SECTION 238416.13 - OUTDOOR, MECHANICAL DEHUMIDIFICATION UNITS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

1. GENERAL
   * + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
      1. SUMMARY
         1. Section includes packaged, factory-assembled and -tested, refrigerant-type, outdoor, mechanical dehumidification units designed for outdoor installation.
      2. SUBMITTALS
         1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
         2. Manufacturer’s installation instructions shall be provided along with product data.
         3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
         4. Product Data: For each type of outdoor, mechanical dehumidification unit.

Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

* + - * 1. Shop Drawings: For each outdoor, mechanical dehumidification unit.

Include plans, elevations, sections, and mounting details.

Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

Detail fabrication and assembly of outdoor, mechanical dehumidification units.

Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bass, rails, and frames for equipment mounting.

Include diagrams for power, signal, and control wiring.

Retain "Delegated-Design Submittal" paragraph below if design services have been delegated to Contractor.

* + - * 1. Delegated-Design Submittal: For outdoor, mechanical dehumidification units.

Retain "Vibration Isolation Base Details" subparagraph if required for "Remote-Mounted, Air-Cooled Condenser Unit" Article.

Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

Include design calculations for selecting vibration isolators[ and seismic restraints] and for designing vibration isolation bases.

Retain "Seismic Qualification Data" paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC" and Section 260548 "Vibration and Seismic Controls for Electrical Systems." See ASCE/SEI 7 for certification requirements for equipment and components.

* + - * 1. Seismic Qualification Data: For outdoor, mechanical dehumidification units, accessories, and components, from manufacturer.

Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

* + - * 1. Product Test Reports: For each outdoor, mechanical dehumidification unit, for tests performed by a qualified testing agency.

Retain "Field quality-control reports" paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
        2. Sample Warranty: For special warranty.
      1. CLOSEOUT SUBMITTALS
         1. Operation and Maintenance Data: For dehumidification units to include in emergency, operation, and maintenance manuals.
      2. MAINTENANCE MATERIAL SUBMITTALS
         1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Filters: **[One] <Insert number>** set(s) of each type of filter specified.

Fan Belts: **[One] <Insert number>** set(s) for each belt-drive fan.

* + - 1. QUALITY ASSURANCE

Retain "Testing Agency Qualifications" paragraph below to require a UL, CE, or ETL marking.

* + - * 1. Testing Agency Qualifications: An NRTL.
      1. COORDINATION
         1. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.
         2. Coordinate installation of roof curbs, equipment supports, and roof penetrations.
      2. WARRANTY

When warranties are required, verify with Director Representative's counsel that special warranties stated in this article are not less than remedies available to Director Representative under prevailing local laws.

* + - * 1. Special Warranty: Manufacturer agrees to repair or replace components of outdoor, mechanical dehumidification units that fail in materials or workmanship within specified warranty period.

Verify available warranties and warranty periods for units and components.

Warranty Period for Compressors: Manufacturer's standard, but not less than **[two] [five] <Insert number>** years from date of Substantial Completion.

Warranty Period for Refrigerant Coils: Manufacturer's standard, but not less than **[five] <Insert number>** years from date of Substantial Completion.

1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or AVITRU. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications.

* + - 1. OUTDOOR, MECHANICAL DEHUMIDIFICATION UNIT MANUFACTURERS
         1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Dectron Internationale.

Dehumidifier Corporation of America.

Desert Aire.

DryAire Systems.

MSP Technology, LLC.

PoolPak Technologies Corporation.

Approved equivalent.

* + - 1. PERFORMANCE REQUIREMENTS
         1. 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.

Retain "Seismic Performance" paragraph below with "Seismic Qualification Data" paragraph in "Informational Submittals" Article for projects requiring seismic design. Delete paragraph if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with structural engineer.

* + - * 1. Seismic Performance: Dehumidification units shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.

Retain first subparagraph below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.

The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified[ and the unit will be fully operational after the seismic event]."

For life-safety components required to function after an earthquake (such as fire-sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

Component Importance Factor: **[1.5] [1.0]**.

See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table for requirements to be inserted in subparagraph below.

**<Insert requirements for Component Amplification Factor and Component Response Modification Factor>**.

Retain "ASHRAE/IES 90.1 Compliance" paragraph below to require compliance with ASHRAE/IES 90.1.

* + - * 1. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.

"ASHRAE 62.1 Compliance" paragraph below may be required to comply with Project requirements or authorities having jurisdiction. LEED 2009 IEQ Prerequisite 1 and LEED v4 EQ Prerequisite, "Minimum Indoor Air Quality Performance," require compliance with requirements in ASHRAE 62.1 (2007 and 2010 versions, respectively), including requirements for controls, surfaces in contact with the airstream, particulate and gaseous filtration, humidification and dehumidification, drain pan construction and connection, finned-tube coil selection and cleaning, and equipment access. Consult manufacturers to verify availability of units having components and features that comply with these requirements.

