RenewAire Energy Recovery Ventilation

CSI Specification

PRODUCT SPECIFICATION GUIDE RD-4XRT
RENEWAIRE MODEL ERV –– AIR-TO-AIR ENERGY RECOVERY VENTILATOR
FOR OUTDOOR OR INDOOR INSTALLATION
CSI MASTERFORMAT CATEGORY 23 72 00

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To view RenewAire product data to include unit description, catalog and instruction manuals, go to www.renewaire.com/our-ervs/

This product is available in multiple different configurations. The unit is typically installed as an element of a building HVAC system.

Questions regarding this product should be directed to your local RenewAire authorized representative. To locate your local rep, go to www.renewaire.com/how-to-buy/find-a-dealer/ and select your region.

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SECTION 23 72 00 - AIR-TO-AIR ENERGY RECOVERY VENTILATOR

PART 1 - GENERAL

1.1 SUMMARY

- This section includes Air-to-Air Energy Recovery Ventilators for rooftop installation.
- Within this document, these units may be referred to as Energy Recovery Ventilator (ERV) for brevity.

1.2 RELATED

Drawing and general provisions of the contract, including General Requirements Division 01, Division 23, Division 23 Specifications Sections, and common work requirements for HVAC apply to work specified in this section.

- Section 23 09 00: Controls and Instrumentation

1.3 SUBMITTALS

- Product data: For each type or model of Energy Recovery Ventilator, include the following:
    - Unit performance data for both Supply Air and Exhaust Air, with system operating conditions indicated.
    - Enthalpy plate performance data for both summer and winter operation.
    - Motor ratings and unit electrical characteristics.
    - Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
    - Estimated gross weight of each installed unit.
    - Filter types, quantities, and sizes
    - Installation, Operating and Maintenance manual (IOM) for each model.
- LEED Submittals:
    - Provide data for prerequisite E01: Documentation indicating that units comply with ASHRAE 62.1-2010, Section 5 - "Systems and Equipment".
- Shop Drawings: For air-to-air energy recovery ventilators, include plans, elevations, sections, details, and attachments to other work.
    - Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field

assembly, components, and location and size of each field connection.
    - Wiring Diagrams: For power, signal, and control wiring.
- Operation and maintenance data for air-to-air energy recovery ventilator

1.4 QUALITY ASSURANCE

- Source Limitations: Obtain Air-to-Air Energy Recovery Ventilator with all appurtenant components or accessories from a single manufacturer.
- For the actual fabrication, installation, and testing of work under this section, use only thoroughly trained and experienced workers completely familiar with the items required and with the manufacturer's current recommended methods of installation.
- The ERV core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten (10) years from the date of purchase. The balance-of-unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two (2) years from the date of installation.
- Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.
- Certifications:
    - The energy recovery cores used in these products shall be third party Certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. AHRI published certifications shall confirm manufacturer’s published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently AHRI certified will not be accepted. OACF shall be no more than 1.02 and EATR shall be at 0% against balanced airflow.
    - Entire unit shall be listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers and comply with CSA Standard 22.2.
    - Units intended for outdoor use shall be rain tested in accordance with UL 1812 Section 67.
- Every unit to be factory tested prior to shipping: Motor Dielectric Voltage-Withstand Bench Test, Unit Dielectric Voltage-Withstand Test, Continuity of Internal Control Circuits Test, Unit Amperage Test

1.5 COORDINATION

- Coordinate size and location of all building penetrations required for installation of each Energy Recovery Ventilator and associated plumbing and electrical systems.
- Coordinate sequencing of construction for associated plumbing, HVAC, electrical supply.
- Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- Available Manufacturers: Subject to compliance with specifications contained within this document, manufacturers offering products that may be incorporated into the work include, but are not limited to:
    - RenewAire
- Manufacturer should be in business for minimum 10 years manufacturing energy recovery ventilators.

