**SECTION 23 84 13**

**HUMIDIFIERS**

**BASED ON DFD MASTER SPECIFICATION DATED 10/1/2012**

***This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.***

**P A R T 1 - G E N E R A L**

**SCOPE**

This section includes specifications for humidifiers. Included are the following topics:

PART 1 - GENERAL

 Scope

 Related Work

 Reference

 Quality Assurance

 Submittals

Operation and Maintenance Data

PART 2 - PRODUCTS

 Steam Jacketed Dispersion Grids

 Short Absorption Dispersion Grids

Evaporative Humidifiers

 Electric Steam Humidifiers (Electrode Type)

 Electric Steam Humidifiers (Resistive Element Type)

 Gas-Fired Steam Humidifiers

PART 3 - EXECUTION

 Steam Jacketed Dispersion Grids

 Short Absorption Dispersion Grids

Evaporative Humidifiers

 Gas-Fired and Electric Steam Humidifiers

Construction Verification Items

Functional Performance Testing

Agency Training

**RELATED WORK**

Section 01 91 01or 01 91 02 – Commissioning Process

Section 23 05 15 – Piping Specialties

Section 23 08 00 – Commissioning of HVAC

Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC

Section 23 22 13 – Steam and Condensate Heating Piping

**REFERENCE**

Applicable provisions of Division 1 govern work under this Section.

**QUALITY ASSURANCE**

Refer to division 1, General Conditions, Equals and Substitutions.

**SUBMITTALS**

Refer to division 1, General Conditions, Submittals.

Include data concerning dimensions, capacities, materials of construction, ratings, weights, wiring diagrams, and appropriate identification.

# OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

***Delete the following if there are no additional requirements.***

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

1. ***[A/E and commissioning provider to define detailed operation and maintenance data requirements for equipment specifications added to this section.]***

**P A R T 2 - P R O D U C T S**

**STEAM JACKETED DISPERSION GRIDS**

Manufacturers: Armstrong, Dri-Steem, Pure Humidifier, Nortec, Sarco, or approved equal.

Steam jacketed manifold type providing clean, dry steam humidification without condensate drip or objectionable noise.

Furnish unit complete with normally closed [pneumatic, electric] control valve, inlet strainer, inverted bucket or float and thermostatic trap sized in accordance with manufacturer's recommendations, and temperature switch to prevent the humidifier from operating before manifold is hot and start-up condensate is drained.

Size steam metering orifices for steam pressure and capacity as scheduled. Orifices to be metallic or high temperature thermoplastic inserts.

Furnish multiple manifolds where required for uniform steam distribution or for applications where multiple manifolds are recommended by humidifier manufacturer.

**SHORT ABSORPTION DISPERSION GRIDS**

Manufacturers: Armstrong, Dri-Steem, Nortec, Pure Humidifier or approved equal.

Factory-assembled steam dispersion unit shall include the following components:

1. Steam supply header/separator.
2. Condensate collection header.
3. Steam dispersion tubes spanning distance between two headers.

Each dispersion tube shall be fitted with steam discharge nozzles inserted into tube wall. Each nozzle shall be metallic or thermoplastic material designed for high steam temperatures. Two rows of nozzles in each dispersion tube shall discharge steam in diametrically opposite directions, perpendicular to airflow.

Each nozzle shall extend through wall of and into center of dispersion tube and contain steam orifice sized for its required steam capacity.

Furnish unit complete with normally closed [pneumatic, electric] control valve, inlet strainer, float and thermostatic trap sized in accordance with manufacturer's recommendations.

Each packaged humidifier panel assembly of tubes and headers shall be contained within galvanized metal casing to allow duct mounting, or to facilitate stacking of and/or end-to-end mounting of multiple humidifier panels in ducts or air handling unit casings.

Tubes and headers shall be 304 stainless steel and be welded.

**EVAPORATIVE HUMIDIFIERS**

***Use only with DFD approval.***

Manufacturers: Research Products "Aprilaire" or approved equal.

Wetted element evaporative type complete with humidistat, solenoid valve, control transformer and mounting accessories.

**ELECTRIC STEAM HUMIDIFIERS (ELECTRODE TYPE)**

***Use this type when building steam is not available. Use only with DFD approval.***

Manufacturers: Carnes, Armstrong, Dri-Steem, Nortec, or approved equal.

Self contained, all electric steam generating humidification system with steam generated in an electrode type steam generating cylinder.

Furnish unit with steam manifold(s), steam hose, condensate return line, air gap fitting, humidistat, air flow switch, duct mounted high limit humidistat, and all necessary accessories for complete installation. Include multiple manifolds where recommended by the manufacturer for the specific application.

Automatic drain cycle to be controlled by an electronic timer to occur at a regular interval. Drain cycle shall adapt to variations in water conditions and not require manual setting.

Provide a prewired electronic control system with transformer to modulate capacity, monitor high limit and other safety controls, and initiate drain cycle for removal of mineral sludge. Provide a differential pressure switch across fans to prove air flow and interlock to the humidifier safety circuit to prevent humidifier operation when there is no air flow. If there is a supply fan status interlock from the control system specified, the differential pressure switch specified above is not required.

