

READ AND SAVE THESE INSTRUCTIONS

CARNES[®]

ELECTRODE STEAM HUMIDIFIER DESIGN J-SERIES
**INSTALLATION, OPERATION,
& MAINTENANCE MANUAL**

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CARNES J-SERIES HUMIDIFIERS



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Table of Contents | ELECTRODE STEAM HUMIDIFIER

Introduction.....	4
Unpacking and Inspection.....	4
Included Materials.....	4
Not Included Materials.....	4
Humidifier Configuration.....	4
Before Installation.....	4
Safety Cautions.....	5
Principles of Operation.....	6
Water Quality.....	7
Choosing a Location.....	8
Humidifier Installation Requirements.....	8
Steam Distribution Pipe(s).....	8
Steam Hose/Tubing.....	9
Typical Installations.....	10
Mounting the Humidifier.....	11
Mounting the Steam Distribution Pipe(s).....	11
Routing the Steam Hose/Pipe.....	12
Hose/Pipe Lengths Less than 12'.....	12
Hose/Pipe Lengths Exceeding 12'.....	12
Flexible Steam Hose.....	12
Copper/Brass Tubing.....	12
Fan Distribution Units.....	13
Mounted Fan Distribution Units.....	13
Short Absorption Manifolds.....	14
Remote Fan Distribution Unit.....	14
Short Steam Manifolds.....	14
Locations of Manifolds.....	14-15
Connecting the Water Supply.....	16
Supply Water Guidelines.....	16
Connecting the Drain Line.....	16
Electrical Power.....	16
Electrical Data Sheet Definitions.....	16
Electrical Data Sheet.....	17-18
Humidifier Component Listing.....	19
Humidity Control.....	20
Humidistat (Model HXHAW, HXHAWT, HXHAS, HXHAST).....	20
High Limit Humidistat (Model HXHAD).....	21
Air Flow Switch (Model HXA AE).....	21
Door Interlock.....	21
Control Connections.....	22
External Controls.....	23
External DDC Control Signals.....	23

Optional Accessory Controls 24

 Wall Humidistat, Proportional Control..... 24

 Air Flow Switch, Pressure Differential Type 24

CarnesLink 25

 External Monitoring 25

Controls and Internal Controls..... 26

 Front Panel Displays and Controls 26

 On/Off/Drain Switch 26

 Fill LED 26

 Drain LED 26

 High Water LED 26

LCD True Touchscreen Display 27-39

 Home Page 27

 Service Required Page 29

 Menu Page..... 30

 Settings Pages..... 31

Startup Procedure 39

Sequence of Operation 40

 Operating Modes 40

 Off..... 40

 Manual Drain 40

 On/Standby..... 40

 Steady State 40

 Fill 40

 Automatic Drain 40

 Pulse Drain 40

Troubleshooting Guide 41-43

Humidifier Operational Specifications 44

Replacement Parts List 45-49

Warranty 50

Unpacking and Inspection

Examine shipping enclosure for visible signs of damage which may have occurred in transit. Remove cabinet from shipping enclosure, and place the unit upright on a flat, clean surface to avoid damaging the monitor, touchpad, and exposed fittings. Inspect the surface for visible defects.

Open the unit's cabinet enclosure and remove any loose hardware and protective packaging. Inspect all visible fittings and electronics for defects.

Unpackage the provided hardware and fittings for your application. Reference the included packing list for each constituent package, and verify their size, count, and part numbers. The following list includes examples of equipment typically provided in Carnes packaged humidifier orders.



Figure 1: Humidifier Unit

Included Materials

- Humidifier (cabinet unit)
- Steam Hose (if ordered with unit)
- Condensate Return Hose (if ordered with unit)
- Hose Clamps
- French Cleat for Mounting
- BMS Connection (if ordered with unit)
- Installation Instructions, form 16765 (this document)

Your humidifier application may require items that ship in packages separate from the humidifier unit, and which may come from Carnes or other vendors. Materials which typically fall under this category are included in the list below.

Not Included with Humidifier

- Main Power Disconnect
- Electrical Service Wire
- Mounting Hardware (anchors, screws, etc.)
- Plumbing
- Drain Hose
- Humidistat Controller

Confirm that all items for your order have arrived. Inform your vendor of damage or shortages immediately. Report damaged packages to the relevant carrier services.

Humidifier Configuration

The J-Series Humidifier line is configured at the Carnes factory facility to match the specifications of each order (electrical, max output, BMS config, etc...). The default settings and user adjustments are discussed further in Page 38.

Important Note: The humidifier unit is pre-configured at the factory and set for optimal performance. Therefore, Carnes recommends careful consideration before adjusting any of these settings.

Before Installation

1. Verify that available voltage, phase, and current requirements correspond with the humidifier settings.
2. Verify the dedicated external fuse disconnect is of sufficient value to handle the rated current as indicated on the specification label. Refer to applicable electric codes.
3. Verify sufficient clearances will be available as described in Table 1.
4. Verify the steam hose can be routed to the duct as described on Page 12.

CAUTION! DO NOT INSTALL, USE OR OPERATE THIS EQUIPMENT UNTIL THIS MANUAL HAS BEEN READ AND UNDERSTOOD. SAVE THESE INSTRUCTIONS FOR FUTURE USE.

⚠ CAUTION — Verify all safety steps before powering unit.

1. Do not mount in area where freezing can occur. Do not mount outdoors. Do not mount on consistently vibrating surface. Do not mount on floor. The humidifier produces steam at atmospheric pressure. Steam lines must be installed so that no restriction can produce back pressure in the humidifier.
2. All electrical work should be done according to local and national electrical code. Electrical connection should be performed by a licensed electrician. Unit recommended to be powered by a dedicated circuit.
3. Plumbing should be performed by a licensed plumber. Drain water from humidifier can be very hot. Do not drain to public sink. All plumbing work should be done according to local and national plumbing code.
4. Carnes humidifiers require a cold-water connection from the facility's main water supply between 20-120 PSIG. A throttle valve may be necessary, and a water shut-off valve is recommended for safety. Reverse Osmosis (RO) and Deionized (DI) water should not be used. Water conductivity is important to ensure the electrode cylinder operates effectively. Carnes recommends using water with conductivity levels between 125-1200 Micromhos (micro siemens/cm) depending on which cylinder model is used.

⚠  WARNING: HOT SURFACES — Water/Steam and Distribution Methods

An electrode cylinder steam humidifier creates steam by passing electrical current directly through water, causing the water to boil. Temperatures of boiling water and steam can reach up to 212°F (100°C). This creates hot surfaces (cylinder surface, steam hose, steam pipe, condensate hose/pipe, distribution piping), hot water, and visible/non-visible steam. Even discharged condensate water can be extremely hot. Contact with these surfaces, water, or steam can cause personal injury. To avoid severe burns, always proceed with extreme caution. Before any service or maintenance is performed, turn off unit, disconnect electrical service, and allow humidifier unit to cool completely.

⚠  WARNING — De-energize Electrical Supply

Before any service or maintenance is performed make sure main power supply is disconnected and safety labeled. Failure to turn off main power supply could result in fire, electrical shock or both, resulting in damage to property, personal injury or death.

CAUTION

Follow all recommendations, instructions and precautions in this Installation, Operation and Maintenance Manual to maximize performance, maintain efficiency and to provide a safe operational environment.

Liability:

Carnes does not accept any liability for installations of humidifier equipment installed by unqualified personnel, or the use of parts, components, equipment, or alterations of Carnes manufactured equipment that is not authorized or approved by Carnes.



This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.



Listed UL Standard 998.

The Carnes J-Series commercial steam humidifiers add conditioned moisture to an otherwise dry space through the use of the existing ductwork or blower fan. Carnes humidifiers use electrode technology to generate pure, sanitary steam from water fed to the unit. The amount of steam generated by the system is controlled through the use of external interlocks and digital controls by modulating the volume of water in contact with the electrodes. The humidifier unit internally verifies that safety and control protocols have been satisfied before filling with water and beginning operation (e.g. the control humidistat is calling for steam, the humidifier door is shut, and the air handling system is active). The fill valve then opens and allows water to flow into the fill cup, where it drops into the standpipe, feeding directly to the steam cylinder. The standpipe directs a column of water into the cylinder using gravity, and the air gap above the fill cup prevents the cylinder from pressurizing against the water supply stream, as shown in *Figure 2*. The steam cylinder normally operates at a pressure of approximately 0 to 1/2 psi above ambient. When the power contactor is activated, current is allowed to flow between the electrodes that are sealed within the steam cylinder. Current passes directly through the water between the electrodes. Accounting for the differences in conductivity due to minerals present in the water, the system uses the resistance of the water to generate the heat needed to turn it into steam (this is the most efficient method to generate steam from tap or softened water). The steam exits the top of the cylinder, passes through the flexible

steam hose, and makes its way out of the steam distributor pipe mounted inside the ductwork of the air handling system. The steam distribution pipe delivers steam over a wide area in the duct and directs any condensed moisture back into the steam cylinder.

A digital control-board calculates when to open and close the water supply valve to maintain constant steam production. In combination with the drain valve, the system automatically responds to conditional changes and periodically drains the required quantity of water to provide stable operation, flush dirty electrolyte, and prolong cylinder life. As mineral deposits build up within the cylinder, the water level will slowly rise to utilize fresh electrode surface-area in an attempt to maintain the desired steam output rate. If mineral deposits encrust too much of the electrode surface or the electrode itself degrades, current flow will be reduced to a level where the desired steam output cannot be reached. At such a point, the “Service Required” indication on the monitor will alert the user to perform maintenance or insert a new cylinder. Cylinders can be easily replaced in a span of minutes (not including cool down time).

Important Note: Many variables affect the operation of humidifiers (water conductivity, water hardness, etc.). Systems may require up to 24 hours of steam generation before a humidifier is truly operating in the nominal range, and the water in the steam chamber is properly conditioned. “Conditioned,” in this case, refers to when the amount of electrolyte dissolved in the water is at a steady state. Conditioned water is typically more conductive than fresh water at the fill valve. Conditioned cylinders may have a film of insoluble precipitate lining the inner walls of the chamber.

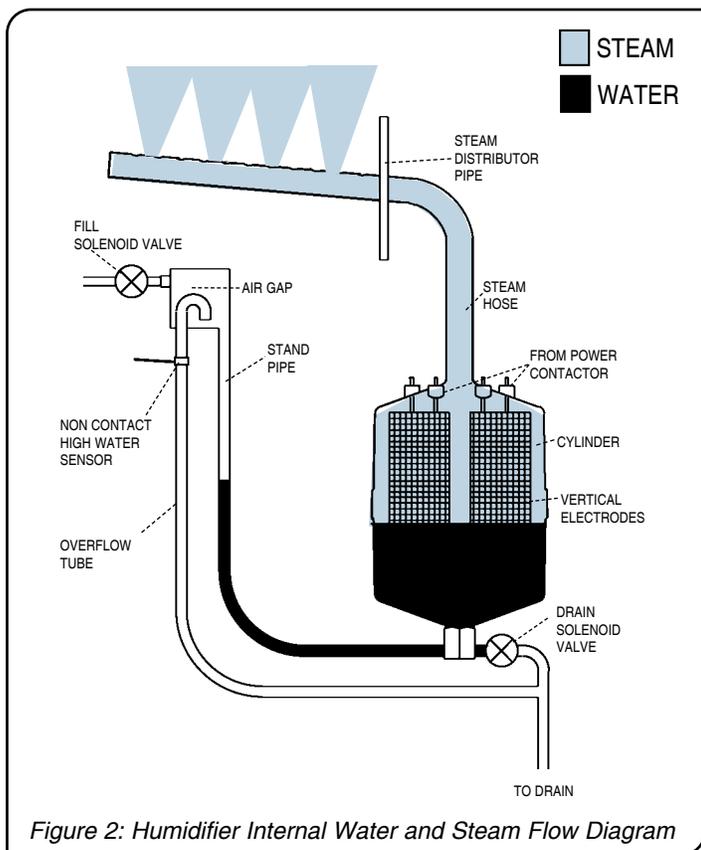


Figure 2: Humidifier Internal Water and Steam Flow Diagram

Important Notes:

- It is recommended to feed the system from a cold tap source (20 to 120 psi).
- DO NOT use hot water, DI (Deionized), or RO (Reverse Osmosis) water for the system.
- Carnes recommends using tap or softened water with a conductivity level between 100-800 micromhos.
- Incoming water that does not meet the above specifications may still allow the unit to function, but will likely require adjustments to the system or operation.
- Each humidifier is shipped with a stock cylinder that matches the specified input power and steam output under normal operating conditions.
- The cylinder type can be adjusted if required, due to abnormal water conditions.

The properties of incoming water greatly affects how the system will operate. Water conductivity and hardness directly impact humidifier efficiency and cylinder lifespan. In general, harder water will conduct electricity with less resistance than soft water. Due to this effect, water with naturally low conductivity may lead the humidifier to take longer to reach desired output from startup, as the unit will need time to condition the water. If water conditioning is required, the unit will do so by temporarily reducing the steam output and allowing water to boil inside the cylinder. As water boils in the cylinder, minerals will deposit on the walls of the chamber. Fresh water then enters the chamber, deposited minerals dissolve, and the cycle of solution to dissolution buffers the conductivity in the chamber. If the water conductivity remains too low or high, a different cylinder model than the one typically paired with the unit in question may be required. The humidifier unit controls current flow by closely timing fill, drain, and steady state sequences.

