. The condensate shall not exceed 4 pH level. The condensate shall be piped to the appropriate building system for removal.
		2. Heating system shall have a minimum thermal efficiency of 81%. The thermal efficiency shall not fall below 80% through the modulated operational range. The Heat exchanger shall have condensate drain to remove and/or prevent water build up in the unit. The condensate shall be piped to the appropriate building system for removal.

\*\* NOTE TO SPECIFIER \*\* Delete one modulation type. Dual heat exchanger use 10:1 control while single gas heat exchanger use 5:1 gas control.

* + 1. Provide 5:1 power vented modulation. The single gas heat section shall have a single modulating gas valve with spark ignition controls. The modulating valve shall allow capacity control from 20 to 100%. (5:1). The gas control shall consist of ignition board, 2-speed venter, flame sensor, igniter, gas valve and associated safeties. The spark ignition board shall have LED status & diagnostic. The unit shall lock out heating system for the following failures: venter pressure switch failure, ignition lockout, excessive limit switch losses and excessive flame sense losses. The gas control system shall be designed to maintain constant gas efficiency throughout is modulated range. The control system shall allow 50% capacity ignition for 1-2 minutes than it shall allow the valve to modulate to maintain the active discharge air or space temperature setpoints.
		2. Provide 10:1 power vented modulation. The dual gas heat sections shall have a modulating gas valve for first section and a single stage gas value for the second section with spark ignition controls for both sections. The gas value shall modulate and stage to provide 10 to 100% capacity control. (10:1) The gas control shall consist of ignition boards, 2 speed venters, flame sensors, igniters, gas valves and associated safeties. The spark ignition boards shall have LED status & diagnostic. The unit shall lock out heating system banks for the following failures: venter pressure switch failure, ignition lockout, excessive limit switch losses and excessive flame sense losses. The gas control system shall be designed to maintain constant gas efficiency in all throughout the modulated range. The dual heat exchanger shall modulate/stage as follows:
* 10% – 50% Capacity = Bank 1 ON and modulating from 20-100%, Bank 2 OFF
* 50% - 100% Capacity = Bank 1 ON and modulating from 20-100%, Bank 2 100% Capacity

\*\* NOTE TO SPECIFIER \*\* Delete one gas flue extension if not required. Recommended if exhaust system is near building intake or wind can blow exhaust air near intake causing an odor issue.

* + 1. The unit shall be equipped factory supplied, field install flue extension kit. The exhaust shall expel gas while prevent rain, condensate or other water from damaging the gas heat exchanger.

\*\* NOTE TO SPECIFIER \*\* Delete one gas manifold switches if not required.

* + 1. The unit’s gas manifold shall include high and low pressure switches. The auto-reset low pressure switch shall be rated for 50% of the maximum manifold pressure. The manual reset high pressure shall be rated for 125 of the maximum manifold pressure.

\*\* NOTE TO SPECIFIER \*\* Delete gas condensate neutralizer if not required. Recommended for all application because national standard does not exist yet.

* + 1. Manufacturer to provide condensate neutralizer. The neutralizer shall be field installed. It shall not require external power nor added chemicals. The neutralizer shall raise the leaving water pH from 4 to near neutral conditions of 7.0 pH ±1.0. System shall be field rechargeable.

\*\* NOTE TO SPECIFIER \*\* Delete gas condensate pump if not required. Recommended for all application where the condensate could collect in the drain piping.

* + 1. Manufacturer to provide condensate pump. The pump shall be field installed with a dedicated 115V amp service.

\*\* NOTE TO SPECIFIER \*\* Delete Electric Heat if not required.

