DISTRICT WIDE SCHOOL UPGRADES – HVAC
NAUGATUCK, CONNECTICUT 06770

S/P+A PROJECT NO. 16.041

Date Issued: July 28, 2016

The following changes to the Drawings and Project Specifications shall become a part of the Drawings and Project Specifications; superseding previously issued Drawings and Project Specifications to the extent modified by Addendum No. 2.

General Information:

- See attached RFIs. (1)

New Specifications:

- SECTION 237433, DEDICATED OUTDOOR-AIR UNITS, has been added and is attached as part of this addendum (18).

Changes to the Specifications:

- TABLE OF CONTENTS:
  - Page 2, Division 23 – Heating, Ventilating and Air Conditioning (HVAC), add the following:

    "Section 237433 Dedicated Outdoor-Air Units 18"

The bid date is unchanged by this addendum.
The addendum consists of twenty (20) pages of 8½"x11" text.
End of Addendum '2'

RFI #4

Kenneth J. Eldridge

From: Kenneth J. Eldridge
Sent: Thursday, July 28, 2016 2:27 PM
To: 'Pierleoni, Davide'
Cc: Rebecca Bouchard; Ryan Haley
Subject: RE: Andrew Ave Elementary School

Davide,

As we discussed yesterday, the Basis of design is a Greenheck Unit. The specification in the forthcoming addendum #2 should clarify the Trane or Xerxes equivalent substitution.

Thanks,

Kenneth J. Eldridge, PE
Senior Mechanical Engineer

SILVER / PETRUCELLI + ASSOCIATES
P: 203.230.9007 x 260 | F: 203.230.8247 | C: 203.671.3976

From: Pierleoni, Davide [mailto:DAVIDE.PIERLEONI@TRANE.COM]
Sent: Tuesday, July 26, 2016 6:55 PM
To: Kenneth J. Eldridge <keldridge@silverpetrucelli.com>
Subject: Andrew Ave Elementry School

Hi, Ken.

How are you?

I just received the drawings for this project. I noticed that the DOA unit is shown on the roof plans but not on the schedule.

Is this just a budget or the job is actually bidding?

Do you want me to include the DOA unit in my proposal? If so, do you want me to price it as the XeteX unit or as the Trane unit?

Thanks again for specifying my products for this project.

Davide Pierleoni
Account Manager, CT-NY-VT District
Trane Commercial Systems and Services
Ingersoll Rand

716 Brook St, Suite 130, Rocky Hill, CT 06067
Office: 860-616-6517
Fax: 860-616-6599
Cell: 860-637-0775
E-mail: davide.pierleoni@trane.com
www.trane.com

SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes factory-packaged units capable of supplying up to one hundred percent (100%) outdoor air and providing cooling and heating.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Prepare the following by or under the supervision of a qualified professional engineer:

    a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
    b. Include diagrams for power, signal, and control wiring.

1.4 COORDINATION

A. Coordinate layout and installation of air-to-air energy recovery equipment and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof-curb mounting details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Size and location of unit-mounted rails and anchor points and methods for anchoring units to roof curb.
2. Required roof penetrations for ducts and electrical raceways, including size and location of each penetration.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ARI Compliance:

1. Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment."
2. Capacity ratings for air coils shall comply with ARI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Five (5) years from date of Substantial Completion.
2. Warranty Period for Heat Exchangers: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design (DOAS-1):

1. Greenheck; **Model ERCH-90-30L**

B. Acceptable Manufacturers:

1. Carrier Corp
2. Trane

2.2 PERFORMANCE REQUIREMENTS

A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."

B. Cabinet Thermal Performance:

1. Maximum Overall U-Value: Comply with requirements in ASHRAE/IESNA 90.1.
2. Include effects of metal-to-metal contact and thermal bridges in the calculations.

C. Cabinet Surface Condensation:

1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.

D. Maximum Cabinet Leakage: One-half percent (0.5%) of the total supply-air flow at a pressure rating equal to the fan shut-off pressure.