* + - * 1. ASHRAE 62.1 Compliance: Section 5, "Systems and Equipment" and Section 7, "Construction and System Start-up."
        2. ASHRAE 15 Compliance: "Safety Standard for Refrigeration Systems."

If Project has more than one type or configuration of dehumidification unit, delete "Capacities and Characteristics" paragraph below and schedule outdoor, mechanical dehumidification units on Drawings.

* + - * 1. Capacities and Characteristics:

Airflow through Unit:

Supply Air: **<Insert cfm>**.

Outside Air: **<Insert cfm>**.

Exhaust/Return Air: **<Insert cfm>**.

Supply Fan:

Speed: **<Insert number>** rpm.

External Static Pressure: **<Insert inches wg>**.

Motor Size: **<Insert number>** hp.

[Exhaust] [Return] Fan:

External Static Pressure: **<Insert inches wg>**.

Speed: **<Insert number>** rpm.

Motor Size: **<Insert number>** hp.

Refrigeration System:

Sensible Heat-Transfer Rate: **<Insert Btu/h>**.

Total Heat-Transfer Rate: **<Insert Btu/h>**.

Energy-Efficiency Ratio: **<Insert number>**.

Dehumidification Capacity: **<Insert lb of water/h>**.

Evaporator Coil Conditions:

Entering-Air, Dry-Bulb Temperature: **<Insert deg F>**.

Entering-Air, Wet-Bulb Temperature: **<Insert deg F>**.

Entering-Air, Dew-Point Temperature: **<Insert deg F>**.

Leaving-Air, Dry-Bulb Temperature: **<Insert deg F>**.

Leaving-Air, Wet-Bulb Temperature: **<Insert deg F>**.

Leaving-Air, Dew-Point Temperature: **<Insert deg F>**.

Energy Recovery Heat Exchanger (Pool Heater):

Water Flow Rate: **<Insert gpm>**.

Water Pressure Loss: **<Insert feet of head>**.

Entering-Water Temperature: **<Insert deg F>**.

Leaving-Water Temperature: **<Insert deg F>**.

Filters:

Thickness or Depth: **<Insert inches>**.

Hydronic Heating Coil:

Heat-Transfer Rate: **<Insert Btu/h>**.

Entering-Air Temperature: **<Insert deg F>**.

Leaving-Air Temperature: **<Insert deg F>**.

Water:

Water Flow: **<Insert gpm>**.

Maximum Water Pressure Drop: **<Insert feet of head>**.

Entering-Water Temperature: **<Insert deg F>**.

Leaving-Water Temperature: **<Insert deg F>**.

Steam Heating Coil:

Steam Flow: **<Insert lb/h>**.

Inlet Steam Pressure: **<Insert psig>**.

Electric Heating Coil:

kW: **<Insert number>** kW.

Volts: **[120] [208] [230] <Insert number>** V ac.

Phase: **[Single] [Three]** Ph.

Hertz: **[60] <Insert number>** Hz.

Full-Load Amperes: **<Insert number>** A.

Number of Steps: **<Insert number>**.

Assembly Power Requirements:

Volts: **[120] [208] [230] <Insert number>** V ac.

Phase: **[Single] [Three]** phase.

Hertz: **[60] <Insert number>** Hz.

Full-Load Amperes: **<Insert number>** A.

Minimum Circuit Ampacity: **<Insert number>** A.

Maximum Overcurrent Protection: **<Insert number>** A.

* + - 1. CASINGS
         1. Casing: **[Single] [Double]**-wall construction with **[interior corrosion-resistant coating and]** exterior **[baked-enamel] [powder-coated]** steel or aluminum, stainless-steel fasteners, knockouts for electrical and piping connections, condensate drain connection, and lifting lugs.

Access: Hinged access doors with neoprene compression gaskets and cam latches.

Insulation: Minimum 2-inch- thick, glass-fiber-insulation fill or closed cell foam, with thermal breaks.

Fully weatherproof with cross-broken roof for drainage, rain hood or louver for outside air, and relief/exhaust air openings.

"Airstream Surfaces" subparagraph below may be required to comply with Project requirements or authorities having jurisdiction. Retain subparagraph below to comply with LEED 2009 IEQ Prerequisite 1 and LEED v4 EQ Prerequisite, "Minimum Indoor Air Quality Performance," if required by Project requirements or authorities having jurisdiction.

Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

Retain last option in "Drain Pan and Connection" paragraph below to comply with LEED 2009 IEQ Prerequisite 1 or LEED v4 EQ Prerequisite, "Minimum Indoor Air Quality Performance," if required by Project requirements or authorities having jurisdiction.

* + - * 1. Drain Pan and Connection: [Stainless steel] <Insert material>; insulated[ and complying with ASHRAE 62.1].
      1. FANS
         1. Supply Fans:

Blades: **[Forward curved] [Backward inclined]**.

