SECTION 238413.29 - SELF-CONTAINED STEAM HUMIDIFIERS

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:

Self-contained electric-resistance humidifiers.

Self-contained electrode humidifiers.

Self-contained gas-fired humidifiers.

Condensate drain coolers.

* + - 1. DEFINITIONS

Retain terms that remains after this Section has been edited for a project.

* + - * 1. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
			1. 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 product. Include rated capacities, operating characteristics, furnished specialties, and accessories.
				5. Shop Drawings: Detail fabrication and installation of humidifiers. Include piping details, plans, elevations, sections, details of components, distributer tubes/manifolds, and attachments to other work.

Include diagrams for power, signal, and control wiring.

Retain "Coordination Drawings" paragraph below for situations where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. Coordinate paragraph with other Sections specifying products listed below. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

* + - * 1. Coordination Drawings: Detail humidifiers and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

Structural members to which humidifiers will be attached.

Size and location of initial access modules for acoustical tile.

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: Certificates, for humidifiers, 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.

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

* + - * 1. Field quality-control reports.
			1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For humidifiers to include in operation and maintenance manuals.
			2. QUALITY ASSURANCE

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

* + - * 1. Testing Agency Qualifications: An NRTL.
			1. MAINTENANCE MATERIAL SUBMITTALS

Retain this article for self-contained humidifiers with electrode cylinders.

Extra materials may not be allowed for publicly funded projects.

* + - * 1. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Supply one replacement electrode cylinder with each self-contained humidifier.

* + - 1. COORDINATION
				1. Coordinate location and installation of humidifiers with distributer tubes/manifolds in ducts and plenums or occupied space. Revise locations and elevations to suit field conditions and to ensure proper humidifier operation.
1. PRODUCTS

Manufacturers and products listed in SpecAgent and Masterworks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. 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. 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.
				2. Comply with AHRI 640.

Retain first subparagraph below if retaining either electric-resistance or electrode humidifiers.

* + - * 1. Comply with UL 998.

Retain subparagraph below for gas humidifiers. Not all manufacturers offer each option. Coordinate with retained manufacturers.

* + - * 1. Listed and labeled by **[CE] [ETL] [CSA] [, as complying with applicable AGA/CGA standards]**.

Retain subparagraph below for electric-resistance humidifiers. Not all manufacturers offer this option. Coordinate with retained manufacturers.

* + - * 1. Listed and labeled by **[ETL] <Insert option>**.

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: Self-contained steam humidifiers shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.

Retain 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>**.

If retaining an insulated option in "Insulation" subparagraphs in "Self-Contained Electric-Resistance Humidifiers," "Self-Contained Electrode Humidifiers," and "Self-Contained Gas-Fired Humidifiers" articles, retain "Surface-Burning Characteristics" paragraph below.

* + - * 1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

Flame-Spread Index: **[25] <Insert value>** or less.

Smoke-Developed Index: **[50] <Insert value>** or less.

* + - 1. SELF-CONTAINED ELECTRIC-RESISTANCE HUMIDIFIERS
				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:

Armstrong International, Inc.

Carel USA, LLC.

[DRI-STEEM Humidifier Company](http://www.specagent.com/Lookup?uid=123457140955).

Hygromatik; Spirax Sarco.

[Neptronic; National Environmental Products, Inc](http://www.specagent.com/Lookup?uid=123457140958).

Nortec Industries Inc.

Pure Humidifier Company.

Approved equivalent.

If Project has more than one type or size of humidifier, delete "Capacities and Characteristics" paragraph below and schedule humidifiers on Drawings.

* + - * 1. Capacities and Characteristics:

Humidification Rate**: <Insert lb/h>.**

Dry-Bulb Air Temperature at Discharge: **<Insert deg F>**.

Wet-Bulb Air Temperature at Discharge: **<Insert deg F>**.

Maximum Absorption Distance: **<Insert inches>**.

Minimum Makeup Water Supply Pressure: **<Insert psig>**.

Electric-Resistance Evaporation Chamber:

Power Input per Chamber: **<Insert number>** kW.

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

Retain one of three "Steam Distribution Method" subparagraphs below.

Steam Distribution Method - Atmospheric Distributer Tube:

Number of Distributer Tubes: **<Insert number>**.

Steam Distribution Method - Atmospheric Panel Distribution Manifold:

Number of Distribution Manifolds: **<Insert number>**.

Steam Distribution Method - Area Dispersion:

Number of Distributer Tubes: **<Insert number>**.

Fan Airflow: **<Insert cfm>**.

Fan Motor Horsepower: **<Insert hp>**.

Fan Electrical Characteristics:

Volts: **<Insert number>** V.

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.

In "Water Type" paragraph below, retain water type that will be provided to the humidifier. Coordinate with retained manufacturers. Sustainable design systems require compliance with requirements in ASHRAE 62.1 Section 5.12 - "Humidifiers and Water Spray Systems," which sets requirements for the quality of water serving humidifiers.