E. Cabinet Deflection Performance:

1. Walls and roof deflection shall be within 1/200 of the span at the design working pressure equal to the fan shut-off pressure. Deflection limits shall be measured at any point on the surface.
2. Floor deflections shall be within 1/240 of the span considering the worst-case condition caused by the following:

    a. Service personnel.
    b. Internal components.
    c. Design working pressure defined for the walls and roof.

F. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Capacities and Characteristics:

1. Supply Airflow: 7,220 cfm.
2. External Static Pressure: 1.0 inches wg.
3. Supply Fan:

    a. Size: 18-inch.
    b. Speed: 1,025 RPM.
    c. Brake Horsepower: 6.0 HP.

4. Supply Fan Motor:

    a. Size: 7-1/2 HP.
    b. Speed: 1,725 RPM.
    c. Volts: 460
    d. Phase: Three.
    e. Hertz: 60

5. Refrigerant Cooling:

    a. Refrigerant Type: R-410a
    b. Capacity: 248.1 MBH.
    c. Full-Load Efficiency (EER): 11.0
    d. Condenser Ambient-Air Temperature: 95 deg F.
    e. Evaporator Coil:

1) Sensible Heat-Transfer Rate: 182.1 MBH.
2) Total Heat-Transfer Rate: 248.1 MBH.
3) Entering-Air, Dry-Bulb Temperature: 76.5 deg F.
4) Entering-Air, Wet-Bulb Temperature: 64.1 deg F.
5) Leaving-Air, Dry-Bulb Temperature: 53.3 deg F.
6) Leaving-Air, Wet-Bulb Temperature: 52.6 deg F.
7) Suction Temperature: 48.0 deg F.
8) Face Area: 19.4 sq. ft.
9) Maximum Face Velocity: 400 fpm.
10) Maximum Air-Side, Static-Pressure Drop: 0.265 inches wg.
11) Fin Spacing: 10 fins per inch.
12) Number of Rows: 6

f. Hot Gas Reheat:

1) Sensible Heat-Transfer Rate: 139.1 MBH.
2) Leaving-Air, Dry-Bulb Temperature: 71.1 deg F.
3) Capacity: Modulating

6. Electric-Resistance Heating Coils:

a. Leaving-Air Temperature: 72.8 deg F.
b. Power Input: 45.0 kW.
c. Heating coil Elements: Nickel Chrome alloy with ceramic support bushings.
d. UL Listed: Yes
e. Volts: 480
f. Phase: Three.
g. Hertz: 60.
h. Full-Load Amperes: 56.48 Amps
i. Capacity Control Number of Steps: SCR modulation.

7. Overall Unit Electrical Characteristics:

a. Volts: 460
b. Phase: Three.
c. Hertz: 60.
d. Minimum Circuit Ampacity: 66.3 Amps
e. Maximum Overcurrent Protection: 80 Amps

2.3 CABINET

A. Construction: Double wall.

B. Exterior Casing Material: Galvanized steel with paint finish.

C. Interior Casing Material: Galvanized steel.

D. Lifting and Handling Provisions: Factory-installed shipping skids and lifting lugs.

E. Base Rails: Galvanized-steel rails for mounting on roof curb or pad as indicated.

F. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

1. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.

G. Roof: Standing seam or membrane; sloped to drain water.

H. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.

I. Cabinet Insulation:

1. Type: Fibrous-glass duct lining complying with ASTM C 1071, Type II sheet materials.
2. Thickness: 1 inch.
3. Insulation Adhesive: Comply with ASTM C 916, Type I.
4. Mechanical Fasteners: Suitable for adhesive, mechanical, or welding attachment to casing without damaging liner and without causing air leakage when applied as recommended by manufacturer.

J. Condensate Drain Pans:

1. Shape: Rectangular, with one percent (1%) slope in at least two (2) planes to direct water toward drain connection.
2. Size: Large enough to collect condensate from cooling coils including coil piping connections, coil headers, and return bends.

    a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
    b. Depth: A minimum of 2 inches deep.

3. Configuration: Double wall, with space between walls filled with foam insulation and moisture-tight seal.
4. Material: Stainless-steel sheet.
5. Drain Connection:

    a. Located on one (1) end of pan, at lowest point of pan.
    b. Terminated with threaded nipple.
    c. Minimum Connection Size: NPS 1.

6. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
7. Units shall be provided with a Condensate Drain Trap.

    a. P trap assembly shall be provided for each unit, to include cleanout ports, cleanout tool, vacuum break device and see-through reservoir to permit visual verification of water or glycol solution levels.

8. Units shall be provided with a wired and integrated Condensate Overflow Switch.

K. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1 for resistance to mold and erosion.

L. Roof Curb: Full-perimeter curb of sheet metal, minimum 18 inches high, with wood nailer, neoprene sealing strip, and welded Z-bar flashing.

1. Comply with requirements in "The NRCA Roofing Manual."

2.4 SUPPLY FAN

A. Forward-Curved Fan Type: Centrifugal; statically and dynamically balanced.

1. Fan Wheel Material: Galvanized steel, mounted on solid-steel shaft.
2. Bearings: Pillow-block bearings rated L_{50} for 200,000 hours and having external grease fittings.

B. Service Factor for Belt Drive Applications: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly with minimum 1.5 service factor.

C. Motors:

1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors.
2. Enclosure: Open drip-proof.
3. Enclosure Materials: Cast iron.
4. Motor Bearings: Ball Bearings.
5. NEMA Efficiency: Premium efficient.
6. Service Factor: 1.15

D. Mounting: Fan wheel, motor, and drives shall be mounted to fan casing with restrained elastomeric isolators.

2.5 COOLING COILS

A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410.

B. Coil Casing Material: Corrosion Resistant.

C. Tube Material: Copper.

D. Tube Header Material: Copper.

E. Fin Material: Aluminum.

F. Fin and Tube Joints: Mechanical bond.

G. Leak Test: Coils shall be leak tested with air underwater.

H. Refrigerant Coil Capacity Reduction: Circuit coils for interleaved control.

I. Refrigerant Coil Suction and Distributor Header Materials: Seamless copper tube with brazed joints.

2.6 REFRIGERATION SYSTEM

A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."

B. Refrigerant Charge: Factory charged with refrigerant and filled with oil.

C. Compressors: Hermetically sealed, digital scroll compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief, and crankcase heater.

D. Refrigerant: R-410A.

1. Classified as Safety Group A1 according to ASHRAE 34.
2. Provide unit with operating charge of refrigerant.

E. Refrigeration System Specialties:

1. Expansion valve with replaceable thermostatic element.
2. Refrigerant dryer.
3. High-pressure switch.
4. Low-pressure switch.
5. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
6. Brass service valves installed in discharge and liquid lines.

F. Capacity Control:

1. Variable output capacity, digital scroll compressors.

G. Refrigerant condenser and reheat condenser coils:

1. Capacity Ratings: Complying with ASHRAE 33 and ARI 410.
2. Tube Material: Copper.
3. Fin Material: Aluminum.
4. Fin and Tube Joint: Mechanical bond.
5. Leak Test: Coils shall be leak tested with air underwater.

H. Condenser Fan Assembly:

1. Fans: Multiple, direct-drive propeller type with statically and dynamically balanced fan blades.
2. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors.
    b. Motor Enclosure: Totally enclosed non-ventilating (TENV) or totally enclosed air over (TEAO) enclosure.
    c. Enclosure Materials: Cast iron.
    d. Motor Bearings: Permanently lubricated bearings.
    e. Built-in overcurrent and thermal-overload protection.
    f. Efficiency: Premium efficient.

3. Fan Safety Guards: Steel with corrosion-resistant coating.

I. Safety Controls:

1. Compressor motor and condenser coil fan motor low ambient lockout.
2. Overcurrent protection for compressor motor.
3. Condensate pan overflow switch.

2.7 ELECTRIC-RESISTANCE HEATING COIL

A. UL Compliance: Comply with requirements in UL 1995, "Heating and Cooling Equipment."

B. Electric-Resistance Heating Elements:

1. Open-Coil Resistance Wire: Eighty percent (80%) nickel and twenty percent (20%) chromium.
2. Supports and Insulation: Floating ceramic bushings recessed into casing openings; fastened to supporting brackets and mounted in galvanized-steel frame.
3. Heating Capacity: Low density 35 W per sq. in, factory wired for single-point wiring connection; with time delay for element staging and overcurrent- and overheat-protection devices.
4. Safety Controls:

a. Blower-motor interlock, air-pressure switch.
b. Quiet mercury contactors.
c. Time delay between steps.
d. Integral, non-fused power disconnect switch.