There are positive affects to using either hard or soft water. Using softened water will lead to longer cylinder life. There are various reasons for this change, but the most notable is that using soft water will require the unit to drain and fill more frequently, flushing dirty water more often and protecting the electrodes from corrosion. However, more frequent draining and filling means there is a loss of efficiency in water usage and electrical power. Frequent drain and fill cycles also cause the unit to perform less steadily. Hard water, however, may reduce the lifespan of the cylinder as compared to soft water, but use water and electricity more efficiently by operating in steadier states.

High concentrations of chlorides or other corrosive substances in the supply water can cause damage to the unit and leads to rapid corrosion to the cylinder's electrodes. It is recommended that water supplied to the unit have a chloride concentration of less than 50ppm.

ELECTRODE STEAM HUMIDIFIER | Choosing a Location

The following should be considered when choosing a location to install the humidifier and distribution system:

- Location in the duct with respect to other HVAC equipment.
- Height difference between the humidifier and the distribution pipe.
- Horizontal distance from humidifier to the duct.
- Proximity of drain receptacle.
- Proximity to incoming water supply.

Humidifier Installation Requirements:

Important Notes:

- The humidifier must never be located outside or where it may be exposed to freezing temperatures. Do not mount the humidifier on a hot or vibrating surface.
- Carnes recommends that the humidifier system should only be installed by a licensed HVAC professional.

The humidifier should be mounted, flush to a surface, as close to the steam distribution pipe as possible, but also at a convenient height for servicing. Allow 12 inches or more on each side for panel access and 16 inches from the bottom of the unit to floor to allow for drain connections. Allow 18 inches in front of the cabinet for convenient servicing.

Table 1: Clearance Tolerances

Top Clearances	24" (61cm)
Side Clearances	12" (31cm) + on each side
Front Clearances	18" (46cm)
Bottom Clearances	16" (41cm)

In a typical installation, the humidifier is located below the duct as shown in *Figure 7*. The space between the humidifier cabinet and the steam distributor pipe should be the minimum distance possible (refer to Table 2).

Steam Distribution Pipe(s):

Important Notes:

- Always avoid installing the distribution pipe(s) upstream of any insulation in the duct, as excess moisture may cause damage.
- Single steam distribution pipes should never be connected to multiple humidifier steam outputs. Each cylinder requires its own distribution apparatus (perforated release pipe(s), steam hose, condensate return).

The steam distribution pipe (*Figure 3*) should be oriented vertically so condensate that forms will run back down the return line. The perforated distribution segment should be installed as close to the center of the duct as possible to facilitate maximum distribution of steam into the airstream. A minimum clearance of 4 inches should be maintained between the top of the duct and the end of the distribution pipe.

The best location to install the steam distribution pipe is in the supply duct downstream of the fan (*Figure 4*). If the humidifier unit is only meant to service an isolated area, then the unit's distributor pipe should be mounted downstream of the fan discharge for that space. It is important to install the distribution apparatus as far upstream from any obstructions in the ductwork as possible. This allows the steam to disperse in the air before it can condense on the internal surface of the duct. It is recommended that installers allow a minimum of 6 feet (2m) between the distribution pipe(s) and any downstream fans, coils, filters, dampers, elbows, or outlets to reduce the possibility of unwanted condensation. If this distance cannot be met, it may be possible to reduce the necessary distance for maximum dispersal by using multiple distribution pipes with an accessory 'T' fitting, or a Carnes Short Absorption Manifold (See Short Absorption Manifold Section of this document).

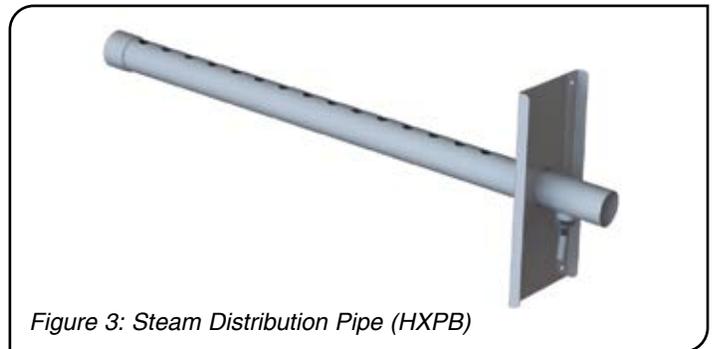


Figure 3: Steam Distribution Pipe (HXPB)

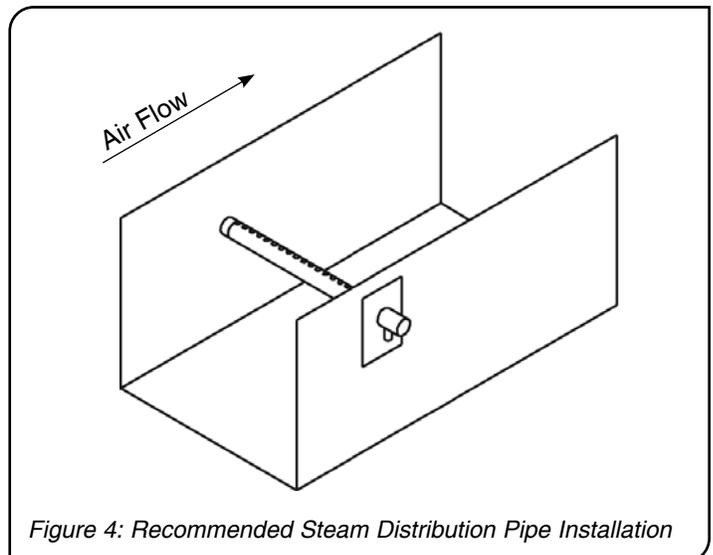


Figure 4: Recommended Steam Distribution Pipe Installation

Important Notes:

- The distance between the humidifier and steam hose/pipe should be the minimum length possible. The maximum approved length of steam hose/pipe for a system has been determined to impact duct static pressure and steam capacity as shown in Table 2.
- Copper or brass tubing is the only acceptable substitute for steam or condensate flexible hose.
- Both steam delivery and condensate return lines should be installed so there are no sags, low points, dips or horizontal runs between the outlet or dispersal fittings.

Table 2: Hose Length vs. Steam Output Loss vs. Maximum Allowable Duct Static Pressure

Hose/Pipe Length (ft.)	Approx. Steam Output Loss (Lb/Hr)	Max. Duct Static Pressure (" wg)
5	0.5	7
10	1.0	6
15	1.5	5
20	2.0	4
25	2.5	3
30	3.0	2
35	3.5	1
40	4.0	0

Table Notes: As steam hose/pipe length increases, steam output loss increases, and maximum allowable static duct pressure decreases. As a result, longer runs of steam hose/pipe decrease the overall efficiency of the humidification system and create issues with duct static pressure allowance.

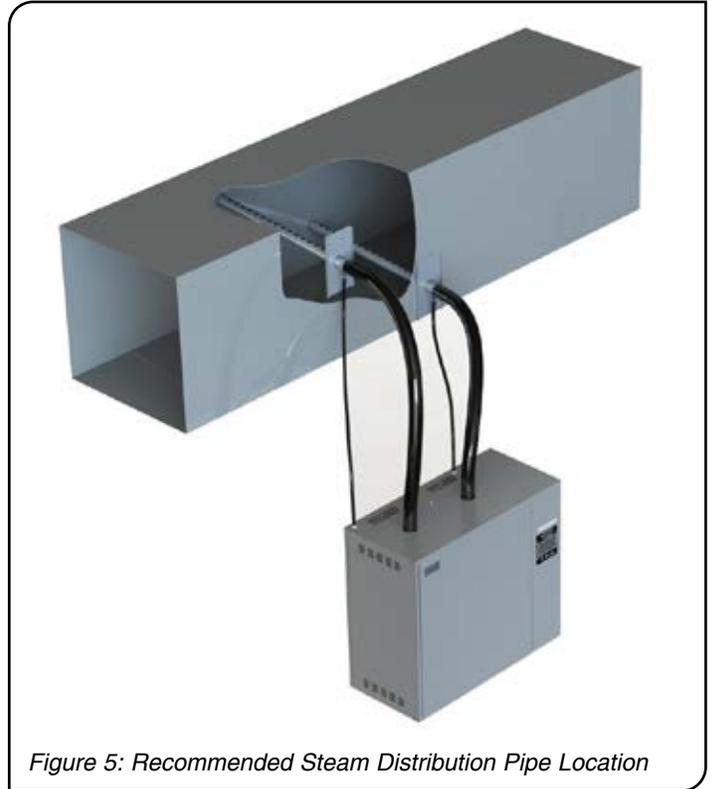


Figure 5: Recommended Steam Distribution Pipe Location

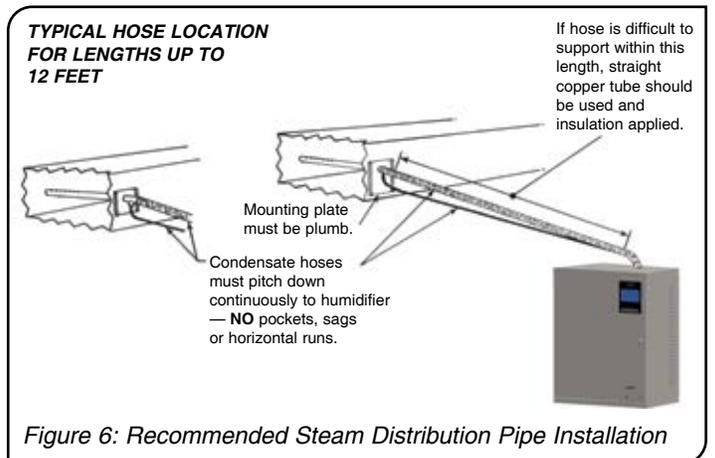
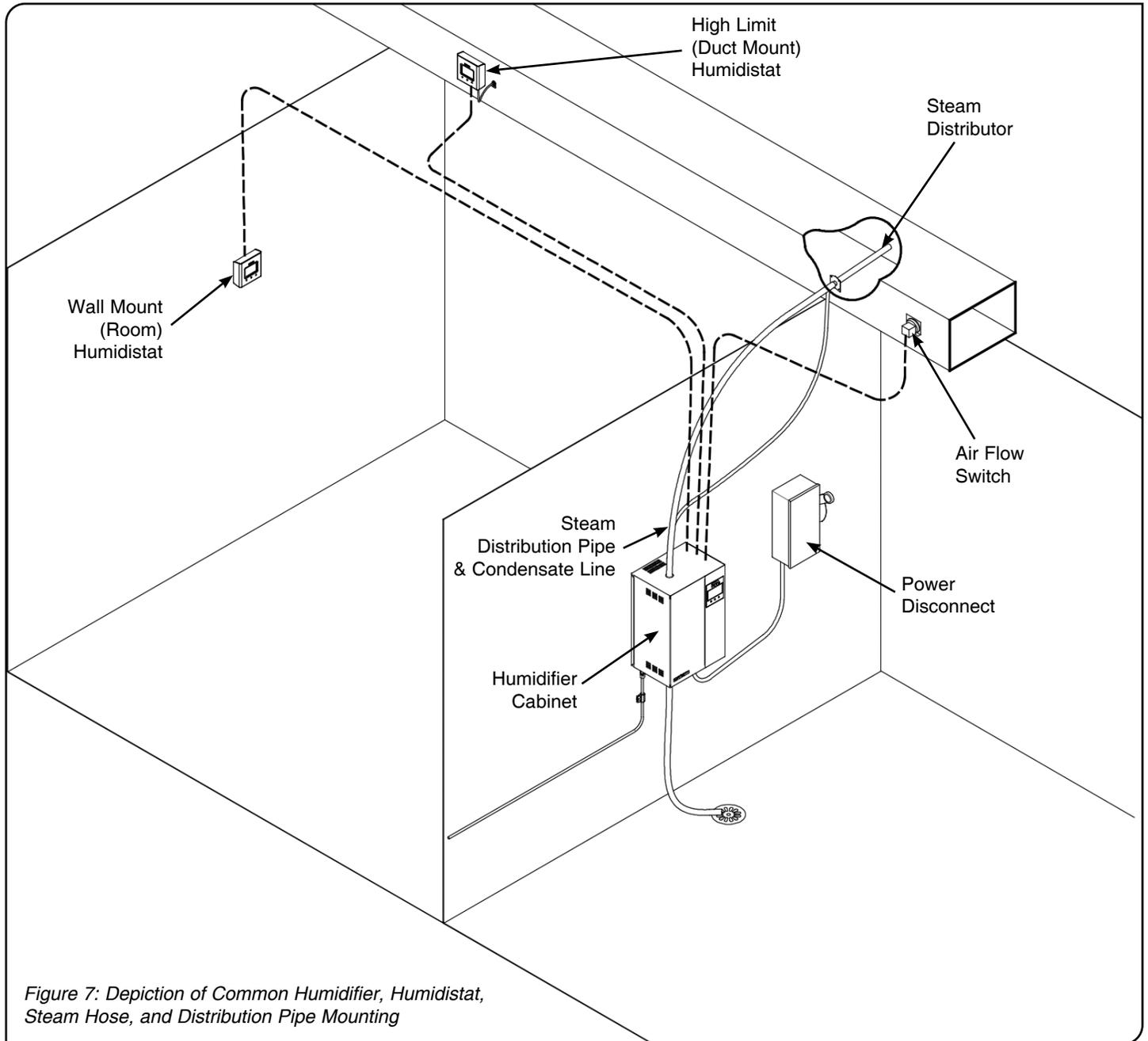


Figure 6: Recommended Steam Distribution Pipe Installation

ELECTRODE STEAM HUMIDIFIER | Typical Installations

Important Note: Using a licensed HVAC professional to install the humidifier and distribution pipe is recommended.