2.2 MANUFACTURED UNITS

- Air-to-Air Energy Recovery Ventilators shall be fully assembled at the factory and consist of a fixed-plate cross-flow heat exchanger with no moving parts, an insulated [single][double] wall [G90 galvanized][painted] 20-gauge steel cabinet, outdoor air hood with bird screen, motorized outside air intake damper, filter assemblies for both intake and exhaust air,

enthalpy core, supply air blower assembly, motorized exhaust air damper, exhaust air hood, exhaust air blower assembly and electrical control box with all specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection. Entire unit with the exception of field-installed components shall be assembled and test operated at the factory.

2.3 CABINET

- Materials: Formed [single][double] wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
- Outside casing: 20 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish. [Painted components as supplied by the factory shall have polyester urethane paint on 20 gauge G90 galvanized steel.]
- Access doors shall be hinged with airtight closed cell foam gaskets. Door pressure taps, with captive plugs, shall be provided for cross-core pressure measurement allowing for accurate airflow measurement.
- Unit shall have factory-installed duct flanges on all duct openings.
- Cabinet Insulation: Unit walls and doors shall be insulated with 1 inch, 4 pound density, foil/scrim faced, high density fiberglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibers, and with a minimum R-value of 4.3 (hr-ft^2-°F/BTU).
- Enthalpy core: Energy recovery core shall be of the total enthalpy type, capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air. No condensate drains shall be allowed. The energy recovery core shall be designed and constructed to permit cleaning and removal for servicing. The energy recovery core shall have a ten year warranty. Performance criteria are to be as specified in AHRI Standard 1060.
- Control center / connections: Energy Recovery Ventilator shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections to the [non-fused][fused] disconnect.
- Passive Frost Control: The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10ºF and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.
- Motorized Isolation Damper(s): Exhaust Air and Fresh Air motorized damper(s) of an AMCA Class I leakage type shall be factory installed.

2.4 BLOWER SECTION

- Blower section construction, Supply Air and Exhaust Air: Blower assemblies consist of a [208-230V][460V][575V] 3 Phase 60 HZ, TEFC motor, and a direct driven forward-curved blower.
- Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

2.5 MOTORS

- Blower motors shall be Premium Efficiency, EISA compliant for energy efficiency. The blower motors shall be totally enclosed (TEFC) and be shall be supplied with factory installed motor starters.

2.6 UNIT CONTROLS

- Fan control: Onboard VFDs both airstreams.
- Bypass economizer control: Differential enthalpy control, 2 position dampers with 100% airflow through the core or 100% airflow bypassing the core.
- Sensors: [None.][Dirty filter monitor for both airstreams.]
- Timeclock: Digital Time Clock [wall mount][mouting in outdoor, enclosed NEMA 3R enclosure], with up to 8 on/off cycles per day or 50 per week, 24VAC power, witrh battery backup protection of program settings against power failure to energize unit
- Motion (Occupancy) Sensor: Passive infrared sensor for [wall][ceiling] mounting with adjustable time-off delay to 30 minutes,

