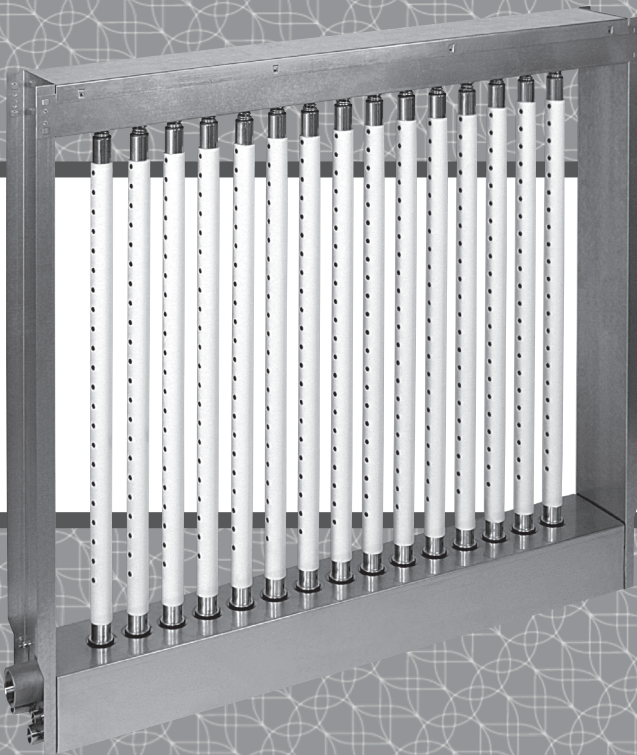


READ AND SAVE THESE INSTRUCTIONS



ULTRA-SORB® MODEL XV

Steam Dispersion Panel

Installation, Operation,
and Maintenance Manual

For pressurized steam applications

Table of contents

MECHANICAL SPECIFICATIONS	1
INSTALLATION	2
Field assembly	2
Piping	4
Selecting the location	6
Mounting and support	8
Installation in a cold air stream	8
Placement upstream from an elbow or duct split	8
Installation above valuable equipment	8
Panel support	8
Mounting in a duct	9
Mounting in an air handler	9
Installation drawings:	10
Mounting in a duct	10
Mounting in an air handler	11
Recommendations and steam inlets	12
Controls	13
Confirming steam dispersion panel configuration	13
Optional header overflow P-trap water seal	17
OPERATION	19
Ultra-sorb XV operation	19
Sequence of operation	21
Start-up checklist	27
Performance data	28
Strainer, traps, and valves	29
MAINTENANCE	29
Dispersion tubes and heat exchanger	30
Humidifier de-scaling solution	31
Replacement parts	32
Troubleshooting	33
WARRANTY	36



WARNING

Hot surface hazard

Steam humidification systems have extremely hot surfaces.

To avoid burns, allow humidifier, steam pipes, and dispersion assemblies to cool before touching any part of the system.

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ATTENTION INSTALLER

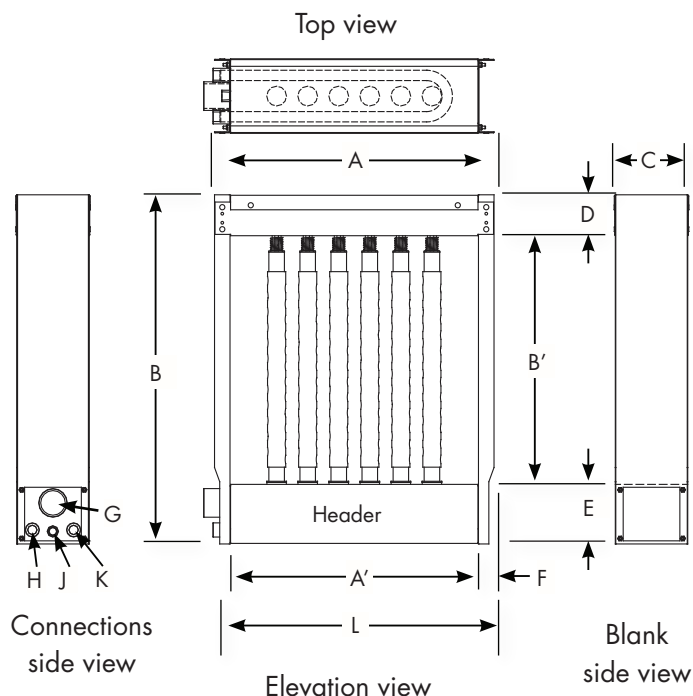
Read this manual before installing.
Leave manual with product owner.

DriSteem technical support

800-328-4447

Mechanical specifications

FIGURE 1-1: ULTRA-SORB MODEL XV DIMENSIONS



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**Table 1-2:
Ultra-sorb Model XV tube steam capacity***

Diameter	lbs/hr	kg/h
1.5"	43	19.5
2.0"	80	36.3

* Consult DriSteem if face height is less than 17" (432 mm) for 1.5" tubes or less than 24" (610 mm) for 2.0" tubes.

**Table 1-1:
Ultra-sorb Model XV dimensions**

Dimension	Inches (mm)
A Unit width	15" (380 mm) min, 147" (3735 mm) max, in 1" (25 mm) increments
A' Face width	12" (305 mm) min, 144" (3660 mm) max, in 1" (25 mm) increments
B Unit height*	21.75" (550 mm) min, 153.75" (3905 mm) max, in 1" (25 mm) increments
B' Face height	12" (305 mm) min, 144" (3660 mm) max, in 1" (25 mm) increments
C Frame depth	7.2" (183 mm)
D Frame enclosure	3.9" (99 mm)
E Header enclosure	5.85" (149 mm)
F Mounting flange	1.5" (38 mm)
G Humidification steam inlet (internal thread)	<ul style="list-style-type: none"> 1" or 2" NPT (DN25 or DN50), determined by maximum steam capacity 3" (DN80) flange, for humidification steam from STS humidifier only
H Pressurized steam inlet (internal thread)	3/4" NPT (DN20)
J Float switch or optional header overflow/ access port (internal thread)	1/2" NPT (DN15)
K Pressurized condensate outlet (internal thread)	3/4" NPT (DN20)
L Overall width	<ul style="list-style-type: none"> 1" (DN25) connection, same as dimension A; 2" (DN50) connection, dimension A + 1" (dimension A + 25 mm) 3" (DN80) flange, dimension A + 6.5" (dimension A + 165 mm)
Control cabinet	See Page 17.

* Panels with unit height more than 120" (3048 mm) have two-piece side flanges and are shipped with brackets for easy field assembly. Panels with unit height more than 98" (2490 mm) are shipped unassembled.

Field assembly

UNPACK THE DISPERSION ASSEMBLY

- Remove shipping materials from the dispersion assembly, being careful not to bump or scrape the white PVDF dispersion tube insulation.
- Do not lay dispersion tubes (if shipped loose by request or by shipping necessity) across or under anything that could compress or damage the insulation. Compressing insulating material may reduce its R-value.

VERIFY THAT THE ORDER IS COMPLETE

Verify that all panel and piping components are included in the delivery. Check the packing list, and see the tables on Page 32.

- Orders may include control valve(s), humidity transmitters or humidistats, airflow switches, and a control cabinet.

Note the dispersion assembly serial number:

- The serial number will be required to ensure proper identification of replacement parts.

CAUTION

Remove clear poly film; do not remove white PVDF insulation.

High-Efficiency Tubes are sleeved in clear poly film for protection during processing, shipping, and installation. Leave the clear poly film on until installation is complete so the insulation stays clean.

Remove and discard the clear poly film before start-up by tearing it along the perforations. **Do not remove the white PVDF insulation.**

- Keep flame away from the insulating material to avoid damage.
- Indirect, low-intensity UV-C light from germicidal lamps will not cause the insulating material to degrade.
- Do not tighten mounting clamps or fasteners to any part of the dispersion tube.

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Field assembly

LAY OUT THE PANEL COMPONENTS

Orient the panel components on a large, flat working surface.

ATTACH THE FLANGES

Guide the flanges onto the threaded studs of the header assembly, and start the locknuts onto the threads finger-tight.

ATTACH THE TOP FRAME ASSEMBLY

Span the flanges with the top frame assembly. Align the locating buttons on the flanges and top frame, and insert screws.

TIGHTEN THE FLANGE LOCKNUTS

Torque the eight flange locknuts to 16 ft-lb (22 N-m) using a 7/16" deep-well socket.

INSTALL THE DISPERSION TUBES

Note: Do not remove the poly film from the dispersion tubes until after the panel is installed.

Ensure that each dispersion tube has the seal and spring in place (see Figure 3-1). Push the dispersion tube plug end into the top frame hole to compress the spring. Seat the seal end in the corresponding header hole on the bottom. Rotate the dispersion tubes so the tubelets discharge steam perpendicular to the airstream. See Figure 9-1.

Note: These assembly instructions are for Ultra-sorb Model XV panels shipped unassembled by request or as required. Panels with overall height more than 98" (2490 mm) are shipped unassembled.

FIGURE 3-1: ULTRA-SORB MODEL XV COMPONENTS

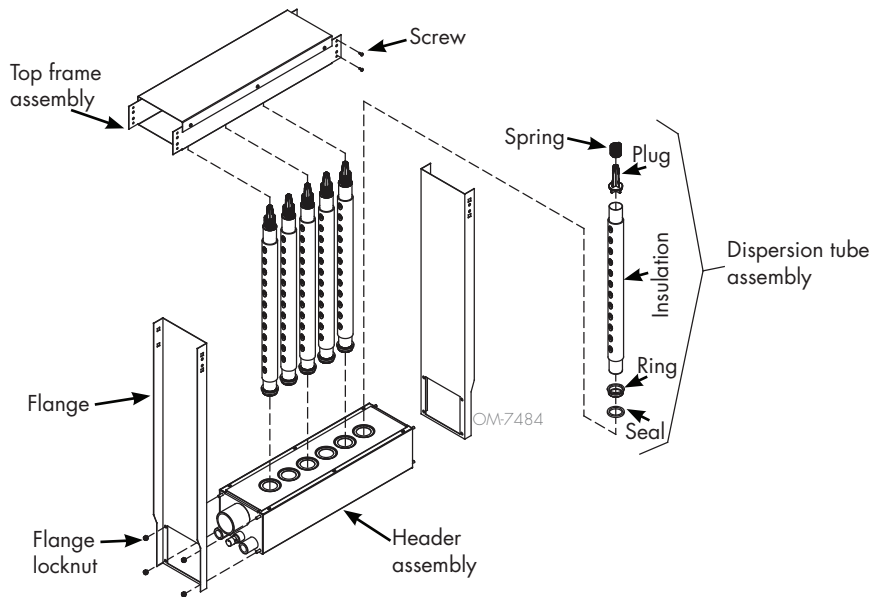
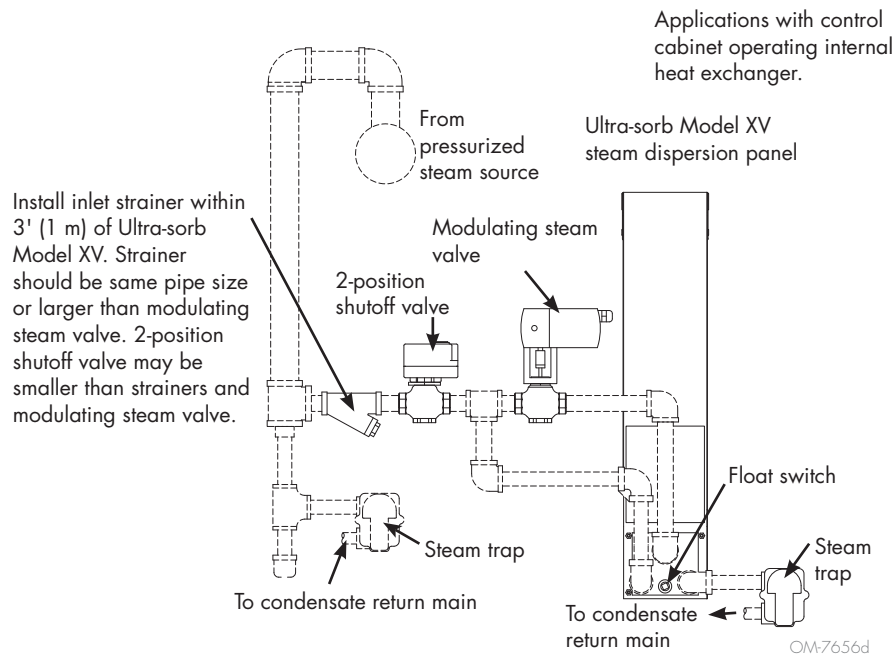


