

SECTION 23 8413 - HUMIDIFIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Heat exchanger humidifiers.
  - 2. Dispersion grids/manifolds.
  - 3. Condensate drain cooling equipment.
  - 4. Clean steam generators.

1.3 DEFINITION

- A. 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.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail fabrication and installation of humidifiers, grids, and coolers. Include piping details, plans, elevations, sections, details of components, manifolds, and attachments to other work.
  - 1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Detail humidifiers, grids, and drain coolers 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:
  - 1. Structural members to which humidifiers will be attached.
  - 2. Size and location of initial access modules for acoustical tile.
- B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For humidifiers, grids and coolers to include in operation and maintenance manuals.
- B. Northwestern University Maintenance Requirement Forms, see Division 01.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with ARI 640, "Commercial and Industrial Humidifiers."
- C. Comply with FM Global requirements for and pressure vessels, piping, and pressure relief devices.

1.8 COORDINATION

- A. Coordinate location and installation of humidifiers with manifolds in ducts and air-handling units or occupied space. Revise locations and elevations to suit field conditions and to ensure proper humidifier operation.

1.9 SPECIAL WARRANTIES

- A. Five (5) years, see Division 01.

PART 2 - PRODUCTS

2.1 HEAT-EXCHANGER HUMIDIFIERS (STEAM-TO-STEAM)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong International, Inc.
  - 2. Carel.
  - 3. Dri-Steem Model STS (Basis of Design).
  - 4. Pure Humidifier Company.
  - 5. Penn Separator (for alternate condensate drain cooler only).
- B. Fabricate and label steam generator to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- C. For campus "Clean Steam" applications, generator, Clean Steam and condensate piping, dispersion grids/manifolds, and condensate drain cooler all to be rated for use with provided RO or DI water. Type 304 stainless steel is acceptable.
- D. Fabrication requirements:

1. Tank and cover: Minimum 14-gauge, 304-stainless steel with Heli-arc welded seams.
2. Removable cover with ¼" screws (M6).
3. Easily accessible cleanout plate.
4. Steam outlet on top of tank configured to connect to hose, pipe, or flange connection.
5. Tubular copper heat exchanger and header with nickel coating.

E. Mounting:

1. Humidifier shall be mounted on a pair of trapeze hangers with factory-provided threaded steel rods, hardware, and predrilled angle irons for smaller models, and on painted H-legs for larger models.

F. Water requirements: The humidifier shall be capable of generating steam from tap, softened, or DI/RO water.

G. Drain: An electric operated drain valve shall be mounted on the humidifier assembly to allow tank to drain automatically at the end of a humidification season.

H. Steam trap and strainer: Humidifier shall include a float/thermostatic steam trap and steam supply line strainer.

**I. Humidifier Options**

**1. Fabrication options:**

- a. **Tank and cover shall be 316 stainless steel with Heli-arc welded seams.**
- b. **Factory insulation: Humidifier shall be covered with 1" thick (25 mm) rigid, foil-faced fiberglass insulation. All surfaces except front face panel shall have insulation.**
- c. **Humidifier shall have a tubular 316 stainless steel heat exchanger and header with no coating.**

**2. Mounting options:**

- a. **Four support legs shall provide a minimum of 24" (610 mm) between underside of humidifier and floor.**
- b. **Two welded and painted steel wall brackets shall support humidifier on a vertical surface (for smaller units).**

**3. Options for use with DI/RO water:**

- a. **Humidifier shall have a stainless steel manually operated drain valve and a stainless steel float operated fill valve (standard on DI/RO models).**
- b. **Humidifier shall have a stainless steel electric operated drain valve and a stainless steel float operated fill valve with an electric solenoid to prevent tank from filling when the tank drains automatically at the end of a humidification season (requires Vapor-logic controller, which allows user to define the number of hours of humidifier inactivity that must occur before automatic end-of-season draining begins).**
- c. **Low water float switch. Humidifier shall have a field-wired float switch to provide water level indication for building management systems.**