**ELECTRIC STEAM HUMIDIFIERS (RESISTIVE ELEMENT TYPE)**

***Use this type when building steam is not available. Use only with DFD approval.***

Manufacturers: Dri-Steem, Armstrong, Nortec, Carel, Pure Humidifier Co. or approved equal.

Unit shall be self contained, electric steam generating humidification system. Steam shall be generated by boiling off [softened water][purified RO/DI water].

Unit shall be completely pre-wired and include built-in transformer to provide 24 volt supply for control circuit. Provide fused disconnect switch.

Vaporizing chamber, cover and fittings shall be constructed of series 300 stainless steel with welded seams and fitted for quick access for cleaning. Immersion Heaters shall be INCOLOY alloy-sheathed resistance type designed for no more than 80 watts per square inch. A single element shall be provided for each electrical phase.

***Use the following section when softened make-up water is provided.***

[Electronic water level control system shall provide for automatic refill, low water cut off and skimmer bleed-off functions. System shall consist of:

1. Water level sensing unit comprised of three Teflon-coated stainless steel probes screwed into threaded probe head.
2. A solenoid operated fill valve factory mounted on front of the humidifier.
3. Microprocessor controls.
4. Heater Protection:
	1. First step shall be low water probe. In the event of failure, second step shall be a manual reset over-temperature switch factory installed on the humidifier.]

***Use the following section when purified RO/DI make-up water is provided.***

[Electronic water level control system shall provide for automatic refill, low water cut off and skimmer bleed-off functions. System shall consist of:

1. Water level sensing unit comprised of a stainless steel float operated water fill valve.
2. Microprocessor controls.
3. Heater Protection:
4. First step shall be low water float operated low-water switch. In the event of failure, second step shall be a manual reset over-temperature switch factory installed on the humidifier.]

Surface water skimmer system shall be furnished to provide for optimum precipitated mineral removal with minimum water waste.

Control cabinet shall be UL-and CUL-listed JIC enclosure. Control devices shall be mounted on sub-panel within enclosure isolated from vaporizing chamber. Control devices shall include microprocessor, magnetic contactor for each heater group, control circuit transformer, fuses for each heater, numbered terminal strip and all internal wiring. As-built wiring diagram is to be included.

Microprocessor controls shall be factory mounted and wired in humidifier control panel. Mounting instructions and wiring diagram shall be included. The following features and functions shall be provided:

1. LED fault indicator. Performs software self diagnosis at every start-up.
2. Water make-up valve control and low-water safety shut down.
3. Auto drain valve and drain/flush sequence whereby microprocessor accumulates actual humidifying "on" time, and activates auto drain/flush sequence.
4. End of season drain.
5. Switch on microprocessor board for, "AUTO", "STANDBY", "DRAIN", "TEST".
6. Airflow proven switch.
7. 100% solid state, power controller shall be mounted and wired in control cabinet. A compatible humidity sensor shall be shipped loose for field installation in return duct. System shall modulate humidifier output from 0% to 100% of maximum capacity.
8. A two position high limit humidistat shall be shipped loose for field installation. Humidistat shall sense humidity level within duct and protect against saturation of air stream.

[Furnish associated steam dispersion unit as scheduled.]

[Furnish unit with condensate after cooler.]

**GAS-FIRED STEAM HUMIDIFERS**

 ***Use this type when building steam is not available. Use only with DFD approval.***

Manufacturers: Dri-Steem, Pure Humidifier Co., Nortec or Carel.

Tank and cover shall be 300 series stainless steel with welded seams and a removable cover with gasketed flanges and fitted for quick access for cleaning.

Provide an accessible cleanout plate, steam outlet on top of tank for pipe connection and a stainless steel round flue outlet to vent flue gas. Humidifier shall be certified to use Class B flue materials.

Provide four steel support legs to provide 12" minimum between underside of humidifier and floor.

Provide with a stainless steel heat exchanger with welded joints.

Humidifier shall be covered with 3/4" thick rigid, foil faced fiberglass insulation. Insulation shall be covered with reinforced aluminum foil. Surfaces except front face panel shall be covered.

Humidifier shall be capable of generating steam from [softened water][purified RO/DI water].

***Use the following section when softened make-up water is provided.***

[Electronic water level control system shall provide for automatic refill, low water cut off and skimmer bleed-off functions. System shall consist of:

1. Water level sensing unit comprised of three Teflon-coated stainless steel probes screwed into threaded probe head.
2. A solenoid operated fill valve factory mounted on front of the humidifier.
3. Microprocessor controls.]

***Use the following section when purified RO/DI make-up water is provided.***

[Electronic water level control system shall provide for automatic refill, low water cut off and skimmer bleed-off functions. System shall consist of:

1. Water level sensing unit comprised of a stainless steel float operated water fill valve.
2. Microprocessor controls.]

Provide an electric drain valve shall be mounted on humidifier assembly to allow tank to drain automatically at end of humidification season.