2.8 ENERGY RECOVERY WHEELS

A. Casing:

1. Steel with standard factory-painted finish.
2. Integral purge section limiting carryover of exhaust air to between 0.05 percent at 1.6-inch wg and 0.20 percent at 4-inch wg differential pressure.
3. Casing seals on periphery of rotor and on duct divider and purge section.
4. Support vertical rotors on grease-lubricated ball bearings having extended grease fittings or permanently lubricated bearings. Support horizontal rotors on tapered roller bearing.

B. Rotor: Aluminum segmented wheel strengthened with radial spokes, with nontoxic, noncorrosive, silica-gel desiccant coating.

1. Maximum Solid Size for Media to Pass: 500 micrometers.

C. Drive: Fractional horsepower motor and gear reducer and self-adjusting multilink belt around outside of rotor.

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

D. Controls:

1. Starting relay, factory mounted and wired, and manual motor starter for field wiring.
2. Variable frequency controller, factory mounted and wired, permitting input of field connected 4-20 mA or 1-10-V control signal.
3. Pilot-Light Indicator: Display rotor rotation and speed.
4. Speed Settings: Adjustable settings for maximum and minimum rotor speed limits.

2.9 OUTDOOR-AIR INTAKE HOOD

A. Type: Manufacturer's downturned hood.

B. Materials: Match cabinet.

C. Bird Screen: Comply with requirements in ASHRAE 62.1.

D. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.10 FILTERS

A. Cleanable Filters: 2-inch-thick, cleanable metal mesh.

B. Disposable Panel Filters:

1. Comply with NFPA 90A.
2. Factory-fabricated, viscous-coated, pleated type.
3. Thickness: 2 inches.
4. Minimum Arrestance: 90, according to ASHRAE 52.1.
5. Minimum MERV in the exhaust stream: 8, in accordance with ASHRAE 52.2.
6. Minimum MERV in the intake stream: 13, in accordance with ASHRAE 52.2.
7. Media: Interlaced glass fibers sprayed with nonflammable adhesive.

C. Mounting Frames:

1. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.
2. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

2.11 ELECTRICAL POWER CONNECTIONS

A. General Electrical Power Connection Requirements: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a field power connection to unit.

B. Enclosure: NEMA 250, Type 3R, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key,

C. Wiring: Numbered and color-coded to match wiring diagram.

D. Wiring Location: Install factory wiring outside an enclosure in a raceway.

E. Power Interface: Field power interface shall be to factory-supplied NEMA KS 1, heavy-duty, non-fused disconnect switch.

F. Factory Wiring: Branch power circuit to each motor and to controls with one (1) of the following disconnecting means:

1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.

G. Factory-Mounted, Overcurrent-Protection Service: For each motor.

H. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

I. Controls: Factory wire unit-mounted controls where indicated.

J. Receptacle: Factory wire unit-mounted, ground fault interrupt (GFI) duplex receptacle.

K. Control Relays: Auxiliary and adjustable time-delay relays.

2.12 CONTROLLERS AND SEQUENCE OF OPERATION

A. Controller shall be provided with required sensors and programming for rooftop unit. Controller shall be factory programmed, mounted and tested. Controller shall have a LCD readout for changing set points and monitoring unit operation.

B. The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats and sensors or it can be operated as a heating and cooling system controlled by a Building Management System (BMS).

C. Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status, operating settings and alarm conditions. DDC controller shall have a built-in keypad to permit operator to access read-out screens and change settings without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable.

D. Control Wiring: Factory wire connection for controls' power supply.

E. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.

F. Unit-Mounted Status Panel:

1. Cooling/Off/Heating Controls: Control operational mode.
2. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.
3. Status Lights:

a. Filter dirty.

b. Fan operating.
c. Cooling operating.
d. Heating operating.
e. Smoke alarm.
f. General alarm.
g. Drain pan overflow.