**4. Outdoor enclosure system:**

- a. **Factory assembled and tested with the humidifier installed to provide complete weather protection and to operate within the following temperature limits: -40 to 120 °F (-40 to 50 °C)**
- b. **Humidifier and outdoor enclosure shall be shipped as one unit.**
- c. **Frame construction: 5" (127 mm), 12-gauge, G-90 galvanized steel formed frame, suitably reinforced and braced to permit loading, shipping, unloading and rigging to the unit destination without damage to external or internal components. The base frame shall be corrosion resistant without painting or further coating.**
- d. **Housing construction: 16-gauge, G-90 galvanized steel panels fabricated into self-framing, double standing seam-type construction. All joints shall be caulked weather-tight with a silicone sealant. All interior surfaces shall be insulated with 1" (25 mm), 2.2 lbs/sq ft (10.8 kg/m<sup>2</sup>) rigid, noncombustible glass fiber insulation. No exposed insulation shall be permitted on the top-wearing surface of the floor of the unit. The floor shall be insulated from underneath. The floor shall have a drain connection.**
- e. **Access door construction: Access door shall provide access to all internal components, be constructed of 16-gauge, G-90 galvanized steel with a gasket around the full perimeter of the doorframe, with heavy-duty stainless steel hinges, and latches.**
- f. **Ventilation fans: wired to a thermostat to ventilate the control cabinet and the enclosure.**
- g. **Heaters:**
  - 1) **Thermostatically-controlled heaters to ensure proper operation during cold weather**
  - 2) **Outdoor enclosure less heaters (option). The outdoor enclosure shall be provided without electric heaters, control thermostat and wiring.**
- h. **Roof curb option. The roof curb shall be manufactured of 16-gauge, galvanized steel and provided with necessary hardware for bolt-together assembly. The curb is to be a minimum of 14" (356 mm) high. A 2" (50 mm) by 1/2" (13 mm) closed cell curb gasket with adhesive on one side is to be supplied with the hardware.**
- i. **Internal steam vapor plumbing option. The outdoor enclosure shall have piping to discharge steam through the base of the unit.**

**J. Humidifier Controls**

1. **Steam valve: Valve shall be a normally closed modulating type with modified linear flow characteristics, stainless steel trim, and electric actuator.**
2. **Control cabinet: Control cabinet shall be shipped loose and shall be a UL/CSA listed JIC enclosure. Control devices shall be mounted on a subpanel within the cabinet. A wiring diagram shall be included in the control cabinet.**
3. **Vapor-logic<sup>®</sup> 4 (or approved equal by alternate listed manufacturer) microprocessor controller with the following features or functions:**
  - a. **Web interface and server, included standard on all models:**
    - 1) **Web interface shall have same functionality as Vapor-logic keypad/display**
    - 2) **Web interface shall allow multiple remotely located users to simultaneously view system operation and/or change system parameters.**

- 3) **Web interface shall have password-protected secure access.**
- 4) **Web interface shall be compatible with standard Internet browsers.**
- 5) **Web interface shall connect directly to a personal computer or through a system network via Ethernet cable.**

- a) **Automatic cable configuration shall allow straight-through or crossover cables.**

- b. **Interoperable with any Modbus® network**
- c. **Fully modulating (0% to 100%) control of humidifier outputs**
- d. **PID control capability with field-adjustable settings**
- e. **Water level control for softened or hard water:**

- 1) **Automatic refill, low water cutoff, field-adjustable skimmer bleed-off functions and automatic drain-down of humidifier. System shall consist of:**

- a) **A water level sensing unit comprised of three metallic probes screwed into a threaded probe head. Probe head shall incorporate probe isolation chamber to eliminate short-circuiting between probes caused by mineral coating of probe head. Probe head shall be mounted on the humidifier assembly.**
- b) **A slow opening solenoid operated fill valve factory mounted on the humidifier assembly**
- c) **End-of-season drain automatically drains humidifier tank after a user-defined period of system inactivity.**

- f. **Temperature sensor: A factory mounted sensor, with a temperature range of -40 to 248 °F (-40 to 120 °C) mounted on the humidifier to enable the following functions:**

- 1) **Maintain the evaporating chamber water temperature above freezing**
- 2) **Maintain a user-defined preset evaporating chamber water temperature**
- 3) **Allow rapid warm-up of water in evaporating chamber after a call for humidity, providing 100% operation until steam production occurs**

- g. **USB port on the control board for software updates, data backups, and data restoration**

- h. **Up-time optimizer function to keep humidifier(s) operating through conditions such as fill, drain, or run-time faults, as long as safety conditions are met, minimizing production down-time**

- i. **Real-time clock to allow time-stamped alarm/message tracking, and scheduled events**

- j. **Factory commissioning of humidifier and control board, including system configuration as-ordered**

- k. **Keypad/display operable within a temperature range of 32 to 158 °F (0 to 70 °C), and that provides backlighting for viewing in low light**