Type: **[Housed] [Unhoused plenum type]**, centrifugal.

Blade and Housing Material: Galvanized steel with **[baked-enamel] [powder-coated]** finish.

Drive: **[Direct-driven with keyed motor shaft] [Belt-driven with adjustable sheaves and self-aligning, grease-lubricated ball bearings, with extended grease fittings easily accessible inside the casing of the dehumidification unit]**.

* + - * 1. **[Exhaust] [Return]** Fans:

Blades: **[Forward curved] [Backward inclined]**.

Type: **[Housed] [Unhoused plenum type]**, centrifugal.

Blade and Housing Material: Galvanized steel with **[baked-enamel] [powder-coated]** finish.

Drive: **[Direct-driven with keyed motor shaft] [Belt-driven with adjustable sheaves and self-aligning, grease-lubricated ball bearings, with extended grease fittings easily accessible inside the casing of the dehumidification unit]**.

Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment." If different characteristics are required, insert subparagraphs below to suit Project.

* + - * 1. Fan Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

Verify enclosure types with manufacturer of specified equipment. Retain "Enclosure Type" subparagraph below if enclosure is not open-dripproof type.

Enclosure Type: Totally enclosed, fan cooled.

Retain one of two "Variable-Frequency Motor Controller" paragraphs below. First paragraph coordinates with the electrical variable-frequency motor control specification. Second paragraph describes basic features of variable-frequency motor controllers and can be used when the variable-frequency motor controller is not on a schedule on the Drawings or is different from that specified in the variable-frequency motor controller specification. Coordinate either paragraph with electrical engineer and retained manufacturers.

* + - * 1. Variable-Frequency Motor Controller: Comply with Section 262923 "Variable-Frequency Motor Controllers."
        2. Variable-Frequency Motor Controller:

Manufactured Units: Pulse-width modulated; **[constant torque] [and] [variable torque] <Insert application>** for **[Design A and Design B motors] [inverter-duty motors]**.

Output Rating: Three phase; 10 to **[60 Hz, with voltage proportional to frequency throughout voltage range] [66 Hz, with torque constant as speed changes]**; maximum voltage equals input voltage.

Unit Operating Requirements:

Internal Adjustability:

Minimum Speed: 5 to 25 percent of maximum rpm.

Maximum Speed: 80 to 100 percent of maximum rpm.

Acceleration: **[0.1 to 999.9] <Insert range>** seconds.

Deceleration: **[0.1 to 999.9] <Insert range>** seconds.

Current Limit: 30 to minimum of 150 percent of maximum rating.

Self-Protection and Reliability Features:

Surge suppression.

Loss of input signal protection.

Under- and overvoltage trips.

Variable-frequency controller and motor-overload/overtemperature protection.

Critical frequency rejection.

Loss-of-phase protection.

Reverse-phase protection.

Motor-overtemperature fault.

Bidirectional autospeed search.

Torque boost.

Motor temperature compensation at slow speeds.

Panel-mounted operator station.

Historical logging information and displays.

Digital indicating devices.

Control Signal Interfaces: **[Electric] [Pneumatic]**.

Proportional-integral-derivative control interface.

DDC system for HVAC Protocols for Network Communications: **[ASHRAE 135] <Insert protocol type>**.

Line Conditioning:

Input line conditioning.

Output filtering.

EMI/RFI filtering.

Bypass Systems:

Bypass Mode: **[Manual operation only] [Field-selectable automatic or manual]**.

Retain one of two "Bypass Controller" subparagraphs below.

Bypass Controller: Two-contactor style, with bypass and output isolating contactors**[ and isolating switch]**.

Bypass Controller: Three-contactor style, with bypass and input and output isolating contactors**[ and isolating switch]**.

Bypass Contactor Configuration: **[Full-voltage (across the line)] [Reduced-voltage (autotransformer)] <Insert type>** type.

* + - 1. FILTERS

Retain "MERV 6" option in "Pleated" paragraph below if applying for LEED 2009 or LEED v4 certification. LEED 2009 IEQ Prerequisite 1 and LEED v4 EQ Prerequisite, "Minimum Indoor Air Quality Performance," require compliance with ASHRAE 62.1 (2007 and 2010 versions, respectively), which require a MERV rating of 6 or higher for service to occupied spaces. Retain "MERV 13" option in "MERV Rating" subparagraph below if applying for LEED 2009 IEQ Credit 5 or LEED v4 EQ Credit, "Enhanced Indoor Air Quality Strategies," which require MERV 13 or higher.

* + - * 1. Pleated:

Thickness: **[1 inch] [2 inches] [4 inches] [Manufacturer's standard depth]**.

MERV Rating: **[MERV 6] [MERV 13] <Insert value>**, according to ASHRAE 52.2.

