XT HUMIDIFIER
INSTALLATION GUIDELINES

INTRODUCTION

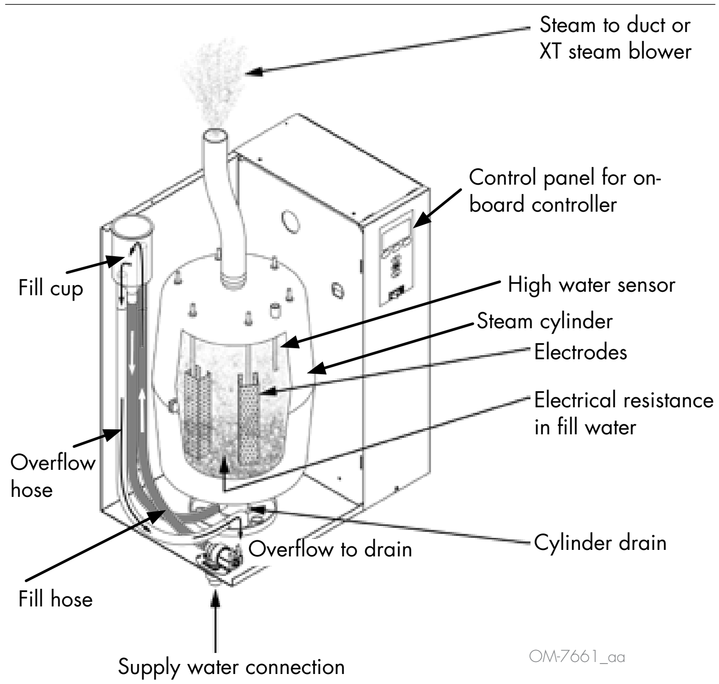
The XT humidifier uses heat caused by electrical resistance in conductive fill water to boil the water into steam. Automatic drain and fill cycles keep electrical current within demand parameters, based on water conditions and steam production.

This guide explains what type of water to use and how to manage the water within the XT humidifier more efficiently. Supply water, draining, and how proper piping affects the steam of the humidifier will also be reviewed.

Hardness and cylinder build-up is a factor when installing an XT humidifier. With correct installation and maintenance of the cylinder, the XT humidifier is one of the most affordable humidification systems to purchase and install.

FIGURE 1-1: XT HUMIDIFIER

FIGURE 1-2: XT SERIES HUMIDIFIER COMPONENTS



WATER

Supply Water

- **Hard water**: The benefit of hard water is less frequent draining and filling than with softened water, which results in better energy and water efficiency and more consistent steam output. However, cylinder replacement could be more frequent with hard water, because hard water scale coats the electrodes. The harder the water, the more frequent the need for a new cylinder.

Conductivity of the water

All of DriSteem's isothermal humidifiers can use hard, softened, deionized, or reverse osmosis water except for XT Series electrode humidifiers. Electrode humidifiers require conductive water and, therefore, cannot use water with little or no total dissolve solids (TDS), such as DI, RO or softened water.

Electrical conductivity in water is proportional to the concentration of conductive ions in the water. The higher the concentration of conductive ions, the higher the conductivity of the water.

Resistivity is the inverse of conductivity. Ultra-pure water has so few conductive ions that it is, for all practical purposes, infinitely resistive. Conductivity is determined by the following:

- Charge on the ions
- Size of the ions
- Temperature of the water

Conductivity and resistivity are critical to the operation of an electrode humidifier. In electrode humidifiers, steam output is directly related to the resistance of the water in the steam cylinder and, therefore, to the conductivity of the water between the electrodes.

Table 2-1:
DriSteem supply water guidelines for XT series electrode humidifiers

Supply water conductivity	125-350 mS Low conductivity cylinder* 350- 1250 mS Standard cylinder
Chlorides	Stay below MAX supply water conductivity
pH	6.5 to 8.5
Silica	< 15 ppm
Demineralized, **deionized**, **reverse-osmosis,** and **additionally softened** water cannot be used.	
Supply water outside of these guidelines may void your DriSteem warranty. Please contact your DriSteem Representative or DriSteem Technical Support if you need advice. The start-up time will vary based on supply water conductivity and operational conditions, the humidifier may not reach the full steam capacity during the first few hours of operation. NOTE: For very low conductivity supply water applications, when full capacity is required quickly, DriSteem's resistance style generators are recommended. * For optimal low conductivity operation enable the Mini Drain feature in your Vapor-logic controller: Main > Setup > XT management > Mini Drain > Enable.	