24VAC power to energize unit

- Carbon Dioxide: Adjustable control from 600 - 2000 PPM for [wall][duct] mounting with digital display
- Factory-installed microprocessor controller and sensors, Premium ERV controls that:
    - Comply with requirements in Division 23 Section "Sequence of Operations for HVAC Controls"
    - Has factory-installed hardware and software to enable the building automation interface via [Modbus][BACnet] to monitor, control, and display status and alarms
    - The microprocessor controller shall be capable of operating at temperatures between -20F to 160F
    - The microprocessor controller shall be a DIN rail mounting type
    - Factory-installed microprocessor controller shall come with backlit display that allows menu-driven display for navigation and control of unit
    - The microprocessor controller shall have the ability to communicate with the BMS via Modbus RTU/TCP and BACnet MSTP/IP
    - The microprocessor controller shall have integrated ethernet interface and a web server for displaying unit parameters
    - The microprocessor shall have near field communication (NFC) capability for android devices
    - The microprocessor controller shall have an internal programmable time clock that will allow the user to add up to different occupancy schedules and add holidays
    - The microprocessor control shall be capable of integral diagnostics
    - The microprocessor control shall be capable of IP or SI unit display
    - The microprocessor controller shall have a battery powered clock
    - The microprocessor controller shall at a minimum offer the ability for three modes of determining occupancy: a dry contact, the internal time clock or the BMS
    - A remote user terminal to allow for remote monitoring and adjustment of parameters, allowing ease of control access without going outdoors or into the mechanical room if desired by the user
    - The microprocessor controller shall have at a minimum (10) universal inputs/outputs (AI, DI, AO) and have (6) six relay outputs (DO)
    - The microprocessor controller shall have an integrated fieldbus port
    - The microprocessor controller shall have the capability for I/O expansion
    - The microprocessor controller shall have a micro USB port to load the application program, the unit parameters, saving logs, etc.
    - The sensors that will be required for control are:
        - (2) Temperature sensor for fresh air and exhaust air
        - (2) Temperature and humidity sensor for outside air, return air
        - (2) Differential pressure sensors for filter alarms
        - [(2) Differential pressure sensors for measuring pressure drop across energy recovery core and for determining airflow in both airstreams]
        - (2) Adjustable current switches
        - [Field-installed duct or room IAQ sensor]
        - [Field-installed duct or room CO2 sensor]
        - [Field-installed duct static sensor]
        - [Field-installed room pressurization sensor]
    - The microprocessor controller shall have the capability to monitor the unit conditions for alarm conditions. Upon detecting an alarm, the microprocessor controller shall have the capability to record the alarm description, time, date, available temperatures, and unit status for user review. A digital output shall be reserved for remote alarm indication. Alarms to be also communicated via BMS as applicable. Provide the following alarm functions:
        - Outside air temperature sensor alarm
        - Outside air humidity sensor alarm
        - Return air temperature sensor alarm
        - Return air humidity sensor alarm
        - Fresh air sensor alarm

        - Exhaust air sensor alarm
        - Dirty filter alarm
        - Supply and exhaust air proving alarm
        - [Outside airflow sensor alarm]
        - [Exhaust airflow sensor alarm]
        - [Duct static pressure sensor alarm]
        - [Room pressurization sensor alarm]
        - [CO2 sensor alarm]
        - [TVOC sensor alarm]
        - [Airflow out of range alarm]
        - [Supply air temperature out of range alarm]
        - [Supply air temperature low limit alarm]
    - Display the following on the face of microprocessor controller:
        - Unit on
        - Unit economizer/bypass mode
        - [Cooling status]
        - [Heating status]
        - Outdoor air temperature
        - Outdoor air humidity
        - Return air temperature
        - Return air humidity
        - Supply air temperature
        - [Airflows in both airstreams]
        - Unit on/off
        - Fan on/off
        - Damper status
        - Alarm digital display
    - The microprocessor controller shall have factory pre-programmed multiple operating sequences for control of the ERV. Factory default settings shall be fully adjustable in the field. Available factory pre-programmed sequences on operations are:

SEQUENCE OF OPERATIONS

DDC CONTROLLER:

- Controller with integral LCD readout for changing set points and monitoring unit operation.
- Provided with required sensors and programming.
- Factory programmed, mounted, and tested.
- Integral USB and Ethernet ports for updating programs and retrieving log files.

BMS INTERFACE:

- [BACnet MS/TP]
- [BACnet IP]
- [Modbus RTU]
- [Modbus TCP]

GENERAL OPERATION

POWER UP:

- When the unit main disconnect is closed a delay of 10 seconds (adjustable) occurs for the controller to come online.

ERV UNIT START COMMAND:

- An input signal is required to enable the unit operation. The unit will be commanded on by:
    - [Digital input]
    - [BMS command]
    - [Internal time clock]
    - [Enable via controller display]
- All types of input that are enabled must be true before the unit will start.

- The exhaust fan starts after a 3 second delay (adjustable). The exhaust fan will not start until the damper actuator end switch closes.
- The supply fan starts after a 6 second delay (adjustable). The supply fan will not start until the damper actuator end switch closes.
- The supply fan, exhaust fan, economizer, [heating], [cooling] are controlled based on the chosen unit operating modes and air conditions.

ERV UNIT STOP COMMAND (OR DE-ENERGIZED):

- The unit can then be commanded off by:
  - [Digital input]
  - [BMS command]
  - [Internal time clock]
  - [Disable via controller display]
- Supply fan and exhaust fan are de-energized.
- All dampers are unpowered and spring return to their default position after a 10 second delay (adjustable).