* + - 1. REFRIGERATION SYSTEM

LEED 2009 EA Prerequisite 2 and LEED v4 EA Prerequisite, "Minimum Energy Performance," require minimum efficiency equal to requirements in ASHRAE/IES 90.1 (2007 and 2010 versions, respectively).

* + - * 1. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IES 90.1.
        2. Refrigerant Coils with Multiple Refrigerant Circuits:

Tubes: **[Copper] <Insert material>**.

Fins:

Material: **[Aluminum] [Copper] <Insert material>**.

Fin Spacing: Maximum **[12] [10] [8] <Insert number>** fins per inch.

Fin and Tube Joints: Mechanical bond.

Headers: **[Seamless-copper headers with brazed connections] <Insert material and connections>**.

Frames: **[Galvanized-steel] [Stainless-steel] <Insert material>** frame.

Coatings: **[None] [Corrosion-resistant coating]**.

Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.

Source Quality Control: Factory test to minimum 450-psig internal pressure and to minimum 300-psig internal pressure while underwater.

* + - * 1. Compressors: Hermetic, scroll compressors with integral vibration isolators and crankcase heaters that de-energize during compressor operation; with thermal-expansion valves, filter-dryers, sight glasses, compressor service valves, and liquid- and suction-line service valves.

Minimum Number of Refrigerant Circuits: Two for compressor capacities of more than 7-1/2 tons.

LEED 2009 Credit EA 4 and LEED v4 EA Credit, "Enhanced Refrigerant Management," have stringent requirements for refrigerant management. If LEED is applicable to the Project, coordinate refrigerant selections to comply with LEED requirements.

Refrigerant: **[R-134a] [R-407C] [R-410A] [R-134a, R-407C, or R-401A]**.

Capacity Control:

Retain applicable control features in first two subparagraphs below. First subparagraph is for multiple compressors and for pool dehumidifiers.

Hot-gas bypass valve and piping on one compressor.

Cycle compressor.

Retain applicable control features in first four subparagraphs below.

Low-Pressure Cutout: Manual reset after three automatic-reset failures.

High-Pressure Cutout: Manual reset.

Compressor Motor Overload Protection: Manual reset.

Antirecycling Timing Device: Prevent compressor restart for five minutes after shutdown.

Retain "Defrost Cycle" subparagraph below for ice rinks.

Defrost Cycle: Adjustable timer shuts off supply fan. Compressor cycles until suction-line temperature confirms thawed evaporator coil.**[ Timer limits defrost time to 10 minutes.]**

**<Insert additional control features>**.

Heat exchanger in "Energy Recovery Heat Exchanger (Pool Heater)" paragraph below is a feature used only for pool dehumidification units.

* + - * 1. Energy Recovery Heat Exchanger (Pool Heater): Cupronickel, coaxial, vented, double-wall construction for potable-water service.

If unit is to be equipped with an air-cooled condenser, retain "Integral, Air-Cooled Condenser" or "Remote-Mounted, Air-Cooled Condenser Unit" articles below.

* + - 1. INTEGRAL, AIR-COOLED CONDENSER
         1. Description: Mounted on same framing skid as outdoor, mechanical dehumidification unit.
         2. Casing: Steel, **[baked-enamel] <Insert finish type>** finish, with access doors or removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
         3. Refrigerant Coil:

Copper tube with mechanically bonded aluminum fins; with liquid subcooler.

Coating: **[None] [Corrosion-resistant coating]**.

* + - * 1. Fan: Aluminum-propeller type, directly connected to permanently lubricated motor with integral thermal-overload protection.
        2. Adjustable, Low Ambient Head-Pressure Control: Designed to operate at temperatures as low as 0 deg F by cycling condenser fans and controlling speed of last fan of each circuit.
        3. Mounting Base: **[Same material as unit base] <Insert material>**.
      1. REMOTE-MOUNTED, AIR-COOLED CONDENSER UNIT
         1. Casing: Steel, **[baked-enamel] <Insert finish type>** finish; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
         2. Refrigerant Coil:

Copper tube with mechanically bonded aluminum fins; with liquid subcooler.

Coating: **[None] [Corrosion-resistant coating]**.

* + - * 1. Fan: Aluminum-propeller type, directly connected to permanently lubricated motor with integral thermal-overload protection.

"Adjustable, Low Ambient Head-Pressure Control" and "Mounting Base" paragraphs below include optional equipment that may not be available from all manufacturers.

* + - * 1. Adjustable, Low Ambient Head-Pressure Control: Designed to operate at temperatures as low as 0 deg F by cycling condenser fans and controlling speed of last fan of each circuit.
        2. Mounting Base: **[Polyethylene] [Same material as unit base] <Insert material>**.
      1. HEATING COILS

Retain "Hot-Water Coil," "Steam Coil," or "Electric-Resistance Heating Coil" paragraph below to specify a heating coil, which are optional features.

* + - * 1. Hot-Water Coil: Continuous circuit coil.