As the water in an electrode humidifier cylinder heats up, the conductivity increases. When it boils into steam, the concentration of the conductive ions increases until it reaches a threshold that triggers a drain-and fill cycle. This rids the cylinder of highly conductive water and replaces it with less conductive supply water.

The more conductive the supply water and the higher the demand, the more quickly the threshold is reached, and the more frequently the cylinder automatically drains and fills to stay within the parameters for the proper steam output. The frequency and duration of the drain-and-fill cycles is proportional to the conductivity of the supply water. Generally, less conductive supply water takes somewhat longer to reach full output at startup but requires less frequent drain-and-fill cycles. This results in more consistent steam output over time and more efficient use of energy and water.

To test your job site's water conductivity use conductivity tester kit or ask your local municipalities for a water report.

Water conductivity is temperature dependent. For example, water entering a cylinder may have an initial conductivity of 300 μS at 60°F (16°C). Its conductivity will increase as it's temperature increases, eventually quadrupling to ~1200 μS as it approaches 165°F (74°C). 165°F (74°C) is the point where most "hard" water minerals begin to precipitate. As precipitation continues, conductivity begins to fall eventually settling out at about three times the initial hardness, or ~900μS in our example.

Water conductivities affect how a cylinder operates. Lower conductivity water requires deeper electrode immersion to achieve a given current flow (output capacity) between electrodes. Higher conductivity waters can achieve that same current flow (output capacity) with shallower immersion.

High conductivity water

High conductivity water can lead to erratic performance and excessive draining. Steps to mitigate include, considering alternate cylinder selections (consult factory). Ensure mini-drain is not selected. Alternate cylinder wiring (consult factory).

Low conductivity water

Low-conductivity water leads to greater water efficiency because it will result in fewer drains, slower concentration of mineral precipitates i.e. more of the water that comes in is boiled. However, longer time to full steam production can result.

PIPING

Supply water

In addition to providing water for normal operation/boiling, supply water is also used for tempering of the cylinder drain water. Using heated supply water will negatively impact the ability to temper drain water.

Important: Thoroughly flush supply water piping to remove pipe residue and stagnant water before connecting piping to humidifier. Pipe residue and stagnant water in water supply piping can cause foaming, preventing humidifier from reaching required steam capacity.