4. Digital Numeric Display:

a. Outdoor airflow.
b. Supply airflow.
c. Outdoor dry-bulb temperature.
d. Outdoor dew point temperature.
e. Space temperature.
f. Supply temperature.
g. Space relative humidity.
h. Space carbon dioxide level.

G. Control Dampers:

1. Damper Location: Factory installed inside unit for ease of blade axle and bushing service. Arrange dampers located in a mixing box to achieve convergent airflow to minimize stratification.
2. Damper Leakage: Low leakage in accordance with AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. at a static-pressure differential of 4.0 inches water column when a torque of 5 inch pounds per sq. ft. is applied to the damper jackshaft.
3. Damper Rating: Rated for close-off pressure equal to the fan shutoff pressure.
4. Damper Label: Bear the AMCA seal for both air leakage and performance.
5. Blade Configuration: Unless otherwise indicated, use parallel blade configuration for two-position control and equipment isolation service and use modulating control when mixing two (2) airstreams. For other applications, use an opposed-blade configuration.
6. Damper Frame Material: Galvanized steel.
7. Blade Type: Insulated metal reinforced with multiple V-grooves or hollow-shaped airfoil.
8. Blade Material: Extruded aluminum.
9. Maximum Blade Width: 6 inches.
10. Maximum Blade Length: 48 inches.
11. Blade Seals: Replaceable, continuous perimeter vinyl seals and jambs with stainless-steel compression-type seals.
12. Bearings: Thrust bearings for vertical blade axles.
13. End Switch(es): As required to satisfy the sequence of operations under all operating conditions and modes.
14. Airflow Measurement:

a. Monitoring System: Complete and functioning system of airflow monitoring as an integral part of the damper assembly where indicated.
b. Remote Monitoring Signal: 0-10 volt or 4-20 mA scaled signal.
c. Accuracy of flow measurement: Within five percent (5%) of the actual flow rate between the range of the scheduled minimum and maximum airflow. For units with a large range between minimum and maximum airflow, configure the damper sections and flow measurement assembly as necessary to comply with accuracy.

d. Straightening Device: Integral to the flow measurement assembly if required to achieve the specified accuracy as installed.
e. Flow measuring device: Suitable for operation in untreated and unfiltered outdoor air. If necessary, include temperature and altitude compensation and correction to maintain the accuracy.

H. Damper Operators:

1. Factory-installed electric operator for each damper assembly with one (1) operator for each damper assembly mounted to the damper frame.
2. Operator capable of shutoff against fan pressure and able to operate the damper with sufficient reserve power to achieve smooth modulating action and proper speed of response at the velocity and pressure conditions to which the damper is subjected.
3. Maximum Operating Time: Open or close damper 90 degrees in 60 seconds.
4. Adjustable Stops: For both maximum and minimum positions.
5. Position Indicator and Graduated Scale: Factory installed on each actuator with words "OPEN" and "CLOSED," or similar identification, at travel limits.
6. Spring-return operator to fail-safe; either closed or open as required by application.
7. Operator Type: Direct coupled, designed for minimum sixty thousand (60,000) full-stroke cycles at rated torque.
8. Position feedback Signal: For remote monitoring of damper position.
9. Coupling: V-bolt and V-shaped, toothed cradle.
10. Circuitry: Electronic overload or digital rotation-sensing circuitry.

I. Refrigeration System Controls:

1. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb of dry air or outdoor-air temperature is less than 60 deg F.
2. Outdoor-air sensor de-energizes dehumidifier operation when outdoor-air temperature is less than 60 deg F.
3. Relative-humidity sensor energizes dehumidifier operation when relative humidity is more than fifty percent (50%).

J. Electric-Resistance Heat Controls:

1. Factory-mounted sensor in unit discharge with sensor adjustment located in control panel to control electric coil to maintain temperature.
2. Capacity Controls: Modulating SCR.

K. Damper Controls: Space pressure sensor modulates outdoor- and return-air dampers to maintain a positive pressure in space at a minimum of 0.05 inch wg with respect to outdoor reference.