Tubes: **[Copper] <Insert material>**.

Retain fin spacing in "Fins" subparagraph below if not in a schedule.

Fins:

Material: **[Aluminum] [Copper] <Insert material>**.

Fin Spacing: Maximum **[12] [10] [8] <Insert number>** fins per inch.

Fin and Tube Joints: Mechanical bond.

Headers: **[Cast iron] <Insert material>** with drain and air vent tappings.

Frames: **[Galvanized-steel channel, minimum 0.052 inch] <Insert material>**.

Coatings: **[None] [Corrosion-resistant coating]**.

Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.

Pressure and temperature ratings in "Working-Pressure Ratings" subparagraph below are standard for most copper tube coils. Other materials have different ratings; revise to suit Project.

Working-Pressure Ratings: 200 psig, 325 deg F.

Source Quality Control: Test to 300 psig.

* + - * 1. Steam Coil: Distribution header coil fabricated according to AHRI 410, with threaded steam supply and condensate connections.

Tubes: **[Copper] <Insert material>**.

Retain fin spacing in "Fins" subparagraph below if not in a schedule.

Fins:

Material: **[Aluminum] [Copper] <Insert material>**.

Fin Spacing: Maximum **[12] [10] [8] <Insert number>** fins per inch.

Fin and Tube Joints: Mechanical bond.

Headers: **[Cast iron] <Insert material>** with drain and air vent tappings.

Frames: **[Galvanized-steel channel, minimum 0.052 inch] <Insert material>**.

Coatings: **[None] [Corrosion-resistant coating]**.

Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.

Pressure and temperature ratings in "Working-Pressure Ratings" subparagraph below are standard for most copper tube coils. Other materials have different ratings; revise to suit Project.

Working-Pressure Ratings: Minimum 100 psig, 400 deg F.

Source Quality Control: Test to 200-psig internal pressure).

* + - * 1. Electric-Resistance Heating Coil: Comply with UL 1995.

Retain one of two "Heating Element" subparagraphs below.

Heating Element: Coiled resistance wire of 80 percent nickel and 20 percent chromium; surrounded by compacted magnesium oxide powder in tubular-steel sheath; with spiral-wound, copper-plated steel fins continuously brazed to sheath.

Heating Element: Open-coil resistance wire of 80 percent nickel and 20 percent chromium; supported and insulated by floating ceramic bushings recessed into casing openings; fastened to supporting brackets and mounted in galvanized-steel frame.

Coatings: [None] [Corrosion-resistant coating].

Overtemperature Protection: Disk-type, automatic-reset, thermal-cutout safety device; serviceable through terminal box without removing heater from unit.

Thermal Cutouts: Load carrying, manual reset or replaceable, and factory wired in series with each heater stage.

Control: Disconnecting means, overcurrent protection, and airflow proving switch.

* + - 1. DAMPERS

If only a single unit is required for Project and the unit will have a damper option, retain one of first four paragraphs below. If Project includes multiple units with different damper arrangements, retain applicable paragraphs in this article and indicate in a schedule which unit gets each component.

* + - * 1. Outdoor-Air Dampers: Opposed-blade, **[galvanized-steel] [aluminum] [extruded-aluminum] <Insert material>** dampers with **[zinc-plated-steel] <Insert material>** operating rod rotating in sintered bronze or nylon bearings. Provide blade gaskets and edge seals, and mechanically fasten blades to operating rod. Size for 0 to 25 percent outdoor air, with **[manual] [motorized]** operator and filter.
        2. Face-and-Bypass Dampers: Opposed-blade, **[galvanized-steel] [aluminum] [extruded-aluminum]** dampers with **[zinc-plated-steel] <Insert material>** operating rods rotating in sintered bronze or nylon bearings, with operating rods connected with a common linkage. Provide blade gaskets and edge seals, and mechanically fasten blades to operating rod.

Dampers in first paragraph below are standard quality. Low-leakage dampers are available from some manufacturers and from manufacturers of temperature-control equipment.

* + - * 1. **[Outdoor- and Return-Air] [Outdoor-, Return-, and Exhaust-Air]** Dampers:

Parallel-blade, **[galvanized-steel] [aluminum] [extruded-aluminum] <Insert material>** dampers.

Mechanically fastened to **[zinc-plated-steel] <Insert material>** operating rod in reinforced cabinet.

Connect operating rods with common linkage and interconnect linkages, so dampers operate simultaneously.

* + - * 1. **[Outdoor- and Return-Air] [Outdoor-, Return-, and Exhaust-Air]** Dampers:

Low-leakage, double-skin, airfoil-blade, **[galvanized-steel] [aluminum] [extruded-aluminum] <Insert material>** dampers.

Compressible jamb seals and extruded-vinyl blade edge seals in **[opposed] [parallel]**-blade arrangement.