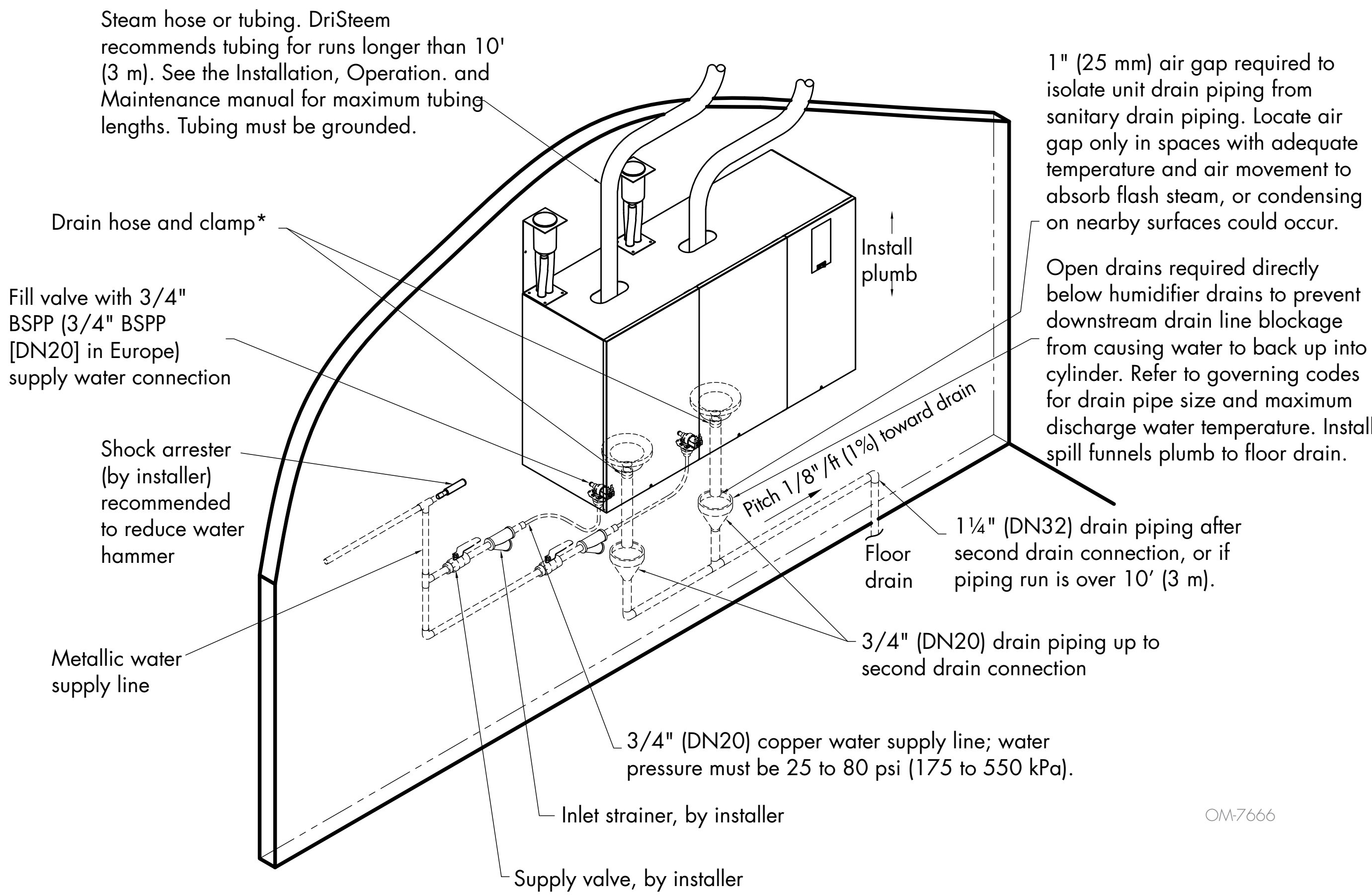
Drain

1" (25 mm) air gap required to isolate unit drain piping from sanitary drain piping. Locate air gap only in spaces with adequate temperature and air movement to absorb flash steam or condensing on nearby surfaces could occur.

Open drains required directly below humidifier drains to prevent downstream drain line blockage from causing water to back up into cylinder. Refer to governing codes for drain pipe size and maximum discharge water temperature. Install spill funnels plumb to floor drain.

When in still air, condensing environments, increase the vertical distance to reach the air gap to greater than 12" (300 mm). See Figure 4-1.

FIGURE 4-1: XT SERIES HUMIDIFIER FIELD PIPING OVERVIEW



Notes:
- Dashed lines indicate provided by installer.
- Two-cylinder model shown.

* Ships with humidifier

Interconnecting Piping

Stainless steel, copper tubing or DriSteem steam hose (other manufacturer's hose may cause foaming) may be used. Carbon steel and/or iron pipe are not recommended. For distances exceeding 10' (3m), steam hose is not allowed.

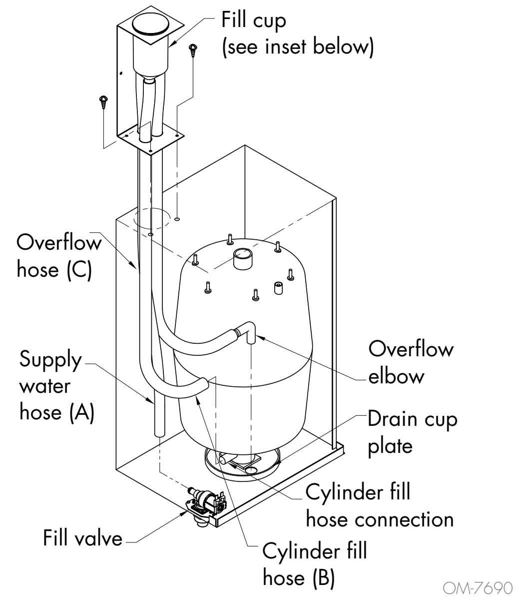
XT humidifiers steam output will vary based on the conductivity of the water in the cylinder and the amount of electrode coverage. The maximum steam output may exceed nominal capacity by up to 10%. Ensure that the dispersion device(s) and corresponding piping are sized to meet the maximum steam output of the generator.