- l. **Alarms, unit configuration, and usage timer values shall remain in nonvolatile memory indefinitely during a power outage.**

- m. **The capability to monitor, control, and/or adjust the following parameters:**

- 1) **Relative humidity (RH) set point, actual conditions in the space (from humidity transmitter), RH offset**

- 2) *Dew point set point, actual conditions in the space (from dew point transmitter), dew point offset*
- 3) *Relative humidity (RH) duct high limit set point (switch) and actual conditions*
- 4) *Relative humidity (RH) duct high limit set point, actual conditions (from transmitter), high limit span, and high limit offset*
- 5) *Total system demand in % of humidifier capacity*
- 6) *Total system output in lbs/hour (kg/h)*
- 7) *Drain/flush duration*
- 8) *End-of-season drain status (on standard water systems and if ordered as a DI water option) and hours humidifier is idle before end of season draining occurs*
- 9) *Window glass surface temperature (in % RH offset application using sensor ordered as an option) with programmable offset*
- 10) *Air temperature or other auxiliary temperature monitoring with programmable offset (using sensor ordered as an option)*
- 11) *System alarms and system messages, current and previous*
- 12) *Adjustable water skim duration*
- 13) *Programmable outputs for remote signaling of alarms and/or messages, device activation (such as a fan), or for signaling tank heating and/or steam production*
- 14) *System diagnostics that include:*
  - a) *Test outputs function to verify component operation*
  - b) *Test humidifier function, by simulating demand to validate performance*
  - c) *Data collection of RH, air temperature, water use, energy use, alarms, and service messages for viewing from the keypad/display or Web interface*
- 15) *Service notification scheduling*
- 16) *Password-protected system parameters*
- 17) *Keypad/display or Web interface displays in English, French, or German languages*
- 18) *Numerical units displayed in inch-pound or SI units*

#### **K. Humidifier Control Options**

1. *Interoperability using BACnet®*
2. *Multiple humidifier tank control. Vapor-logic shall be programmed and configured at the factory to control multiple humidifier tanks. Controller functions shall include all Vapor-logic functions listed above plus:*
  - a. *The controller shall control up to 16 humidifier tanks.*
  - b. *Automatic run-time balancing. The controller shall assign duty to all humidifier tanks in the multi-tank group such that each humidifier accrues approximately the same hours of duty, thereby ensuring equal wear across all humidifiers in the multi-tank group.*
  - c. *One humidifier tank shall be capable of being controlled as a redundant tank.*
  - d. *One Vapor-logic keypad/display shall be included with each multi-tank group.*
3. *Water level control for DI/RO water:*

- a. **System shall provide for continuous control of water level and will accommodate the use of deionized or reverse osmosis water with resistance up to 18 M-ohm/cm.**
- b. **System shall:**
  - 1) **Have a water level sensing unit comprised of a float operated stainless steel valve for water makeup**
  - 2) **Have a low water cutoff float switch**
  - 3) **Operate within inlet water pressure range of 25 to 80 psi (172 to 552 kPa)**
4. **Control cabinet mounted: Control cabinet shall be a UL/CSA listed NEMA-12 enclosure. Control devices shall be mounted on a subpanel within the cabinet. A wiring diagram shall be included in the control cabinet. Control cabinet shall be factory attached to the side of humidifier with all wiring between cabinet and humidifier completed at factory.**
5. **Microprocessor water level controller with the following features or functions:**
  - a. **Makeup water valve control and low water safety shutdown**
  - b. **Field adjustable auto-drain and flush sequence whereby microprocessor activates auto-drain and flush sequence after a user-defined run time**
  - c. **Self-diagnostic test at start-up**
  - d. **Water level sensing unit comprised of three metallic probes screwed into a threaded probe head**
  - e. **Probe head mounted on the vaporizing chamber**
  - f. **A solenoid operated water fill valve factory mounted on humidifier**
6. **Valve options:**
  - a. **Modulating electronic control valve: Valve shall be a normally closed modulating type with an electronic actuator. Actuator to respond to a variable electronic signal. Available signal inputs 4 to 20 mA and 2 to 10 VDC.**
7. **Remote keypad: Provide a keypad with cable for remote mounting. Available cable lengths: 10' (3 m), 25' (7.6 m), 50' (15 m), 100' (30 m) or 500' (152 m)**
8. **Keypad mounted on cabinet: The keypad shall be factory-mounted on the side of the control cabinet.**
9. **Cabinet door interlock switch: The control cabinet shall have an interlock control switch with manual override to remove control voltage when door is opened**
10. **Control cabinet door lock: Control cabinet shall have a lock with keys provided.**
11. **Freeze protection: A factory-mounted aquastat shall be mounted on the front of humidifier to sense and maintain the evaporating chamber water temperature above freezing. Set point adjustable from 40 to 180 °F (4 to 82 °C).**
12. **Control input accessory options:**
  - a. **Humidity transmitter, room: Humidity transmitter shall be a room-mounted device that measures from 0% to 100% of RH range and provides a linear output (10% to 90% RH) from 4 to 20 mA. Accuracy  $\pm$  2% RH. Supply voltage 21 VDC. Operating temperature range: -4 to 140 °F (-20 to 60 °C). (Vapor-logic only)**
  - b. **Humidity transmitter, duct: Humidity transmitter shall be a duct-mounted device that measures from 0 to 100% RH range and provides a linear output (10% to 90% RH) from 4 to 20 mA. Accuracy  $\pm$  2% RH. Supply voltage 21**