**[Zinc-plated-steel] <Insert material>** operating rods rotating in **[stainless-steel sleeve] [sintered bronze or nylon] <Insert material>** bearings mounted in a single **[galvanized-steel] [aluminum] [extruded-aluminum] <Insert material>** frame.

Operating rods connected with a common linkage.

Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch wg and 9 cfm/sq. ft. at 4-inch wg.

* + - * 1. Damper Operator: **[115] [24]** V ac, close coupled, with gear train sealed in oil and with spring return.
      1. CONTROLS

Retain first paragraph below to specify temperature controls in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC." Delete first paragraph and retain second paragraph to require controls integral to the dehumidification unit to be provided by manufacturer of dehumidification unit.

* + - * 1. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC" for control equipment.
        2. Control Panel: Integral service compartment containing fan-motor thermal and overload cutouts, compressor thermal and overload cutouts, 115-V control transformer if required, magnetic contactors for fan and compressor motors, and a nonfused factory-mounted and -wired disconnect switch for single external electrical power connection.

Retain "Interface with DDC System for HVAC" paragraph below to require controls of dehumidification unit to interface with the DDC system for HVAC. Coordinate with Section 230923 "Direct Digital Control (DDC) System for HVAC."

* + - * 1. Interface with DDC System for HVAC: Factory-installed hardware and software to enable the DDC system for HVAC to monitor, control, and display status and alarms.

Retain one of three "Operating Control" paragraphs below. Retain first paragraph for ice-rink units.

* + - * 1. Operating Control: Space humidistat cycles the compressor. Humidistat shall incorporate fan on-off-auto switch.

Retain "Operating Control" paragraph below for indoor pool units with typical manufacturer's control panel. Revise for installed and optional features.

* + - * 1. Operating Control: Factory-installed microprocessor controller, capable of being remotely mounted.

Display the following on the face of controller:

System on.

System dehumidifying mode.

System air-conditioning mode.

System outdoor-air (economizer) mode.

System heating pool water.

Auxiliary space heat is operating.

Unit requires service.

Return-air (space) temperature.

Return-air (space) humidity.

First two subparagraphs below are optional displays requiring additional hardware.

Pool-water temperature.

Outdoor-air temperature.

Indicate the following sensor failures on panel:

Airflow: Dirty air filter, blocked airflow, and fan failure.

Refrigerant high and low pressure.

High water temperature.

High and low evaporator temperature.

Low water flow.

Communication fault.

System off.

Antishort cycle delay.

Power failure.

Provide access to the following set points on panel:

Space temperature.

Space relative humidity.

Outdoor ventilation/air-conditioning changeover temperature.

Airflow alarm.

Provide the following displays on panel:

Space temperature.

Space relative humidity.

Outdoor-air temperature.

Supply-air temperature.

Return-air temperature.

Airflow rating.

Air-off evaporator temperature.

Return-air relative humidity.

Service codes.

Provide the following controls on panel:

System on-off, fan continues to run.

Fan on-off.

Service code access.

System dehumidifying mode.

System air-conditioning mode.

System outdoor-air (economizer) mode.

Auxiliary space heat is operating.

Outdoor-air-temperature, conditioned-space-temperature, and control set-point-temperature digital display.

Outdoor enthalpy digital display.

Filter pressure drop digital display.

Status: Airflow, fans, system, unit operation, and operating mode.

Alarm digital display.

Retain "Operating Control" paragraph below for manufacturer's typical microprocessor controller capable of being monitored, programmed, and linked on a LAN. Revise for installed and optional features.

* + - * 1. Operating Control: Factory-installed microprocessor controller.

Factory-installed operator panel with backlit display, capable of being remotely mounted, allows menu-driven display for navigation and control of unit.

Integral clock.

Personal computer interface.

Integral LAN for direct connection to **[BACnet] [LonWorks] [MODBUS] <Insert other communication protocol>**.

Factory programmed.

Unit-Mounted Sensors:

Airflow switch.

Compressor-discharge temperature.

Evaporator-air temperature.

Pool-water-out temperature.

Pool-water-in temperature.

Relative humidity.

Return-air temperature.

Supply-air temperature.

Integral diagnostics.

Nonvolatile memory.

IP or SI display.

Provide the following status and alarm functions:

System: On-off.

Power failure.

Fan: Off, overload.

Compressor: On, turned off, overload, high pressure, low pressure, overheat, oil failure, and pumpdown.

Evaporator damper closed.

Pool: Low water flow, heating on.

Dehumidification: Call for, on.

Air Conditioning: Call for, on.

System outdoor-air (economizer) mode.

Auxiliary space heat on.

Alarms: Firestat, freezestat, and filters.

Provide the following controls via operator panel:

Compressor auto-off.

Fan auto-off.

Set-Point Adjustments: Relative humidity, temperatures, deadbands, and differentials.

Sensor calibration.

* + - 1. ACCESSORIES

Accessories listed in this article are optional features available from most manufacturers.