* 1. Electric Heat
		1. Manufacturer to provide factory installed electric resistance heat for unit. Unit shall include field-replaceable heat sections. All heat sections are to be sub-fused. Electric heat shall include SCR control for 0-100% capacity control. The packaged unit shall be certified to UL-1995 – UL Standards for Safety Heating & Cooling Equipment Second Edition: CAN/CSA C22.2 NO. 236-95.
	2. Cabinet
		1. Unit shall have Foam panel construction for all exterior surfaces and base. The foam insulation shall meet ASTM E-84 with a flame spread of 20 and smoke density of 300. No foam panel acceptable if unit construction exceeds R12 value, no exposed installation air stream and exceed flame safety characteristic of foam paneling. Outer casing shall be fabricated from G90 galvanized steel substrate with 60 gloss painted finish coat. Finish shall be rated for > 1000 salt spray hours. The cabinet design shall prevent condensation forming on the outside of the unit casing in operation via a dedicated thermal break from all internal components to the external surface. Fully gasketed, hinged doors of foam construction shall provide access to filters, dampers, evaporator coils section, supply fan section. Provide hinged single wall construction doors for the heater section and control section. On hinged doors frequently used for service (i.e. filter and coil access) The unit control panel section shall be laid out to provide separation of high and low voltage components per UL standards. High voltage contactors & distribution shall be touch safe. The control panels shall be hinged for easy access to the unit controls. For ease of service, all electrical components will be clearly identified with 1/2 inch (13 mm) diameter self adhesive labels to match the unit specific wiring diagram. The low voltage and unit controller access electrical panel shall be physically isolated from the high voltage section. The open door to the control section reveals the wiring diagrams, DDC programming instructions and all manuals and literature protected and permanently attached to the cover. Control transformers will incorporate integral, resettable circuit breaker protection.

\*\* NOTE TO SPECIFIER \*\* Delete Convenience outlet if not required.

* 1. Supply Fan
		1. The unit’s supply fan shall be direct drive with an ABB variable frequency drive allowing peak fan efficiency and system RPM. The fan system shall be made of galvanized steel. The impeller shall have RAL 5002 coating, directional arrows marketing. The fan sled shall allow up to 176°F (80°C) for the impeller and the motor shall allow ambient temperatures -4°F to 104°F (-20°C to 40°C). The impeller and motor shall be designed for continuous operation. The fan system shall utilize Zie Ziehl-Abegg patented rotating diffusor which reduces noise and helps increase overall system efficiency. The 7 blade, welded construction impeller shall be dynamically balanced at the factory with hub; admissible vibration level less than 2,8 mm/s (0.11 in/s) in conformity with ANSI/AMCA 204.
			1. The supply fan sled shall have slide out design for easy inspection and replacement.
			2. The fan sled shall also allow inspection of the gas or electric heat exchangers.
			3. The fan sled shall have rubber dampers to isolate and minimize vibration.
			4. The fan sled shall include Inlet cone with measuring device for airflow measurement. The packaged unit shall allow fan inlet differential pressure readings inside the control panel to measure supply fan CFM with an accuracy of +/-5%. The unit controller shall allow fan speed settings for occupied and unoccupied modes. The unit controller shall also allow fan speed settings for heating and cooling modes. The unit shall meet the schedule performance. The unit control system shall have test and balance function to allow permanent setting of the airflow(s) as shown in the mechanical schedule.
			5. The ABB frequency drive shall be factory installed with line reactor, ECM Filter and all necessary wiring per UL standard. The drive shall have built in menu drive display with test, start-up, maintenance and diagnostic assistant. The drive shall be factory programmed for 30 second soft start. The drive shall have the following protection and alarms: single phase, overvoltage trip limit, under voltage trip limit, over temperature, microprocessor fault, motor stall protection, motor over temperature.

\*\* NOTE TO SPECIFIER \*\* pick one of the fan control options.