* + - * 1. Water Type: Suitable for use with **[tap] [softened] [reverse osmosis] [deionized]** water.
				2. Immersion Heating:

In "Evaporation Chamber" paragraph below, retain material desired. Coordinate material type with manufacturers and purity of water used. Type 316 stainless-steel piping is typically used with reverse osmosis and deionized water. However, only one of the listed manufacturers specifically offers a Type 316 stainless-steel option. For this reason, the options for specific types of stainless steel are indicated as Type 304 or Type 316. Not all manufacturers offer each type of stainless-steel piping listed below or publish the type of stainless steel they offer. Coordinate with retained manufacturers. If specific type of stainless steel is not desired, retaining first option will allow for the greatest number of manufacturers to comply.

Evaporation Chamber: Cleanable, **[stainless steel] [stainless steel, Type 304 or stainless steel, Type 316]**.

Elements: Incoloy-sheathed, stainless-steel sheathed, or alloy-sheathed aluminum.

* + - * 1. Cabinet:

Coordinate first subparagraph below with retained manufacturers. Not all manufacturers make each type of cabinet enclosure. Not all manufacturers offer factory insulation.

**[Stainless-steel] [or] [painted-steel]** enclosure**[, factory-insulated for safe operating surface temperature,]** for housing heater cylinder, electrical wiring, components, controls, and control panel.

Hinged or removable cover, keyed to restrict unauthorized access.

Plumbing and electrical components housed in separate parts of the cabinet.

Threaded outlet in bottom of cabinet for drain piping.

Coordinate "Weatherproof Outdoor Enclosure" subparagraph below with retained manufacturers. Not all manufacturers make this type of enclosure.

* + - * 1. Weatherproof Outdoor Enclosure:**[ Insulated, with automatically controlled heating and ventilating system to maintain minimum operating conditions within the enclosure.]**

In "Control Panel" paragraph below, not all options may be available from all manufacturers. Coordinate with retained manufacturers.

* + - * 1. Control Panel:

Microprocessor-based control system for **[modulating] [cycling]** control.

Factory-wired disconnect switch.

Liquid-crystal display.

Programmable keypad.

Low-voltage control circuit, with fused transformer.

Diagnostic, maintenance, alarm, and status features.

Safety switch interlocked to shut off heaters when cabinet is open.

Internal electrical controls prewired to appropriately marked terminals for field connection.

Electrical terminals for connection to each controlling device and alarm.

NEMA 250, **[Type 3R] [Type 4] [Type 4X] [Type 12] <Insert type>**, to comply with environmental conditions at installed locations.

Material: **[Galvanized] [Powder-coated] [Stainless]** steel **<Insert material>**.

Not all manufacturers offer building automation system interface. Manufacturers that do offer building automation system interface do not offer each communication protocol. Coordinate communication protocol with retained manufacturers. Some manufacturers offer web-based monitoring. Coordinate with retained manufacturers.

Building Automation System Interface:

Full Communication Interface: **[Modbus] [BACnet] [LonWorks] <Insert interface type>**.

**[Web-based remote factory online monitoring with same functionality as local keypad/display.]**

* + - * 1. Controls:

In "Solenoid Fill Valve Maintains Water Level" and "Inlet Strainer, Y-Pattern" subparagraphs below, retain first option if retaining reverse osmosis or deionized water in "Water Type" paragraph above.

Solenoid Fill Valve Maintains Water Level: [Stainless steel] [Bronze], including fill tee with built-in air gap to prevent back siphoning. Include [stainless-steel] [bronze] inlet strainer.

Retain first or second option below for tap or softened water.

Field-adjustable [**timer**] [**conductivity controller**] to control drain cycle for flush duration and interval.[**Automatic flush is not required for reverse osmosis or deionized water applications.**]

Controls shall drain tanks if no demand for humidification for more than 72 hours.

Set-point adjustment.

Retain second option in first subparagraph below if retaining reverse osmosis or deionized water in "Water Type" paragraph above.

[**Tri-conductivity sensor probes**] [**Stainless-steel float switches**] for water-level control.

Low-water switch shuts down heater to protect elements.

Over-temperature switch shuts down heater.

Aquastat maintains minimum water temperature in tank during short periods of no demand.

A limited number of manufacturers offer types of foaming detection and correction. See the Evaluations for more information on foaming detection and correction. Do not retain first subparagraph below if a broader range of compliant manufacturers is required. Coordinate with retained manufacturers.

Foaming detection and correction.

Retain "Area Dispersion Accessory," "Steam Distributer Tube(s)," or "Atmospheric Steam Panel Distribution Manifold" paragraph below. Retain first paragraph if humidifier discharges directly into occupied space. Not all manufacturers make remote mounting or integral mounting accessory for direct discharge into occupied space. Coordinate with retained manufacturers.