Heat exchanger in "Water-Cooling Heat Exchanger" paragraph below may be provided in place of optional, remote-mounted, air-cooled condenser unit.

* + - * 1. Water-Cooling Heat Exchanger: Coaxial, vented, double-wall construction; with three-way refrigerant control valve.
        2. Smoke Detectors: Photoelectric detector located in return-air plenum, to de-energize unit.

Operating Voltage: 24 V dc, nominal.

Self-Restoring: Detectors do not require resetting or readjusting after actuation to restore them to normal operation.

Plug-in Arrangement: Detector and associated electronic components mounted in module with tamper-resistant connection to fixed base with twist-locking plug. Terminals in fixed base accept building wiring.

Integral Visual-Indicating Light: Digital-display type indicating detector operation.

Sensitivity can be tested and adjusted in place after installation.

Retain "Integral Addressable Module" subparagraph below for addressable systems.

Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the fire-alarm control panel.

Sensor: Digital display or infrared light source with matching silicon-cell receiver.

Detector Sensitivity: Between 2.5 and 3.5 percent/foot of smoke obscuration when tested according to UL 268A.

Retain "Integral Thermal Detector" subparagraph below if using combination smoke/thermal detectors.

Integral Thermal Detector: Fixed-temperature type with 135 deg F setting.

See Evaluations in Section 262726 "Wiring Devices" for wiring device grades.

* + - * 1. Electrical Convenience Outlet: 125 V ac, duplex, straight-blade receptacles, separately fused and located inside control panel.
      1. ROOF CURBS

Retain one of first three "Roof Curbs" paragraphs below. Retain first paragraph for roof curbs with vibration isolation bases and seismic or wind restraints; retain second paragraph for roof curbs with vibration isolation bases with no seismic or wind restraints; retain third paragraph if roof curbs are provided by manufacturer of dehumidification unit without vibration isolation and without either seismic or wind restraints.

* + - * 1. Roof Curbs: Vibration isolation and wind or seismic restraint roof curbs are specified in Section 230548 "Vibration and Seismic Controls for HVAC."
        2. Roof Curbs: Vibration isolation with no wind or seismic restraint roof curbs are specified in Section 230548.13 "Vibration Controls for HVAC."
        3. Roof Curbs:

Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

Materials: ASTM C1071, Type I or II.

Thickness: **[1 inch] [1-1/2 inches] [2 inches] <Insert dimension>**.

Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

Liner Adhesive: Comply with ASTM C916, Type I.

Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.

Liner materials applied in this location shall have airstream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric, depending on service-air velocity.

[Provide sheet metal liner to separate insulation from contact with the airstream].

* + - * 1. Curb Height: **[14 inches] [24 inches] [36 inches] <Insert dimension>**.
        2. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match dehumidification unit; used to anchor unit to the curb and designed for loads at Project site. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for wind-load requirements.
      1. MATERIALS
         1. Steel:

ASTM A36/A36M for carbon structural steel.

ASTM A568/A568M for sheet steel.

* + - * 1. Stainless Steel:

Manufacturer's standard grade for casing.

Manufacturer's standard type, ASTM A240 for bare steel exposed to airstream or moisture.

* + - * 1. Galvanized Steel: ASTM A653.
        2. Aluminum: ASTM B209.

Retain first paragraph below if corrosion-resistant coating is specified in Section 230546 "Coatings for HVAC." Retain "Corrosion-Resistant Coating" paragraph below if corrosion-resistant coating options are cited in "Integral, Air-Cooled Condenser" Article, "Refrigeration System" Article, "Remote-Mounted, Air-Cooled Condenser Unit" Article, or "Heating Coils" Article and if corrosion-resistant coating is specified in this Section. Determine availability with dehumidification unit manufacturers.

* + - * 1. Comply with Section 230546 "Coatings for HVAC" for corrosion-resistant coating.
        2. Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a [3,000] <Insert time>-hour salt-spray test according to ASTM B117.

Standards:

ASTM B117 for salt spray.

ASTM D2794 for minimum impact resistance of 100 in/lb.

ASTM B3359 for cross hatch adhesion of 5B.

Application: **[Immersion] [Spray]**.

Thickness: **[1 mil] <Insert measurement>**.

Gloss: Minimum gloss of 60 on a 60 degree meter.

* + - 1. SOURCE QUALITY CONTROL
         1. Verification of Performance: Factory test and rate dehumidification units according to AHRI 910.
         2. Sound-Power-Level Ratings: Factory test and rate dehumidification units according to AHRI 575.

1. EXECUTION
   * + 1. EXAMINATION
          1. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
          2. Examine roughing-in for **[hot-water] [steam] [refrigerant]** piping systems to verify actual locations of piping connections before equipment installation.
          3. Examine walls, floors, and roofs for suitable conditions where dehumidification units will be installed.
          4. Proceed with installation only after unsatisfactory conditions have been corrected.
       2. INSTALLATION
          1. Equipment Mounting:

Retain first subparagraph below to require equipment to be installed on cast-in-place concrete equipment bases.