- VDC. Operating temperature range: -4 to 140 °F (-20 to 60 °C). (Vapor-logic only)
- c. **Dew point transmitter:** A dew point transmitter (duct- or room-mounted) shall measure the humidity and temperature in the environment and then compute the dew point. Output 4 to 20 mA (700 ohms maximum). Supply voltage 24 VDC. Operating temperature range when duct mounted: -40 to 185 °F (-40 to 85 °C). Operating temperature range when room mounted: -32 to 122 °F (0 to 50 °C). (Vapor-logic only)
  - d. **Cold snap offset transmitter:** A window surface temperature transmitter, operating temperature range -20 to 160 °F (-29 to 71 °C), shall be provided for field installation. Transmitter shall supply its signal (4 to 20 mA) to the microprocessor control system, which shall lower the indoor RH set point to a level 5% or more below the dew point temperature during a cold spell, thus preventing window condensation. The indoor RH shall be returned automatically to the normal setting when the glass temperature rises. (Vapor-logic only)
  - e. **Humidistat, modulating, room:** Electric humidistat control shall be a modulating style, room mounted with a control range of 20% to 80% RH. Compatible with 24 VAC. Output signals shall be 0 to 10 VDC. Operating temperature range 32 to 122 °F (0 to 50 °C). (Not available for Vapor-logic)
  - f. **Humidistat, modulating, duct:** Electric humidistat control shall be a modulating style, duct mounted with a control range of 20% to 80% RH. Compatible with 24 VAC. Output signals shall be 0 to 10 VDC. Operating temperature range 40 to 125 °F (4 to 52 °C). (Not available for Vapor-logic)
  - g. **Humidistat, on-off, high limit:** Electric humidistat control shall be an on-off style, duct mounted with a control range of 15% to 95% RH. Compatible with 24, 120, and 240 VAC. Operating temperature range 40 to 125 °F (4 to 52 °C).
  - h. **VAV control package:** The VAV control package shall be a modulating control system with two modulating electronic humidity transmitters (one space mounted, the other duct mounted downstream of the humidifier). Both shall transmit to the microprocessor controller to modulate humidifier output and maintain the highest desired space humidity possible, at all airflow volumes, without saturation of the airstream. (For this application, it is recommended to use a sail type airflow proving switch.) (Vapor-logic only)
  - i. **Airflow proving switch, pressure type:** Airflow proving switch shall be diaphragm operated with pitot tube for field installation. Switch shall have an adjustable control point range of 0.05" to 12" wc (12.5 to 2,988 Pa). Operating temperature range -40 to 180 °F (-40 to 82 °C). Compatible with 24, 120, and 240 VAC.
  - j. **Airflow proving switch, sail type:** Airflow proving switch shall be a sail-operated electric switch for field installation. Switch makes @ 250 fpm (1.3 m/s), breaks @ 75 fpm (0.4 m/s). Maximum operating temperature for sail: 170 °F (77 °C). Maximum operating temperature for switch: 125 °F (52 °C).

## 2.2 CLEAN STEAM GENERATORS (VERTICAL TANK TYPE)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. CEMLINE Model Series USG (Basis of Design).
  - 2. Approved equal.