* + - * 1. Area Dispersion Accessory: Stainless-steel tube, with integral fan that discharges vapor directly into occupied space. Designed for **[remote mounting] [integral mounting onto humidifier cabinet]**.
				2. Atmospheric Steam Distributer Tube(s): Single or multiple, atmospheric steam distributer tube extending across entire width of duct or plenum and equipped with mounting brackets on ends. Nozzles/metered orifices are spaced evenly along distributer tubes and provide dry and uniform steam distribution.

If specific type of stainless steel is not desired, retaining first option in "Material" subparagraph below will allow for the greatest number of manufacturers to comply. Consider Type 316 stainless steel for steam generated from deionized or reverse osmosis water. Not all manufacturers offer a Type 316 stainless-steel option. Coordinate with retained manufacturers.

Material: **[Stainless steel] [Stainless steel, Type 304] [Stainless steel, Type 316]**.

Retain one of three options in "Insulation" subparagraph below. ASHRAE/IES 90.1-2013 requires minimum R-0.5 insulation of humidifier distribution tubes, with certain exceptions; however, most manufacturers do not publish specific R-value information for the insulation they offer. If retaining the specific R-value option, verify specific availability with manufacturers. Some manufacturers consider airspace between double tube walls to be insulation. Coordinate with retained manufacturers.

Insulation: **[Uninsulated] [Insulated] [Insulated, minimum R-0.5]**.

* + - * 1. Atmospheric Steam Panel Distribution Manifold:

Prefabricated steam dispersion grid assembly.

Designed for short absorption distance.

Suitable for atmospheric steam applications.

Extending the full width and height of duct or plenum.

Not all manufacturers offer each configuration combination. Coordinate with retained manufacturers. If retaining horizontal headers, vertical tubes are applicable. If retaining vertical headers, horizontal tubes are applicable. If either configuration is acceptable, retain both and "or" option.

**[Horizontal] [or] [vertical]** header with multiple **[vertical] [or] [horizontal]** tubes designed for dry steam injection within short absorption distance.

Nozzles/metered orifices, spaced evenly along distribution tubes, provide dry and uniform steam distribution.

Distribution panel extending the full width and height of duct or plenum.

Headers and Distribution Tubes:

If specific type of stainless steel is not desired, retaining first option in "Material" subparagraph below will allow for the greatest number of manufacturers to comply. Consider Type 316 stainless steel for steam generated from deionized or reverse osmosis water. Not all manufacturers offer a Type 316 stainless-steel option. Coordinate with retained manufacturers.

Material: **[Stainless steel] [Stainless steel, Type 304] [Stainless steel, Type 316]**.

Retain one of three options in "Insulation" subparagraph below. ASHRAE/IES 90.1-2013 requires minimum R-0.5 insulation of humidifier distribution tubes, with certain exceptions; however, most manufacturers do not publish specific R-value information for the insulation they offer. If retaining the specific R-value option, verify specific availability with manufacturers. Some manufacturers consider airspace between double tube walls to be insulation. Coordinate with retained manufacturers.

Insulation: **[Uninsulated] [Insulated] [Insulated, minimum R-0.5]**.

Steam Separator: Separators/baffles, integral to the header, provide condensate-free steam to distribution tubes.

* + - * 1. Accessories:

Delete items in subparagraphs below that are specified in individual Division 23 control Sections.

A humidistat is a device that senses and controls directly. A humidity sensor is a device that senses only, with the control being accomplished via DDC system. In first two subparagraphs below, retain humidistat options for self-contained control; retain sensor option for control via DDC system. Most manufacturers provide these optional accessories, but some do not. Coordinate with retained manufacturers.

**[Humidistat] [Humidity Sensor]: [Wall] [Return-duct]** mounted.

Duct-mounted, high-limit **[humidistat] [humidity sensor]**.

Airflow switch prevents humidifier operation without airflow.

Some manufacturers do not recommend hoses for outdoor installations. For outdoor installations and as an alternative serving indoor installations, use hard piping. Base piping, valve, and fitting materials on water type used. For reverse osmosis and deionized water applications, match piping, valve, and fitting materials to materials selected for humidifier.

Steam and Condensate Hoses: For interconnection of humidifier to distributer tube(s)/manifold.

* + - 1. SELF-CONTAINED ELECTRODE HUMIDIFIERS
				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:

Armstrong International, Inc.

[Carel USA, LLC](http://www.specagent.com/Lookup?uid=123457140962).

Carnes Company.

DRI-STEEM Humidifier Company.

Hygromatik; Spirax Sarco.

Nortec Industries Inc.

Approved equivalent.

If Project has more than one type or size of humidifier, delete "Capacities and Characteristics" paragraph below and schedule humidifiers on Drawings.

* + - * 1. Capacities and Characteristics:

Humidification Rate: **<Insert lb/h>**.

Dry-Bulb Air Temperature at Discharge: **<Insert deg F>**.

Wet-Bulb Air Temperature at Discharge: **<Insert deg F>**.

Maximum Absorption Distance: **<Insert inches>**.