Install dehumidification units on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-In-Place Concrete."

Retain one of two subparagraphs below. Retain first subparagraph for projects in seismic areas; retain second subparagraph for projects not in seismic areas. Indicate vibration isolation and seismic-control device type and minimum deflection in supported equipment schedule on Drawings.

Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

* + - 1. PIPING CONNECTIONS

Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Where piping is installed adjacent to dehumidification units, allow space for service and maintenance of dehumidification units.
        2. Connect piping to dehumidification units mounted on vibration isolators with flexible connectors.
        3. Connect condensate drain pans using minimum NPS 1-1/4 copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan, and install cleanout at changes in direction.

Retain "Refrigerant Piping" paragraph below for units with remote-mounted air-cooled condensers.

* + - * 1. Refrigerant Piping: Comply with requirements in Section 232300 "Refrigerant Piping." Connect to supply and return coil tappings with shutoff valve and union or flange at each connection.

Retain "Hot-Water Piping" paragraph below for units with hot-water coils.

* + - * 1. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Connect to supply coil tappings with shutoff valve, return coil tappings with balancing valve, and union or flange at each connection.

Retain "Steam and Condensate Piping" paragraph below for units with steam coils.

* + - * 1. Steam and Condensate Piping: Comply with requirements in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 Steam and Condensate Heating Piping Specialties." Connect with shutoff valve and union or flange.

Coordinate duct installation requirements with Drawings and with requirements specified in duct systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Duct installation requirements are specified in **[Section 233113 "Metal Ducts."] [Section 233116 "Nonmetal Ducts.] [Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts."]** Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

Install ducts to termination in roof-mounted frames. Where indicated, terminate return-air duct through roof structure, and insulate the space between roof and bottom of dehumidification unit.

* + - 1. ELECTRICAL CONNECTIONS
         1. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
         2. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
         3. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

Retain one of first two subparagraphs below. First subparagraph cross-references to Section 260553 "Identification for Electrical Systems" and should be retained for consistent electrical identification. Second subparagraph is an abbreviated version of the product specified in Section 260553 "Identification for Electrical Systems."

Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

Locate nameplate where easily visible.

* + - 1. CONTROL CONNECTIONS
         1. Install control and electrical power wiring to field-mounted control devices.

Coordinate paragraphs below on the basis of device types retained in Part 2.

* + - * 1. Connect control wiring between control devices.
        2. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."
        3. Connect smoke detector to fire alarm system.
      1. FIELD QUALITY CONTROL

Retain one of first four paragraphs below. Retain first "Testing Agency" paragraph below if Director Representative will hire an independent testing agency.

* + - * 1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

Retain "Manufacturer's Field Service" paragraph below to require a factory-authorized service representative to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a Company Field Advisor per OGS Spec Section 014216 to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform the following tests and inspections" paragraph below to require the Contractor to perform tests and inspections, and retain option to require Contractor to arrange for the assistance of a factory-authorized service agent.

* + - * 1. Perform the following tests and inspections**[ with the Company Field Advisor per OGS Spec Section 014216]**.

Leak Test: After installation, fill water coils with water, and test coils and connections for leaks. Repair leaks and retest until no leaks exist.

Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.

Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

* + - * 1. Dehumidification unit will be considered defective if it does not pass tests and inspections.
        2. Prepare test and inspection reports.
      1. CLEANING
         1. Clean dehumidification units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils' entering-air face.
         2. After completing system installation, testing, and startup service of dehumidification units, clean filter housings and install new filters.
      2. ADJUSTING
         1. Adjust damper linkages for proper damper operation.
         2. Adjust initial temperature and humidity set points.
      3. STARTUP SERVICE
         1. **[Engage a Company Field Advisor per OGS Spec Section 014216 to perform] [Perform]** startup service.

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

* + - * 1. Perform the following final checks before startup:

Verify that shipping, blocking, and bracing are removed.

Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

Perform cleaning and adjusting specified in this Section.

Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.

Check lubrication of bearings, pulleys, belts, and other moving parts.

Set outside- and return-air mixing dampers to minimum outside-air setting.

Install clean filters.

Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

* + - * 1. Starting procedures for dehumidification units include the following:

Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace malfunctioning motors, bearings, and fan wheels.

Measure and record motor's electrical values for voltage and amperage.

Manually operate dampers from fully closed to fully open position and record fan performance.

* + - * 1. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing of dehumidification unit.
        2. Startup Report: Report findings during startup. Identify startup steps, corrective measures taken, and final results.
      1. DEMONSTRATION
         1. **[Engage a Company Field Advisor per OGS Spec Section 014216 to train] [Train]** Director Representative's Facility’s maintenance personnel to adjust, operate, and maintain dehumidification units.

END OF SECTION 238416.13