Mounting the Humidifier:

Fasten the mounting bracket to a solid surface using 1/4” lag screws with at least 1” of length, (refer to Table 3 below for required counts). Verify that the mounting surface can handle the maximum operating weight of the unit, (unit weights shown in Table 3 below). Once the humidifier mounting bracket is placed and secured to the wall, the humidifier unit can attach to the bracket rail. A sheet metal screw should be installed through the back of the humidifier cabinet to secure the humidifier to the mounting bracket.

Important Note: Fasteners are not provided by Carnes, and must be sourced from other vendors.

Table 3: Humidifier Mounting Information

Cabinet Style	Dry Weight	Max. Weight	# of Fasteners Required (1/4” Lag Screw, 1” Length)
H_AJ	48 lbs.	61 lbs.	4
H_AJ w/ Blower Package			4
H_BJ	59 lbs.	72 lbs.	4
H_BJ w/ Blower Package			4
H_CJ	65 lbs.	110 lbs.	4
H_CJ w/ Blower Package			4
H_HJ	113 lbs.	230 lbs.	6

Mounting the Steam Distribution Pipe(s):

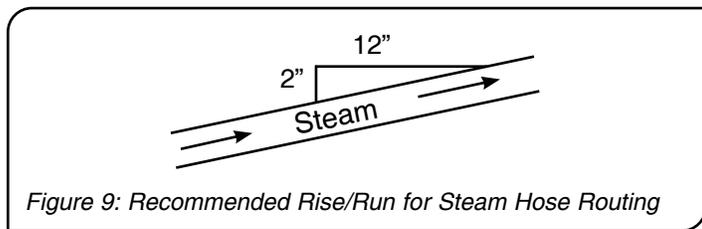
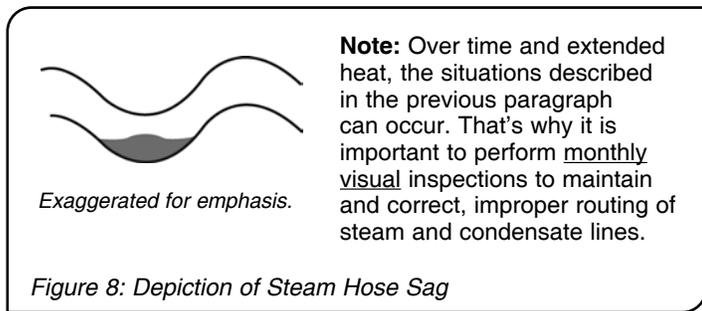
The perforated steam distribution pipe must be mounted perpendicular to the flow of air such that the holes of the pipe face upwards. The distribution end itself should be roughly horizontal, pitched back slightly towards the delivery pipe. This is required so that any condensation in the distribution pipe will drain to the return line. Once the distribution pipe is in place, it should be secured with 4 sheet metal screws (not included with unit). Multiple distribution pipes may be required to achieve a shorter steam absorption length and if so, each distribution pipe should be mounted following the instructions described above.

Important Notes:

- Special distribution systems are shipped with specific instructions on how to mount them properly.
- If a blower pack is utilized for the system, a standalone steam distribution pipe is not required.
- Fasteners required to affix the distribution apparatus are not provided by Carnes, and must be sourced from other vendors.

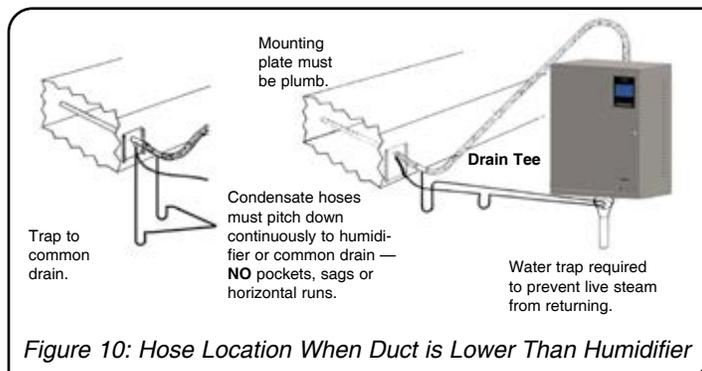
Hose/Pipe Lengths Less than 12'

For any hose less than or equal to 12 feet in length, it is highly recommended that the hose be routed with a continuous vertical rise from the cabinet with no sags, low points, dips, or horizontal runs (shown in *Figure 8*). The delivery pipe should be sloped 10° up from the horizontal position, or 2" of vertical for every 12" of horizontal, to allow for proper condensate drainage shown in *Figure 9*. Supports at intermediate points may be necessary to help eliminate any issues due to sagging or low points. Any turns should have a minimum radius of 8" to prevent the hose from kinking. Push the steam hose through the top of the humidifier cabinet and slip it over the outlet stub on the top of the cylinder. The steam hose should be fastened to the humidifier and distribution pipe with hose clamps provided.



Hose/Pipe Lengths Exceeding 12'

For hose lengths exceeding 12 feet, an alternative installation can be utilized, if the previously described requirements cannot be met. The steam hose can be routed out vertically from the humidifier and pitched downward toward the distribution pipe drain 'T', as shown in *Figure 10*. A drain 'T' fitting might be required to remove condensate that occurs when using a steam hose with a length exceeding 12 feet. It is possible to lose significant volumes of steam output due to improper hose routing.



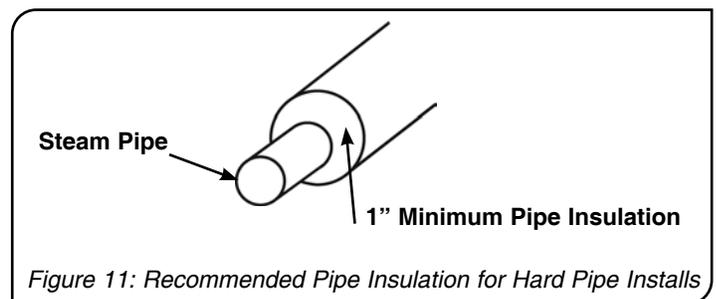
Flexible Steam Hose

All Carnes humidifier units are shipped with a segment of flexible steam hose that fits directly on the cylinder and can be secured with hose clamps. The stock flexible steam hose is the most commonly used method to connect the steam output of the humidifier to the distribution pipe(s), due to ease of installation and maintenance.

Extended use and heat cycles may cause hoses over 12 feet in length to sag over time. It is important to perform monthly visual inspections to maintain and potentially fix any improper routing of steam and condensate lines.

Copper/Brass Tubing

If it is not possible to prevent sagging of flexible hosing, or if hard tubing is desired at the time of installation, copper or brass tubing may be used instead. A minimum of 1 inch of insulation must be applied to prevent excessive condensation when rigid metal tubing is used (See *Figure 11*). A short length of steam hose must be used to connect the cylinder in the humidifier to the copper tube and another short length to connect the copper tube to the distributor pipe. Size 3/4" copper/brass tube (with 7/8" steam hose) can be used with steam cylinders that have an output rate of less than 30 pounds per hour. Size 1-1/2" copper/brass tube (with 1-5/8" steam hose) should be used for steam cylinders which output over 30 pounds per hour. The use of 90° elbows add the equivalent resistance of 3 feet of delivery tubing, which negatively impacts capacity and efficiency. Elbow fittings may also cause cylinder back-pressure issues. It is very important that both the steam hose and condensate return line, whether flexible or hard tubing, be installed so there are no sags, low points, dips, or horizontal runs. The steam is at a very low pressure and it cannot overcome any resistance caused by accumulating water standing in the steam hose. Accumulation in the condensate return hose will hamper the flow and may cause water to back up into the duct or create a back pressure in the cylinder potentially causing water to be forced back into the fill cup and resulting in a false high water alarm.



ELECTRODE STEAM HUMIDIFIER | Fan Distribution Units

Fan distribution units are available for use in areas which do not have duct systems or where duct air temperatures are too low to provide sufficient humidification. For example, in computer areas the desired relative humidity may not be possible in the conditioned space without causing condensation in the duct.

Fan distribution units must be mounted securely on a level and plumb surface at least 3 feet below the ceiling for a Model HXBJB and at least 4 feet below the ceiling for a Model HXBJC to prevent steam condensing on the ceiling surface. Allow 20 feet in front of the HXBJB and 30 feet in front of the HXBJC for the steam to be absorbed into the air. Do not mount the units above any items that would be damaged if a water leak were to develop.

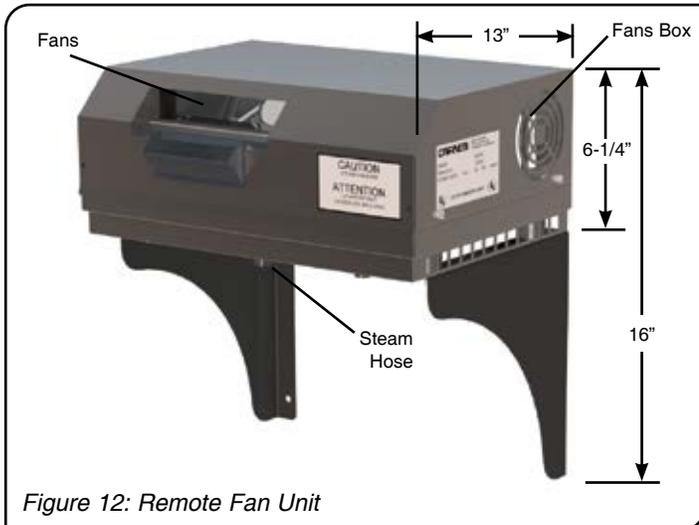


Figure 12: Remote Fan Unit

Table 4: Blower Package Match List

Humidifier Model	Nominal Steam Output Rate	Remote Mounted Fan Unit Model
H_AJ	005, 010	HXBJB (1 Req'd)
H_DJ	020, 030	HXBJB (1 Req'd)
H_GJ	030, 040, 050, 060, 080, 100	HXBJC (1 Req'd)
H_HJ	125, 150, 175, 200	HXBJC (2 Req'd)



Figure 14: Mounted Fan Unit

Mounted Fan Distribution Unit

A mounted fan distribution unit and its associated humidifier are shipped as a complete assembled unit. In this case, a 6-wire connection is made from the circuit board to the 8-pin fan connection (green). This connection is already assembled in the factory.

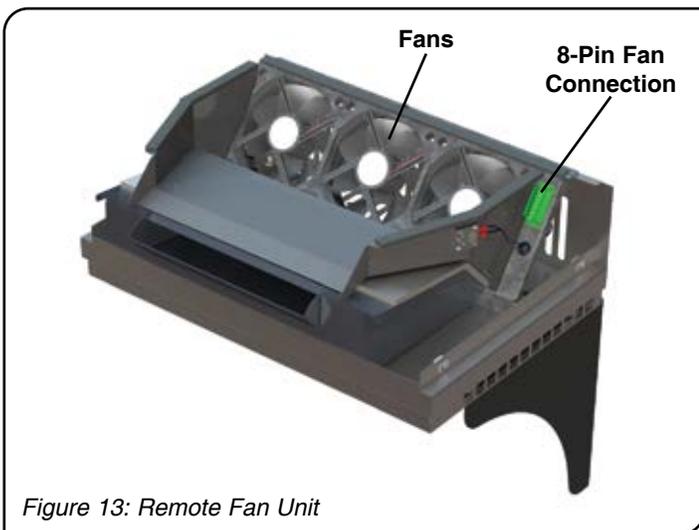


Figure 13: Remote Fan Unit

Remote Fan Distribution Unit

A remote fan distribution unit comes with two separate male plugs to connect 6-conductor wires from the humidifier to the fan distribution unit at a remote location. One of the male connectors goes to the humidifier’s female connector, the other goes to the remote unit. We recommend Alpha Wire 1181C (non-Carnes) as an appropriate 6-conductor wire, but there are many available that will suffice. Each conductor should be rated at minimum for 1 amp. If individual wires are used, utilize 26 or 28 gauge wire.

When connecting the humidifier male ends to the wire, pin 1 of the humidifier connector should be routed to pin 1 of the fan distribution unit connector. Pin 2 should be routed to pin 2, etc. Use a small regular head screwdriver to connect each conductor into the male connector. It is important to make sure the conductor is grasped inside the screw compression, and not the wire insulation.

A remote fan distribution unit should not be mounted any more than 40 feet away from the humidifier but this is dependent on the capacity of the unit. Small capacity units cannot provide steam at greater distance. When wiring the fan distribution unit remotely, it is not absolutely necessary to wire through the electrical conduit, but it is recommended for providing some strain relief on the connector.

Short Steam Manifolds

Carnes Steam Manifolds are designed to provide dry steam with rapid absorption in the duct air stream. It achieves this by distributing steam evenly across the face of the duct. The distance needed for absorption is dependent on a number of factors, some of which are air velocity, steam volume, air temperature, and characteristics of air flow in the duct. For minimum absorption distance, the manifold should be located in the warmest air stream of the duct and where fully developed laminar air flow occurs.