Minimum Makeup Water Supply Pressure: **<Insert psig>**.

Electrode Cylinder:

Power Input Cylinder: **<Insert number>** kW.

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

Retain one of three "Steam Distribution Method" subparagraphs below.

Steam Distribution Method - Atmospheric Distributer Tube:

Number of Distributer Tubes: **<Insert number>**.

Steam Distribution Method - Atmospheric Panel Distribution Manifold:

Number of Distribution Manifolds: **<Insert number>**.

Steam Distribution Method - Area Dispersion:

Number of Distributer Tubes: **<Insert number>**.

Fan Airflow: **<Insert cfm>**.

Fan Motor Horsepower: **<Insert hp>**.

Fan Electrical Characteristics:

Volts: **<Insert value>** V.

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

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

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

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

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

Only tap water is noted in "Water Type" subparagraph below, because electrode-type humidifiers are unsuitable for use with softened, reverse osmosis, or deionized water. See the Evaluations. Sustainable design systems require compliance with requirements in ASHRAE 62.1- Section 5.12 - "Humidifiers and Water Spray Systems," which sets requirements for the quality of water serving humidifiers.

* + - * 1. Water Type: Suitable for use with tap water.

Retain one of three options in "Cylinders" paragraph below. Not all manufacturers make replaceable and cleanable types. Coordinate with retained manufacturers.

* + - * 1. Cylinders: **[Replaceable] [or] [cleanable]** plastic humidifier water reservoir, steel electrode assembly, suitable for use with tap water.
				2. Cabinet:

Coordinate first subparagraph below with retained manufacturers. Not all manufacturers offer each type of cabinet enclosure. Not all manufacturers offer factory insulation.

**[Baked-enamel][,] [Powder-coated-steel][,] [or] [stainless-steel]** enclosure houses heater cylinder, electrical wiring, components, controls, and control panel.**[ Cabinet is factory insulated for safe operating surface temperature.]**

Hinged or removable cover, keyed to restrict unauthorized access.

Plumbing and electrical components housed in separate compartments of the cabinet.

Threaded outlet in bottom of cabinet for drain piping.

Coordinate "Weatherproof Outdoor Enclosure" subparagraph below with retained manufacturers. Not all manufacturers make this type of enclosure.

* + - * 1. Weatherproof Outdoor Enclosure: Insulated, with automatically controlled heating and ventilating system to maintain minimum operating conditions within the enclosure.

In "Control Panel" paragraph below, not all options may be available from all manufacturers. Coordinate with retained manufacturers.

* + - * 1. Control Panel:

Microprocessor-based control system for **[modulating] [cycling]** control.

Factory-wired disconnect switch.

Liquid-crystal display.

Programmable keypad.

Low-voltage control circuit.

Diagnostic, maintenance, alarm, and status features.

Safety switch interlocked to shut off heaters when cabinet is open.

Internal electrical controls prewired to appropriately marked terminals for field connection.

Electrical terminals for connection to each controlling device and alarm.

NEMA 250, **[Type 3R] [Type 4] [Type 4X] [Type 12] <Insert type>**, to comply with environmental conditions at installed locations.

Not all manufacturers offer building automation system interface. Manufacturers that do offer building automation system interface do not offer each communication protocol. Coordinate communication protocol with retained manufacturers. Some manufacturers offer web-based monitoring. Coordinate with retained manufacturers.

Building Automation System Interface:

Full communication interface: **[Modbus] [BACnet] [LonWorks] <Insert interface type>**.

**[Web-based remote factory online monitoring with same functionality as local keypad/display.]**

* + - * 1. Controls:

Solenoid fill valve and automatic drain valve or drain pump maintain water level. Include bronze inlet strainer, bronze solenoid fill valve with flow regulator, bronze solenoid drain valve or drain pump, and fill tee with built-in air gap to prevent back siphoning.

Controls shall drain tanks if no demand for humidification for more than 72 hours.

Set-point adjustment.

Electrode current shutdown upon sensing unsafe condition (e.g., drain system malfunction, fill system malfunction, or overcurrent malfunction).

Tri-conductivity sensor probes for water-level control.

A limited number of manufacturers offer types of foaming detection and correction. See the Evaluations for more information on foaming detection and correction. Do not retain if broader range of compliant manufacturers are required. Coordinate with retained manufacturers.

Foaming detection and correction.

Retain "Area Dispersion Accessory," "Steam Distributer Tube(s)," or "Atmospheric Steam Panel Distribution Manifold" paragraph below. Retain first paragraph if humidifier discharges directly into occupied space. Not all manufacturers make remote mounting or integral mounting accessory for direct discharge into occupied space. Coordinate with retained manufacturers.

* + - * 1. Area Dispersion Accessory: Stainless-steel tube, with integral fan that discharges vapor directly into occupied space. Designed for **[remote mounting] [integral mounting onto humidifier cabinet]**.
				2. Atmospheric Steam Distributer Tube(s): Single or multiple, atmospheric steam distributer tube extending across entire width of duct or plenum and equipped with mounting brackets on ends. Nozzles/metered orifices are spaced evenly along distributer tubes and provide dry and uniform steam distribution.