* + - * 1. <Supply fan shall be control by duct static pressure. Duct static pressure sensor shall be unit mounted; sensing range 0 -2.5” w.c.; 24 Vac, 0-10V signal; ± 1% FS accuracy; 1/4” barb connections. Sensor shall have field installed 1/4” pneumatic tubing to the ductwork located 2/3 down the duct. **Sequence**: Whenever the supply fan is running in any mode, the fan speed shall varies to maintain the user selected duct static pressure setpoint. (Default 1”, adjustable range 0-2.5”) When the supply fan is OFF, the VFD supply fan signal will be 0%. (OFF) The control system shall limit the actual VFD range between a user adjusted minimum and maximum output setting with default values of 25% and 100% output - other mechanical limits may apply.
				2. Supply fan shall be control by building static pressure control. The unit mounted building static pressure sensor; sensing range -0.5 thru 0.5” w.c.; 24 Vac, 0-10V signal; ± 1% FS accuracy; 1/4” barb connection. Requires field installed 1/4” pneumatic tubing to the building. **Sequence**: Whenever the supply fan is running in any mode, the fan speed shall vary to maintain the user selected building static pressure setpoint. (Default 0.1”, adjustable range -0.5” thru 0.5”) When the supply fan is OFF, the VFD supply fan signal will be 0%. The control system shall limit the actual VFD range between a user adjusted minimum and maximum output setting with default values of 25% and 100% output - other mechanical limits may apply.
				3. The supply fan shall be adjustable constant volume control. **Sequence:** Whenever the supply fan is ON, the VFD will shall drive to the user defined % based upon the unit display or Network provided value. The control system shall limit the adjustable drive speed between a minimum of 25% and a maximum of 100%.

\*\* NOTE TO SPECIFIER \*\* Delete outdoor air intake hood if not required. Recommended for all application unless outside air is ducted to the unit.

* 1. Intake & Section
		1. Unit shall outdoor air hood design for 100% airflow to allow uniform coil velocity and filter loading. The motorized damper shall be spring return for closure during unit shutdown or power interruption. Outdoor air inlet hood shall include 1 inch (25 mm) permanent filters and screen. Hood filter and screen shall meet MERV 4 rating. (Dust mites, pollen, and water spray) Hood airflow shall not exceed 300 fpm intake velocity to prevent snow and rain entrainment. Units designed for 100% outside air intake only shall include an integrated transition section (without return air opening) designed specifically for 100% outside air introduction

\*\* NOTE TO SPECIFIER \*\* Delete air section damper type if not required.

* + 1. Units shall have fully integrated factory installed 100% motorized outdoor air damper.
		2. Units shall be available with fully integrated factory installed 100% motorized outdoor damper and return damper.
		3. Units shall be available with fully integrated factory installed 100% motorized outdoor damper, return with gravity exhaust damper.
		4. Units shall be available with fully integrated factory installed 100% motorized outdoor damper, return and exhaust air to exhaust fan with gravity relief damper.
		5. Units shall be available with fully integrated factory installed 100% motorized outdoor damper, return and exhaust air to factory installed energy recovery section
		6. Units shall be available with 100% opening with no factory installed dampers.

\*\* NOTE TO SPECIFIER \*\* Delete air section damper construction if not reequired.

* + 1. Damper Construction: The control damper shall be low leak with blade and jamb seals. The damper leakage shall not exceed 10 cfm per square foot at 4” sp. The damper shall be constructed of 16 gage galvanized steel with reinforcement to insure structural integrity. Blade edge seals shall be PVC coated polyester fabric suitable for -25°F to +180°F (-32°C to +83°C) mechanically locked into the blade edge. Jamb seals shall be flexible stainless steel metal, compression type to prevent leakage between end of the blade and the damper frame. Bearings shall be corrosion resistant, molded synthetic sleeve type turning in an extruded hole in the damper frame. Linkage shall be concealed out of airstream, within the damper frame to reduce pressure drop and noise and lessen the need for maintenance.

\*\* NOTE TO SPECIFIER \*\* Delete air section damper control type, if not required.