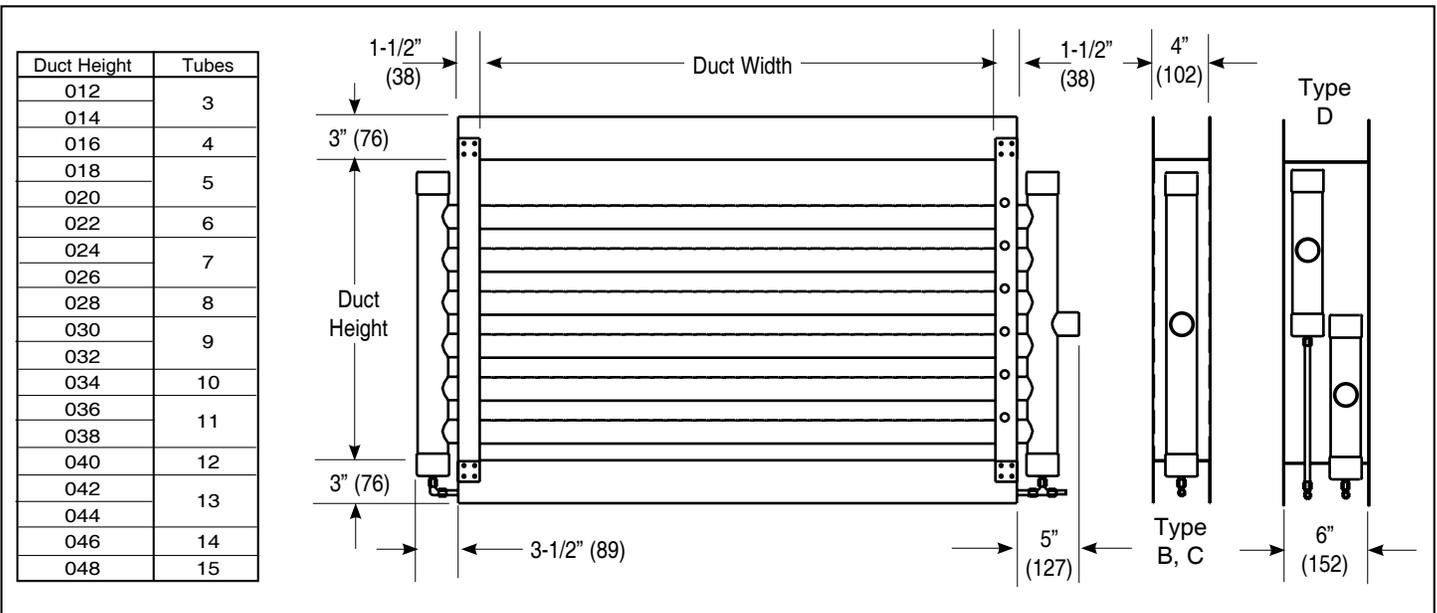


Figure 15: Short Steam Manifold

Location of Manifolds

The manifold is usually located in the supply duct downstream of the fan, heating coil, cooling coil, and/or filter. When installed in packaged units, the manifold is to be mounted just downstream of the fan discharge.

Table 5: Manifold Mounting Information



ELECTRODE STEAM HUMIDIFIER | Short Absorption Manifolds

The non-wetting dimension is the distance necessary to prevent condensation on any obstruction downstream from the manifold. Condensation could occur on a cooling coil because of lower temperatures. Steam plumes may be visible beyond the non-wetting dimension and may moisten high efficiency filters. Additional distance is required for installation upstream of high efficiency filters.

Carnes humidifiers operate at 1/2 psi or less so there are limitations on the length between the humidifier cabinet and the steam manifold. The maximum distance depends on the static pressure in the duct and is shown in Table 6.

Table 6: Maximum Steam Hose Length

Duct Static Pressure "wg"	0	1	2	3	4	5
Max Steam Hose Length (Ft.)	40	35	30	25	15	10

In a typical installation, the humidifier is located below the duct and the steam manifold is installed as shown in *Figure 16*. The maximum recommended length of steam hose for this type of installation is 12 feet.

For lengths beyond 12 feet additional steps are shown in *Figure 17*. If sufficient headroom is not available, it is possible to install the steam hose with an upward slope with a minimum rise of 2" for every 12" of run.

The steam manifold may be located below the humidifier if the installation is made in accordance with *Figure 18*. The steam manifold cannot be installed in a vertical duct.

The manifold has an integral mounting flange for ease of installation. Separate mounting flanges, supplied by others, are needed to mate with the manifold. Refer to *Figure 19*.

If the steam manifold is used with a humidifier having two cylinders it will require two separate lengths of steam hose. **Do not combine the outputs of two cylinders into one steam hose.**

It is very important that both the steam hose and condensate return line be installed so that sags are prevented.

If it is difficult to prevent sags, it is recommended that a copper tube be used as a substitute. If a copper tube is used, a minimum of one inch of insulation must be applied to prevent excessive condensation and contact with the hot pipe. A short length of steam hose must be used to connect the plastic cylinder in the humidifier to the copper tube and another to connect the copper tube to the steam manifold. It is very important to include adequate space to move the steam hose far enough when replacing cylinders. Any turns in the steam hose should have a minimum radius of eight inches to prevent kinking.

Size 3/4" copper tube can be used with steam cylinders having output rates up to 30 pounds per hour. Size 1-1/2" copper tube should be used with steam cylinders over 30 pounds per hour. Length restrictions shown in Table 6 also apply where copper tube is used and any 90° elbows add approximately three feet of equivalent length.

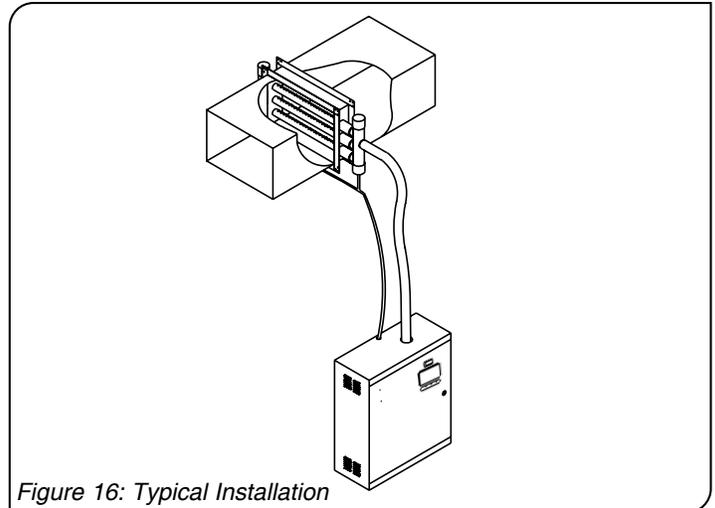


Figure 16: Typical Installation

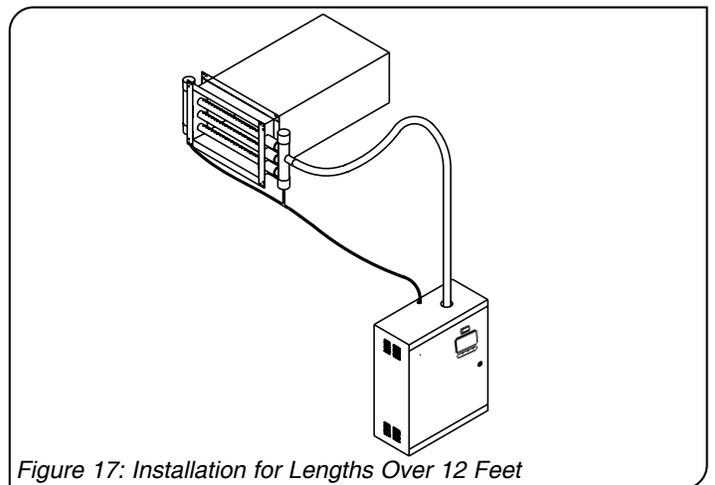


Figure 17: Installation for Lengths Over 12 Feet

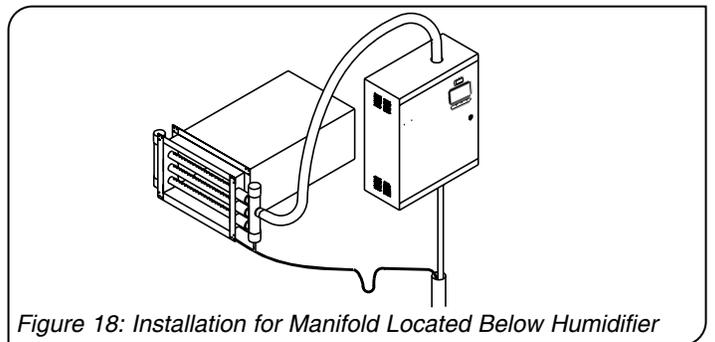


Figure 18: Installation for Manifold Located Below Humidifier

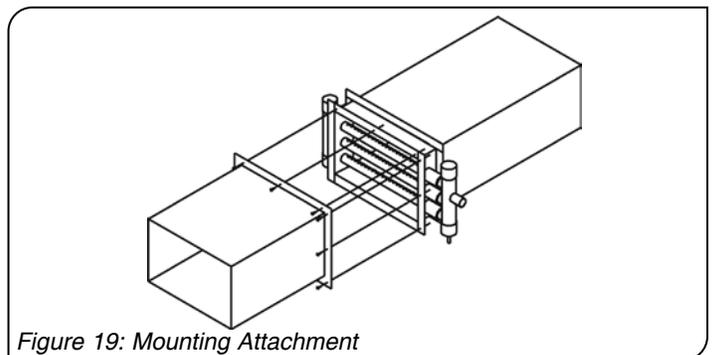


Figure 19: Mounting Attachment



Figure 20: Depiction of Fill and Drain Line Connections

Supply Water Guidelines

Important Notes:

- Carnes recommends that supply lines be installed by a licensed plumbing professional.
- Verify the water supply satisfies the guidelines listed in the Water Quality Section of this document.
- Carnes does not supply optional plumbing such as shutoff valves with humidifier units, and these will need to be sourced from another vendor if desired.
- Connect a supply hose to the 3/8" FPT fitting that is provided, located at the bottom of the humidifier for connection to tap water. It is recommended that the installer adds a shutoff valve ahead of this fitting in order to disable the water source before servicing the system.

Connecting the Drain Line

Important Notes:

- Carnes recommends that drain lines be installed by a licensed plumbing professional
- Plumbing materials used on drain lines should be able to tolerate hot water (+160°F).

Connect a 1 inch-ID hose (not included) to the port of the humidifier drain cup located at the bottom of the unit (See *Figure 20*). The drain should slope downward along its full length to avoid bubbles in the line which may cause water to back up into the humidifier cabinet. An S or P-trap or air gap may be required to help with draining.

Electrical Power

Important Notes:

- Never perform any work on unit with power active.
- Shut off main power disconnect and disable water supplies before servicing the unit.
- Carnes does not supply equipment to disconnect primary power and such equipment must be sourced from another vendor.
- Carnes recommends that all high-voltage connections should be installed by a licensed electrical professional.

Check the electrical characteristics on the unit label, located on the outside of the cabinet. The power provided must be the same as what is described on the label. If it does not match, contact your Carnes Representative. All local and national codes must be followed when connecting power to the unit.

A fused disconnect or circuit breaker **MUST** be installed per local and national codes (See Table 7 for recommended circuit ratings). Any circuit breaker switch provided by Carnes is not to be used as a replacement for the required external disconnect switch, but as a maintenance convenience.

Electrical Data Sheet Definitions

1. Optional Circuit Breaker designates the quantity and amp rating of optional factory installed circuit breakers. Circuit breakers are available in models with an 'HT' prefix. All models over 48 amps have internal circuit breakers factory installed.
2. Maximum Lb/Hr designates maximum capacity of the humidifier. Units are shipped from the factory preset at the maximum rate. The output rate may be easily reset after installation anywhere between 100% and 20% of maximum capacity.
3. Voltage and Phase designates available phase and nominal voltages. Single phase units may be operated from two legs of a three phase supply but the load will be unbalanced.
4. kW is the power rating of the maximum output rate of the humidifier. If a unit's max output is adjusted lower, the kW is reduced proportionally.
5. Line Amp and Disc. Size are amp ratings shown for use in selecting electrical service requirements.
6. Steam Cylinder shows the quantity and model of steam generating cylinders mounted inside the humidifier. Each cylinder requires its own steam distribution pipe, steam hose, and condensate return line.
7. Cylinder Wire Current is the current a single cylinder wire should be carrying for a given unit at max output. This does not include 'dummy' electrode wires that never carry any current, i.e. humidifiers with C65 cylinders and single phase humidifiers not using AX cylinders.