- B. Unfired steam generators shall be furnished as a complete package ready for installation and shall be shall be ASME Code constructed and stamped in accordance with Section VIII, Division I, for Unfired Steam Generators, they shall bear the ASME "UB" stamp, and they shall be registered with the National Board of Boiler and Pressure Vessel Inspectors (with a signed copy of shop inspection report shall furnished).
- C. The generators and all components subject to steam side shall be 316-L grade stainless steel, they shall have submerged coils of 18 BWG **(316) (304)** stainless steel tubes expanded into a **(316) (304)** stainless steel tube sheet with cast iron heads, they shall be insulated with not less than 3" of fiberglass insulation, protected by not less than 20 ga. thick enameled steel jacket, and they shall be mounted on a suitable I-Beam support skid, which shall be permanently welded to the shell.
- D. Steam Control Valve(s): Generators shall be furnished with an electric operated control valve to modulate the in-coming steam to maintain the desired output of steam pressure +2 psi. Control valves shall be suitable for 150 psi and control valve pilot shall monitor output steam pressure and modulate the steam to maintain constant output pressure.
- E. Steam Traps, Strainers, Relief Valves, Gages, and Other Specialties: Generators shall be factory supplied with dual float and thermostatic traps, one for the coil and one for the drip before the control valve, and the generators shall have incoming strainers. The generators shall be furnished with ASME Code Section I pressure relief valve or valves with a capacity to relieve the total BTU of output of the generators. Generators shall be furnished with a vessel steam gauges, electronic level controllers, water columns with gauge glasses, and tandem blow off valves.
- F. All components for the generators shall be factory mounted, piped, and tested and the unit shall be shipped from the factory as a complete unit ready for installation, and they be furnished with steam separators.
- G. Unfired steam generators shall be supplied with solid-state control module with LED backlit LCD display and LED pilot lights to indicate on off, high pressure, low pressure, low water, and water feed. Solid-state control module shall allow the owner to set pressure limits on display screen. Solid-state control module shall have flashing red alarm light and alarm horn with built in alarm silence relay. Solid-state control module shall be supplied with dry contact closure outputs to indicate to building automation controls (BAC) the occurrence of power on, high pressure, low pressure, low water, and water feed. The control module shall allow the BAC to turn the unfired steam generator on or off through a remote relay suitable for 24 VAC, 1 amp. The control module shall allow the BAC to remotely monitor the operating pressure. Control module shall be supplied with an on-off switch and shall be mounted in a NEMA 1 panel. All solenoids and limits shall be 24 VAC.
- H. Furnish a factory installed stainless steel feed water slow opening solenoid valve sized to feed the capacity of the boiler with a maximum pressure drop of 5 psi. Slow opening solenoid valve shall be factory wired to the level controller. Furnish a factory installed check valve between the solenoid valve and Unfired Steam Generator.
- I. **Other features:**
- 1. Package shall be supplied with vacuum breaker.**
  - 2. Package shall be supplied with alarm bell and light to signal low water or high pressure. Alarm silence relay shall be provided to silence the bell but not the light.**
  - 3. Package shall be provided with relay with 120-volt coil to remotely start or stop the Generator.**

4. *Package shall include a centrifugal boiler blow off condensate cooler.*
5. *High water shut off shall be factory furnished. High water cut off shall be factory furnished. High water cut off shall include an electronic probe mounted in the top of the unit connected to an (air) (electric) operated power to open spring to close ball valve. In the event of high water, ball valve will close.*

**J. ADDITIONAL MAKE UP WATER FEEDING OPTIONS (CHOOSE)**

**1. FEED WATER CONDENSATE PUMP WITH RECIEVER:**

- a. *Furnish a factory installed feed water condensate system consisting of a receiver, inlet strainer, pump, water make up assembly, NEMA 1 panel with fused starter. Furnish factory installed check valve between the feed water condensate system and the unfired steam generator. Pump shall be factory wired to level controller.*

**2. FEED WATER PUMP:**

- a. *Furnish and install a feed water pump with flexible connector, shut off valve, and check valve. Feed water pump shall be factory wired to level controller and furnished with fused starter in NEMA 1 enclosure.*

**K. AUTOMATIC BLOWDOWN (CHOOSE ONE)**

**1. AUTOMATIC BLOWDOWN TDS SAMPLING METHOD**

- a. *Time sample Walchem WBL-400, feed water system. Furnish a factory installed time sample feed water system consisting of a control which measures the total dissolved solids of the unfired steam generator on a timed basis. If the total dissolved solids exceed the set point shall blow the boiler off until fresh water brings the total dissolved solids level to the desired setting. Automatic blow off system shall be furnished with a NEMA 1 control system and all factory wired to a single point 120 volt connection. Tie into BAS for monitoring and alarming of TDS.*