Table 3-1: Ultra-sorb Model XV components	
Component	Qty.
Header assembly	1
Dispersion tube	Varies
Top frame assembly	1
Flanges	2
Screws	8
Flange locknuts	8

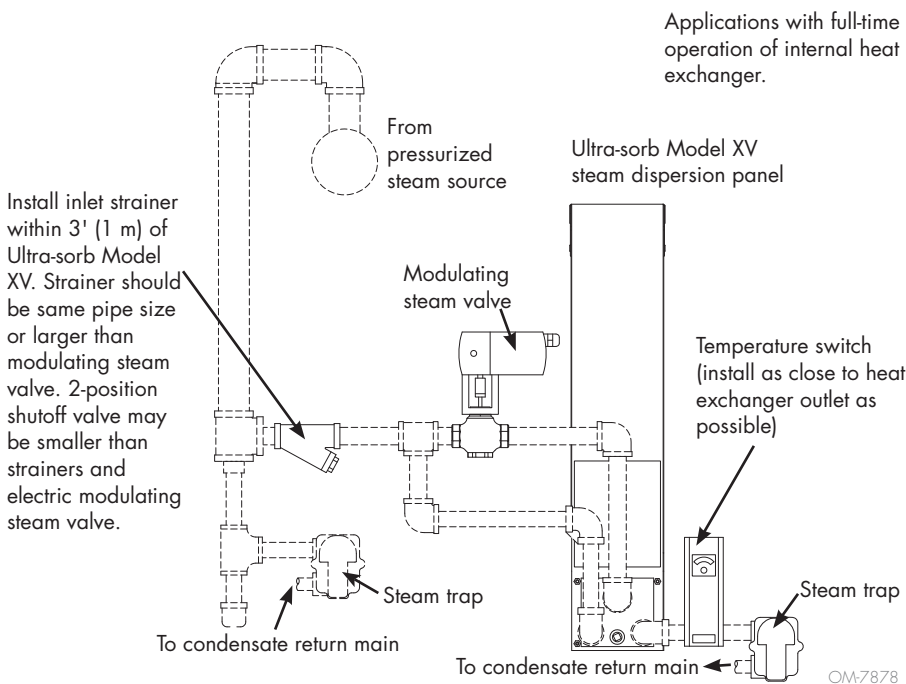
Piping

FIGURE 4-1: ULTRA-SORB MODEL XV PIPING COMPONENTS WITH ON/OFF SHUTOFF VALVE, FLOAT SWITCH, PRESSURIZED STEAM SOURCE



Note: Dashed lines indicate provided by installer.

FIGURE 4-2: ULTRA-SORB MODEL XV PIPING COMPONENTS WITH TEMPERATURE SWITCH, PRESSURIZED STEAM SOURCE

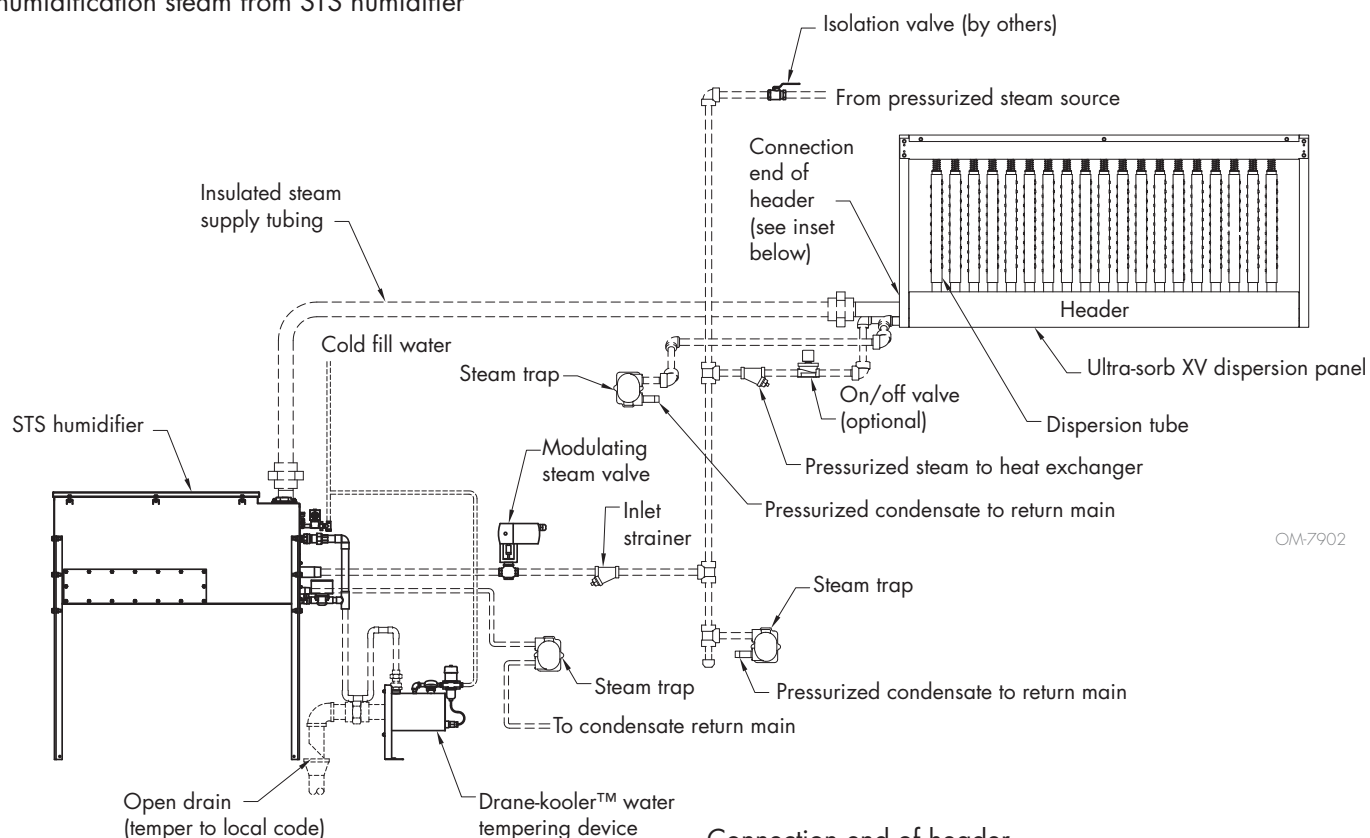


Note: Dashed lines indicate provided by installer.

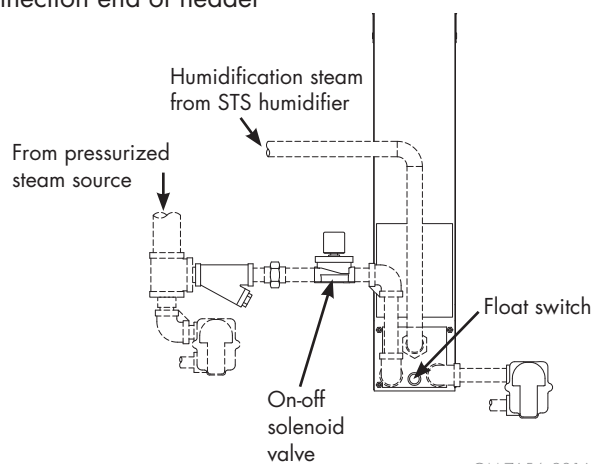
Piping

FIGURE 5-1: ULTRA-SORB MODEL XV PIPING WITH STS HUMIDIFIER

Steam to heat exchanger from pressurized steam source,
humidification steam from STS humidifier



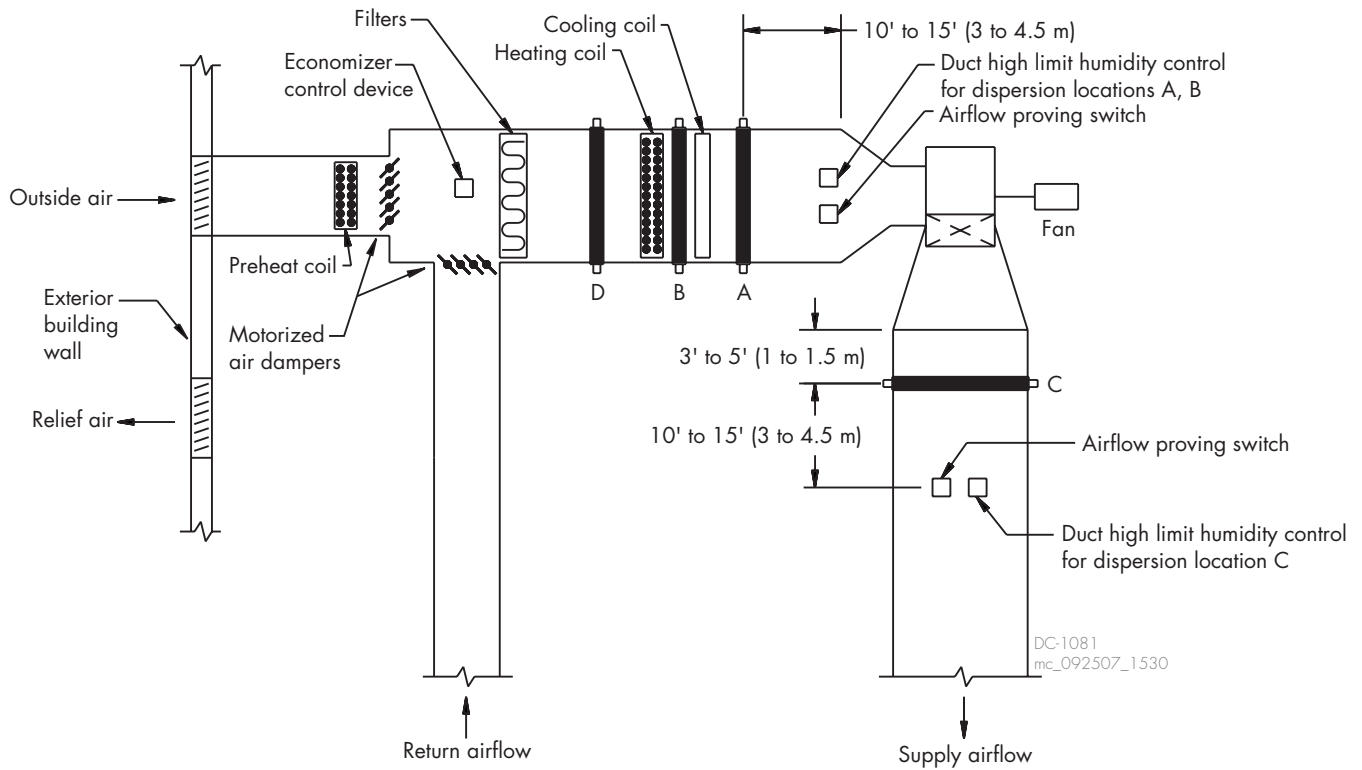
Connection end of header



Note: Tubing union shown at steam connection. For STS humidifier, connection may also be 3" (DN80) flange.

Selecting the location

FIGURE 6-1: PLACING A DISPERSION ASSEMBLY IN AN AIR HANDLING UNIT



Selecting the location

DETERMINE STEAM DISPERSION PANEL PLACEMENT

Dispersed steam must be absorbed into the airflow before it comes in contact with duct elbows, fans, vanes, filters, or any object that can cause condensation and dripping.