ELECTRODE STEAM HUMIDIFIER | Electrical Data Sheet

Table 7: Electrical Data and Unit Detail Sheet

	Model	Max Lb/Hr	Voltage	Phase	kW	Line Amp	Disc. Size	Optional Circuit Breaker*	Steam Cylinder	Cyl Wire Current
HSAJ HTAJ	H_AJAU	5	120	1	1.725	14.4	25	1-20 Amp	AX220	14.4
	H_AJBU	5	208	1	1.725	8.3	15	1-15 Amp	AX380	8.3
	H_AJDU	5	230	1	1.725	7.5	15	1-20 Amp	AX380	7.5
	H_AJFU	5	277	1	1.725	6.2	15	1-15 Amp	AX380	6.2
	H_AJLU	5	380	1	1.725	4.5	15	1-15 Amp	AX600	4.5
	H_AJQU	5	415	1	1.725	4.2	15	1-15 Amp	AX600	4.2
	H_AJMU	5	460	1	1.725	3.7	15	1-15 Amp	AX700	3.7
	H_AJNU	5	575	1	1.725	3.0	15	1-15 Amp	AX700	3
	H_AJAU	10	120	1	3.45	28.7	45	1-40 Amp	AX220	28.7
	H_AJBU	10	208	1	3.45	16.6	25	1-25 Amp	AX380	16.6
	H_AJDU	10	230	1	3.45	15.0	25	1-25 Amp	AX380	15
	H_AJFU	10	277	1	3.45	12.4	20	1-20 Amp	AX380	12.4
	H_AJLU	10	380	1	3.45	9.1	15	1-15 Amp	AX600	9.1
	H_AJQU	10	415	1	3.45	8.3	15	1-15 Amp	AX600	8.3
	H_AJMU	10	460	1	3.45	7.5	15	1-15 Amp	AX700	7.5
H_AJNU	10	575	1	3.45	6.0	15	1-15 Amp	AX700	6	
HSDJ HTDJ	H_DJBU	20	208	1	6.9	33.1	50	1-45 Amp	B381	33.1
	H_DJDU	20	230	1	6.9	29.9	45	1-40 Amp	B381	30
	H_DJFU	20	277	1	6.9	24.9	40	1-35 Amp	B381	24.9
	H_DJLU	20	380	1	6.9	18.1	30	1-30 Amp	B600	18.1
	H_DJQU	20	415	1	6.9	16.6	25	1-25 Amp	B600	16.6
	H_DJMU	20	460	1	6.9	15.0	25	1-25 Amp	B700	15
	H_DJNU	20	575	1	6.9	12.0	20	1-15 Amp	B700	12
	H_DJCU	20	208	3	6.9	19.1	30	1-25 Amp	B500	19.1
	H_DJEU	20	230	3	6.9	17.3	30	1-25 Amp	B500	17.3
	H_DJTU	20	380	3	6.9	10.4	20	1-20 Amp	B600	10.4
	H_DJWU	20	415	3	6.9	9.6	20	1-20 Amp	B600	9.6
	H_DJGU	20	460	3	6.9	8.6	15	1-15 Amp	B700	8.6
	H_DJHU	20	575	3	6.9	6.9	15	1-15 Amp	B700	6.9
	H_DJCU	30	208	3	10.3	28.7	45	1-40 Amp	B500	28.7
	H_DJEU	30	230	3	10.3	25.9	40	1-35 Amp	B500	25.9
	H_DJTU	30	380	3	10.3	15.6	25	1-25 Amp	B600	15.6
	H_DJWU	30	415	3	10.3	14.4	25	1-25 Amp	B600	14.4
	H_DJGU	30	460	3	10.3	13.0	20	1-20 Amp	B700	13
H_DJHU	30	575	3	10.3	10.4	20	1-15 Amp	B700	10.4	
HSGJ HTGJ	H_GJBU*	30	208	1	10.3	49.7*	80	2-35 Amp*	C62	24.8
	H_GJDU	30	230	1	10.3	44.9	70	1-60 Amp	C62	22.4
	H_GJFU	30	277	1	10.3	37.3	60	1-50 Amp	C62	18.6
	H_GJLU	30	380	1	10.3	27.2	45	1-40 Amp	C62	13.6
	H_GJQU	30	415	1	10.3	24.9	40	1-40 Amp	C62	12.5
	H_GJMU	30	460	1	10.3	22.5	35	1-30 Amp	C62	11.3
	H_GJNU	30	575	1	10.3	17.9	30	1-25 Amp	C62	9.0
	H_GJCU	40	208	3	13.8	38.3	60	1-60 Amp	C62	19.1
	H_GJEU	40	230	3	13.8	34.6	60	1-50 Amp	C62	17.2
	H_GJTU	40	380	3	13.8	20.9	35	1-35 Amp	C65	20.9
	H_GJWU	40	415	3	13.8	19.2	30	1-30 Amp	C65	19.2
	H_GJGU	40	460	3	13.8	17.3	30	1-25 Amp	C65	17.3
H_GJHU	40	575	3	13.8	13.8	25	1-20 Amp	C65	13.8	

ELECTRODE STEAM HUMIDIFIER | Electrical Data Sheet

Table 7: Electrical Data and Unit Detail Sheet (Continued)

	Model	Max Lb/Hr	Voltage	Phase	kW	Line Amp	Disc. Size	Optional Circuit Breaker*	Steam Cylinder	Cyl Wire Current
HSGJ HTGJ	H_GJCU	50	208	3	17.2	47.8	80	2-35 Amp	C62	23.9
	H_GJEU	50	230	3	17.2	43.2	70	1-60 Amp	C62	21.6
	H_GJTU	50	380	3	17.2	26.2	40	1-40 Amp	C65	26.2
	H_GJWU	50	415	3	17.2	24.0	40	1-40 Amp	C65	24
	H_GJGU	50	460	3	17.2	21.6	35	1-30 Amp	C65	21.6
	H_GJHU	50	575	3	17.2	17.3	30	1-25 Amp	C65	17.3
	H_GJCU*	60	208	3	20.7	57.4*	90	2-40 Amp*	C62	28.7
	H_GJEU*	60	230	3	20.7	51.9*	80	2-40 Amp*	C62	26
	H_GJTU	60	380	3	20.7	31.4	50	1-50 Amp	C65	31.4
	H_GJWU	60	415	3	20.7	28.8	45	1-45 Amp	C65	28.8
	H_GJGU	60	460	3	20.7	26.0	40	1-40 Amp	C65	26
	H_GJHU	60	575	3	20.7	20.8	35	1-30 Amp	C65	20.8
	H_GJCU*	80	208	3	27.5	76.5*	125	2-60 Amp*	C62	38.2
	H_GJEU*	80	230	3	27.5	69.2*	110	2-50 Amp*	C62	34.6
	H_GJTU	80	380	3	27.5	41.9	70	1-60 Amp	C12	21
	H_GJWU	80	415	3	27.5	38.4	60	1-60 Amp	C12	19.2
	H_GJGU	80	460	3	27.5	34.6	60	1-50 Amp	C12	17.3
	H_GJHU	80	575	3	27.5	27.7	45	1-40 Amp	C12	13.9
	H_GJCU*	100	208	3	34.4	95.6*	150	2-60 Amp*	C62	47.8
	H_GJEU*	100	230	3	34.4	86.4*	150	2-60 Amp*	C62	43.2
	H_GJTU*	100	380	3	34.4	52.3*	110	2-50 Amp*	C12	34.2
	H_GJWU	100	415	3	34.4	47.9	80	2-40 Amp	C12	24
	H_GJGU	100	460	3	34.4	43.3	70	1-60 Amp	C12	21.7
	H_GJHU	100	575	3	34.4	34.6	60	1-50 Amp	C12	17.3
HSHH HTHH	H_HJCU*	125	208	3	43	119.5*	200	4-40 Amp*	C62 (2)	29.8
	H_HJEU*	125	230	3	43	108*	175	4-40 Amp*	C62 (2)	27
	H_HJTU*	125	380	3	43	65.3*	100	2-50 Amp*	C12 (2)	16.3
	H_HJWU*	125	415	3	43	59.8*	90	2-45 Amp*	C12 (2)	15
	H_HJGU*	125	460	3	43	54.0*	90	2-40 Amp*	C12 (2)	13.5
	H_HJHU	125	575	3	43	43.2	70	2-30 Amp	C12 (2)	10.8
	H_HJCU*	150	208	3	51.7	143.5*	225	4-50 Amp*	C62 (2)	35.8
	H_HJEU*	150	230	3	51.7	129.7*	200	4-50 Amp*	C62 (2)	32.4
	H_HJTU*	150	380	3	51.7	78.6*	125	2-60 Amp*	C12 (2)	19.7
	H_HJWU*	150	415	3	51.7	71.9*	110	2-60 Amp*	C12 (2)	18
	H_HJGU*	150	460	3	51.7	64.8*	100	2-50 Amp*	C12 (2)	16.2
	H_HJHU*	150	575	3	51.7	51.9*	80	2-35 Amp*	C12 (2)	13
	H_HJCU*	175	208	3	60.3	167.3*	300	4-60 Amp*	C62 (2)	41.8
	H_HJEU*	175	230	3	60.3	151.3*	250	4-60 Amp*	C62 (2)	37.8
	H_HJTU*	175	380	3	60.3	91.6*	150	4-35 Amp*	C12 (2)	22.9
	H_HJWU*	175	415	3	60.3	83.9*	150	2-60 Amp*	C12 (2)	21
	H_HJGU*	175	460	3	60.3	75.6*	125	2-60 Amp*	C12 (2)	18.9
	H_HJHU*	175	575	3	60.3	60.5*	100	2-50 Amp*	C12 (2)	15.1
	H_HJCU*	200	208	3	68.9	191.2*	300	4-60 Amp*	C62 (2)	47.8
	H_HJEU*	200	230	3	68.9	172.9*	300	4-60 Amp*	C62 (2)	43.2
	H_HJTU*	200	380	3	68.9	104.7*	175	4-40 Amp*	C12 (2)	26.2
	H_HJWU*	200	415	3	68.9	95.9*	150	4-35 Amp*	C12 (2)	23.9
	H_HJGU*	200	460	3	68.9	86.4*	150	2-60 Amp*	C12 (2)	21.6
	H_HJHU*	200	575	3	68.9	69.2*	110	2-50 Amp*	C12 (2)	17.2

ELECTRODE STEAM HUMIDIFIER | Humidifier Component Listing

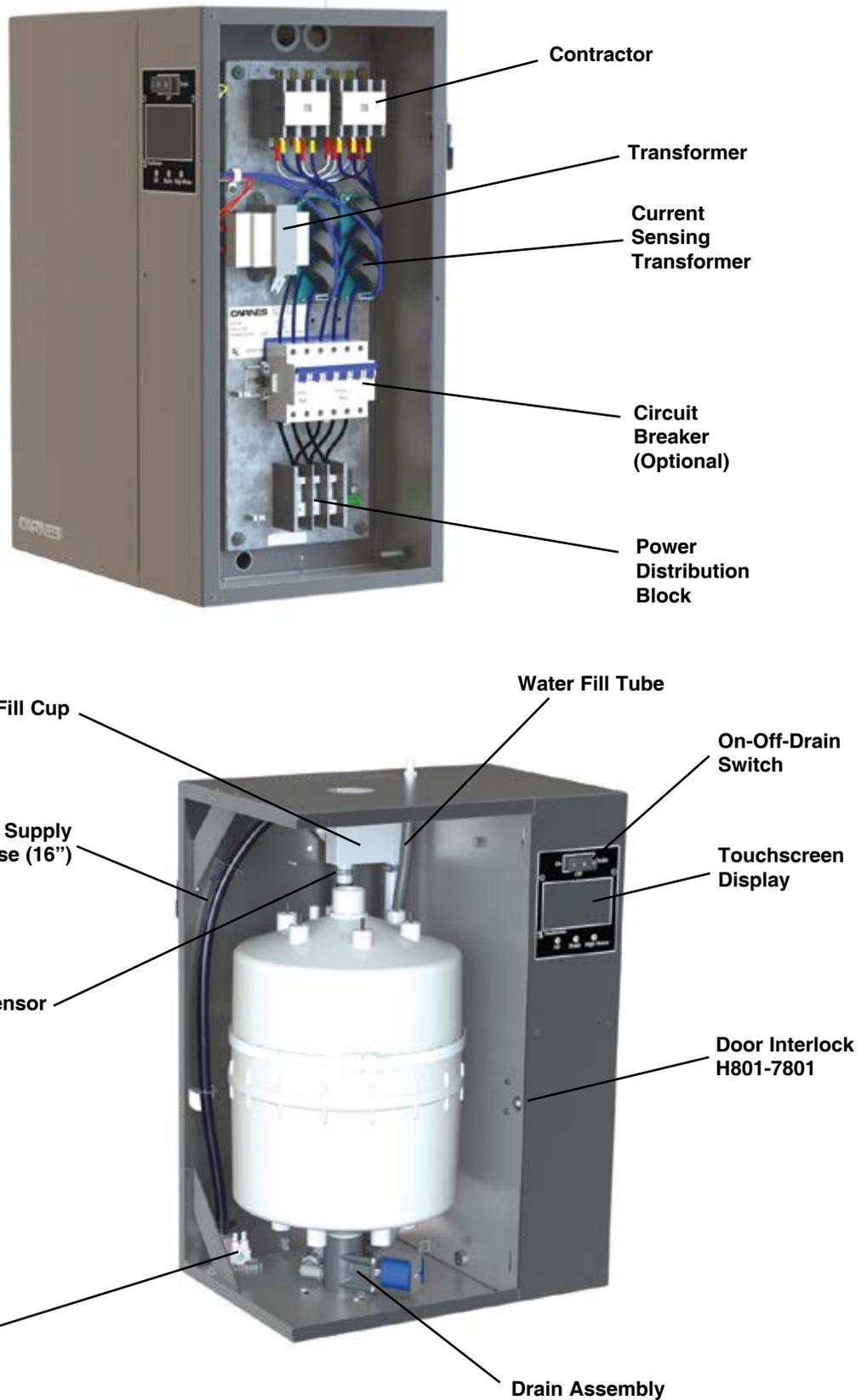


Figure 21: J-Series Component List

The output steam of the humidifier is primarily controlled through the use of various humidistats/sensors. It is very important to understand the difference between a humidistat and humidity sensor before connecting control wiring and power cables to the unit. Carnes humidifiers require a distinct set-up depending on the control scheme.

Humidistat (Carnes Model HXHAW, HXHAWT, HXHAS, HXHAST)

- **Humidistat:** A humidistat is the industry standard humidity controller. It functions by sending an analog (0-10VDC, 4-20mA) or an on/off demand signal directly to the input of a humidifier. A humidistat calculates the demand output by measuring the difference between actual relative humidity and the desired humidity setpoint selected by the user.
- If on-off mode is used, the humidifier will generate steam at the max output rate and cycle on or off as necessary to satisfy the conditioned area requirements. All humidifiers are preset at the factory for the maximum rating of the unit. The maximum output may be easily reset to a lower limit between 20-100% in the settings menu of the touchscreen.
- If proportional mode is used the humidifier will automatically vary the steam output rate in the range of 20-100% of the humidifier's maximum output (set by the user) in response to the 0-10V signal from the humidistat. However, the output of the humidifier will not drop below 20% of the preset nominal output of the humidifier set at the factory. Proportional control provides less cycling of the humidifier.
- A wall humidistat or duct mounted humidistat in the return air needs to be used. The wall mounted humidistat is the most common as it allows the setting to be easily changed to accommodate for changing requirements or to lower the level of relative humidity in the space to prevent condensation on windows during extremely cold weather. In applications where it may be desirable to prevent the occupants of a space from changing the setting, a duct mounted humidistat in the return may be used. This is normally mounted in the equipment room or in the duct.