SUPPLY FAN OPERATION:

- [The supply fan will operate at a constant speed.]
- [The supply fan speed will be controlled for:]
  - [Fixed percentage of max speed (0%-100%)]
  - [Supply air flow (CFM)]
  - [Supply duct static pressure]
  - [Room pressure]
  - [IAQ (TVOC)]
  - [Fixed CO_2]
  - [CO_2 flow]
- The unit will attempt to start the supply fan when the supply fan delay timer expires. When the supply fan starts the supply fan adjustable current switch should close and remain closed until the fan is turned off.

SUPPLY FAN STATUS:

Once the supply fan current switch closes [heating], [cooling] operation is allowed. After a delay of 90 seconds (adjustable) from supply fan start signal, if the supply fan current switch is still open the supply fan alarm should be set to true and [heating], [cooling] operation shall be prohibited. The supply fan status shall be set to true only when the supply fan output is on and supply fan current switch is closed. The supply fan status shall be false in all other circumstances.

FIXED FAN SPEED OPTION:

The analog voltage command to the supply fan VFD can be set from the unit controller display [or by the BMS]. The adjustable range of 0% to 100% correspond to the minimum and maximum fan operating speed. This supply fan operation mode can be used to field balance the supply air flow rate.

SUPPLY AIR FLOW CONTROL OPTION:

The controller will adjust the supply fan VFD command to maintain the supply air flow rate at a set point. The supply air flow rate set point is entered and adjusted from the unit controller display [or provided by the BMS]. The minimum and maximum values for supply air flow rate set point are unit dependent. An adjustable PI (proportional & integral) loop will compare the measured supply air flow to the air flow rate set point and adjust the fan speed. If the measured supply air flow rate varies from the desired air flow rate by more than 10% (adjustable) for more than 60 seconds (adjustable) a supply air flow rate alarm will be set to true. This supply fan operation mode can be used to provide a constant supply air flow rate as the unit filters become loaded.

SUPPLY DUCT STATIC PRESSURE CONTROL OPTION:

The controller will adjust the supply fan VFD command to maintain the supply duct static pressure at a set point. The supply air duct static pressure set point is entered and adjusted from the unit controller display [or provided by the BMS]. The minimum and maximum values for supply air duct static pressure set point are unit dependent. An adjustable PI (proportional & integral) loop will compare the measured supply air duct static pressure to the static pressure set point and adjust the fan speed. If the measured static pressure varies from the desired static pressure by more than 0.05 inches water gauge (adjustable) for more than 60 seconds (adjustable) a supply air static pressure alarm will be set to true. This supply fan operation mode can be used to provide a constant supply duct pressure for VAV systems.

ROOM STATIC PRESSURE CONTROL OPTION:

The controller will adjust the supply fan VFD command to maintain the room static pressure at a set point. The room static pressure measurement is typically a differential pressure measurement between the room and an adjacent space or outdoors. The room static pressure set point is entered and adjusted from the unit controller display [or provided by the BMS]. An adjustable PI (proportional & integral) loop will compare the measured room static pressure to the static pressure set point and adjust the supply fan speed. If the measured static pressure varies from the desired static pressure by more than 0.05 inches water gauge (adjustable) for more than 60 seconds (adjustable) a supply air static pressure alarm will be set to true. This supply fan operation mode can be used to provide a constant static pressure in an area to control infiltration or exfiltration from an adjacent area or outdoors.

IAQ (TVOC) CONTROL OPTION:

The controller will adjust the supply fan VFD command to maintain the room or return air VOC level at a set point. The VOC set point is entered and adjusted from the unit controller display [or provided by the BMS]. An adjustable PI (proportional & integral) loop will compare the measured VOC level to the VOC set point and adjust the fan speed. The minimum and maximum fan speed commands are adjustable. If the measured VOC level exceeds 1000 ppm (CO_2 equivalent, adjustable) for more than 60 seconds (adjustable) a VOC alarm will be set to true. This supply fan operation mode can be used to provide demand controlled ventilation of a space. The minimum fan speed will provide the required minimum outdoor air when the VOC level is at or below the VOC set point.