- Install the Ultra-sorb panel in a location where discharged water vapor will be absorbed by the airstream.
- Place the Ultra-sorb panel where the air temperature is capable of absorbing discharged steam without causing condensation at or after the unit. This will normally be downstream of the heating coil where the air is warmest.
- Do not place the Ultra-sorb panel in an outside air intake unless the air is first tempered with a preheat coil.
- Do not place the Ultra-sorb panel near the entrance of a high-efficiency filter. The filter will remove visible moisture and become waterlogged. See the Caution "Installing Ultra-sorb upstream from filter media" on Page 28.
- Do not place the Ultra-sorb panel where discharged visible mist will impinge directly on a metal surface.

PLACEMENT IN AN AIR HANDLING UNIT (FIGURE 6-1)

- Location A is the best choice. Installing downstream of heating and cooling coils provides the most even flow through the dispersion unit; plus, the heated air provides an environment for best absorption.
- Location B is the second-best choice. However, in change-over periods, the cooling coil will eliminate some moisture for humidification.
- Location C is the third-best choice. Air leaving a fan is usually very turbulent and can cause vapor to not absorb at the expected non-wetting distance. Allow for more distance if installing downstream of a fan.
- Location D is the poorest choice. The cooler air at this location requires an increased non-wetting distance.

Mounting and support

INSTALLATION IN A COLD AIR STREAM

When a steam dispersion panel is installed in a duct that will carry cold air, determine the dew point temperature. If the psychrometric chart reveals that saturation may occur, protection should be provided. A high-limit humidistat or thermostat set to cut off the steam dispersion panel at a safe temperature can be used for this purpose. See Figure 8-1.

PLACEMENT UPSTREAM FROM AN ELBOW OR DUCT SPLIT

Due to Ultra-sorb's rapid steam absorption performance, installation upstream from elbows or duct splits can be done with confidence. See Figure 8-2.

INSTALLATION ABOVE VALUABLE EQUIPMENT

Water piping and humidifiers should not be installed above expensive equipment. A condensing or leaking water pipe or other accidental water spillage could cause serious damage to the equipment below. When such an installation cannot be avoided, install a galvanized drip pan under the humidifier piping, valve, etc. to catch and drain away unintended water. See Figure 8-3.

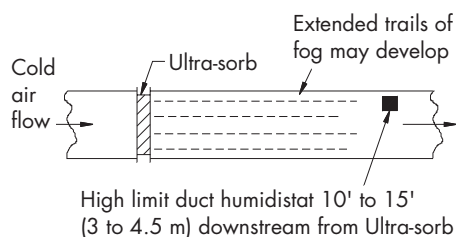
See also "Optional header overflow P-trap water seal" on Page 17.

PANEL SUPPORT

The duct or air handler section and Ultra-sorb panel must be properly supported to carry the weight of the assembly. The weight of the piping must be supported by the building structure rather than by the Ultra-sorb unit. Otherwise, the weight may impose stress on the connections, causing them to fracture and leak.

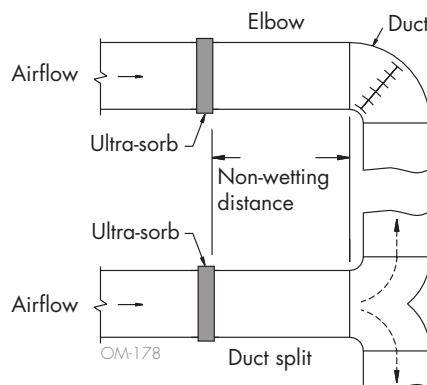
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FIGURE 8-1:
INSTALLATION IN A COLD AIR STREAM



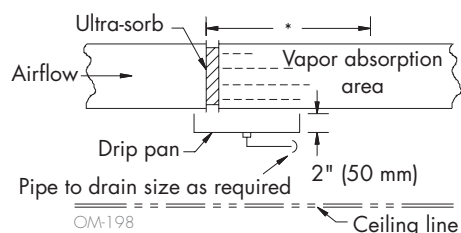
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FIGURE 8-2: UPSTREAM PLACEMENT



OM-178

FIGURE 8-3:
INSTALLATION ABOVE VALUABLE EQUIPMENT



* This length of duct should have sealed seams and should be at least three times the height of the Ultra-sorb panel.

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Mounting and support

Where allowed, screws and drill bits must not penetrate more than 3/4" (20 mm) into the header assembly. See Figure 10-1 for allowable drill and screw locations.

Ultra-sorb Model XV must be installed in horizontal airflows only.

MOUNTING IN A DUCT

Mounting flanges on both sides of the unit and the header and frame can be used as mounting surfaces (see Figure 10-1). A matching flange or metal frame is required on the ductwork for connection to the Ultra-sorb flanges. Use a #12 self-drilling and tapping screw 3/4" (20 mm) long, spacing not to exceed 12" (305 mm). If an angle-iron frame is provided on the duct section, a longer screw may be required.

MOUNTING IN AN AIR HANDLER

Metal support frames should be anchored to the air handler casing. When mounting the Ultra-sorb to a metal support frame, use 1/4" - 20 nuts and bolts or #12 self drilling and tapping screws. Fastener spacing should not exceed 6" (150 mm).

Duct smoke detector

Do not install a duct smoke detector downstream from the Ultra-sorb panel. If downstream installation is required, install it far enough from the Ultra-sorb panel to avoid false alarms.

Dispersion tube orientation

Verify that the steam discharge tubelets are perpendicular to the airstream (see Figure 9-1). The spring-loaded dispersion tubes easily rotate for proper orientation.

**FIGURE 9-1:
DISPERSION TUBE ORIENTATION**

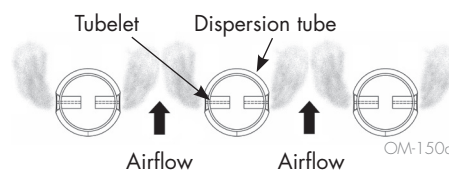
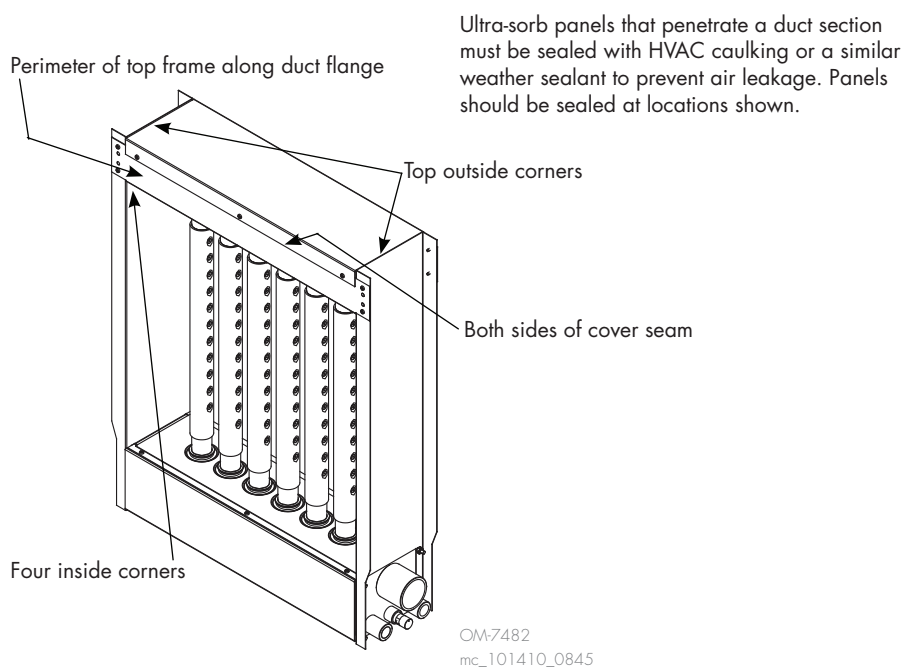
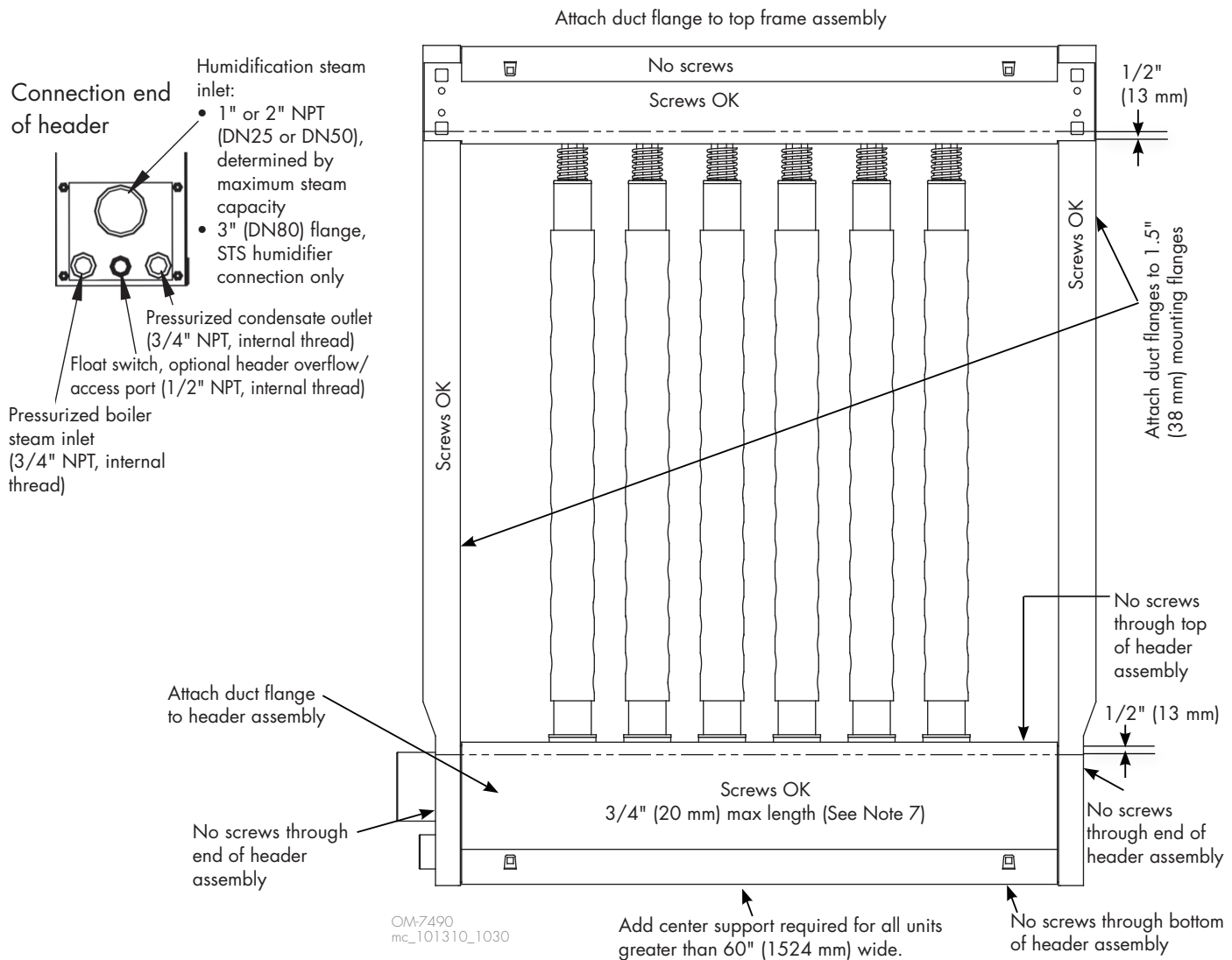