If specific type of stainless steel is not desired, retaining first option in "Material" subparagraph below will allow for the greatest number of manufacturers to comply. Coordinate with retained manufacturers.

Material: **[Stainless steel] [Stainless steel, Type 304]**.

Retain one of three options in "Insulation" subparagraph below. ASHRAE/IES 90.1-2013 requires minimum R-0.5 insulation of humidifier distribution tubes, with certain exceptions; however, most manufacturers do not publish specific R-value information for the insulation they offer. If retaining the specific R-value option, verify specific availability with manufacturers. Some manufacturers consider airspace between double tube walls to be insulation. Coordinate with retained manufacturers.

Insulation: **[Uninsulated] [Insulated] [Insulated, minimum R-0.5]**.

* + - * 1. Atmospheric Steam Panel Distribution Manifold:

Prefabricated steam dispersion grid assembly.

Designed for short absorption distance.

Suitable for atmospheric steam applications.

Extending the full width and height of duct or plenum.

Not all manufacturers offer each configuration combination. Coordinate with retained manufacturers. If retaining horizontal headers, vertical tubes are applicable. If retaining vertical headers, horizontal tubes are applicable. If either configuration is acceptable, retain both and "or" option.

**[Horizontal] [or] [vertical]** header with multiple **[vertical] [or] [horizontal]** tubes designed for dry steam injection within short absorption distance.

Nozzles/metered orifices, spaced evenly along distribution tubes, provide dry and uniform steam distribution.

Distribution panel extending the full width and height of duct or plenum.

Headers and Distribution Tubes:

If specific type of stainless steel is not desired, retaining first option in "Material" subparagraph below will allow for the greatest number of manufacturers to comply. Coordinate with retained manufacturers.

Material: **[Stainless steel] [Stainless steel, Type 304]**.

Retain one of three options in "Insulation" subparagraph below. ASHRAE/IES 90.1-2013 requires minimum R-0.5 insulation of humidifier distribution tubes, with certain exceptions; however, most manufacturers do not publish specific R-value information for the insulation they offer. If retaining the specific R-value option, verify specific availability with manufacturers. Some manufacturers consider airspace between double tube walls to be insulation. Coordinate with retained manufacturers.

Insulation: **[Uninsulated] [Insulated] [Insulated, minimum R-0.5]**.

Steam Separator: Separators/baffles, integral to the header, provide condensate-free steam to distribution tubes.

* + - * 1. Accessories:

Delete items subparagraphs below that are specified in individual Division 23 control Sections.

A humidistat is a device that senses and controls directly. A humidity sensor is a device that senses only, with the control being accomplished via DDC system. In first two subparagraphs below, retain humidistat options for self-contained control. Retain sensor options for control via DDC system. Most manufacturers provide these optional accessories, but some do not. Coordinate with retained manufacturers.

**[Humidistat] [Humidity Sensor]: [Wall] [Return-duct]** mounted.

Duct-mounted, high-limit **[humidistat] [humidity sensor]**.

Airflow switch prevents humidifier operation without airflow.

Some manufacturers do not recommend hoses for outdoor installations. For outdoor installations and as an alternative serving indoor installations, use hard piping.

Steam and Condensate Hoses: For interconnection of humidifier to distributer tube(s)/manifold.

* + - 1. SELF-CONTAINED GAS-FIRED HUMIDIFIERS
				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:

Armstrong International, Inc.

Carel USA, LLC.

DRI-STEEM Humidifier Company.

Neptronic; National Environmental Products, Inc.

Nortec Industries Inc.

Pure Humidifier Company.

Approved equivalent.

If Project has more than one type or size of humidifier, delete "Capacities and Characteristics" paragraph below and schedule humidifiers on Drawings.

* + - * 1. Capacities and Characteristics:

Humidification Rate: **<Insert lb/h>**.

Dry-Bulb Air Temperature at Discharge: **<Insert deg F>**.

Wet-Bulb Air Temperature at Discharge: **<Insert deg F>**.

Maximum Absorption Distance: **<Insert inches>**.

Minimum Makeup Water Supply Pressure: **<Insert psig>**.

Gas-Fired Generator:

Fuel Input: **<Insert Btu/h>**.

Fuel Pressure: **<Insert inches wg>**.

Retain one of three "Steam Distribution Method" subparagraphs below.

Steam Distribution Method - Atmospheric Distributer Tube:

Number of Distributer Tubes: **<Insert number>**.

Steam Distribution Method - Atmospheric Panel Distribution Manifold:

Number of Distribution Manifolds: **<Insert number>**.

Steam Distribution Method - Area Dispersion:

Number of Distributer Tubes: **<Insert number>**.

Fan Airflow: **<Insert cfm>**.