CO_2 CONTROL OPTION:

The controller will adjust the supply fan VFD command to maintain the room or return air CO_2 level at a set point. The CO_2 set point is entered and adjusted from the unit controller display [or provided by the BMS]. An adjustable PI (proportional & integral) loop will compare the measured CO_2 level to the CO_2 set point and adjust the fan speed. The minimum and maximum fan speed commands are adjustable. If the measured CO_2 level exceeds 1000 ppm (adjustable) for more than 60 seconds (adjustable) a CO_2 alarm will be set to true. This supply fan operation mode can be used to provide demand controlled ventilation of a space. The minimum fan speed will provide the required minimum outdoor air when the CO_2 level is at or below the CO_2 set point.

CO_2 FLOW CONTROL OPTION:

The controller will adjust the supply fan VFD command based on the measured room or return air CO_2 level. The supply air flow set point is derived from the user entered minimum and maximum CO_2 levels and minimum and maximum desired air flow rates. When the CO_2 level is at or below the minimum CO_2 level the air flow set point is at the minimum and when the CO_2 level is at or above the maximum CO_2 level the air flow set point is at the maximum. Between the minimum and maximum CO_2 levels the air flow set point is linearly scaled. If the measured CO_2 level exceeds 1000 ppm (adjustable) for more than 60 seconds (adjustable) a CO_2 alarm will be set to true. This supply fan operation mode can be used to provide demand controlled ventilation of a space. The minimum fan speed will provide the required minimum outdoor air when the CO_2 level is at or below the CO_2 set point.

EXHAUST FAN OPERATION:

- [The exhaust fan will operate at a constant speed.]
- [The exhaust fan speed will be controlled for:]
    - [Fixed percentage of max speed (0%-100%)]
    - [Exhaust air flow (CFM)]
    - [Supply fan command tracking]
    - [Supply fan flow rate tracking]
    - [Room static pressure]
- The unit will attempt to start the exhaust fan when the exhaust fan delay timer expires. When the exhaust fan starts the exhaust fan adjustable current switch should close and remain closed until the fan is turned off.

EXHAUST FAN STATUS:

After a delay of 90 seconds (adjustable) from exhaust fan start signal, if exhaust fan current switch is still open the exhaust fan alarm should be set to true. The exhaust fan status shall be set to true only when the exhaust fan output is on and exhaust fan current switch is closed. The exhaust fan status shall be false in all other circumstances.

FIXED FAN SPEED OPTION:

The analog voltage command to the exhaust fan VFD can be set from the unit controller display [or provided by the BMS]. The adjustable range of 0% to 100% correspond to the minimum and maximum fan operating speed (0 VDC minimum to 10 VDC maximum, adjustable). This exhaust fan operation mode can be used to field balance the exhaust air flow rate.

EXHAUST AIR FLOW CONTROL OPTION:

The controller will adjust the exhaust fan VFD command to maintain the exhaust air flow rate at a set point. The exhaust air flow rate set point is entered and adjusted from the unit controller display [or provided by the BMS]. The minimum and maximum values for the exhaust air flow rate set point are unit dependent. An adjustable PI (proportional & integral) loop will compare the measured exhaust air flow to the air flow rate set point and adjust the fan speed. If the measured exhaust air flow rate varies from the desired air flow rate by more than 10% (adjustable) for more than 60 seconds (adjustable) an exhaust air flow rate alarm will be set to true. This exhaust fan operation mode can be used to provide a constant exhaust air flow rate as the unit filters become loaded.

SUPPLY FAN COMMAND TRACKING CONTROL OPTION:

The controller will adjust the exhaust fan VFD command to track the supply fan command. The minimum (50%) and maximum (200%) tracking rates are adjustable. This exhaust fan operation mode can be used to maintain proportional supply and exhaust fan commands as the supply fan modulates.

SUPPLY FAN FLOW TRACKING CONTROL OPTION:

The controller will adjust the exhaust fan VFD command to track the supply fan air flow rate. The offset from the supply air flow rate is adjustable from -25% to +25%. An adjustable PI (proportional & integral) loop will compare the measured exhaust air flow to the air flow rate set point and adjust the fan speed. If the measured exhaust air flow rate varies from the desired air flow rate by more than 10% (adjustable) for more than 60 seconds (adjustable) an exhaust air flow rate alarm will be set to true. This exhaust fan operation mode can be used to maintain proportional supply and exhaust air flows as the supply fan modulates and as the unit filters become loaded.