* + 1. The damper(s) shall be control from an external 0-10V input signal. Sensors/Signal: User supplied 0-10 volt , 2 wire signal. Independent power source. Sequence: The control system accepts a 0-10 volt signal that will position the damper from 0-100% open between the user set maximum and minimum settings.
		2. The damper(s) shall have User Adjustable Two Position Control. Sensors/Signal: None, controlled by the unit’s control system. Sequence: Whenever the unit supply fan is ON in the occupied mode, the dampers will be open to outside air from 0-100% based upon the user setting.. If the supply fan is ON in the unoccupied mode, the dampers will open to outside air to a second user define setting. When the supply fan is OFF, the dampers will be closed 100% to the outside air.2 Position damper control
		3. The damper(s) shall be controlled Building Static Pressure. Sensors/Signal: Unit mounted pressure sensor; sensing range -0.5” w.c. thru 0.5” w.c.; 24 Vac, 0-10V signal; ± 1% FS accuracy; 1/4” barb connections. Requires field installed 1/4” pneumatic tubing to the sensing zone. Sequence: Whenever the supply fan is called to run in the occupied mode, the dampers modulate to maintain the user selected building static pressure setpoint. The dampers are limited to 25%-100% open position. When the supply fan is OFF or in the unoccupied mode, the dampers are closed to the outside air.
		4. The damper(s) shall have 4 Position damper control Option GF4: Sensors/Signal: Quantity 2, user supplied, dry contact closures. (4 wires) Sequence: Whenever the supply fan is ON in the occupied mode, the dampers will open to a user defined % of outside air based upon 2 dry contact closure inputs. When the supply fan is OFF, the dampers will be closed to outside air.

|  |  |  |
| --- | --- | --- |
| State | External Switch Position | Damper % Open to Outside (default values) |
| Position 1 | Open | Open | 20% |
| Position 2 | Close | Open | 40% |
| Position 3 | Open | Close | 60% |
| Position 4 | Close | Closer | 80% |

\*\* NOTE TO SPECIFIER \*\* Delete Exhaust fan, if not required.

* + 1. The unit shall have factory installed exhaust fan meeting the performance as shown on the mechanical drawing. The exhaust fan shall be direct drive plenum with EC motor. The unit’s controller shall directly control the ECM speed. The exhaust section shall be factory installed and shipped as one unit. Field installed exhaust fan option is not acceptable. The exhaust air orientation shall meet the intent of ASHRAE Std 62.1 which is to not allow exhaust air to re-entrain into the outdoor air intake. The exhaust section shall have a gravity or back draft damper, counter balanced, allowing exhaust air to exit the unit. In the closed position the damper maximum back pressure is 4.5 inches w.g. (1.1 kPa). In the open position the damper maximum air velocity can be 1,000 feet per minute (305 m/min). The damper maximum pressure drop is 0.04 inch w.g. (0.01 kPa) at 1,000 feet per minute (305 m/min) through 24 inch x 24 inch (610 x 610 mm) damper.

\*\* NOTE TO SPECIFIER \*\* Delete Energy recovery, if not required. Recommended when the primary use of the equipment is for ventilation. See ASHRAE Std 90.1 for specific requirements by weather zone.

* + 1. The unit shall have factory install total energy recovery wheel that meets the unit performance as shown in the mechanical schedule. The energy recovery component shall incorporate a rotary wheel in an insulated cassette frame complete with seals, drive motor and drive belt, Coatings and Desiccants. The total energy recovery wheel shall be coated with silica gel desiccant permanently bonded. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. The total enthalpy shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel and the wheel shall be connected to the shaft by means of taper locks. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belts of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and ARI Standard 1060, Rating Air-to-Air Energy Recovery Ventilation Equipment. Cassettes shall be listed in the ARI Certified Products Directory and bear the ARI Certified Product Seal.

\*\* NOTE TO SPECIFIER \*\* Delete electric preheat for ERV, if not needed. Recommended when space humidity greater than 35% in the winter time and/or outdoor air can drop below 0F.

* + - 1. The manufacturer shall provide electric preheat for energy recovery frost protection. The electric heat shall automatically engage when the unit’s controller determines that a frost condition exist. All heat sections are to be sub-fused. Electric heat shall be single stage for simplistic operation. capacity control. The packaged unit & pre-heat shall be certified to UL-1995 – UL Standards for Safety Heating & Cooling Equipment Second Edition: CAN/CSA C22.2 NO. 236-95.

\*\* NOTE TO SPECIFIER \*\* Delete exhaust fan control if neither energy recovery nor exhaust fan is not required.