**2.3 HUMIDIFIER ACCESSORIES (CONDENSATE PUMPS AND DRAIN COOLERS)**

- A. *Pump, low-flow, high-temperature: Pump shall be suitable for pumping water up to 212 °F (100 °C). Maximum pump flow rate shall be 3.8 gpm (228 gph) with a 12-foot head (36 kPa). Pump shall have a 1-gallon cast aluminum reservoir with a 3/8" pipe thread (DN10) outlet connection, two 1-1/4" (DN32) inlet openings, and integral float switch. Pump shall be used with 115 VAC. Pump also available with 230 VAC. Pump shall be UL recognized and wired per NEC requirements.*
- B. *Pump, high-flow, high-temperature: Pump shall be suitable for pumping water up to 212 °F (100 °C). Maximum pump flow rate shall be 55 gpm (3300 gph) with a 12-foot head (36 kPa). Pump shall have a 4-gallon cast aluminum reservoir with vapor seal, a 3/4" pipe thread (DN20) outlet connection, a 1-1/2" pipe thread (DN40) inlet connection, and integral float switch. Pump shall be used with 115 VAC. Pump can be wired for use with 115/230 VAC. Pump shall be UL recognized and wired per NEC requirements.*
- C. *Pump, high-flow, low-temperature: Pump shall be suitable for pumping water up to 150 °F (65.5 °C). Maximum pump flow rate shall be 55 gpm (3300 gph) with a 12-foot head*

*(36 kPa). Pump shall have a 2-gallon cast aluminum reservoir, a 1" pipe thread (DN25) outlet connection, a 1-1/2" pipe thread (DN40) inlet connection, and integral float switch. Pump shall be used with 115 VAC. Pump can be wired for use with 115/230 VAC. Pump shall be UL recognized and wired per NEC requirements.*

- D. *Drane-kooler (Dri-Steem model, or approved equal by alternate listed manufacturer): A thermostatically controlled water valve shall meter an amount of cold water into a stainless steel mixing chamber to temper 212 °F (100 °C) water with a 6 gpm (0.38 l/s) in-flow rate to a 140 °F (60 °C) discharge temperature to sanitary system.*

## 2.4 HUMIDIFIER DISPERSION OPTIONS

- A. See drawing schedules and details.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine ducts, air-handling units, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before humidifier installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install humidifiers, generators, and dispersion with required clearance for service and maintenance. [ **Maintain path, downstream from humidifiers, clear of obstructions as required by ASHRAE 62.1.** ]
- B. Seal humidifier manifold duct or plenum penetrations with flange.
- C. Install humidifier manifolds in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- D. Install stainless-steel drain pan under each manifold mounted in duct.
1. Construct drain pans with connection for drain; insulated and complying with ASHRAE 62.1.
  2. Connect to condensate trap and drainage piping.
  3. Extend drain pan upstream and downstream from manifold a minimum distance recommended by manufacturer but not less than required by ASHRAE 62.1.
- E. Install manifold supply piping pitched to drain condensate back to humidifier.
- F. Install drip leg upstream from steam trap a minimum of [ **12 inches (300 mm)** ] <Insert height> tall for proper operation of trap.

G. Equipment Mounting:

1. Install steam generators on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in [**Section 03 3000 "Cast-in-Place Concrete."**] [**Section 03 3053 "Miscellaneous Cast-in-Place Concrete."**]
2. Comply with requirements for vibration isolation devices specified in Section 23 0550 "Vibration Isolation."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Install piping adjacent to humidifiers to allow service and maintenance.
2. Install shutoff valve, strainer, backflow preventer, and union in humidifier makeup line.

B. Install electrical devices and piping specialties furnished by manufacturer but not factory mounted.

C. Install piping from safety relief valves to nearest floor drain.

**D. Ground equipment according to Section 26 0526 "Grounding and Bonding for Electrical Systems."**

**E. Connect wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."**

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

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PROJECT NAME \_\_\_\_\_

JOB # \_\_\_\_\_

FOR: \_\_\_\_\_

ISSUED: 03/29/2017

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain humidifiers. ***Refer to Section 01 7900 "Demonstration and Training."***

**END OF SECTION 23 8413**

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