ROOM STATIC PRESSURE CONTROL OPTION:

The controller will adjust the exhaust fan VFD command to maintain the room static pressure at a set point. The room static pressure measurement is typically a differential pressure measurement between the room and an adjacent space or outdoors. The room static pressure set point is entered and adjusted from the unit controller display [or provided by the BMS]. The minimum and maximum values for the exhaust fan speeds are adjustable. An adjustable PI (proportional & integral) loop will compare the measured room static pressure to the static pressure set point and adjust the exhaust fan speed. If the measured static pressure varies from the desired static pressure by more than 0.05 inches water gauge (adjustable) for more than 60 seconds (adjustable) an exhaust air static pressure alarm will be set to true. This exhaust fan operation mode can be used to provide a constant static pressure in an area to control infiltration or exfiltration from an adjacent area or outdoors.

ECONOMIZER (BYPASS) OPERATION:

During normal operation the bypass damper shall remain closed and the face damper open to allow full energy recovery. During economizer operation the bypass damper will be open and the face damper will close to bypass the core. The economizer state can be controlled by temperature or enthalpy.

TEMPERATURE:

- The economizer will be locked out when:
  - The outside air temperature is less than the economizer adjustable low lockout.
  - The outside air temperature is greater than the economizer adjustable high lockout.

ENTHALPY:

- The economizer will be locked out when:
  - The outside air enthalpy is greater than return air enthalpy.
  - The outside air temperature is less than the economizer field adjustable low lockout.

COOLING OPERATION:

Cooling will be locked out if the outdoor air temperature is below 70 degrees (adjustable) or if heating is enabled. The temperature set point can be configured as constant (adjustable) or can be reset by the outside air temperature. Cooling will be controlled using the supply air temperature or return air temperature.

CONSTANT SUPPLY AIR TEMPERATURE OPTION:

The controller will adjust the 0 to 10 VDC analog output to the cooling device to maintain the air temperature at a set point. The air temperature set point is entered and adjusted from the unit controller display [or provided by the BMS]. The minimum and maximum values for the supply air temperature set point are unit dependent and are adjustable. An adjustable PI (proportional & integral) loop will compare the measured supply air temperature to the supply air temperature set point and adjust the 0 to 10 VDC analog output. Digital outputs that indicate a call for up to 2 stages of cooling will also be provided. The analog and digital outputs can be used to control a chilled water valve, remote DX condensing units, or a heat pump.

RESET AIR TEMPERATURE OPTION:

The controller will adjust the 0 to 10 VDC analog output to the cooling device to maintain the air temperature at a set point. The air temperature set point is calculated based on the outdoor air temperature. The air set point is adjusted between the 70 degree F maximum (adjustable) and the 55 degree F minimum (adjustable) as the measured temperature varies from the 70 degree F minimum (adjustable) to the 90 degree F maximum (adjustable). These values are entered and adjusted from the unit controller display [or provided by the BMS]. An adjustable PI (proportional & integral) loop will compare the measured air temperature to the air temperature set point and adjust the analog output. Digital outputs that indicate a call for up to 2 stages of cooling will also be provided. The analog and digital outputs can be used to control a chilled water valve, remote DX condensing units, or a heat pump. Coil freeze protection must be provided by others in the field.

HEATING OPERATION:

Heating will be locked out if the outdoor air temperature is above 70 degrees (adjustable). The temperature set point can be configured as constant (adjustable) or can be reset by the outside air temperature. Heating will be controlled using the supply air temperature or return air temperature.

CONSTANT TEMPERATURE OPTION:

The controller will stage the heaters or adjust the 0 to 10 VDC analog output to the heating device to maintain the air temperature at a set point. The air temperature set point is entered and adjusted from the unit controller display [or provided by the BMS]. The minimum and maximum values for the air temperature set point are unit dependent and are adjustable. An

adjustable PI (proportional & integral) loop will compare the measured air temperature to the air temperature set point and adjust the analog output. A digital output that indicates a call for heating will also be provided. The analog and digital output can be used to control a hot water valve, electric heater, gas heater, or heat pump.