* + - 1. The exhaust fan shall run based upon Static Pressure Control. **Sensors/Signal:** Unit mounted pressure sensor; sensing range -0.5 thru 0.5” w.c.; 24 Vac, 0-10V signal; ± 1% FS accuracy; 1/4” barb connection. Requires field installed 1/4” pneumatic tubing to the building. Sequence: Whenever the supply fan is running in any mode, the fan speed varies to maintain the user selected building static pressure setpoint. (Default 0.1”, adjustable range -0.5” thru 0.5”) When the supply fan is OFF, the VFD supply fan signal will be 0%.
			2. The exhaust fan shall run based upon user set constant volume control. Sensors/Signal: none, speed control by unit’s controller. Sequence: Whenever the supply fan is ON, the exhaust fan VFD drive to the user defined % “off set” from the supply fan speed.
			3. The exhaust fan shall run based upon user set constant volume offset from the supply fan. (Supply Fan Tracking) control. Sensors/Signal: none, unit’s control systems directly control exhaust fan speed control. Sequence: Whenever the supply fan is ON, the exhaust fan will drive to the user defined % based upon the unit display or Network provided value.

\*\* NOTE TO SPECIFIER \*\* Delete One or All Filter options as required. Std 62.1 recommends a minimum of MERV 6 or higher filtration.

* + 1. The unit shall have factory installed 4” MERV 13 filters before the evaporator coils. The filters shall be accessible through a hinged door. None hinge door access is not acceptable. The filters shall be pleated V configuration with an average arrestance of 95%; MERV Rating 13 per ASHRAE 52.2-99. The filters shall be manufactured from recycled synthetic material with moisture & microbial growth resistant properties. The filter shall have less than 0.36” w.c. pressure drop at 500 fpm air velocity. The filter area shall be sized to handle the rated airflow as shown on the mechanical schedule.
		2. The unit shall have factory installed 4” MERV 8 filters before the evaporator coils. The filters shall be accessible through a hinged door. None hinge door access is not acceptable. The filters shall be pleated V configuration with an average arrestance of 95%; MERV Rating 8 per ASHRAE 52.2-99. The filters shall be manufactured from recycled synthetic material with moisture & microbial growth resistant properties. The filter shall have less than 0.36” w.c. pressure drop at 500 fpm air velocity. The filter area shall be sized to handle the rated airflow as shown on the mechanical schedule.

\*\* NOTE TO SPECIFIER \*\* Delete one or all curbs if not required.

* 1. Full Perimeter Curbs:
		1. The curbs available from the manufacturer shall be designed to meet the National Roofing Contractors Association August 1985 guidelines for roof mounted installations. The roof curbs shall be 12 gauge (2.8 mm) zinc coated steel with a 2 inches by 6 inches (51 mm by 152 mm) nailer. Factory curb shall be required for systems requiring vertical discharge or return air connection. The curb is shipped knocked down with assembly instructions.
		2. Manufacturer shall furnish a 36" Tall Curb, with Horizontal (front) Discharge, capable of up to 10,000 cfm. Shall be a full perimeter curb with integral horizontal supply air and optional return air ductwork and duct connections. The horizontal airflow curb shall be designed for either roof or slab installation. 36" Tall Curb, Horiz (front) Discharge, up to 10,000 cfm. A full perimeter curb with integral horizontal supply air and optional return air ductwork and duct connections is also available. The horizontal airflow curb is designed for either roof or slab installation. 36" Tall Curb, Horiz (front) Discharge, MAPS2, up to 10,000 cfm.
	2. Make-up Air Control System. The unit shall operates to maintain one of the following discharge air temperature setpoints during all weather conditions.
* Space Cooling Required: 55F DAT (Range 50 – 100F)
* Space Heating Required: 90F DAT (Range 50 – 100F)
* Space cooling required during winter operation. 55F DAT (Range 50 – 100F)
* Neutral Air - Dehumidified: 70F DAT @ 52-55 Dewpoint (Range 50 – 100F)
* Neutral Air - Heating: 70F DAT (Range 50 – 100F)
	+ 1. The unit shall operate based upon a 7-day programmable time schedule, contact closure or a BMS command to operate in either occupied or unoccupied mode. In the occupied mode the unit supply fan shall run continuous based upon one of the following controls: Constant volume (summer/winter), duct static pressure, or building static pressure. See fan sequence for further details. In the unoccupied mode the fan shall run intermittently to maintain a space temperature setpoint. (84F cooling/ 64F heating).
		2. The optional unit supplied exhaust fan shall run whenever the supply fan is on, otherwise it is OFF. The exhaust fan shall operate based upon one of the following: Constant volume, building static pressure, supply fan tracking. See fan sequence for further details. In the unoccupied mode the exhaust shall be OFF.
		3. The intake dampers shall operate based upon one of the following: 100% outside, external input from user supplied 0-10v, 2-position, 4 position or building static pressure. In the unoccupied period the outside air damper shall be 100% closed while the return air damper shall be 100% open. For units only having one damper, the damper shall be 100% open whenever the supply fan is running.
		4. The mechanical heating and cooling shall operate to maintain the discharge air temperature setpoint. The energy recovery wheel shall be operational in the occupied mode and OFF in the unoccupied mode.
		5. The control system shall incorporate all the necessary safeties.
		6. The alarm functionality shall include low temperature, compressor failure, sensor failure, smoke alarm, power failure, heating failure and supply fan failure. The failures shall protect the unit and displays a code at the unit’s display and the optional wall mounted display. The unit will have test and diagnostics routines for services and start-up.
		7. The control system shall be able to provide neutral air and space temperature control per the sequence of operation shown.