L. Integral Smoke Alarm: Smoke detector installed in supply and return air.

M. DDC Temperature Control: Standalone control module for link between unit controls and DDC temperature-control system. Control module shall be compatible with control system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC." Links shall include the following:

1. Start/stop interface relay, and relay to notify DDC temperature-control system alarm condition.

a. Factory mounted and wired outdoor air and recirculated air damper actuators are powered.
b. Exhaust fan starts after a 10 second (adjustable) delay.
c. Supply fan starts 5 seconds (adjustable) after exhaust fan.
d. Tempering options and energy wheel option to function as described below.
e. Supply fan, exhaust fan, energy wheel and tempering options de-energized.
f. Outdoor air damper actuator is spring return close, and the recirculated air damper actuator is spring open.

2. Occupied/Unoccupied Modes: Shall be based on a 7-day time clock internal to the controller. The schedule shall be set by the end user. When a user initiates an override input, the DDC would switch from unoccupied to occupied mode. The DDC will return to the scheduled occupied/unoccupied mode after the override time has expired (60 minutes, adjustable). If internal time clock is disabled, a remote contact or a BMS can control the occupied/unoccupied mode.

   a. Occupied Mode:

      1) Supply fan ON.
      2) Exhaust fan ON.
      3) Energy wheel control per below.
      4) Heating per below.
      5) Cooling per below.
      6) Damper control per below.

   b. Unoccupied Mode (Unit Off): Default setting when there is no recirculation damper or room temperature sensor.

      1) Supply fan OFF.
      2) Exhaust fan OFF.
      3) Tempering OFF.
      4) Outdoor air damper closed.
      5) Return damper closed.

3. Supply Blower Sequence: The supply blower is provided with a factory mounted variable frequency drive. The supply blower speed can be controlled with the following sequences.

   a. The supply blower speed is modulated based upon the signal from a CO2 Sensor (factory provided, field mounted and wired). The microprocessor controller will modulate the supply fan based upon a comparison of the CO2 set point (adjustable) to the actual CO2 levels reported from the sensor.
   b. Contractor shall furnish and install mechanical high static protection cutoffs to protect the system and equipment from over-pressurization.

4. Exhaust Blower Sequence: The exhaust blower is provided with a factory mounted variable frequency drive. The exhaust blower speed can be controlled with the following sequences.

   a. The exhaust fan will modulate to track the speed of the supply fan.

5. Cooling Sequence: The cooling is controlled to maintain the supply temperature set point. The mechanical cooling will be locked out when the outside air is < 55°F - 2°F hysteresis, adjustable.

    a. Packaged DX Cooling (Digital Scroll): DDC will provide a modulating signal for cooling. From ten to fifty percent (10-50%), the digital scroll will be controlled to maintain the discharge temperature. From fifty to one hundred percent (50-100%), the second stage will be on in combination with the digital scroll compressor to maintain the discharge temperature.

6. Dehumidification Sequence: The cooling is controlled to maintain the cooling-coil set point. The dehumidification sequence will be locked out when the OA is <10°F above the cold-coil set point. The mechanical cooling will be locked out when the outside air is < 55°F - 2°F hysteresis, adjustable.

    a. Packaged DX Cooling (Digital Scroll): DDC will provide a modulating signal for dehumidification. From ten to fifty percent (10-50%), the digital scroll will be controlled to maintain the after-coil temperature. From fifty to one hundred percent (50-100%), the second stage will be on in combination with the digital scroll compressor to maintain the after-coil temperature.

7. Reheat Sequence: While the unit is in dehumidification mode, the outdoor air can be reheated via Primary Heating Source, On/Off Hot Gas Reheat or Modulating Hot Gas Reheat for Space Neutral Applications.

    a. Modulating Hot Gas Reheat: The controller will modulate the hot gas reheat reheat valve with a 0-10 V signal to maintain the supply temperature set point (adj.).

8. Heating Sequence: The heating is controlled to maintain the supply temperature set point. The heating will be locked out when the outside air is > 70°F + 2°F hysteresis, adjustable.

    a. Electric Heater: DDC will modulate an electric heater to maintain the supply temperature set point (adj.).

9. Supply Set Point Reset Function. Either a room temperature sensor or the outdoor air reset function (if no room temperature sensor wired to controller) will determine the supply temperature of the unit.