- **Humidity Sensor:** A humidity sensor is a device which only measures relative humidity, and does not allow a user to control the desired conditions. Carnes commercial humidifiers have the ability to operate using a standalone humidity sensor, so long as it can send a 0-10VDC or 4-20mA signal corresponding to 0-100% relative humidity. The humidifier unit needs to be reconfigured before operating in this mode, as each Carnes humidifier is shipped with a standard humidistat as the default control method to serve the industry standard. Humidifiers which use standalone sensors must have their relative humidity setpoint programmed into the unit itself, and the controller calculates a demand internally. The main advantage of this style of control is the ability to use extra features inside the humidifier. Additional features include password protected settings, graphical status indicators, and scheduling functions of the humidifier. The scheduling function allows the user to choose certain desired humidity levels for a given timeslot. Another feature of this style of control is that the humidifier can then communicate the measured humidity level over external communication to a Building Management System.
- **Control Humidistat / Temperature Compensated:** The HXHAWT or HXHAST can be used if your application has a requirement for an outdoor temperature compensation feature. Both controls will provide monitoring of RH percentage and outdoor temperature, along with automatically adjusting the RH setpoint as outdoor temperatures change. The HXHAWT or HXHAST provides a 0-10V signal in either a proportional or on-off configuration. See *Figure 23*.

High Limit Humidistat (Model HXHAD)

The high limit humidistat functions similarly to the standard control humidistat. However, it is always mounted in a duct and has a higher setpoint than the primary controller. The high limit humidistat is used as an interlock to prevent excess condensation building up in the duct or conditioned space. The duct mounted sensor must be a minimum of 10 feet downstream of the steam distribution pipe. The high limit humidistat is installed 10 feet downstream from the distribution pipe and is normally set to 90-95% RH. The high limit humidistat opens the circuit if the humidity level in the duct exceeds the setpoint. Use of this device is recommended particularly when the humidifier is used in applications where cooling air is being humidified or where a VAV system may throttle back to a point where air flow is insufficient to absorb the steam being introduced. Either an on-off or proportional control high limit humidistat may be used with Carnes humidifiers. If a proportional humidistat is used the output of the humidifier will automatically be decreased to reduce the possibility of condensation. Two proportional humidistats may be used to control Carnes humidifiers if desired. One humidistat is in the area to be humidified or return duct and another humidistat is used as a high limit in the supply duct. The humidifier will automatically select the lowest signal to control the humidifier output.



Figure 16: Humidistat Duct Probe

Air Flow Switch (Model HXAEE)

The air flow switch should be mounted in the duct upstream to where the steam is supplied as shown in *Figure 17*. The air flow switch is used as an interlock to prevent the humidifier from generating steam when there is not enough air movement to disperse it. If the system were allowed to generate steam without adequate air flow, then the steam would condense in the ductwork and cause saturation issues. The air flow switch is vital for proper control of humidity because it tells the unit when the air handling system is operating.

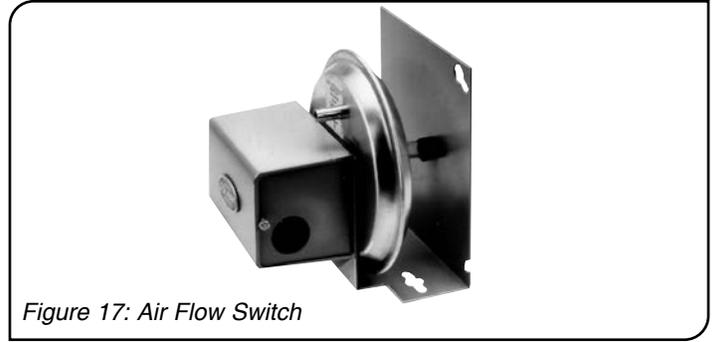


Figure 17: Air Flow Switch

Door Interlock

The door interlock is located on the front of the humidifier. It provides an extra layer of protection to the user by stopping the unit from generating steam if the front door is not present and locked shut. It is never advised to service a unit without first disconnecting power, but in the event that power is required to perform maintenance on an open unit, the door interlock safety switch prevents the unit from sending power to the cylinder compartment.

External controls for the humidifier are connected through use of screw-terminal connector J11 located on the bottom of the humidifier main control board. The terminals are labeled on the board and the connection diagrams are shown in *Figure 18*. The circuit board can provide either a Carnes legacy 18VDC or an industry standard 24VAC, as a supply for those humidistats which require it. The supply for both the control humidistat and high limit humidistat are output on pin1 and pin 2 of J11.

EXTERNAL DDC CONTROL SIGNALS

Carnes humidifiers can also accept a 0-10 volt DC signal to modulate the output of the humidifier. Polarity must be observed. Input impedance is 20K ohms. If a 4-20 mA input signal is provided to the humidifier a 470 ohm 1/4 watt resistor must be installed as shown below (*Figure 21*).

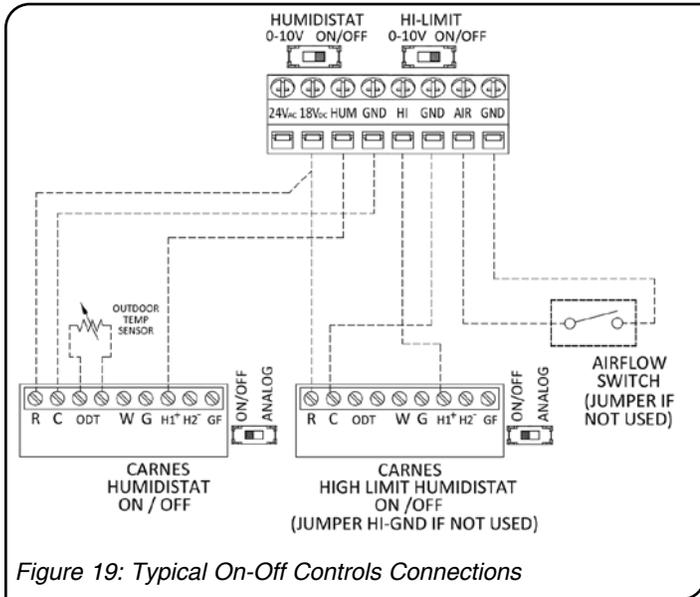


Figure 19: Typical On-Off Controls Connections

Connections shown in *Figure 19* are for typical on-off controls. The switches on R21 and R16 come defaulted in the on-off position (switched to the right). For Carnes proportional controls, switches on R21 and R16 will need to be switched to the left (0-10v) see diagram *Figure 20*. All controls are shipped with detailed wiring instructions (See Commercial Humidistat Owner’s Manual form 16767).

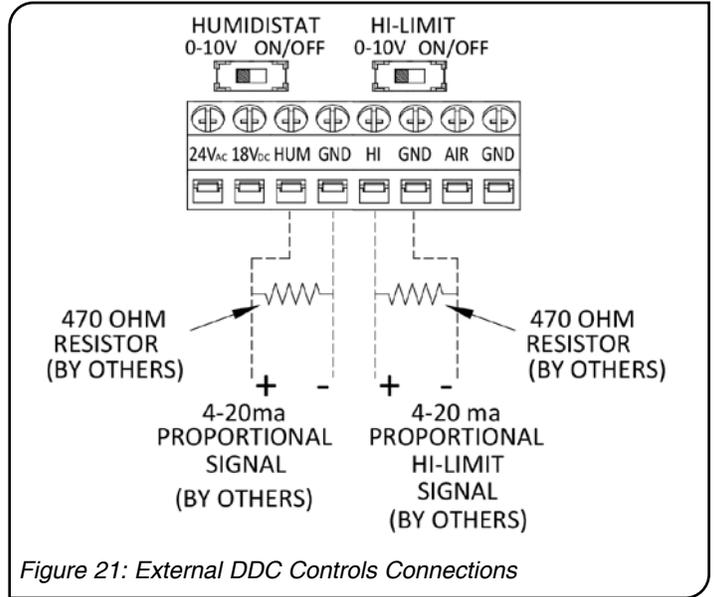


Figure 21: External DDC Controls Connections

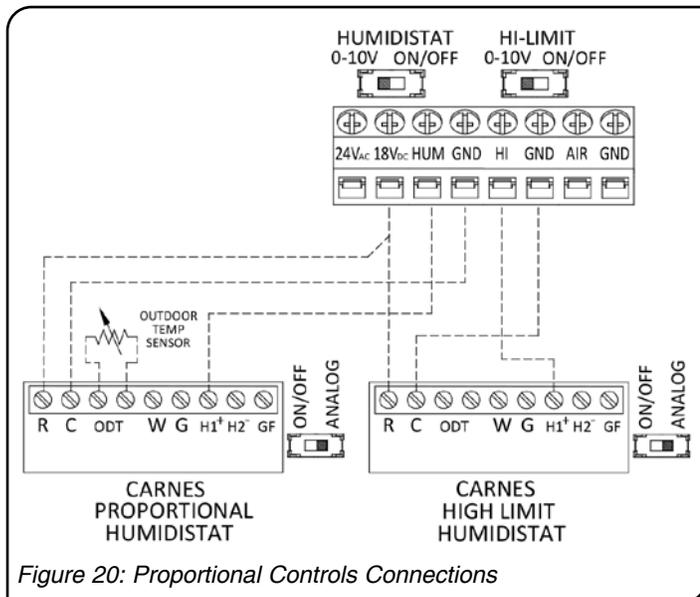


Figure 20: Proportional Controls Connections

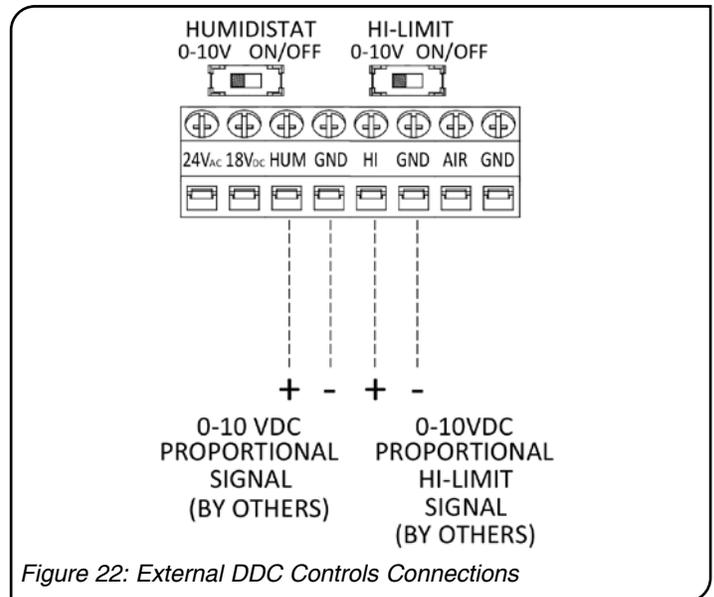


Figure 22: External DDC Controls Connections

Wall Humidstat, Proportional Control

The Model HXHAM is a wall-mounted, microprocessor-controlled humidistat solution for humidity control. The HXHAM employs a backlit LCD module, which displays both the ambient temperature and humidity of the surrounding air. The embedded software allows user navigation between temperature/humidity viewing mode, setpoint adjustment mode, and outdoor temperature/humidity viewing mode. An optional outdoor temperature compensation sensor can be added (HXHAMT).



Figure 23: Model HXHA

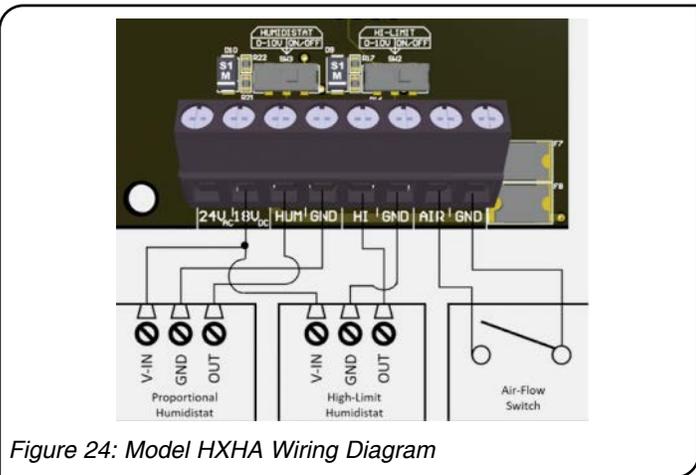


Figure 24: Model HXHA Wiring Diagram

Air Flow Switch, Pressure Differential Type

Air flow in the duct may be sensed by using this differential pressure switch. The differential in pressure between the interior of the duct closes a switch when air is moving. Air pressure differential as low as .07 w.g. may be sensed with this switch.

Environment:

Ambient Temperature Limits,

Shipping -40 to 140°F (-40 to 60°C).

Operating 35 to 140°F (0 to 60°C).

Humidity, 5 to 95% RH, non-condensing.

Locations, NEMA Type 1 indoor only.