\*\* NOTE TO SPECIFIER \*\* Delete wall space sensor if not required.

* + 1. **The unit shall be supplied with a** wall mounted DDC temperature monitor and setpoint adjustment interface device. The wall mounted unit communicating thermostat shall provide space temperature and space humidity values back to the unit controller. The room module shall allow the user to set the space temperature setpoint and read current values. The room module shall allow the user to read alarm codes from the control system. The room interface module shall allow occupancy time schedules and direct unit mode commands.

\*\* NOTE TO SPECIFIER \*\* Delete one or all factory installed disconnects, if not required.

* + 1. The unit shall be supplied with factory installed disconnect. The line voltage connections to the unit shall be made through a flush-mounted, nema 4X switche with lock-out feature. The disconnect shall be rated for the unit MCA/MOP as shown on the schedule. The unit shall carry a rating plate showing necessary data and all approval.
		2. The unit shall be supplied with factory installed dual disconnect. The dual line voltage connections to the unit shall be made through a two flush-mounted, nema 4X switches with lock-out feature. The unit shall have one circuit dedicated to the DX system comprised of the compressor(s), condenser fans and directly associated contactors/controls. The unit shall have another circuit dedicated to all unit functions such as heat, control, supply fan, energy recovery, intake control and other functions not associated with the DX circuit which is part of circuit 1.

\*\* NOTE TO SPECIFIER \*\* Delete options that are not required.

* 1. Options
		1. A weatherproof convenience outlet shall be provided. The outlet shall be field powered utilizing an independent circuit form the main unit power. The circuit shall be 20 amp circuit with breaker and installed per local and state building codes.
		2. The unit shall have a factory installed dirty filter switch installed for both the unit DX filters and the energy recovery filters. The switch shall have an adjust differential pressure range between 0.25 - 1.5 inch w.c. The switch shall be connected to the unit’s controller and display and alarm when the switch makes indicating an alarm.
		3. Unit shall have factory installed phase lost protection
		4. Unit shall have a factory provided 5 year compressor warranty
		5. Unit shall have a factory provided 5 year gas heat exchanger warranty
		6. Unit shall have a factory provided 10 year gas heat exchanger warranty
		7. Unit shall have a factory provided 5 year electric heat warranty
		8. Unit shall have a factory provided 2 year all parts warranty
		9. Photoelectric Smoke Detector: The unit shall have a factory supplied, field installed 24V ac/dc photoelectric smoke detector with 2 auxiliary contacts for control. The smoke detector shall be hard wired to the unit’s blower OFF. Communication connection for unit shut down is not acceptable. The unit shall have a second alarm output connected to the units control system that will allow the unit to shut down and not restart unit the alarm has been cleared through the unit controller.
		10. The unit shall have a factory install remote start/stop dry contacts. The contacts when are OPEN will command the unit shall be in the OFF state. When the contacts are CLOSE, the unit shall be in the ON state following its normal sequence of operation.