FIGURE 9-2: PREVENTING DUCT AIR LEAKS



Installation drawings: Mounting in a duct

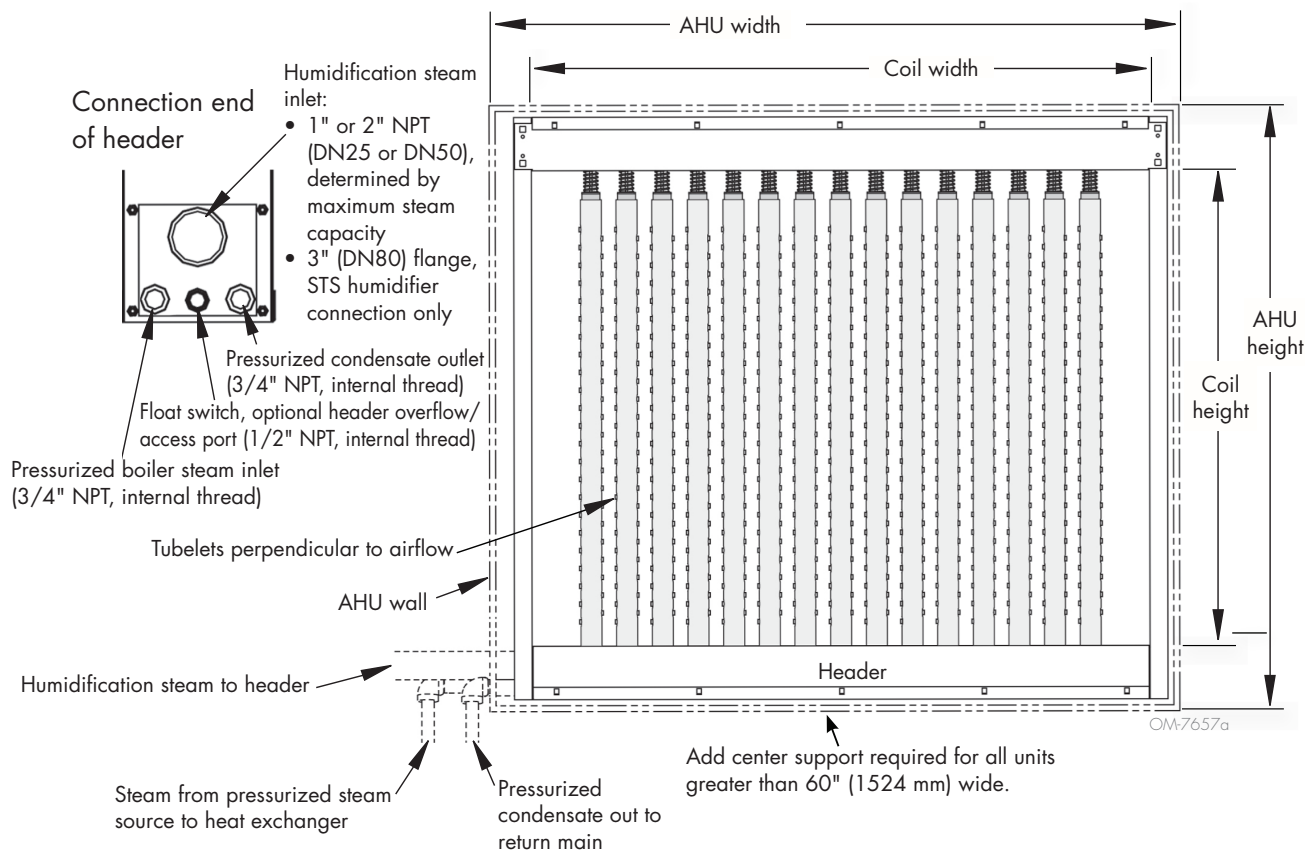
FIGURE 10-1: ULTRA-SORB MODEL XV IN A DUCT (HORIZONTAL AIRFLOW ONLY)



- Notes:
1. See Figure 12-1 for trap clearance.
 2. Steam supply line to unit and piping are not included.
 3. Dispersion tubes are available on 3", 4", 6", 9" and 12" (76, 102, 152, 229, and 305 mm) centers.
 4. Ultra-sorb steam dispersion panels will be assembled, crated, and shipped intact in all sizes up to 98" (2490 mm) overall height. Any Ultra-sorb can be shipped unassembled by request, requiring field assembly.
 5. Standard sizes are 12" x 12" up to 144" x 144" in 1" increments (305 x 305 mm up to 3660 x 3660 mm in 25 mm increments). Larger sizes are available.
 6. Install the panel level. If slope cannot be avoided, ensure that the slope is toward the drain end of the panel.
 7. Drill or screw through the header assembly only where shown.
Screws and drill bits must not penetrate more than 3/4" (20 mm) into the header assembly. Use 1/4"-20 nuts and bolts or #12 self drilling and tapping screws for mounting the Ultra-sorb to a metal support frame.

Installation drawings: Mounting in an air handler

FIGURE 11-1: ULTRA-SORB MODEL XV IN AN AIR HANDLER (HORIZONTAL AIRFLOW ONLY)



Notes:

1. Dashed lines indicate provided by installer.
2. See Figures 12-1 and 12-2 for trap clearance alternatives.
3. Steam supply line to unit and piping are not included.
4. Dispersion tubes are available on 3", 4", 6", 9" and 12" (76, 102 152, 229, and 305 mm) centers.
5. Ultra-sorb steam dispersion panels will be assembled, crated, and shipped intact in all sizes up to 98" (2490 mm) overall height. Any Ultra-sorb can be shipped unassembled by request, requiring field assembly.
6. Standard sizes are 12" x 12" up to 144" x 144" in 1" increments (305 x 305 mm up to 3660 x 3660 mm in 25 mm increments).
Larger sizes are available.
7. Heat exchanger requires 5 psig (35 kPa) minimum steam pressure.

Mounting in an air handling unit

- Metal support frames should be anchored to the air handler casing.
- Drill or screw through the header assembly only where shown in Figure 10-1. Screws and drill bits must not penetrate more than 3/4" (20 mm) into the header assembly.
- Use 1/4"-20 nuts and bolts or #12 self drilling and tapping screws.
- Fastener spacing should not to exceed 6" (150 mm).
- When Ultra-sorb Model XV is installed in bypass air applications provide additional bracing for the unsupported side(s).
- Install the panel level. If slope cannot be avoided, ensure that the slope is toward the drain end of the panel.

CAUTION

Use a backup wrench

Use a backup wrench on all plumbing connections. Failure to use a backup wrench could cause damage to the Ultra-sorb Model XV.

Recommendations and steam inlets

RECOMMENDATIONS

Trapping - steam supply and pressurized condensate return

- Low pressure, up to 15 psi (103 kPa) — float and thermostatic (steam) trap (Figure 12-1)
- High pressure, more than 15 psi (103 kPa) — inverted bucket trap (Figure 12-2)
- Lifting condensate — Steam trap (up to 15 psi/103 kPa) or inverted bucket trap (Figure 12-3)

Driest steam

To ensure driest steam, take humidifier steam off the top of the steam main (not the side or bottom).

Airflow proving switch

Use an airflow proving switch to prevent humidification steam from entering the header if air is not moving in the duct.

High limit humidistat

To prevent over saturation use a high limit (duct mounted) humidistat (Figure 6-1). Mount it 10' to 15' (3 to 4.5 m) downstream from the Ultra-sorb panel, and set it at 80 to 90% RH.

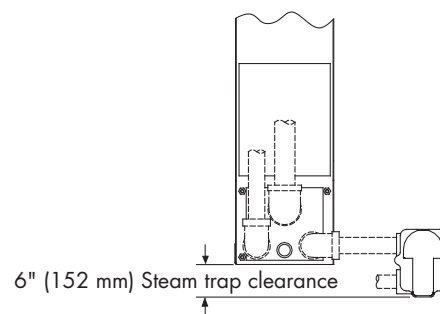
HEAT EXCHANGER PRESSURIZED BOILER STEAM INLET (SEE FIGURE 11-1)

Steam pressure for steam entering the heat exchanger must be least 5 psig (35 kPa) to vaporize condensate in the header.

Integral heat exchanger

- Ultra-sorb Model XV employs an integral heat exchanger to pressurize and lift condensate up to 12" per psi (300 mm per 6.9 kPa) of steam pressure.
- Steam pressure entering the heat exchanger must be at least 5 psig (35 kPa).
- Condensate may be piped to the condensate return main.

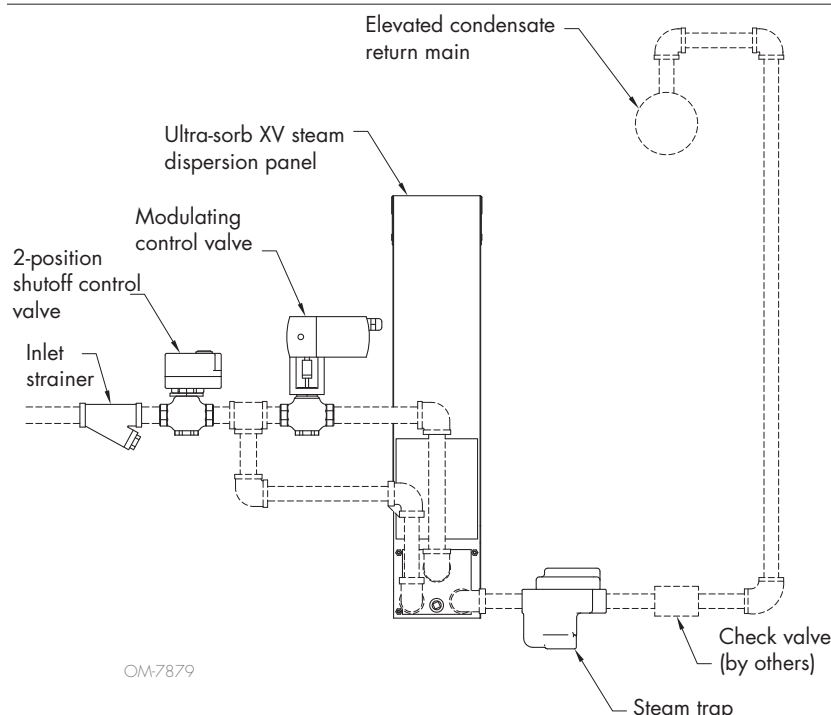
FIGURE 12-1: ULTRA-SORB MODEL XV STEAM TRAP DIMENSIONS



Note: Dashed lines indicate provided by installer.

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FIGURE 12-2: LIFTING CONDENSATE WITH ULTRA-SORB MODEL XV



OM-7879

Controls

CONTROL OPTIONS

CONFIRMING STEAM DISPERSION PANEL CONFIGURATION

The Ultra-sorb XV steam dispersion panel utilizes a built-in heat exchanger to evaporate condensate generated in the humidification process. For maximum energy efficiency, this requires a unique control sequence that operates a 2-position shutoff valve for the heat exchanger, in addition to a modulating valve for humidification control. A float switch in the steam dispersion panel header, along with control sequence timings assure effective condensate management along with humidification output based on demand.

Control options are described in Table 16-1.

CONTROL OPTION #1 - DRISTEEM CONTROL CABINET

The Ultra-sorb XV dispersion panel is provided with controls by DriSteem. Operation of both the 2-position shutoff valve, and modulating control valve is coordinated by the electronic controller provided in the DriSteem control cabinet. A demand signal or space RH is sent to the DriSteem controller, and the controller opens/closes the two steam valves based on the signal and inputs including the steam dispersion panel float switch, and (optionally) a duct air flow switch and humidity high limit control.

Note: The Ultra-sorb XV control cabinet utilizes the same control board as other DriSteem products, when configured as a Vapor-logic controller. The Ultra-sorb XV application firmware is different from Vapor-logic control. Board wiring terminal connections do not have the same functions as used for the Vapor-logic controller. Please refer to the wiring diagram included with the unit for proper wiring. Field configuration of the Ultra-sorb XV board is as described in the following paragraphs. Adjust the Vapor-logic control signals and setting from the Vapor-logic keypad interface or web server. Refer to the Vapor-logic IOM for further details.