Mounting: In vertical position on any surface free of vibration

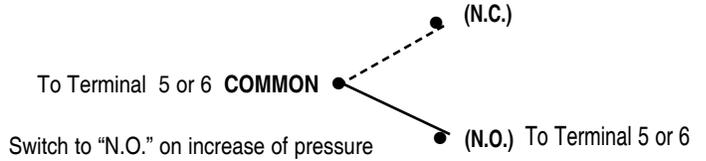


Figure 25: Model HXAAE

When there is an increase of air pressure to above setpoint, the switch is switched from normally closed (N.C.), common ground contact to normally open (N.O.) contact. On a decrease of air pressure to below setpoint, normally closed, common ground contact of the switch is switched to normally closed contact. Avoid locations where excessive moisture, corrosive fumes, or vibrations are present.

Setpoint:

Factory Set, 0.07" (1.8mm) w.g.

Field Adjustable, 0.07 to 1" (1.8 to 25.4mm) w.g.

Sensing Element: Neoprene diaphragm.

Adjustment

Note: Units are shipped at minimum setpoint.

To increase setpoint, turn adjustment screw clockwise. Adjustable 0.05 ±0.02" to 1.0" (1.25mm ±0.5mm to 25mm) w.g. To decrease setpoint, turn adjustment screw counter-clockwise.

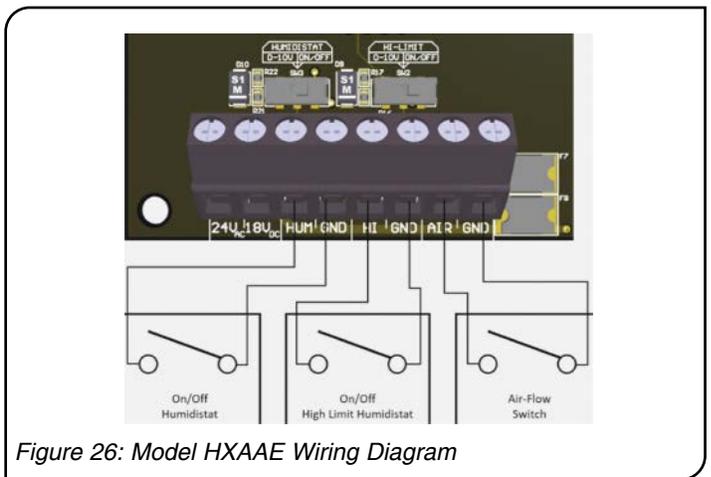


Figure 26: Model HXAAE Wiring Diagram

EXTERNAL MONITORING

CarnesLink is an option to have full external monitoring and control of your Carnes humidifier(s) by allowing the humidifier(s) to link to a Building Management System (BMS) using one of the following protocols: BACnet® (MS/TP), Modbus® (RTU), Metasys® (N2) and Siemens® (FLN). The user friendly interface on the True Touchscreen makes setting up CarnesLink easy and convenient. (See the CarnesLink Communication Protocol Installation, Operation, and Maintenance Manual for further info.)

If the unit was selected with CarnesLink the control board will come with an external mounted BMS card located on pin J8 on the control board, shown in *Figure 27*. See Form 16865 for module functions and wiring diagram.

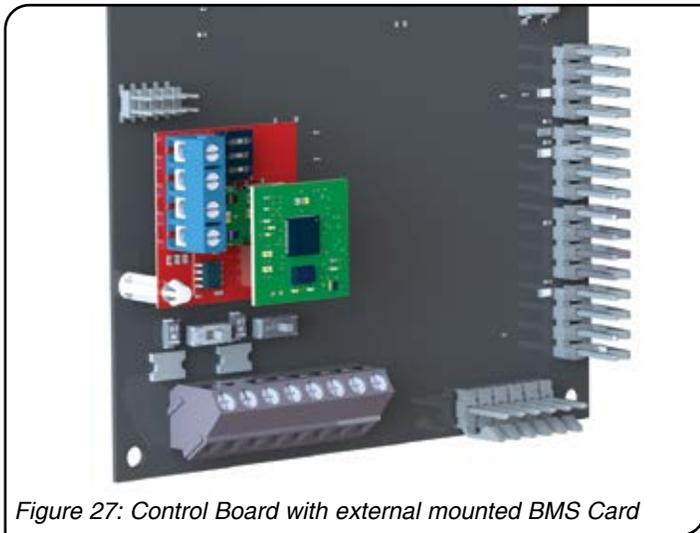


Figure 27: Control Board with external mounted BMS Card

Table 8: Networked Control Variables

Description	Database Address
Status	0
Service Required	2
Off / On / Drain	4
Air Flow	6
Contactors	8
Door Interlock	10
Drain Valve	12
Fill Valve	14
High Water	16
Control Setpoint	18
Control Humidistat	20
High Limit Humidistat	22
Output	24
Reduced Setpoint	26
CommunicationInd	28
Cylinder Life	30
72-Hour Drain	32
Auto-Dim Display	34
Drain Pulse	36
Output Units	38
Humidistat Select	40
Fan Speed	42
Max Setpoint	44
Corrective Drain Length	46
Boil Down Timer	48
High Water Timeout	50
Setpoint Timeout	52
Humidity Setpoint	54

Front Panel Displays and Controls

The display on the front panel of the humidifier cabinet contains the “On-Off-Drain” switch, the LCD True Touchscreen display and the “Fill”, “Drain”, and “High Water” LED.



Figure 28: Front Panel Display

On-Off-Drain Switch

When the humidifier toggle switch is placed in the “On” position, the humidifier will generate steam if all internal and external control requirements are met. The “Off” position is used for seasonal shut down if desired. The “Drain” position is used to drain water from the steam cylinder for maintenance.

Important Note: When the toggle switch is in the “Drain” position, the fill valve and drain valve will both be active. The fill valve opens to mix cold water into the cylinder for a short cycle before the drain valve opens. This reduces the water’s temperature to ensure it is no longer boiling. Water exiting the drain port should never exceed 140°F.

Fill LED

The LED which indicates that the cylinder is filling is blue and turns on as the fill-valve activates. An activated fill valve allows water to flow from the source into the primary infeed lines. An analogous indicator, and a description of its operation can be accessed through the Unit Activity Page (See LCD True Touchscreen Display Section (Unit Activity Page)).

Drain LED

The LED indication which indicates that the cylinder is drained is red and illuminates when the drain valve is active. An activated drain valve allows water to exit the humidifier cylinder and dump into the drain line. An analogous indicator, and a description of its operation can be accessed through the Unit Activity Page (See LCD True Touchscreen Display Section (Unit Activity Page)).

High Water LED

The LED labeled “High Water” is an orange light that illuminates when the high water sensor is triggered. A tripped high water sensor indicates that the water has risen to the maximum allowable level in the cylinder. This can be a normal situation, particularly for cylinders filled with mostly unconditioned water. Frequent tripping of the high water sensor may also indicate that the cylinder is close to end-of-life and needs replacing. An analogous indicator, and a description of its operation can be accessed through the Unit Activity Page. More information on troubleshooting high water situations can also be found in the Help pages (See LCD True Touchscreen Display Section (Help Page)).

ELECTRODE STEAM HUMIDIFIER | LCD True Touchscreen Display

This LCD True Touchscreen display offers an intuitive interface to control and monitor many variables of the humidifier. The screen uses pressure-sensitive technology, and can be activated by touching emulated buttons with any stylus or even just a finger. Various buttons and labels allow the user to navigate through menus, adjust and password-protect various settings, and visualize internal operations.

Home Page

The home page is the main page through which most other device menus can be accessed. The home page primarily serves as a display for the current steam output, but also shows indications of factors. The home page features multiple navigation buttons; four of these are always active, while others appear on the home page when different services or issues are active.



- **Carnes Icon:** Tapping the Carnes logo on the home page opens a window which displays Carnes Company contact information (address, phone number, and company website). This feature is for the purpose of contacting the factory for any startup questions, troubleshooting, or service issues that may arise.
- **Menu Icon:** Tapping the menu icon will take you to the main menu page. This can be used to access most of the unit's specific function menus.
- **Settings Icon:** After powering the unit on, the first time the settings icon is pressed, the unit will display the settings password screen. The unit is shipped with the settings password enabled and a default password of "1212". The settings password can be enabled, disabled, and updated through the settings password page.
- **Steam Icon:** The steam icon is displayed in white when all of the external control signal requirements are met, and red if any of the controls are missing or faulted. Pressing the steam icon will take the user to the steam menu page.

- **Steam Output:** The steam output value is displayed as white text when the unit is switched on and able to generate steam (ready no-fault condition). If the unit is switched on and cannot generate steam due to missing external controls or fault signals, then the steam output text will be red.



- **Service Required Icon:** The service required icon will appear at the bottom of the screen if the unit detects a fault that requires maintenance. Pressing the service required icon will take the user to the service required page, where fault details can be found.



- **Control Override Icon:** The control override icon will appear at the bottom of the screen if a manual override of a control signal or limit is currently active. Pressing the control override icon will take the user to the control override page.

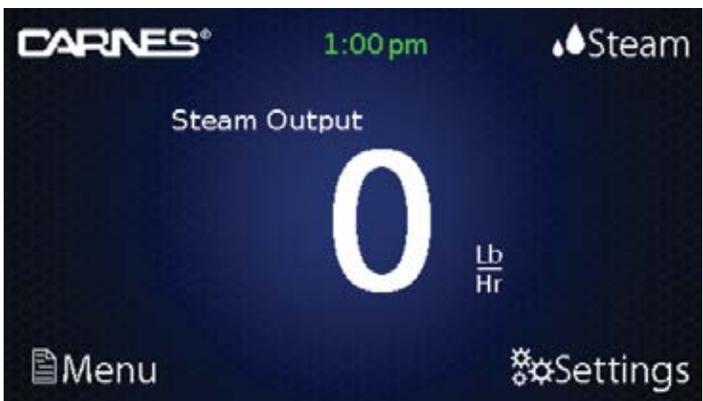


ELECTRODE STEAM HUMIDIFIER | LCD True Touchscreen Display

- **Backend Override Icon:** The backend override icon will appear if an external communication protocol is active and the external device has commanded the unit on or off. Pressing the backend override icon will take the user to the backend override page.



- **Time Icon:** The time icon will appear if the schedule function of the humidifier unit is enabled. If the schedule function is active but the time setting does not fall between a scheduled “on” time, the time icon will be white, signifying that the schedule function is not currently commanding the humidifier. If the time falls between a scheduled “on” time, the time icon will appear green, signifying that the unit is following the demand of the schedule.



- **Humidity Sensor Display:** The humidity sensor display will appear on the home screen if the selected method of external humidity control is by use of a humidity sensor. The humidity sensor display shows the current measurement of the humidity sensor and the internal humidity setpoint of the humidifier. When the schedule function is active and the time falls between a schedule “on” time, the humidity sensor setpoint will display in green, signifying that the schedule is currently controlling the humidity sensor setpoint. Pressing the humidity sensor display will take the user to the humidity control method page.



Service Required Page

The service required page displays any faults or issues with the humidifier unit that require attention. If no service is required, there should be no access to the service required page. If service is required, a detailed description will appear on the page with the ability to acknowledge the issue and force the unit to try and operate normally again.



Steam Menu Page

The steam menu page displays to the user the status of the external control signals. The external control signals shown on this page are the humidistat, high limit humidistat, air flow switch, and door interlock switch. If a control signal is satisfied, a green check mark will appear on the corresponding icon. If the condition is not satisfied, a red "x" will appear on the icon. If the control signal has been overridden for troubleshooting, the button will appear with a yellow "!".



Control Humidistat Page

If the humidifier is configured to use a common humidistat with an output demand signal, the control humidistat icon will be shown on the steam menu page instead of the humidity sensor icon. The control humidistat page explains the device status, shows the current demand signal of the control humidistat, and has a toggle switch to allow for a temporary override of the control humidistat signal. The control humidistat must issue a demand signal greater than 20% for the humidifier to run. The humidistat override toggle button can set the humidistat demand to 100% for up to 30 minutes, at which time it will revert back to normal operation mode. The override is intended to only be used for troubleshooting purposes.



- **Humidity Sensor Page**

If the humidifier control settings are set to use a humidity sensor with measured humidity as the output signal, the humidity sensor icon will be shown on the steam menu page instead of the control humidistat icon. The humidity sensor page explains the status, shows the measured humidity and humidifier demand, and has a toggle switch to allow for a temporary override of the humidity sensor signal. The calculated demand must be greater than 20% for the humidifier to run. If pressed, the humidity sensor override toggle will set the calculated demand to 100% for up to 30 minutes, which time it will revert back to normal operation mode. The override is intended to only be used for troubleshooting purposes.



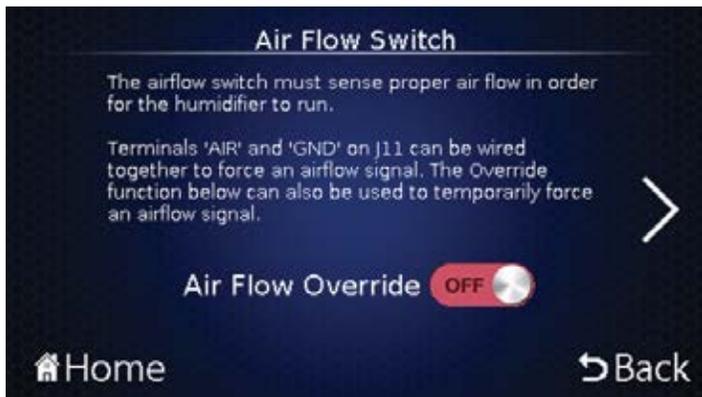
High Limit Humidistat Page

The high limit humidistat page explains the status, shows the current demand of the high limit humidistat, and has a toggle switch to allow for a temporarily override of the control humidistat signal. The high limit humidistat must call for a demand greater than 20% for the humidifier to run. The high limit humidistat override toggle will set the high limit humidistat demand to 100% for up to 30 minutes, at which time it will revert back to normal operation mode. The override is intended to only be used for troubleshooting purposes.