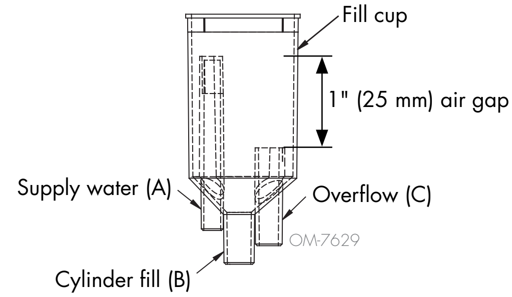
Routing the steam from the cylinder to the dispersion device(s) is important as it will impact both the amount of steam loss to condensate and also the amount of pressure exerted on the cylinder. The distance of the piping is determined using developed length which includes both the measured distance along with the equivalent length of all fittings in the piping. For ease, add 50% to the measured length to determine the developed length. Refer to Installation, Operation, and Maintenance manual for guidance on maximum developed length per XT model.

Steam piping can affect unit performance and efficiency due to back pressure and condensate formation. Back pressure is related to the developed length of steam piping. Right angle connections are generally assigned a developed length of 1-1/2 ft (0.46 m). It is generally recommended that steam piping runs exceeding a 10ft. developed length should be installed with insulated SST, or copper tubing. Outdoor steam runs should be installed with hard pipe, insulated, and protected from the sun. Where steam hose is used for piping (< 10 ft. developed length), horizontal runs must be supported at regular intervals to ensure there are no droops where condensate can collect and pitched 2" per foot (50 mm) to ensure that condensate can drain.

Long runs with excessive fitting will allow steam to be lost as condensate. Steam piping runs will result in condensate loss, especially in cool areas. Insulate to reduce steam loss. **Steam hose should not be insulated.**

FIGURE 5-1: FILL CUP EXTENSION KIT



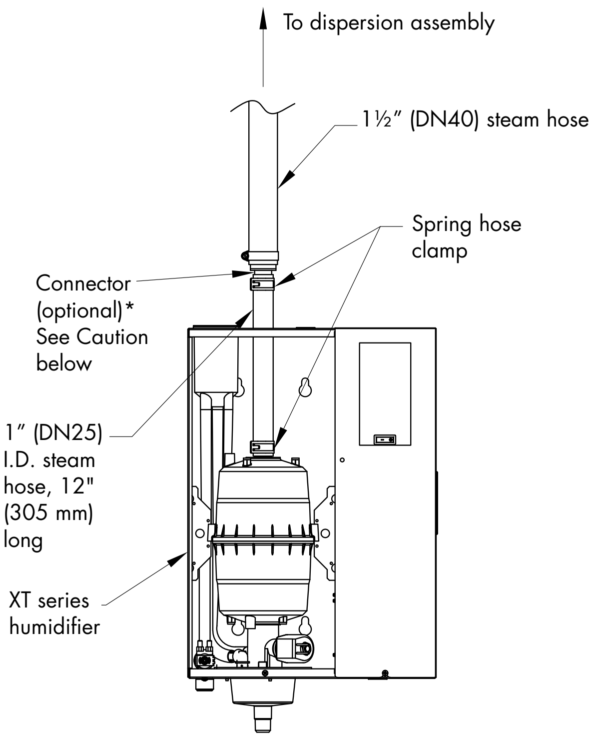


Removal of condensate is important for proper operation. Failure to remove condensate may result in increased operating pressure at the cylinder or result in condensate entering areas not desired (i.e. duct or air handler). Refer to Installation, Operation, and Maintenance manual for specific guidelines regarding when condensate can be returned (pitched to) to the cylinder.