RESET AIR TEMPERATURE OPTION:

The controller will adjust the 0 to 10 VDC analog output to the heating device to maintain the air temperature at a set point. The air temperature set point is calculated based on the outdoor air temperature. The air set point is adjusted between the 100 degree F maximum (adjustable) and the 70 degree F minimum (adjustable) as the measured temperature varies from the 20 degree F minimum (adjustable) to the 70 degree F maximum (adjustable). These values are entered and adjusted from the unit controller display [or provided by the BMS]. An adjustable PI (proportional & integral) loop will compare the measured supply air temperature to the supply air temperature set point and adjust the 0 to 10 VDC analog output. A digital output that indicates a call for heating will also be provided. The analog and digital output can be used to control a hot water valve, electric heater, gas heater, or heat pump. Coil freeze protection must be provided by others in the field.

2.7 FILTER SECTION

- ERV shall have 2" thick [MERV 8][MERV 13] disposable pleated filters located in the outdoor air and exhaust airstreams. All filters shall be accessible from the exterior of the unit.

2.8 FLUID COILS

- General: Fluid coils are intended for use with water, glycol, or other appropriate heat transfer fluids. Coils are to be designed to maximize performance under specified conditions with minimal air-side pressure drop.
- Certification: All water coils designed with 1/2” or 5/8” tubes are to be ARI performance certified and shall bear the ARI symbol. Coils outside the scope of ARI’s standard rating conditions or the manufacturer’s certification program will be acceptable since the manufacturer is a current member of the ARI coil certification program, and coils will be rated in accordance with ARI Standard 410.
- Tubes: Tubes and return bends shall be constructed from seamless UNS C12200 copper conforming to ASTM B224 and ASTM E527. Properties shall be O50 light annealed, with a maximum grain size of 0.040 mm. Tubes are to be mechanically expanded into fins (secondary surface) for maximum heat transfer. Materials are to be 3/8” diameter x (0.014, 0.022) wall thickness, 1/2” diameter x (0.016, 0.025) wall thickness, or 5/8” diameter x (0.020, 0.025, 0.035, 0.049) wall thickness.
- Fins: Secondary surface (fins) shall be of the plate-fin design using aluminum or copper, with die-formed collars. Fin design to be flat, waffle, or sine-wave in a staggered tube pattern to meet performance requirements. Collars will hold fin spacing at specified density, and cover the entire tube surface. Aluminum properties are to be Alloy 1100 per ASTM B209, with O (soft) temper; copper is to be Alloy 11000 per ASTM B152-06 with soft (anneal) temper. Fins are to be free of oils and oxidation.
- Headers: Headers are to be constructed of seamless UNS C12200, Type L (drawn) copper material sized to match specified connection size. Type K (drawn) copper headers and Schedule 40 steel headers shall be offered as optional materials. Die-fored copper end caps are brazed on the inside of the headers, unless spun-closed (for sizes up to 1-3/8”). 1/4” vents and drains are to be provided for all fluid coils.
- Connections: Connection material shall be copper, or Schedule 40 steel or red brass pipe. The type of connection is to be sweat type, MPT or FPT, grooved, or flanged as required.
- Casing: Coil casing material shall be of G90 galvanized steel, 16 gauge minimum. Heavier material, stainless steel, copper, or aluminum casings are to be provided as required. Intermediate tube supports are to be provided on all coils 48” and longer fin length. Coil casings on top and bottom of coils are to have double-flange construction, allowing for vertical stacking of coils.
- Brazing: All coils are to be brazed with minimum 5% silver content (BCup-3) filler material to insure joint integrity. Low-fuming, flux-coated bronze braze-weld material is to be used for ferrous to non-ferrous joints.
- Pressure Testing: Coils shall be tested at 550 psig using dry nitrogen, submerged under water. Dual-operator verification shall determine that all coils are leak-free.
- Operating Pressures and Temperatures: Fluid coils shall be designed to withstand 300° F maximum operating fluid temperature, and 250 psig maximum operating pressure.
- Installation: Coils are to be installed according to manufacturer’s instructions and applicable piping codes.