Fan Motor Horsepower: **<Insert HP>**.

Fan Electrical Characteristics:

Volts: **<Insert number>** V.

Phase: **[Single] [Three] <Insert value>** phase.

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

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

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

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

Retain "Water Type" paragraph below, retain water type that will be provided to the humidifier. Coordinate with retained manufacturers. Sustainable design systems require compliance with requirements in ASHRAE 62.1 Section 5.12 - "Humidifiers and Water Spray Systems," which sets requirements for the quality of water serving humidifiers.

* + - * 1. Water Type: Suitable for use with **[tap] [softened] [reverse osmosis] [deionized]** water.
				2. Burner and Heat Exchanger:

Description: Produces atmospheric steam.

Burner Type: **[Natural-gas] [Propane]** fired with modulating, low-NOx infrared burner, minimum **[80] <Insert number>** percent efficient.

Gas Train: Safety shutoff valves, gas cock, strainer, and pressure-regulating valve.

Ignition: Hot-surface ignition with flame safety system.

Combustion Chamber: Sealed with outdoor-air and flue-vent connections.

Not all manufacturers provide each "Heat-Exchanger Tank" material option. Coordinate with retained manufacturers.

Heat-Exchanger Tank: Cleanable, **[stainless steel] [stainless steel, Type 304] [stainless steel, Type 316]** with corrosion-resistant coating.

* + - * 1. Cabinet:

Coordinate first subparagraph below with retained manufacturers. Not all manufacturers offer each type of cabinet enclosure. Not all manufacturers offer factory insulation.

**[Painted-steel][,] [Powder-coated-steel][,] [Painted-aluminum][,] [or] [stainless-steel]** enclosure.**[ Cabinet is factory insulated for safe operating surface temperature.]**

Enclosure houses internal components, controls, and control panel.

Hinged or removable cover, keyed to restrict unauthorized access.

Weatherproof outdoor enclosure, with automatically controlled heating and ventilating system to maintain minimum operating conditions within the enclosure.

In "Control Panel" paragraph below, not all options may be available from all manufacturers. Verify with retained manufacturers.

* + - * 1. Control Panel:

Microprocessor-based control system for **[modulating] [cycling]** control.

Factory-wired disconnect switch.

Liquid-crystal display.

Programmable keypad.

Low-voltage control circuit.

Diagnostic, maintenance, alarm, and status features.

Internal electrical controls prewired to appropriately marked terminals for field connection.

Electrical terminals for connection to each controlling device and alarm.

NEMA 250, **[Type 3R] [Type 4] [Type 12] <Insert type>**, to comply with environmental conditions at installed location.

Not all manufacturers offer building automation system interface. Manufacturers that do offer building automation system interface do not offer each communication protocol. Coordinate communication protocol with retained manufacturers. Some manufacturers offer web-based monitoring. Coordinate with retained manufacturers.

Building Automation System Interface:

Full Communication System Interface: **[BACnet] <Insert interface type>**.

**[Web-based remote factory online monitoring with same functionality as local keypad/display.]**

* + - * 1. Controls:

Retain first and third option in first subparagraph below if retaining reverse osmosis or deionized water in "Water Type" paragraph above.

Solenoid fill valve and automatic drain valves maintain water level. Include **[stainless-steel] [bronze]** inlet strainer, **[stainless-steel] [bronze]** solenoid valve with flow regulator, and fill tee with built-in air gap to prevent back siphoning.

Retain first or second option below for tap or softened water.

Field-adjustable **[timer] [conductivity controller]** to control drain/fill cycle for flush duration and interval.**[ Automatic flush is not required for reverse osmosis or deionized water applications.]**

Controls shall drain tanks if no demand for humidification for more than 72 hours.

Set-point adjustment.

Retain second option if first subparagraph below if retaining reverse osmosis or deionized water in "Water Type" paragraph above.

**[Tri-conductivity sensor probes] [Float switches]** for water-level control and to shutdown heat exchanger upon low-water condition.

Over-temperature heater shutdown.

Aquastat maintains minimum water temperature in tank during short periods of no demand.

Thermal safety switch monitors stack temperature for shutdown on overheating.

A limited number of manufacturers offer types of foaming detection and correction. See the Evaluations for more information on foaming detection and correction. Do not retain first subparagraph below if a broader range of compliant manufacturers is required. Coordinate with retained manufacturers.

Foaming detection and correction.

Retain "Area Dispersion Accessory," "Steam Distributer Tube(s)," or "Atmospheric Panel Steam Distribution Manifold" paragraph below. Retain first paragraph if humidifier discharges directly into occupied space.

* + - * 1. Area Dispersion Accessory: Stainless-steel tube with integral fan that discharges vapor directly into occupied space.
				2. Atmospheric Steam Distributer Tube(s): Single or multiple, atmospheric steam distributer tube extending across entire width of duct or plenum and equipped with mounting brackets on ends. Nozzles/metered orifices are spaced evenly along distributer tubes and provide dry and uniform steam distribution.