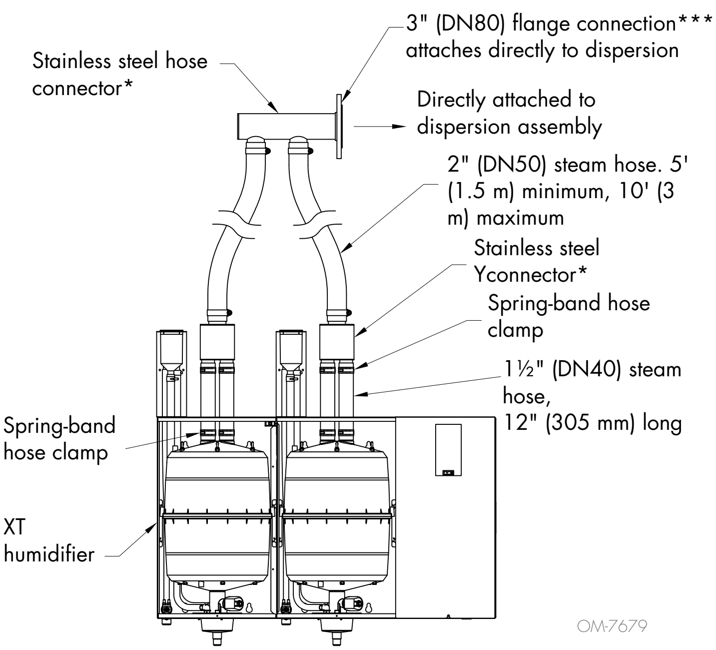
When connecting multiple cylinders together to a single dispersion device, ensure that all steam connections are made at the dispersion device. This minimizes potential for steam and/or condensate to flow between cylinders and disrupt typical operation (see Figure 6-1). Multiple single-tubes not for use with a single generator.

FIGURE 6-1: STEAM OUTLET CONNECTIONS WITH HOSE

Models XTP 002 through 006



Models XTP 067 through 096



CAUTION

Connector kit location

Install the connector for increasing from 1" to 1½" (DN25 to DN40) hose or tube immediately above the XT Series humidifier as shown above.

Failure to install the connector kit immediately above the humidifier will cause system pressure fluctuations and increase cylinder pressure, steam velocity, and condensate noise.

XT series humidifiers has a maximum operating pressure determined by the height of the fill cup (see Figure 5-1).

A fill cup extension kit is available to allow for higher operation pressure (refer to Installation, Operation, and Maintenance manual for installation guidance) and should be utilized under the following conditions:

- A dispersion device is an Ultra-sorb® steam dispersion panel or a Rapid-sorb® dispersion tube system.
- When developed length exceeds 20' (6 m) or duct static pressure exceeds 2" w.c. (498 Pa)
- If unit is shipped along with a fill cup extension, it must be installed.

Minimizing steam losses to condensate:

- Avoid long steam runs from electrode humidifier and dispersion device(s).
- Avoid running steam piping through cold areas.
- Insulate steam piping (except steam hose).
- Dispersion piping must be uniform developed length to avoid potential back pressure issues.

Cylinder pressure considerations

- Dispersion placed after a supply fan increases back pressure. Dispersion placed before a supply fan will reduce back pressure.
- Output limiting of the unit will reduce the effects of excessive back pressure.
- Ensure that the piping distance is similar when connecting to multiple steam dispersion devices.

- Each fitting will increase pressure drop. Minimize where possible. Utilize 90° long sweep elbows or two 45°elbows versus straight 90°s.

Condensate formation and management

Customer can allow condensate (2,3,6kW) return to cylinder, must direct condensate to drain for 10kW and larger. Excessive condensate can become entrained and pressure within cylinder can fluctuate. See the XT humidifier Installation, Operation, and Maintenance manual for piping guidelines.

Cylinder outlets

Do not use hard wall (wire-reinforced) hose to directly connect to the cylinder outlet. Steam hose should not impart any side loads/thrust to the cylinder. Use cylinder hose cuff and tube stub/adapter kits for cylinder connections.