WARNING

Electric shock hazard

Only qualified electrical personnel should perform field wiring installation procedures. Improper wiring or contact with energized circuits can cause property damage, severe personal injury, or death as a result of electric shock and/or fire.

Do not open control cabinet or subpanel access panels until electrical power is disconnected.

CAUTION

Damage from debris

When drilling penetrations in the control cabinet, protect all internal components from debris, and vacuum out the control cabinet when finished. Failure to comply with this directive can damage sensitive electronic components, cause erratic operation or failure, and void your DriSteem warranty.

Important:

Failure to follow these wiring procedures can result in erratic operation or failure.

This product has been tested at the factory for proper operation. Product failures resulting from faulty handling, incorrect wiring, or shorting of wires together on external components are not covered under your DriSteem warranty. Review information and diagrams before proceeding.

Controls

FLOAT SWITCH

Wire the float switch to the DriSteem control cabinet. A wiring diagram is included with the unit.

Under normal conditions the float switch in the Ultra-sorb Model XV header is closed, and the modulating steam valve or STS humidifier operates according to the humidification control system's call for humidity. In the event condensate levels rise in the humidifier header, the float switch rises and the circuit opens, activating a condensate mitigation sequence. Refer to the sequence of operation on page 33.

If you suspect problems with the float switch operation, see float switch maintenance instructions on Page 31. These instructions must be followed for the float switch to function properly.

AIR FLOW SWITCH

Air flow indication is required. Indication can be provided by a BAS input or air flow switch wired to the DriSteem control cabinet. Wire the air flow switch to the DriSteem control cabinet as shown in the diagram included with the unit. The steam dispersion panel will not run if the air flow switch input of the DriSteem controller is left open. A circuit-closing jumper is provided on the controller board input and must be removed to the air flow input.

HIGH LIMIT HUMIDISTAT

Wire the duct high limit humidistat to the DriSteem control cabinet. Refer to the Vapor-logic external connections diagram or the Vapor-logic IOM for wiring instructions.

Controls

CONTROL OPTION #2 – ELECTRIC TEMPERATURE SWITCH ONLY; CONTINUOUS HEAT EXCHANGER OPERATION

The DriSteem control cabinet is not provided. An electric modulating control valve is controlled by a 2-10 VDC/4-20 mA signal from a control system (BAS) or modulating humidistat. Optional air flow switch, high limit humidistat are wired in series with 24 VAC control circuit of the modulating control valve. See the wiring diagrams provided with the unit.

ELECTRIC TEMPERATURE SWITCH

Install the temperature switch (Figure 20-1) to prevent the header from flooding with condensate if the heat exchanger cools, such as if the condensate return main becomes flooded or the trap fails closed. DriSteem's temperature switch is a temperature-actuated make-break switch. The temperature at which it switches is adjustable and should be set at 210 °F (99 °C).

- Install the sensing element of the temperature switch in the condensate return piping between the Ultra-sorb heat exchanger outlet and the inlet to the steam trap, as shown in Figure 20-1. Include a tee with a 1/2" (DN15) pipe thread opening to receive the sensing element. When steam surrounds the sensing element, the switch will "make," allowing the steam dispersion panel valve to open.
- Install all wiring according to national and local electrical codes, and size transformer VA to load VA.
- When using a temperature switch to control the on-off heat exchanger valve, follow the wiring instructions supplied with the modulating humidification-steam control valve.

CONTROL OPTION #3 – PNEUMATIC TEMPERATURE SWITCH ONLY; CONTINUOUS HEAT EXCHANGER OPERATION

The DriSteem control cabinet is not provided. A pneumatic modulating control valve is sent a 3-15 PSI signal from a pneumatic humidistat or other pneumatic device, to modulate the valve based on humidity demand.

- The 2-position shutoff valve is not used. Steam supply to the panel's internal heat exchanger is continuous.

PNEUMATIC TEMPERATURE SWITCH

Install the pneumatic temperature switch as shown in (Figure 20-2). The temperature switch will prevent the header from flooding with condensate by closing the modulating steam valve if the heat exchanger cools (if the condensate return main becomes flooded or the trap fails closed). DriSteem's pneumatic temperature switch is a temperature-actuated open-closed pneumatic switch. The pneumatic signal (3-15 PSI) is maintained above 210°F (99°C) and is opened (bled off) below 200°F (93°C).

Controls

CONTROL OPTION #4 – CONTROLS BY BAS/CONTROLS CONTRACTOR

The BAS or controls contractor will provide the necessary controller and programming logic to sequence the steam dispersion panel valves as described for Control Option #1. This includes providing control outputs for the modulating control valve and 2-position shutoff valve. Refer to the BAS controls contractor wiring diagrams for specific valve and float switch connection terminals.

Table 16-1:
Boiler steam application control options

Heat exchanger and humidifier control option	2-position shutoff valve	Modulating control valve	Float switch in header	Temperature switch at condensate outlet	DriSteem control cabinet
Control Cabinet with time delay (#1) Coordinated Heat exchanger and humidification control through DriSteem control cabinet.	Electric - Wired to DriSteem control cabinet	Electric - Wired to DriSteem control cabinet	Yes - Wired to control cabinet	No (optional)	Yes
Temperature switch only (Electric) (#2) The heat exchanger operates continuously (100%). Electric temperature switch opens, shutting off the power to the modulating valve if the condensate backs up in the heat exchanger (failed trap).	Not Used	Electric	No	Yes- Electric	No
Temperature switch only (Pneumatic) (#3) The heat exchanger operates continuously (100%). Pneumatic temperature switch opens, closing the modulating valve if the condensate backs up in the heat exchanger (failed trap).	Not Used	Pneumatic	No	Yes - Pneumatic	No
BAS Control (#4) Controls by BAS/controls contractor; Contractor to provide and follow control sequence of Control Option #1	Electric - Wired to BAS controller	Electric - Wired to BAS controller	Yes - Wired to BAS controller	No (optional)	No
Control by STS® humidifier (#5) Control by STS humidifier	Optional if chosen with Ultra-sorb XV	Chosen for inlet to STS - Electric or Pneumatic	Yes - Wired to STS humidifier Vapor-logic® controller	Optional if chosen with Ultra-sorb XV	No - Control provided by STS humidifier

Controls

ULTRA-SORB XV WITH DRISTEEM STEAM-TO-STEAM (STS) HUMIDIFIER

If the Ultra-sorb XV panel is used in conjunction with a DriSteem Steam-to-Steam (STS) humidifier, atmospheric steam generated from the STS is piped to the Ultra-sorb XV and distributed through the dispersion header to the humidifier tubes.

Pressurized boiler steam (5 PSI minimum), as used to source the STS unit heat exchanger, is also used to operate the Ultra-sorb XV internal heat exchanger enabling condensate evaporation in the humidifier panel header. See Figure 5-1 for piping connections.

Optional Ultra-sorb XV control devices are located as shown in Figure 5-1 and wired to the Vapor-logic controller provided with the associated STS humidifier. Devices may include a 2-position solenoid valve for XV heat exchanger control, and float or temperature switch(es).

- Refer to the wiring diagram provided with the STS unit for wiring connections.

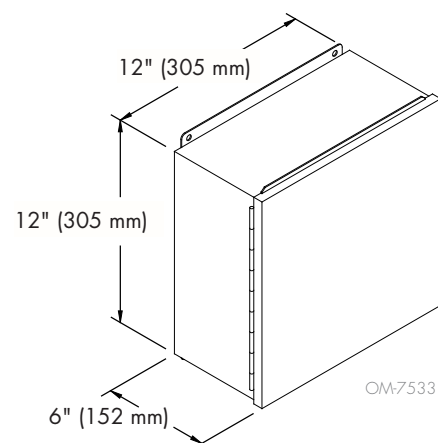
OPTIONAL HEADER OVERFLOW P-TRAP WATER SEAL

Ultra-sorb Model XV is designed to vaporize the condensate generated in a properly designed, installed, operated, and maintained system. An optional, header overflow p-trap (Figure 17-2) is recommended if any of the following are true:

- There is not a float switch installed in the dispersion panel header.
- Boiler chemicals are causing heavy material deposition on heat exchanger.

Before operating the Ultra-sorb, and after extended shutdown periods, prime the P-trap with about 1 cup (200 mL) of water. A water seal cannot be assured via condensate generated within the humidifier header. Do not feed the P-trap with a water source to maintain prime, as this will force water into the header.

FIGURE 17-1: ULTRA-SORB MODEL XV CONTROL CABINET

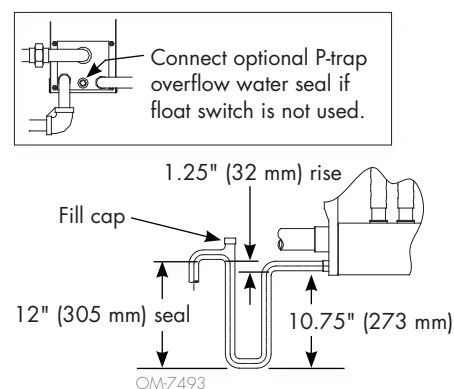


Notes:

- Electrical power requirements: 120 VAC, 1.0 Amps, or 230 VAC, 0.5 Amps
- Components are 24 VAC, powered by a transformer in the control cabinet. 50 VA available from internal transformer for operation of two 24 VAC control valves.
- Maximum distance from control cabinet to Ultra-sorb Model XV is 50' (15 m).

FIGURE 17-2: ULTRA-SORB MODEL XV OPTIONAL HEADER OVERFLOW P-TRAP WATER SEAL

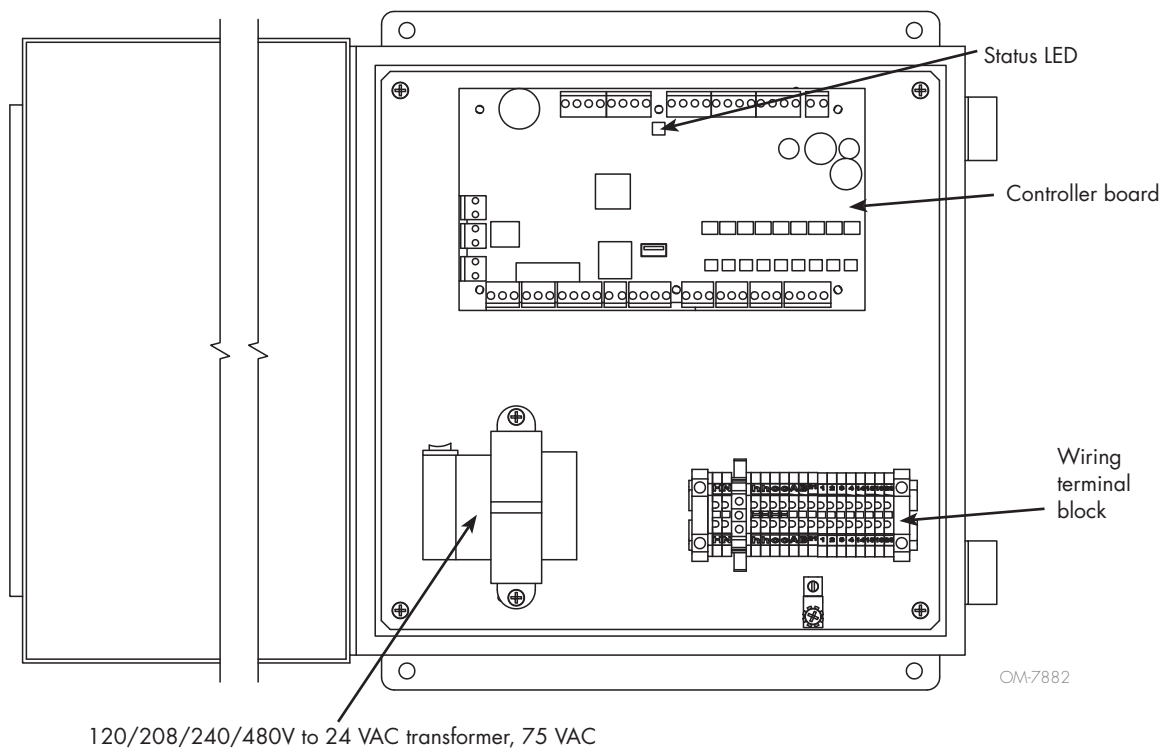
Connection end of header



Note: After the water seal, run a 1 1/2" (DN40) drain line to an open drain with a 1" (25 mm) air gap. Water seal must cover height of internal heat exchanger tube as shown to provide condensate evaporation in normal operating conditions.