If specific type of stainless steel is not desired, retaining first option in "Material" subparagraph below will allow for the greatest number of manufacturers to comply. Consider Type 316 stainless steel for steam generated from deionized or reverse osmosis water. Not all manufacturers offer a Type 316 stainless-steel option. Coordinate with retained manufacturers.

Material: **[Stainless steel] [Stainless steel, Type 304] [Stainless steel, Type 316]**.

Retain one of three options in "Insulation" subparagraph below. ASHRAE/IES 90.1-2013 requires minimum R-0.5 insulation of humidifier distribution tubes, with certain exceptions; however, most manufacturers do not publish specific R-value information for the insulation they offer. If retaining the specific R-value option, verify specific availability with manufacturers. Some manufacturers consider airspace between double tube walls to be insulation. Coordinate with retained manufacturers.

Insulation: **[Uninsulated] [Insulated] [Insulated, minimum R-0.5]**.

* + - * 1. Atmospheric Panel Steam Distribution Manifold:

Prefabricated steam dispersion grid assembly.

Designed for short absorption distance.

Suitable for atmospheric steam applications.

Extending the full width and height of duct or plenum.

Not all manufacturers offer each configuration combination. Coordinate with retained manufacturers. If retaining horizontal headers, vertical tubes are applicable. If retaining vertical headers, horizontal tubes are applicable. If both configurations are acceptable, retain both and "or" option.

**[Horizontal] [or] [vertical]** header with multiple **[vertical] [or] [horizontal]** tubes designed for dry steam injection within short absorption distance.

Nozzles/metered orifices, spaced evenly along distribution tubes, and provide dry and uniform steam distribution.

Distribution panel extending the full width and height of duct or plenum.

Headers and Distribution Tubes:

If specific type of stainless steel is not desired, retaining first option in "Material" subparagraph below will allow for the greatest number of manufacturers to comply. Consider Type 316 stainless steel for steam generated from deionized or reverse osmosis water. Not all manufacturers offer a Type 316 stainless-steel option. Coordinate with retained manufacturers.

Material: **[Stainless steel] [Stainless steel, Type 304] [Stainless steel, Type 316]**.

Retain one of three options in "Insulation" subparagraph below. ASHRAE/IES 90.1-2013 requires minimum R-0.5 insulation of humidifier distribution tubes, with certain exceptions; however, most manufacturers do not publish specific R-value information for the insulation they offer. If retaining the specific R-value option, verify specific availability with manufacturers. Some manufacturers consider airspace between double tube walls to be insulation. Coordinate with retained manufacturers.

Insulation: **[Uninsulated] [Insulated] [Insulated, minimum R-0.5]**.

Steam Separator: Separators/baffles, integral to the header, provide condensate-free steam to distribution tubes.

* + - * 1. Accessories:

Delete items in subparagraphs below that are specified in Division 23 Control Sections.

A humidistat is a device that senses and controls directly. A humidity sensor is a device that senses only, with the control being accomplished via DDC system. In first two subparagraphs below, retain humidistat option for self-contained control. Retain the sensor option for control via DDC system. Most manufacturers provide these optional accessories, but some do not. Coordinate with retained manufacturers.

**[Humidistat] [Humidity Sensor]: [Wall] [Return-duct]** mounted.

Duct-mounted, high-limit **[humidistat] [humidity sensor]**.

Airflow switch prevents humidifier operation without airflow.

Some manufacturers do not recommend hoses for outdoor installations. For outdoor installations and as an alternative serving indoor installations, use hard piping. Base piping, valve, and fitting materials on water type used. For reverse osmosis and deionized water applications, match piping, valve, and fitting materials to materials selected for humidifier.

Steam and Condensate Hoses: For interconnection of humidifier to distributer tube(s)/manifold.

* + - 1. CONDENSATE DRAIN COOLERS
				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:

Armstrong International, Inc.

DRI-STEEM Humidifier Company.

Neptronic; National Environmental Products, Inc.

[Nortec Industries Inc](http://www.specagent.com/Lookup?uid=123457140971).

Pure Humidifier Company.

Approved equivalent.

If Project has more than one type or size of condensate drain cooler, delete "Capacities and Characteristics" paragraph below and schedule condensate drain coolers on Drawings.

* + - * 1. Capacities and Characteristics:

Hot Condensate in: **<Insert gpm>**.

Hot Condensate Temperature: **<Insert deg F>**.

Cold Water in **<Insert gpm>**.

Cold Water Temperature: **<Insert de F>**.

Tempered Water out **<Insert gpm>**.

Tempered Water Temperature: **<Insert deg F>**.

* + - * 1. Description: Mixes hot condensate with a cold water supply to reduce the drain temperature as required by state and local codes.

If DDC system is specified in Division 23 Control Sections, retain second option in "Cold Water Tempering Valve" paragraph below. If standalone control is intended, retain first option.