DISPERSION

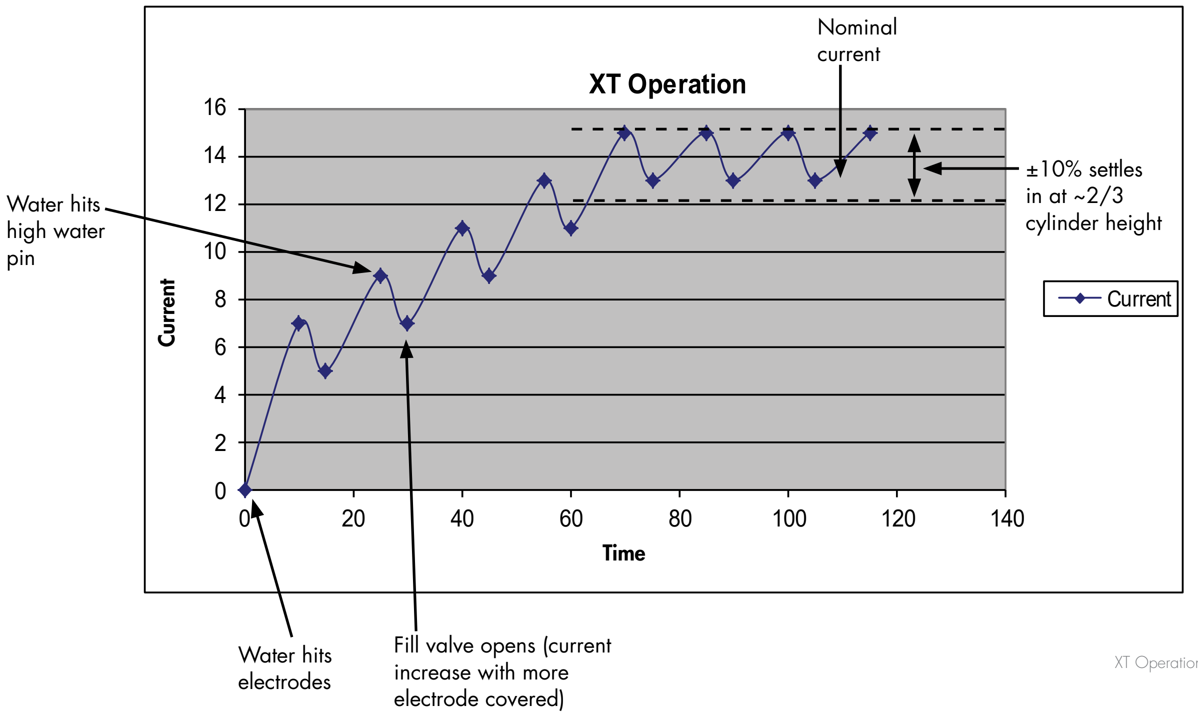
- **In-line tube**: Dispersion tubes (uninsulated) with a condensate drain capacities:
  - 1.5” (DN40) tube has a max load per tube of 62 lb/hr (28 kg/h).
  - 2.0” (DN50) tube has a max load per tube of 93 lb/hr (42 kg/h).
- Steam generator capacities almost always exceed the design load of the space being conditioned, therefore, it is essential to ensure that the dispersion capacity is based on the maximum generator output. Because of the way electrode units operate, the output will intermittently exceed nominal output by 10 % and their maximum output can exceed nominal output by as much as 20 % for short periods. Use DriCalc sizing and selection software for proper selection sizing.
- Ensure dispersion capacity is aligned with generator max output and not space load/conditions/requirements. 110% Amperage translates to 110% output potentially, for example. During normal operation, the VL controller will fill the cylinder with water to a level that will be measured to 110% of nominal amperage, which would correlate to 110% nominal output.

CYLINDER LIFE

- **End of life:** Message is displayed in Vapor-Logic controller when cylinder reaches end of life. Cylinder replacement required.
- **Mineral build up**: Mineral build up is normal, expected, and is highly dependent on water quality. Electrode decay is to be expected but can be accelerated under abnormal operating conditions, such as, high conductivity water and low electrode immersion depth. Cylinder and electrode leads should be inspected at least annually.
- **Hardness:** Water with more total dissolved solids (TDS) will naturally fill the cylinder with precipitate and reach end of life sooner than those running on water with relatively lower levels of dissolved solids.

  Some minerals precipitate differently. Minerals may remain suspended and be readily removed during cylinder drain cycles, while others may cling to electrodes, cylinder walls and coagulate at the cylinder

FIGURE 8-1: XTP CURRENT



base potentially interfering with drain and fill functions. For example, water sources with high silica content must be mitigated to avoid plating the electrodes. Resulting in no output from the cylinder.