2.9 EVAPORATOR COILS

- General: Evaporator coils are intended for use with a wide range of applications and refrigerant types. Coils are to be

designed to maximize performance under specified conditions with minimal air-side pressure drop.

- Certification: Coils shall be UL recognized as Refrigerant Containing Component. Coils to be used with refrigerant R-410A shall have undergone cycle testing, and shall be safety listed with 750 psig rating.
- Tubes: Tubes and return bends shall be constructed from seamless UNS C12200 copper conforming to ASTM B224 and ASTM E527. Properties shall be O50 light annealed, with a maximum grain size of 0.040 mm. Tubes are to be mechanically expanded into fins (secondary surface) for maximum heat transfer. Materials are to be 3/8” diameter x (0.014, 0.022) wall thickness, 1/2” diameter x (0.016, 0.025) wall thickness, or 5/8” diameter x (0.020, 0.025, 0.035, 0.049) wall thickness. Internally enhanced rifled or cross-hatched tubes can be offered as an option.
- Fins: Secondary surface (fins) shall be of the plate-fin design using aluminum or copper, with die-formed collars. Fin design to be flat, waffle, or sine-wave in a staggered tube pattern to meet performance requirements. Collars will hold fin spacing at specified density, and cover the entire tube surface. Aluminum properties are to be Alloy 1100 per ASTM B209, with O (soft) temper; copper is to be Alloy 11000 per ASTM B152-06 with soft (anneal) temper. Fins are to be free of oils and oxidation.
- Headers: Headers are to be constructed of seamless UNS C12200, Type L (drawn) copper material sized to match specified connection size. Type K (drawn) copper headers shall be offered as an optional material. Die-formed copper end caps are brazed on the inside of the headers, unless spun-closed (for sizes up to 1-3/8”).
- Connections: Evaporator coils shall be designed with brass liquid distributors (as required), and copper sweat suction connections. Distributors shall be capped using soft-solder for ease of cap removal; suction connections shall be capped.
- Casing: Coil casing material shall be of G90 galvanized steel, 16 gauge minimum. Heavier material, stainless steel, copper, or aluminum casings are to be provided as required. Intermediate tube supports are to be provided on all coils 48” and longer fin length. Coil casings on top and bottom of coils are to have double-flange construction, allowing for vertical stacking of coils.
- Brazing: All coils are to be brazed with minimum 5% silver content (BCup-3) filler material to insure joint integrity.
- Pressure Testing: Coils shall be tested at 550 psig using dry nitrogen, submerged under water. Dual-operator verification shall determine that all coils are leak-free. Coils shall be shipped with nitrogen charge to verify leak-free integrity, and to prevent moisture migration into coil.
- Operating Pressures: Coils shall be certified to withstand 750 psig working pressures.
- Installation: Coils are to be installed according to manufacturer’s instructions and applicable piping codes. System piping and risers shall be designed for velocities that allow for proper oil return throughout the system.

PART 3 – EXECUTION

3.1 EXAMINATION

- Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.
- Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements. See unit IOM.
- Proceed with installation only after all unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer’s installation instructions as documented in manufacturer’s IOM, Best Practices and all applicable building codes.
- Install unit with clearances for service and maintenance.

3.3 CONNECTIONS

In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.

- Duct installation and connection requirements are specified in Division 23 of this document.
- Electrical installation requirements are specified in Division 26 of this document.

3.4 FIELD QUALITY CONTROL

- Contractor to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to Architect/Engineer in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer’s IOM. Insert any other requirements here.

3.5 START-UP SERVICE

- Contractor to perform startup service. Clean entire unit, comb coil fins as necessary, and install clean filters. Verify water source for compliance with manufacturer's requirements for flow and temperature. Measure and record electrical values for voltage and amperage. Refer to Division 23 “Testing, Adjusting and Balancing” and comply with provisions therein.

3.6 DEMONSTRATION AND TRAINING

- Contractor to train owner’s maintenance personnel to adjust, operate and maintain the entire Make-Up Air unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.