* + - * 1. Cold Water Tempering Valve: Bronze body, **[thermostatic self-actuated with aquastat] [24 VAC electric-actuated with temperature sensor]**.
				2. Drain Temperature Set-Point Range: Field adjustable between 115 deg F and 140 deg F. Drain sensor to control cold water tempering valve to limit drain discharge temperature to set point.

If specific type of stainless steel is not desired, retain first option in "Reservoir Body Material" Paragraph below. Consider Type 316 stainless steel for steam generated from deionized or reverse osmosis water. Not all manufacturers offer a Type 316 stainless-steel option. Coordinate with retained manufacturers.

* + - * 1. Reservoir Body Material: **[Stainless steel] [Cast iron or carbon steel] [Stainless steel, Type 304] [Stainless steel, Type 316]**.
				2. Mounting: Suitable for **[wall] [floor] [suspended]** mounting.
				3. Vacuum breaker or air vent connection.
				4. Condensate drain cooler built into the humidifier cabinet and offered as the humidifier manufacturer's standard product is acceptable in lieu of a separate product by the listed manufacturers.
1. EXECUTION
	* + 1. EXAMINATION
				1. Examine ducts, air-handling units, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
				2. Examine roughing-in for piping systems to verify actual locations of piping connections before humidifier installation.
				3. Proceed with installation only after unsatisfactory conditions have been corrected.
			2. INSTALLATION

Sustainable design systems require compliance with requirements in ASHRAE 62.1. ASHRAE 62.1, Section 5.13 - "Humidifiers and Water-Spray Systems," limits obstructions downstream from humidifiers.

* + - * 1. Install humidifiers with required clearance for service and maintenance.**[ Maintain path, downstream from humidifiers, clear of obstructions as required by ASHRAE 62.1.]**
				2. Seal all duct and plenum penetrations with flange.
				3. Install humidifier assemblies in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
				4. Install **[galvanized] [stainless]**-steel drain pan under each manifold mounted in duct.

Retain option in first subparagraph below to comply with sustainable design systems or if required by Project requirements or authorities having jurisdiction.

Construct drain pans with connection for drain; insulated**[ and complying with ASHRAE 62.1]**.

Connect to condensate trap and drainage piping.

Extend drain pan upstream and downstream from tube(s)/manifold a minimum distance recommended by manufacturer but not less than required by ASHRAE 62.1.

* + - * 1. Install tube(s)/manifold supply piping pitched to drain condensate back to humidifier or as recommended by manufacturer.
				2. Equipment Mounting:

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

Install floor-mounted humidifiers 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 for projects in seismic areas; retain second for projects not in seismic areas. Note 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."

Retain first paragraph below for self-contained gas-fired humidifiers.

* + - * 1. Install gas-fired steam generators according to NFPA 54.
				2. Install all manufacturer-furnished accessories in accordance with manufacturer's written installation instructions.
			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. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

Install piping adjacent to humidifiers to allow service and maintenance.

Install shutoff valve, strainer, backflow preventer, and union in humidifier makeup line.

* + - * 1. Install piping specialties furnished by manufacturer but not factory mounted.

Retain paragraphs below for self-contained gas-fired humidifiers.

* + - * 1. Install piping from safety relief valves to nearest floor drain.
				2. Connect gas piping full size to steam-generator, gas-train inlet with union. Gas piping materials and specialties are specified in **[Section 231123 "Facility Natural-Gas Piping."] [Section 231126 "Facility Liquefied-Petroleum Gas Piping."]**
				3. Connect breeching full size to steam-generator outlet. Venting materials are specified in Section 235123 "Gas Vents."
				4. Connect combustion-air inlet to intake terminal using PVC piping with solvent-cemented joints. Run from boiler connection to outside and terminate adjacent to flue termination.
			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 based on types of devices retained in Part 2.

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

Retain "Testing Agency," "Manufacturer's Field Service," and "Perform the following tests and inspections" paragraphs below to identify who shall perform tests and inspections. If retaining second option in "Testing Agency" paragraph or if retaining "Manufacturer's Field Service" option or "Perform the following tests and inspections" paragraph, retain "Field quality-control reports" paragraph in "Informational Submittals" Article.

Retain "Manufacturer's Field Service" paragraph below to require a Company Field Advisor per OGS Spec Section 014216 to perform tests and inspections.

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

Retain "Perform the following tests and inspections" paragraph below to require Contractor to perform tests and inspections.

* + - * 1. Perform the following tests and inspections**[ with the assistance of a Company Service Advisor per OGS Spec Section 014216]**:

Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

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

* + - * 1. Humidifier will be considered defective if it does not pass tests and inspections.
				2. Prepare test and inspection reports.
			1. DEMONSTRATION
				1. **[Engage a Company Service Advisor per OGS Spec Section 014216 to train] [Train]** Director’s Representative's Facility’s maintenance personnel to adjust, operate, and maintain humidifiers.

END OF SECTION 238413.29