- **Naturally soft water (Less than 10 grains hardness):** Cylinders running on naturally soft water will not accumulate mineral precipitate as rapidly, but can also lack the protective layer of minerals on their electrodes which may lead to electrode decay due to oxidation and arching.

  Cylinders with naturally softened water tend to maintain higher conductivity levels which could result in higher drain frequency.

Electrode leads

- Installation/removal: They should be assembled and removed straight/vertically from the electrode pins.
- Reliable operation requires uniform contact between conductor barrel and electrode pin. Any loose-fitting conductor should be replaced. Conductor designs with a split barrel can become loose with repeated maintenance. Upon inspection, any corrosion detected on either the electrode pin or lead is cause for immediate replacement.
- Electrode lead wires have 302°F (150°C) insulation and may run warmer than typical wiring

Electrodes

- Normal operation: Electrodes can accumulate precipitate.
- Naturally soft and/or high conductivity water can lead to operation under minimal electrode immersion, resulting in accelerated electrode erosion. Lack of mineral precipitate can leave electrodes unprotected. Shallow immersion can lead to arcing and blackened

water discharge. Vapor-logic control settings (ensure mini-drain is not enabled and recommend TP modulation is enabled) can moderate this condition. TP modulation can run higher water level intermittently on/off to meet lower demand which leads to deeper immersion of the electrodes.

- Arcing leads to rapid electrode decay, black water, can result in complete consumption of electrode mesh, leaving only the pins.
- At start up, the electrodes are energized, but there is no water between them, so there is no electrical current. This is the zero point on the nominal current curve shown in the graph. Water is added to immerse the electrodes, at which point, current begin to flow. The water level continues to rise until we reach the target current or until the water level reaches the high-water sensor. In this example, the water level reached the high-water sensor before the target current was reached.

  As the electrical current increases, the water heats up and begins to boil, continuing until enough water boils away to make the current drop to a level that triggers the fill valve to open. As more water enters the cylinder and boils away, conductive ions get left behind, so the conductivity of the water in the cylinder gradually increases. As boiling continues, the water can pass more current with the same amount of electrode immersion. After several fill intervals and boiling away of water, the current increases to the nominal current. In this example with this model, nominal current is 14 amps. The amount of time it takes to reach the nominal current depends on water conductivity, with lower-conductivity water taking longer. See Figure 8-1.

TIPS AND RECOMMENDATIONS

Short cycle

Short cycling is likely an indication that the generator is oversized for the duct capacity. Potential mitigation is to limit the capacity output (Vapor-logic controller setup option).

Condensate in cabinet

Often results from poor steam connection to cylinder outlet, improper drain piping and/or excessive overflow conditions (back pressure) releasing steam into enclosure.

Black water

Generally an indication that arcing is occurring due to high conductivity and/or softened water. See Electrodes on page 8.

Foaming

Foaming may occur due to steam or supply piping contaminants (i.e. flux or other surfactants). Flush piping thoroughly. High mineral content water can induce foaming within the cylinder and lead to low output.

Excessive drain

High back pressure (inappropriate sized dispersion, undersized piping, improper installation of piping) can lead to overflow conditions, and in severe cases can result in siphoning. Vapor-logic can limit capacity of unit output. High conductivity water will naturally drain more often.

Siphon risk

Vigorous boil can force water in fill line to submerge the fill cup overflow opening and a siphon can be initiated which in extreme cases can drain the entire cylinder, leading to erratic operation.

Proper condensate management will mitigate this siphon risk.

Output limiting

Output limiting can reduce the effects of excessive back pressure.

Mini-drain

Mini-drain can avoid steam output downtime and provide steadier output in low-conductivity water conditions. Mini-drain closely watches cylinder performance to avoid over-draining conductive water. 2-6kW units can greatly benefit from selecting Mini-Drain in the Vapor-logic control section.

VISIT THE ON-LINE HUMIDIFICATION UNIVERSITY CENTER

Check out our web site to learn more about properly applying humidification systems, types of humidifiers on the market today, and current humidification issues.

You'll also find information on **DriCalc®** — DriSteem's exclusive software that sizes loads, selects equipment, writes specifications, and creates equipment schedules for DriSteem products.

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