Controls

FIGURE 18-1: CONTROL CABINET



Ultra-sorb XV operation

1. STEAM SUPPLY INLET

Humidification steam from the modulating steam valve (Figure 4-2) or STS humidifier (Figure 19-1) passes through the steam supply inlet into the Ultra-sorb header.

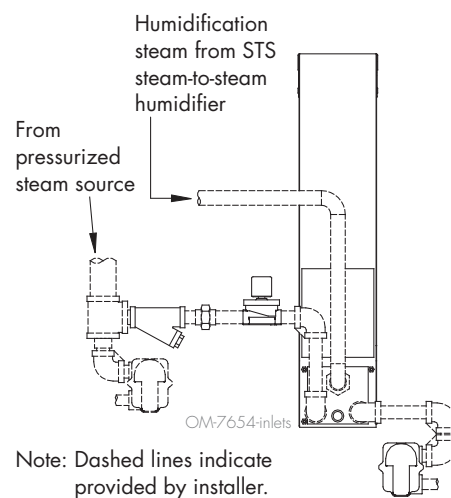
2. HEADER

Humidification steam flows through the insulated header, up the High-Efficiency Tubes, and into the airstream.

3. HEAT EXCHANGER

Pressurized steam enters the heat exchanger inlet. The heat exchanger vaporizes dispersion-generated condensate, while pressurized condensate returns to the boiler via the condensate return main.

FIGURE 19-1: ULTRA-SORB MODEL XV WITH STS; STEAM INLETS DETAILED



Ultra-sorb XV operation

TEMPERATURE SWITCH

The temperature switch circuit's sequence of operation is a safety sequence: In the unlikely event that excessive header condensate cools the heat exchanger while humidifying, the temperature sensor drops below operating temperature, and the switch opens. This signals the modulating steam valve or STS humidifier control system to stop humidification steam from entering the header and prevents further condensate production.

See the temperature switch sensor in Figure 20-1 and Figure 20-2.

FIGURE 20-1: ELECTRIC TEMPERATURE SWITCH

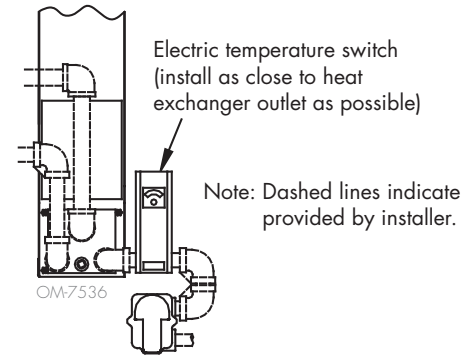
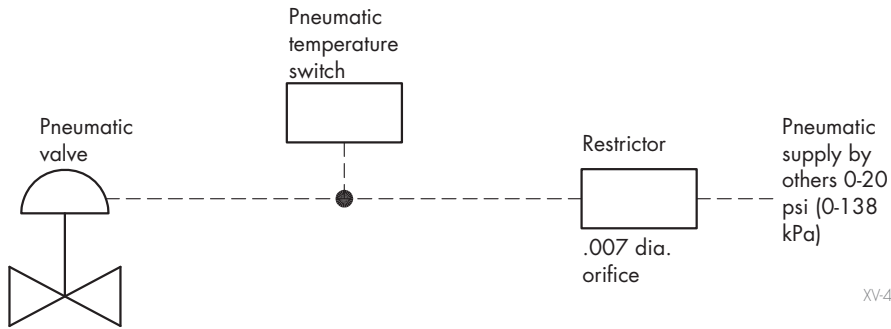
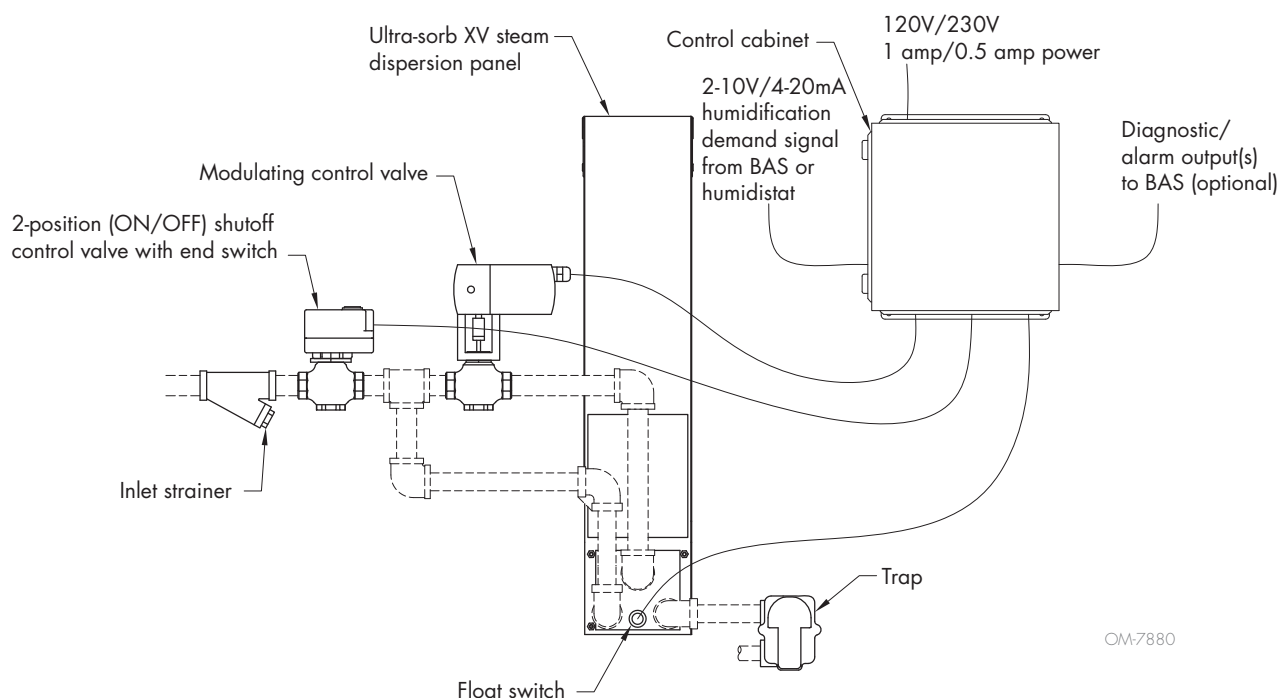


FIGURE 20-2: PNEUMATIC TEMPERATURE SWITCH



Sequence of operation

FIGURE 21-1: CONTROL COMPONENTS - CONTROL OPTION #1



Important: If the steam valve and heat exchanger control is to be provided directly by a separate BAS controller (Control Option #4 without use of DriSteem control cabinet), inputs and valve output controls must be linked to a BAS controller and sequenced as described below.

DRISTEEM CONTROL CABINET INCLUDING 2-POSITION SHUTOFF VALVE AND FLOAT SWITCH

The following control sequence is accomplished through use of the DriSteem control cabinet to provide maximum energy efficiency and operational reliability, through proper timing of operation of the 2-position (on-off) shutoff valve, and modulating control valve. Required inputs include demand signal, and safety interlocks of air flow and header/heat exchanger float switch.

1. Upon air handling unit startup (Occupied Mode), air flow switch enables 2-position (On-Off), normally closed, spring return shutoff valve actuator. Start/stop of fan provided by BAS or other control command.
 - a. If air flow interlock is provided by BAS, then the BAS must provide a contact closure to the DriSteem control cabinet air flow switch input.
2. The 2-position (On/Off) shutoff valve opens only if air flow is detected, and if demand for humidification is present.

Sequence of operation

3. Humidification demand is provided by a control signal to the DriSteem control cabinet. When the demand signal is sufficient, steam will flow to 1) the internal heat exchanger and 2) the modulating control valve that provides steam output based on demand.
4. As the 2-position shutoff valve opens (approx. 75 seconds), the heat exchanger in the steam dispersion panel begins operating. The heat exchanger will continue to operate any time there is duct air flow and humidification demand.
5. The shutoff valve actuator includes an end switch that enables the modulating control valve if the shutoff valve is over 90% open. The end switch of the shutoff valve actuator is wired to an input of the steam dispersion panel controller. If the input is not made, the modulating control valve will remain closed.
6. If the shutoff valve does not reach 90% open after 4 minutes (determined by actuator end switch), the steam dispersion panel controller will close the shutoff valve and activate a failure alarm contact on the control board, and provide LED alarm indication on the controller. See Figure 21 [DriSteem alarm point to be wired to BAS as specified.]
7. When the steam dispersion panel controller verifies the shutoff valve is open, it allows the modulating control valve to modulate based on the control signal, providing a 2-10 VDC signal from the control board to the valve actuator. At low/no demand signal or space RH above setpoint and outside the PID band, the valve is closed. At high demand or space RH below setpoint, the valve opens. Modulating control valve is spring-return to fail to the closed position.
8. When the air handling unit fan stops (Unoccupied Mode by command of BAS, or other means) the air flow input wired to the steam dispersion panel controller opens, and controller returns the modulating control valve to the closed position.
9. After the modulating control valve is closed, the 2-position shutoff valve remains open, to maintain steam flow through the heat exchanger for 15 minutes to evaporate any remaining condensate in the steam dispersion panel header.

Sequence of operation

10. After fifteen minutes of heat exchanger operation, the 2-position shutoff valve will close (Twenty-five second close time). The end switch of the shutoff valve opens to assure the modulating control valve is closed whenever the heat exchanger is off.
11. A float switch is located in the steam dispersion panel header, and wired to the DriSteem controller. The switch circuit will open if condensate (water) depth in the header rises 1/2" above the heat exchanger tube.
 - a. If the condensate level rises above the float switch point, the controller drives the modulating control valve closed, stopping steam flow and the possibility of condensate generation.
12. The steam dispersion panel controller monitors the elapsed time starting when a high condensate level occurs.
13. If the header condensate level falls below the float switch height, the modulating valve will resume normal control as set by BAS/control input.
14. If the level remains at/above the switch, the modulating valve will remain closed.
15. The time interval for condensate management will increase each time the level is exceeded. The time provided to lower/evaporate condensate is initially 2 minutes, and increases by 1 minute intervals each time the condensate level is exceeded, to fifteen minutes maximum.
16. If the condensate level stays below the float switch for more than fifteen minutes, the incremental timer will be reset.
17. If the incremental timer cycle (2 minutes through fifteen minute iterative cycle) is exceeded, and if condensate has not remained below the condensate level switch, the 2-position shutoff valve will be closed. The controller will activate diagnostic outputs (1 NC/ 1 NO) to indicate condensate clearing failure. (The controller provides on-board diagnostic LED to indicate "Condensate Clearing Failure" (see page 25).
18. If the power is reset or interrupted to the unit the entire sequence will be re-initiated.

Sequence of operation

FULL-TIME HEAT EXCHANGER OPERATION WITH ELECTRIC OR PNEUMATIC TEMPERATURE SWITCH

With control options #2 and #3, a 2-position (On-Off) shutoff control valve is not used (see Figure 4-2). The Ultra-sorb XV internal heat exchanger operates any time pressurized steam is available to the dispersion panel. Install the temperature switch downstream of the internal heat exchanger to prevent operation of the modulating control valve if steam is not flowing through the heat exchanger.