Humidifier and burner assembly shall be AGA/CGA/CSA Certified and tested to support natural or LP gas. Gas train assembly shall be complete with burner/mixing tube assembly, igniter, sight glass, flame rod electrode, gas manifold, integral gas valve and Venturi. Each burner shall modulate or time proportion with gas input turndown ration of up to 4:1.

[Indoor sealed combustion option: Combustion air mechanically induced from outside the building, via dedicated piping to CPVC connection.]

Control cabinet shall be factory mounted to side of humidifier with wiring between cabinet and humidifier completed at factory. Control cabinet shall be UL/CSA listed NEMA 12 enclosure. Control devices shall be mounted on subpanel within cabinet isolated from vaporizing chamber. Wiring diagram shall be included in control cabinet.

Provide a microprocessor controller with the following features or functions:

1. Makeup water switch control and low water safety shutdown.
2. Fully modulating (0 to 100%) control of humidifier outputs.
3. PID control capability.
4. Self-diagnostic test at start-up.
5. Integral fault relay for remote signaling of alarms.
6. Capable of monitoring and/or controlling the following parameters:
	1. Relative humidity (RH) set point and actual conditions in space (from humidistat or humidity transmitter).
	2. Relative humidity (RH) set point and actual conditions in duct for variable air volume applications.
	3. Relative humidity (RH) high limit set point and actual conditions.
	4. Total system demand in % of humidifier capacity.
	5. Total system output in lbs/hour.
	6. Drain/flush frequency interval and duration.
	7. End-of-season drain status.
	8. System alarms.
	9. Previous fault messages.
	10. Operating temperature.
7. A two position high limit humidistat shall be shipped loose for field installation. Humidistat shall sense humidity level within duct and protect against saturation of air stream.

[Furnish associated steam dispersion unit as scheduled.]

[Furnish unit with condensate after cooler.]

**P A R T 3 - E X E C U T I O N**

**STEAM JACKETED DISPERSION GRIDS**

Mount units in air handling units or ductwork as indicated on the drawings. Provide additional duct reinforcing or support required for the humidifier body and/or distribution manifold(s). Install piping specialties and controls as detailed and in accordance with manufacturer's instructions.

Install steam and condensate branch lines with a minimum of three elbows to allow for expansion and contraction. Use pipe size indicated on drawings or recommended by the manufacturer, whichever is larger. Ream pipe and blow out at full steam pressure before making final connection to humidifier.

**Short Absorption Dispersion Grids**

Mount units in air handling units or ductwork as indicated on the drawings. Provide additional duct reinforcing or support required for the humidifier body and/or distribution manifold(s). Install piping specialties and controls as detailed and in accordance with manufacturer's instructions.

Install steam and condensate branch lines with a minimum of three elbows to allow for expansion and contraction. Use pipe size indicated on drawings or recommended by the manufacturer, whichever is larger. Ream pipe and blow out at full steam pressure before making final connection to humidifier.

Mount units in air handling units or ductwork with sufficient elevation to drain condensate by non-pressurized gravity condensate lines. Condensate from this type of dispersion grid shall not be wasted to drain. Install condensate piping and specialties as detailed and in accordance with manufacturer’s instructions.

 ***Short absorption dispersion grids should be designed and installed strictly according to manufacturer’s instructions. In most cases, condensate lines from this type of dispersion grid cannot operate with any backpressure and therefore cannot discharge into a pressurized condensate system main. In situations when plant or building steam is being used with this type of dispersion grid the condensate shall be returned to the plant and not wasted to drain. Condensate shall be gravity drained into a condensate pump via a non-pressurized line. A/E is responsible for properly designing system.***

**EVAPORATIVE HUMIDIFIERS**

Mount units in air handling units or ductwork as indicated on the drawings. Provide additional duct reinforcing or support required for the humidifier body. Install make-up water line with solenoid control and shutoff valves, coordinating final connection point with the Plumbing Contractor. Install drain line to nearest drain location or as indicated on the drawings.

**GAS-FIRED AND ELECTRIC STEAM HUMIDIFIERS**

Mount manifold(s) in air handling units or ductwork as indicated on the drawings with proper pitch for condensate drainage. Mount steam generating cylinder assembly and control panel on wall or angle iron stand where indicated. Provide duct reinforcing or support required for the humidifier body and/or distribution manifold(s) as required. Install piping specialties and controls as detailed and in accordance with manufacturer's instructions. Install make-up water line with solenoid control and shutoff valves, coordinating final connection point with the Plumbing Contractor. Install drain line to nearest drain location or as indicated on the drawings.

# CONSTRUCTION VERIFICATION ITEMS

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 23 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

# FUNCTIONAL PERFORMANCE TESTING

Contractor is responsible for utilizing the functional performance test forms supplied under specification Section 23 08 00 in accordance with the procedures defined for functional performance testing in Section 01 91 01 or 01 91 02.

# AGENCY TRAINING

All training provided for agency shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

END OF SECTION