10. Building Freeze Protection: If the supply air temperature drops below 35°F (adjustable), the DDC will de-energize the unit and activate the alarm output after a preset time delay.

11. Optional Frost Control: The DDC controller will output a signal when frosting is occurring which is determined by a temperature set point (OA<5F – 2F hysteresis, adjustable) and a pressure setpoint.

    a. Timed Exhaust (One Hundred Percent (100%) OA Only): When frosting is occurring, the supply blower is cycled (30 minutes ON/5 minutes OFF, adj.) to allow the warm exhaust air to defrost the wheel. Once the pressure drop decreases below the set point, frost mode is de-energized and the supply blower is no longer cycled.

12. Alarms Indication: DDC shall have one digital output for remote indication of an alarm condition. Alarms shall include:

    a. Dirty Filter Alarm: If the outside air or return air filter differential pressure rises above the switch set point (adj.), the differential pressure switch shall signal the DDC to activate an alarm.
    b. Wheel Rotation Alarm: Monitors wheel rotation, and sends a signal to controller (after a 15 second time delay with no rotation) that signals the DDC to activate an alarm.
    c. Supply and Exhaust Air Alarm: DDC monitors proving switch on each blower and displays an alarm in case of blower failure.
    d. DX Alarm: DDC monitors the refrigerant pressure and shuts off refrigeration circuit in the case of high or low refrigerant pressure.
    e. Temperature Sensor Alarm: DDC will send an alarm in the case of a failed air temperature sensor.
    f. Pressure Sensor Alarm: DDC will send an alarm in the case of a failed pressure sensor.

13. Phase and Brown Out Protection: Factory mounted and wired component which monitors the main power coming into the unit. If a phase drops out or exceeds the limitations, or if the incoming voltage exceeds the acceptable range, the component will turn off the unit to help protect the electrical systems.

14. Airflow Monitoring: The outdoor airflow monitoring device is installed as a stand-alone option in the control center. It includes a heated thermistor that is used to measure feet per minute in the housing. This foot per minute is converted to CFM in the factory supplied airflow readout device. This device is not connected to the microprocessor.

15. LonTalk communication interface with the DDC system for HVAC shall enable the DDC system for HVAC operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the DDC system for HVAC.

2.13 ACCESSORIES

A. Duplex Receptacle: Factory mounted in unit supply-fan section, with 20 amp 120 V GFI duplex receptacle and weatherproof cover.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.

B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."

1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations.
3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports.

C. Suspended Units: Suspend and brace units from structural-steel support frame using threaded

D. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.

E. Install separate devices furnished by manufacturer and not factory installed.

F. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

G. Install drain pipes from unit drain pans to sanitary drain.

1. Drain Piping: Schedule 40 PVC pipe complying with ASTM D 1785, with solvent-welded fittings.
2. Pipe Size: Same size as condensate drain pan connection.

3.3 CONNECTIONS

A. Where installing piping adjacent to units, allow space for service and maintenance.

B. Duct Connections:

1. Comply with requirements in Section 233113 "Metal Ducts."
2. Drawings indicate the general arrangement of ducts.
3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."

C. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.

1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

    a. High-limit heat exchanger.
    b. Alarms.

3. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
4. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:

    a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
    b. Cooling coil entering-air, dry- and wet-bulb temperatures.
    c. Condenser coil entering-air dry-bulb temperature.
    d. Condenser coil leaving-air dry-bulb temperature.

5. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.

6. Inspect casing insulation for integrity, moisture content, and adhesion.
7. Verify that clearances have been provided for servicing.
8. Verify that controls are connected and operable.
9. Verify that filters are installed.
10. Clean coils and inspect for construction debris.
11. Inspect and adjust vibration isolators.
12. Verify bearing lubrication.
13. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
14. Adjust fan belts to proper alignment and tension.
15. Start unit.
16. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
17. Operate unit for run-in period.
18. Calibrate controls.
19. Inspect outdoor-air dampers for proper stroke.
20. Verify operational sequence of controls.
21. Measure and record the following airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air flow.
    c. Outdoor-air flow.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within twelve (12) months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two (2) visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 237433