1. Upon air handling unit startup (Occupied Mode), air flow switch enables modulating control valve. Start/stop of fan provided by BAS or other control command.
 - a. If air flow interlock is provided by BAS, then the BAS must provide a contact closure in series with the modulating valve 24 VAC power circuit as shown on the wiring diagram shipped with the Ultra-sorb panel.
2. Humidification demand is provided by a 2-10VDC/4-20mA signal from BAS/control signal or humidistat, to the modulating control valve.
3. Internal heat exchanger operates continuously. A temperature switch (electric or pneumatic) senses condensate temperature leaving the heat exchanger. If the temperature at the outlet of the heat exchanger falls below 210°F (99°C), the temperature switch closes the modulating control valve to prevent condensate buildup in the steam dispersion panel header.

Sequence of operation

CONTROL CABINET STATUS LED

The control board within the control cabinet includes a large Status LED that indicates multiple control conditions (see Figure 18-1). The Status LED is always “blinking”. It will be easy to see that the board is powered and operating because, at a minimum, it is running the Status LED. The blinking will be in a 3-stage cycle starting from being dark, with the LED brightness illuminating up to the first stage of indication. Timing of the 3-stage cycle will be over approximately four seconds.

CONTROL BOARD LED - DIAGNOSTIC CODES

First Blink (long): Wiring Interlocks

Green	OK
Yellow	Interlock circuit open: duct high RH limit or no air flow
Red	On/Off shutoff valve: end switch failed to close (Manual Reset- Cycle Power)

Second Blink: Condensate level status

Green	OK
Yellow	System clearing condensate (>1" depth in header)
Red	Condensate clearing failure (Manual Reset- Cycle Power)

Third Blink: Humidification demand

Blue	No humidification demand
Green	Humidification demand to controller
Yellow	Clearing condensate: waiting to open control valve

Note: A list of the diagnostic codes are in the control cabinet.

Sequence of operation

CONTROL BOARD ALARM OUTPUTS

There are 2 dry contact outputs on the control board that can provide alarm indications to a BAS or other control system.

- Terminals C-1 to NO-1 are normally open and close upon alarm condition(s)
- Terminals C-2 to NO-2 are normally closed and will open upon alarm condition(s)

The conditions under which the alarm conditions occur are:

- If the shutoff valve does not reach 90% open after 4 minutes (actuator end switch), then the steam dispersion panel controller will close the shutoff valve and activate the diagnostic alarm contact
- If the condensate timer cycle (2 minutes through 15 minute iterative cycle) is exceeded, and if condensate has not remained below the condensate level switch, the 2-position shutoff valve will be closed. The controller will activate the diagnostic alarm contacts to indicate condensate clearing failure.

Dry contacts are rated for 125 VAC, 3 AMP or 30 VDC, 3 AMP maximum. Exceeding this maximum rating can cause the dry contact (relay) component or the control board to fail.

Start-up checklist

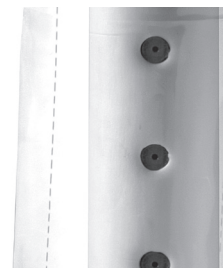
1. Ensure all component wiring and piping connections are complete as shown in the wiring diagrams provided with the unit.
2. Create demand for humidification by providing a demand signal to control cabinet option 1 or control valves options 2 and 3.
3. Prime the header overflow P-trap, if installed. Ensure that it is installed as recommended in "Optional header overflow P-trap water seal" on Page 17.
4. Turn on steam to the heat exchanger. Inspect connections for piping leaks.
5. Turn on the modulating steam valve, and check for piping leaks.
6. Ensure that the traps are operating.
7. Check the dispersion tubes for leaks.
8. Ensure that the dispersion tubes are oriented with the tubelets at a right angle to the airflow. See Figure 9-1.
9. Check for any other leaks from header connections.
10. If a temperature switch is installed (control options #2 or #3), with both heat exchanger and humidification steam turned on, turn off steam to the heat exchanger. Make sure the temperature switch turns off the modulating steam valve to stop humidification steam from entering the dispersion assembly. Depending on the installation, it may take several minutes for the steam valve to close.
11. Heat exchanger operation:
 - Ensure operating steam pressure is at least 5 psig (35 kPa).
 - Ensure on-off and shut-off delay (15 minutes after non humidifier demand - control options #1 or #4) conditions are working as intended.

CAUTION

Remove clear poly film; do not remove white PVDF insulation.

High-Efficiency Tubes are sleeved in clear poly film for protection during processing, shipping, and installation.

Tear the clear poly film along the perforations, and remove and discard it before start-up.



Performance data

NON-WETTING DISTANCE

Non-wetting distance is the dimension downstream from the leaving side of the steam dispersion assembly to the point where wetting of other components will not occur. Current design conditions may vary from conditions used for system design.

- The rise in RH (ΔRH) between entering and leaving air has a direct bearing on the non-wetting distance. As the ΔRH increases, more vapor needs to be dispersed into the air; thus, the non-wetting distance increases.
- Uneven airflow over the Ultra-sorb panel cross-section may result in nonuniform mixing of steam with air, which may increase absorption distance.
- A small amount of duct air pressure loss will be present downstream from the Ultra-sorb panel, depending on air density, velocity, and tube spacing. See Table 28-2.

CAUTION

Do not install an Ultra-sorb upstream from filter media.

If you must install upstream from filter media, consult DriSteem or your local DriSteem representative for recommendations.

Table 28-2:
Ultra-sorb XV air pressure loss

Duct air velocity (55 °F [13 °C] at sea level)		Tube spacing					
		3" (75 mm) - 1.5" (38 mm) tube		4" (102 mm) - 2" (50 mm) tubes		6" (150 mm) - 1.5" (38 mm) tube	
fpm	m/s	wc	Pa	wc	Pa	wc	Pa
500	2.54	0.033	8.3	0.033	8.3	0.005	1.3
1000	5.08	0.121	30.2	0.121	30.2	0.020	5.1
1500	7.62	0.237	59.2	0.237	59.2	0.046	11.5

Notes:

- Ultra-sorb panels with 9" (225 mm) or 12" (300 mm) tube spacings have no measurable air pressure loss.
- Use DriSteem's DriCalc sizing and selection software to calculate your specific air pressure loss.

Strainer, traps, and valves

STRAINER

Inspect at least twice during the first year. If fouled, inspect more frequently.

STEAM TRAPS

Verify that the steam traps are functioning properly at least twice a year. A blocked steam trap will be at room temperature. A “blowing” steam trap is hot and noisy, and the discharge pipe from it is hot for up to 30 feet (9 m). A properly operating steam trap is hot and makes noise at intervals, and the discharge pipe is progressively cooler beginning at the trap.

HEADER OVERFLOW P-TRAP WATER SEAL

If this option is used (see “Optional header overflow P-trap water seal” on Page 17), prime the P-trap with about 8 ounces (200 mL) of water whenever the panel has been idle for 90 days or more.

VALVES

- Electric: Inspect annually to be sure the valve operates freely, closes off steam tightly, and there are no leaks.
- Pneumatic: Inspect annually to be sure the valve tightly closes off steam, the stem packing is not leaking steam, and the actuator diaphragm is not leaking air.

Dispersion tubes and heat exchanger

DISPERSION TUBES

- If steam or condensate is evident at the sealing surface, replace the seal.
- Inspect insulating material for dirt and smudges; gently clean with damp cloth and soapy water or diluted nontoxic, biodegradable cleaner/degreaser. Do not clean insulating material with a pressure washer; direct spray could cause damage.

Humidifier de-scaling solution

HEAT EXCHANGER

A poor quality steam source may cause a buildup of deposits on the heat exchanger which will require periodic cleaning. After 2000 hours of operation, remove a dispersion tube and check whether the heat exchanger is coated with material deposits.

Material deposits can be removed from the heat exchanger with DriSteem's Humidifier De-scaling Solution, available from your DriSteem representative. It is the only cleaner/de-scaler approved for use with DriSteem humidifiers. Use of other cleaners/de-scalers may void your DriSteem warranty.

The Usage Instructions shipped with the DriSteem Humidifier De-scaling Solution contain important handling, mixing, timing, and pH testing information.

The following additional instructions are for Ultra-sorb Model XV humidifier:

1. If a float switch is installed:
 - Note position of orientation mark (see Figure 31-1). Mark must be in same position when float switch is re-installed.
 - Remove float switch; the ½" NPT (DN15) port will be used to drain header.
2. Install a ½" NPT thread drain hose in ½" NPT (DN15) port. After making sure hose can reach a bucket or drain, elevate end of hose well above connection.
3. Remove a dispersion tube, and add water to header to submerge heat exchanger (see Figure 31-2).
4. Add 10 ounces of Humidifier De-scaling Solution per foot of header length (30 mL of solution per 300 mm of header length). A 12-foot (3660 mm) header requires about 1 gallon (3.8 litres) of solution.
5. After performing de-scaling procedure as described in Usage Instructions and before resuming operation: Flush and drain header four times to thoroughly remove Humidifier De-scaling Solution from system.
6. Re-install float switch in port.

See DriSteem's Humidifier De-scaling Solution on the Accessories and options page (under Products) on our website: www.dristeem.com.

! WARNING

Humidifier De-scaling Solution is corrosive.

Read and follow all warnings and instructions shipped with the DriSteem Humidifier De-scaling Solution.

FIGURE 31-1: ORIENTATION MARK ON FLOAT SWITCH

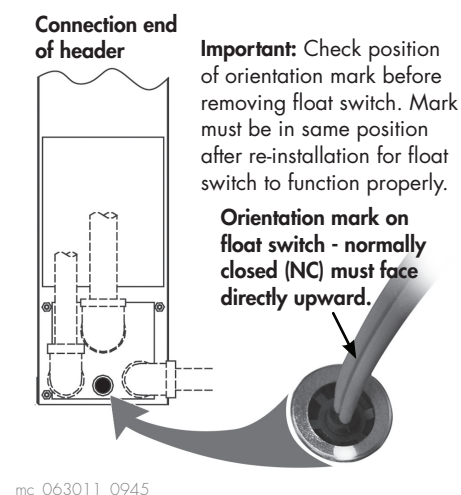
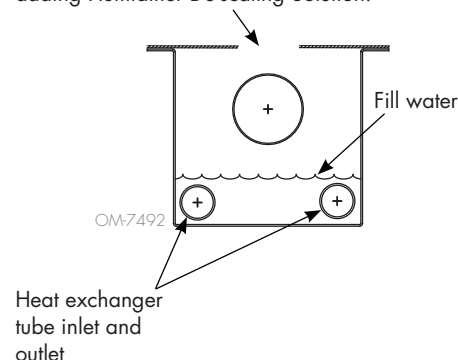


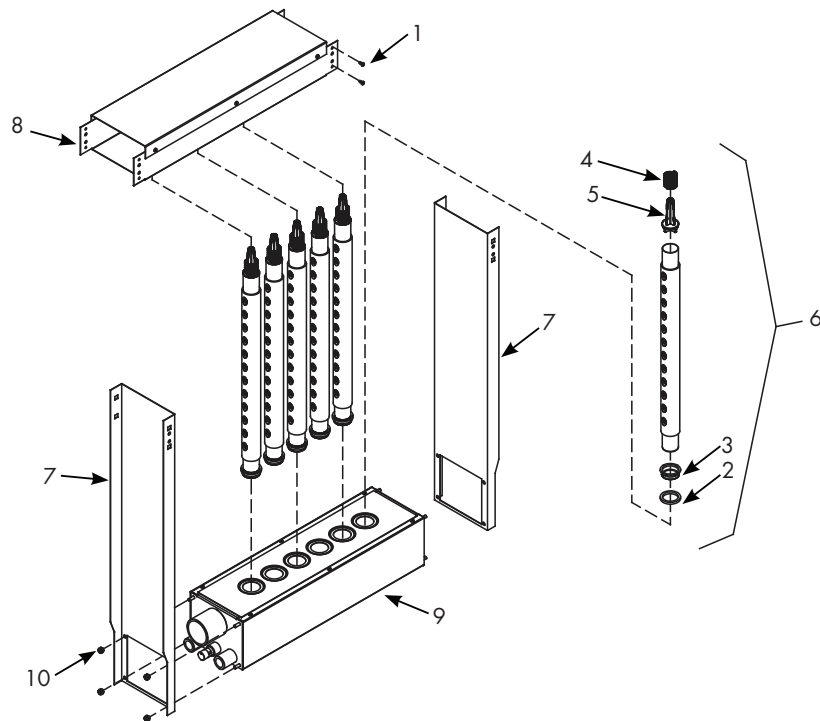
FIGURE 31-2: HEADER CROSS SECTION

Pour water into header through dispersion tube hole to submerge heat exchanger before adding Humidifier De-scaling Solution.



Replacement parts

FIGURE 32-1: ULTRA-SORB MODEL XV REPLACEMENT PARTS



QM-7484b
mc_101410_0835

Table 32-1:
Ultra-sorb Model XV replacement parts

No.	Description	Part No.
1	Screws, frame (package of 4)	191170-010
2	O-ring, square 1.35" ID (package of 10)	191170-015
	O-ring, square 1.77" ID (package of 10)	191171-015
3	Ring, tube end, 1.5" (package of 1)	207010-001
	Ring, tube end, 1.5" (package of 5)	191170-020
	Ring, tube end, 2.0" (package of 1)	207010-002
	Ring, tube end, 2.0" (package of 5)	191171-020
4	Spring, compression, SST (package of 1)	501460-001
	Spring, compression, SST (package of 5)	191170-025
5	Plug, tube end, 1.5" (package of 1)	310260
	Plug, tube end, 1.5" (package of 5)	191170-030
	Plug, tube end, 2.0" (package of 1)	310261
	Plug, tube end, 2.0" (package of 5)	191171-030
6	Dispersion tube assembly	consult factory

Table 32-1:
Ultra-sorb Model XV replacement parts

No.	Description	Part No.
7	Flange, side	consult factory
8	Frame assembly, top	consult factory
9	Header assembly	consult factory
10	Nut, 1/4-20 (package of 4)	191170-035
	HVAC sealant for duct section applications	consult factory
	Electric modulating steam valve	consult factory
	Pneumatic modulating steam valve	consult factory
	On-off valve assembly	consult factory
	Electric temperature switch	400260-001
	Pneumatic temperature switch	307076
	Inlet strainer	consult factory
	Steam trap	consult factory
	Control board	408496
	Float switch	408420-004

Troubleshooting

Table 33-1:
Ultra-sorb Model XV troubleshooting guide

Problem	Possible cause	Action
Humidifier discharges water in duct	• Missing or torn seal	• Replace seal.
	• Dispersion tube not properly installed	• Ensure proper installation. See Figure 3-1.
	• Humidification steam is exceeding capacity per tube	• Ensure humidification is 43 lbs/hr (19.5 kg/h) per tube or less.. Note: For panels with a face height less than 17" (430 mm), contact DriSteam for assistance.
	• Steam main overloaded with water due to boiler discharging water with steam (priming)	• Locate cause of priming and correct.
	• Steam trap not draining properly	• Replace, repair, or clean trap as required. • If condensate return main is overloaded, find an alternative method for draining.
	• Humidifier improperly piped	• Correct piping as shown on Pages 4, 5, and 12.
	• Surges of condensate in steam supply due to condensate collecting at low, undrilled point in steam main	• Install drips and steam traps as required. See "Trapping" on Page 12.
	• Inadequate steam trap capacity	• Replace with larger trap.
	• Pressurized condensate is being lifted too high	• See "Integral heat exchanger" on Page 12.
	• Heat exchanger is caked or dirty	• Flush header. See page 31.
	• Condensate collecting in header	• Increase steam pressure through heat exchanger. • See "Optional header overflow P-trap water seal" on Page 17.
	• Temperature switch downstream from heat exchanger is malfunctioning	• Replace or repair.
	• Float switch in header is malfunctioning	• Replace or repair. See float switch instructions in Step 1 on Page 31.
Humidity exceeds setting of humidistat	• Control valve not fully closing	• Foreign matter holding valve open; clean valve. • Valve spring broken; replace spring. • Valve stem packing too tight; loosen and/or replace packing. • Steam pressure exceeds close-off rating of valve spring; replace actuator or valve spring with one that is compatible with the higher steam pressure. • Valve installed backwards; re-install. • Adjust valve linkage.
	• Faulty or improperly placed humidity controller	• Replace controller or relocate per catalog recommendations.
	• Poor location of control components	• Relocate per catalog recommendations.
	• Incompatible control components	• Replace per specified recommendations.
	• Control valve is hunting	• Humidifier capacity is oversized; change to smaller valve. • Pressure reducing valve is not accurately controlling steam pressure; repair or replace. • Boiler pressure is swinging too widely; adjust.
	• Excessive outside air volume	• Check fans, dampers, VAV, etc. • Mixed air inlet formula: $\begin{aligned} &(\% \text{ outside air}) \times (\text{moisture content}) \\ &+ (\% \text{ return air}) \times (\text{moisture content}) \\ &= \text{mixed air inlet in lbs/100 cfm} \\ &(\text{kg/100 m}^3/\text{h}) \end{aligned}$

Continued

Troubleshooting

Table 26-1:
Ultra-sorb Model XV troubleshooting guide (continued)

Problem	Possible cause	Action
Control system malfunctioning	• Incorrect control voltage	• Verify control board voltage input is 24 VAC.
	• Incorrect control signal	• Verify control signal is valid or RH transmitter is wired.
	• Improper wiring connections	• Rewire.
	• Incorrect humidity sensor	• Replace.
	• Humidity controller out of calibration	• Recalibrate.
Control valves do not open (with control cabinet)	• Air flow switch input open	• Validate/close input.
	• No demand signal	• Verify control signal is valid or RH transmitter is wired.
	• Condensate in header - float switch open	• Check if in condensate clearing sequence (LED). • Wait for condensate clearing cycle. • Cycle power to control cabinet.
Air cannot absorb steam quantity being discharged	• Humidifier operates when blower is off	• Provide interlock.
	• Valve is hunting	• See "Control valve is hunting," on facing page.
	• Air temperature in duct too low for steam quantity	• Raise duct air temperature.
Humidifier is noisy	• Steam pressure too high	• Reduce pressure.
	• Panel is vibrating	• Tighten assembly and/or mounting hardware.
Duct loses static pressure downstream from Ultra-sorb panel	• Improper sealing where Ultra-sorb frame penetrates duct	• Seal all panel corners and all cracks between panel and ducts/flanges. See Figure 9-1.
Space humidity will not rise to humidistat set point (continued on next page)	• Steam pressure too low	• Increase.
	• Manual steam valve partially closed	• Open.
	• Strainer screen partially clogged	• Clean.
	• Boiler pressure too low	• Adjust control.
	• Pressure reducing valve not accurately controlling steam pressure	• Repair or replace.
	• Boiler pressure swinging too widely	• Adjust controls.
	• Incorrect piping	• Correct piping as shown on Pages 4, 5, and 12.
	• Undersized steam piping	• Replace piping.
	• Modulating steam control valve not fully opening	• Valve packing is adjusted too tightly, loosen/replace packing. • Adjust valve linkage. • Recalibrate humidistat.
	• Incorrect control circuit voltage	• Replace components to make all components compatible.
	• Incorrect control signal	• Replace components.
	• Incorrect humidity sensor	• Replace.
	• Humidity controller out of calibration or is malfunctioning	• Repair or replace.
	• Malfunctioning temperature switch downstream from heat exchanger not allowing humidification steam valve to open	• Replace or adjust switch.
	• Malfunctioning float switch in header not allowing humidification steam valve to open	• Replace or repair switch. See float switch instructions in Step 1 on Page 24.

Continued

Troubleshooting

Table 26-1:
Ultra-sorb Model XV troubleshooting guide (continued)

Problem	Possible cause	Action
Space humidity will not rise to humidistat set point (pneumatic controls)	• Air leak in actuator	• Repair or replace diaphragm.
	• Control air pressure is too low	• Adjust pressure.
	• Temperature control switch not allowing modulating steam valve to operate	• Consult DriSteem to assess whether installed panel is correct for application.
Condensate collects in duct	• Foreign matter preventing control valve from closing	• Clean or replace valve.
	• Panel is mounted too close to internal devices (dampers, turning vanes, etc.) in duct	• Move panel to a point further upstream from internal devices. See “Selecting the location” on Page 16. • More dispersion tubes shortens non-wetting distance. Consult DriSteem to determine the total number of tubes required.
	• Uninsulated duct passing through unheated area (low duct surface temperature)	• Insulate ductwork.

Expect quality from the industry leader

For more than 45 years, DriSteem has been leading the industry with creative and reliable humidification solutions. Our focus on quality is evident in the construction of Ultra-sorb steam dispersion panels, which feature stainless steel construction. DriSteem also leads the industry with a Two-year Limited Warranty and optional extended warranty.

For more information

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For the most recent product information visit our Web site: www.dristeem.com

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Part No. 890000-190 Rev C

TWO-YEAR LIMITED WARRANTY

DRI-STEEM Corporation ("DriSteem") warrants to the original user that its products will be free from defects in materials and workmanship for a period of two (2) years after installation or twenty-seven (27) months from the date DriSteem ships such product, whichever date is the earlier. If any DriSteem product is found to be defective in material or workmanship during the applicable warranty period, DriSteem's entire liability, and the purchaser's sole and exclusive remedy, shall be the repair or replacement of the defective product, or the refund of the purchase price, at DriSteem's election. DriSteem shall not be liable for any costs or expenses, whether direct or indirect, associated with the installation, removal or reinstallation of any defective product. The Limited Warranty does not include cylinder replacement for electrode steam humidifiers or media replacement for Wetted Media Systems.

DriSteem's Limited Warranty shall not be effective or actionable unless there is compliance with all installation and operating instructions furnished by DriSteem, or if the products have been modified or altered without the written consent of DriSteem, or if such products have been subject to accident, misuse, mishandling, tampering, negligence or improper maintenance. Any warranty claim must be submitted to DriSteem in writing within the stated warranty period. Defective parts may be required to be returned to DriSteem. Excluded from the Limited Warranty are all consumable and wear and tear items such as cylinders, membranes, filters, or media replacements. These items are subject to usual wear and tear during usage.

DriSteem's Limited Warranty is made in lieu of, and DriSteem disclaims all other warranties, whether express or implied, including but not limited to any IMPLIED WARRANTY OF MERCHANTABILITY, ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, any implied warranty arising out of a course of dealing or of performance, custom or usage of trade. DriSteem SHALL NOT, UNDER ANY CIRCUMSTANCES BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS, REVENUE OR BUSINESS) OR DAMAGE OR INJURY TO PERSONS OR PROPERTY IN ANY WAY RELATED TO THE MANUFACTURE OR THE USE OF ITS PRODUCTS. The exclusion applies regardless of whether such damages are sought based on breach of warranty, breach of contract, negligence, strict liability in tort, or any other legal theory, even if DriSteem has notice of the possibility of such damages.

By purchasing DriSteem's products, the purchaser agrees to the terms and conditions of this Limited Warranty.

EXTENDED WARRANTY

The original user may extend the term of the DriSteem Limited Warranty for a limited number of months past the initial applicable warranty period and term provided in the first paragraph of this Limited Warranty. All the terms and conditions of the Limited Warranty during the initial applicable warranty period and term shall apply during any extended term. An extended warranty term of an additional twelve (12) months or twenty four (24) months of coverage may be purchased. The extended warranty term may be purchased until eighteen (18) months after the product is shipped, after which time no extended warranties are available. When a DriSteem humidifier is purchased with a DriSteem RO system, an extended twenty-four (24) month coverage is included.

Any extension of the Limited Warranty under this program must be in writing, signed by DriSteem, and paid for in full by the purchaser.