Air Flow Switch Page

The air flow switch page explains the status of the air flow switch and has a toggle switch to allow for a temporary override of the signal. The air flow switch must send an active signal for the humidifier to run. The air flow override command will set the air flow switch signal to active for up to 30 minutes, at which time it will revert back to normal operation mode. The override is intended to only be used for troubleshooting purposes.



Door Interlock Page

The door interlock switch page explains the status of the door interlock switch. The door interlock switch needs to be engaged for the unit to generate steam. This can be accomplished by either locking the front door shut or by pulling out the door switch plunger for temporary operation while servicing the unit.

Important Note: Operating the unit with the door off and lock plunger pulled out will allow high voltage and current to pass through the cylinder chamber. Additional precautions must be taken to prevent burns and electric shock.



Menu Page

The menu page is accessed through the bottom left corner of the home screen. There are no settings adjustments directly available from the menu page and it is used solely to access information about the unit.



Unit Activity Page

The unit activity page displays information for troubleshooting potential unit issues. This page was set up to show the internal functions of the unit, the program state of the unit, and all of the relevant settings currently being utilized. Pressing the individual icons on the screen will bring up more information about that segment. Active segments are shown on screen with a green or yellow outline, and relevant data is always displayed as white text.

• **Max Setpoint**

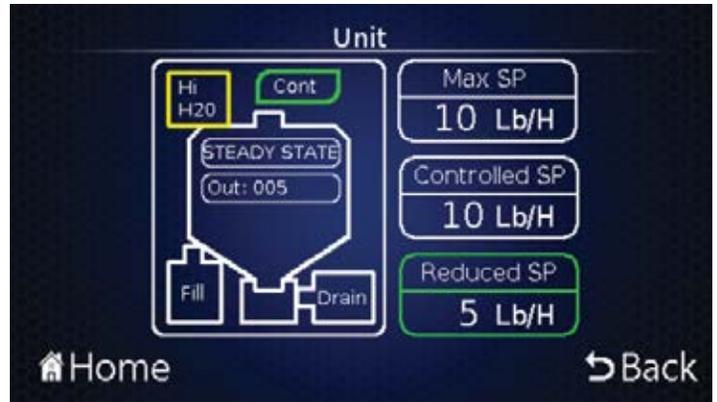
The maximum setpoint is the maximum output limit set by the user in the settings menu. The default maximum setpoint is the maximum rated output for that unit and is set at the factory. This value is used to determine the maximum steam output the system can produce when ramping up to meet the requested humidity.

• **Controlled Setpoint**

The controlled setpoint is the demand output signal specified by the user or an external device, and reduces the unit’s output from the maximum to stabilize humidity during steady state operations.

• **Reduced Setpoint**

The reduced setpoint is the output value limit that is calculated when the maximum or controlled setpoints cannot be reached following repeated high water sensor activations. Setpoints may be reduced if the cylinder becomes clogged, or the electrodes are damaged. Check the home screen to see if service is required.

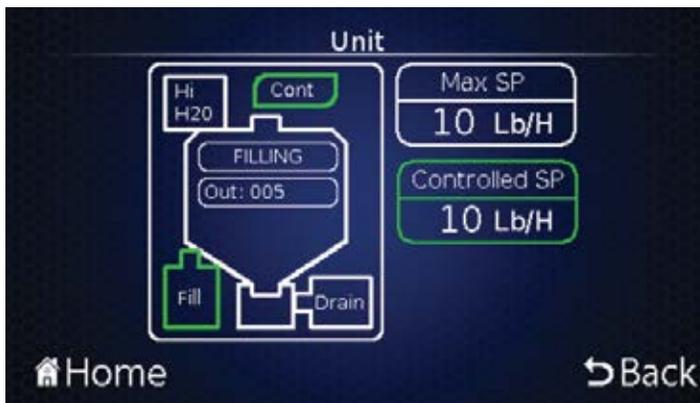
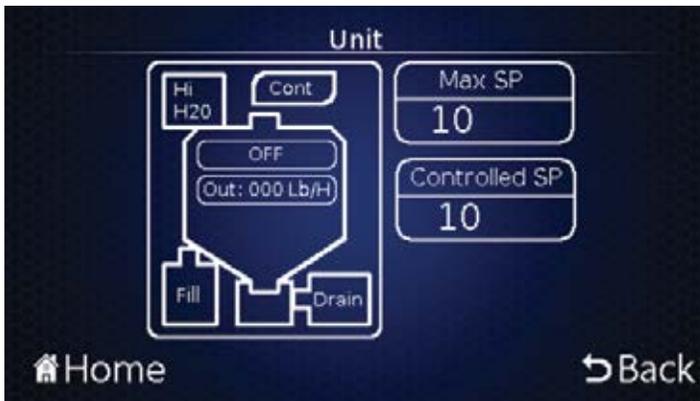


Help Pages

The Help pages display information pertinent to understanding how the unit functions. The multiple help pages were set up to act as a simplified digital manual for the unit, to help the user understand certain functionality and issues that may have arisen.

Settings Pages

The settings pages are where operational parameters of the humidifier can be adjusted. Each unit is shipped with a password protected settings page, and the default password is “1212”. Everything from maximum output to the settings password itself can be adjusted through submenus of the settings page. Most of the settings available on this page can also be adjusted via communications with a Building Management System.



Cylinder Life Counter

The cylinder life span counter is used to help the user monitor cylinder life by recording how long the unit has been actively generating steam. When a used cylinder has reached its end of life, the user should record the cylinder life span and reset the counter before operating the unit with a new cylinder. The cylinder life counter information can help diagnose potential problems with cylinders burning out too quickly.



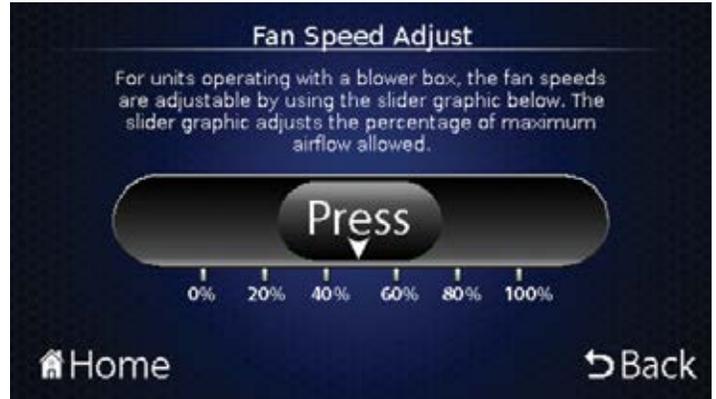
Max Steam Output Adjustment

The maximum steam output of the humidifier can be adjusted through this page. Each Carnes humidifier is shipped with a default maximum steam output that matches the maximum safe output capacity determined for that unit. Lowering the maximum steam output can help with various control issues, such as large humidity fluctuations in the controlled space or nonoptimal air flow in the duct. The maximum steam output cannot exceed the nominal output of the unit, which is listed on the label of the humidifier. Maximum output also cannot be set lower than 20% of the nominal output of the unit. One issue with setting the maximum steam output to its lowest value is that the unit can no longer function in a modulating manor, utilizing the full control of a proportional controller. When using a proportional controller, the unit functions by modulating its maximum steam output, so if this is set at its lowest possible value, there is no modulation of maximum steam output.



Fan Speed Adjustment

Fan speed adjustment only affects units that utilize a Carnes blower pack. The fan speed can be adjusted between 20-100% using the slider selection on the page. Each unit is shipped with a default of 100% fan speed. **Note:** Even with the slider set to 0%, the fans will operate at a minimum of 20% speed to prevent steam from entering a stagnant blower box.



Boil Down Timer

The boil down timer is a value, in seconds, that determines how fast consecutive fill cycles can occur before a periodic drain is required to reduce the conductivity of the water inside the cylinder.

If the unit is on and active, it will begin to fill. Once the desired output has been reached the unit will stop filling and switch into a steady state cycle, where it is only boiling the water and not filling or draining. As steam leaves the cylinder, the water level will drop, causing the unit to eventually begin to fill again, in an attempt to get back to the desired steam output. The boil down time is the length of time that the unit was in the steady state mode in between consecutive fill cycles. Higher conductivity water causes faster steady state cycles, so it is important to monitor this time and periodically reduce the conductivity of the water by draining some of the high conductivity water out and allow new, less conductive water to flow in. If the boil down timer does not elapse before a fill cycle starts again, the unit will drain to the corrective drain length setting.

The boil down timer is a user adjustable variable with a valid range of 10-255 seconds and the unit is shipped with a factory default of 25 seconds. A larger time value will result in an overall higher cylinder water level and increased water usage. A lower time value will operate the humidifier at a lower water level and use less water, but will decrease the total lifespan of the cylinder.

In the case of frequent shutdowns due to inconsistent water conductivity, the service message "Boil down timeout has caused this unit to stop" will appear. If your cylinder has less than 250 operating hours and is at least 1/3 full when this

error occurs, this timer can be disabled in order to bypass this safety feature until water conductivity stabilizes. **Note:** Overriding the boil down timer may increase the chance of arcing in the cylinder, which decreases its lifespan. Use this option with caution, and turn it back off whenever possible.



Corrective Drain Length

The corrective drain length is the percentage of water to be drained from the cylinder during a corrective drain cycle, that occurs when the unit boil down time period has not been met. The corrective drain length and boil down timer are directly connected as the corrective drain will never occur if a boil down time issue did not occur. As the humidifier boils water, minerals increase in the cylinder causing the water to become more conductive.

The corrective drain length setting is a user-adjustable percentage with a valid range of 20-100%, and is shipped with a default value of 30%. Increasing the percentage of the corrective drain flushes more conductive material from the humidifier, decreasing water conductivity, but increasing water usage. Decreasing the percentage of the corrective drain flushes less conductive material from the humidifier with the impacts of only slightly decreasing the water conductivity, reducing water usage, and reducing the cylinder lifespan. Back to back corrective drains can also cause the humidifier to trigger a service required alarm for water conductivity issues.



Filling Timeout Page

The filling timeout is a user adjustable timer that has a valid range of 30-255 minutes, with a default setting of 30 minutes. The filling timeout is the maximum amount of time allowed for a unit to reach a setpoint during a fill sequence. If the time expires during a fill sequence, the humidifier assumes the drain is stuck open and pulses the drain valve. After the pulsing routine, the humidifier will attempt to reach setpoint for second and third time. After the third attempt without reaching setpoint, the humidifier will shut down with a service required indication.



Reduced Setpoint Timeout Page

The reduced setpoint timeout is a user adjustable timer that has a valid range of 0-168 hours, with a default setting of 24 hours. The reduced setpoint timeout is the maximum amount of time, in hours, that a unit can run at a reduced setpoint. If the unit cannot return to full setpoint capacity within the amount of time set by the reduced setpoint timeout value, the unit will shut down with a service required indication.



Humidity Control Method

The humidity control method selection is where the user can set the humidifier to either be controlled by a common humidistat with a demand signal or a humidity sensor with a relative humidity measurement. All Carnes humidifiers are shipped with demand signal control as the default input control signal, because a demand signal is the industry standard for humidifier control. It is important to completely understand the differences in control between a demand signal and a humidity sensor signal before deciding to change from the default. These two control methods are discussed further in the External Controls section of this document.



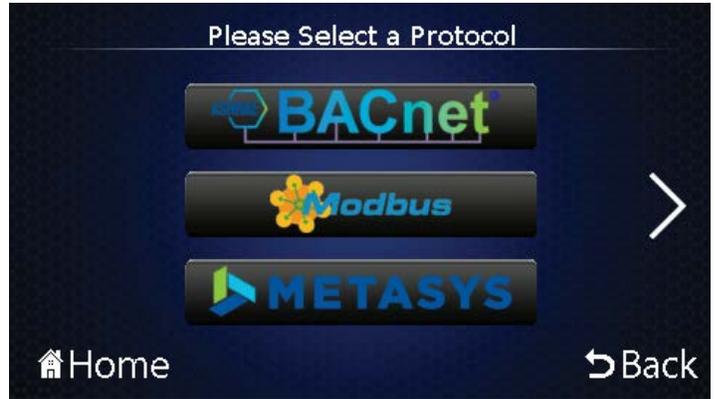
Communication Setup Pages

If the humidifier unit is equipped with the CarnesLink module, the communication setup pages can be fully utilized. All parameters of the selected communication protocol can be adjusted from the communication setup pages.



Protocol Selection

The selected protocol is displayed on the first button on the communication setup page. To change the selected protocol, press the button and select the desired protocol. There are five options in the protocol selection page, those being BACnet®, Modbus®, Metasys®, Siemens®, and no protocol. If no communication is being utilized for a time, make sure to select the no protocol option so the unit does not continuously update the communication database with no main controller protocol feedback.



Address Selection

The address of the unit can be updated by entering into the address page. Each address value range is protocol specific and each unit address should be completely unique to the Building Management System. Repeat addresses on the same network can cause issues with network communication because the network uses unit-specific addresses to communicate to individual units.



• **Baud Rate Selection Page**

The baud rate of the unit can be updated by entering into the baud rate selection page. Each unit on the network must have a baud rate that matches the main controller or the units will not be able to communicate with the network properly. It is possible that one unit with a mismatched baud rate can take down the whole network by sending information at an unrecognized rate. Metasys® utilizes a single baud rate of 9600 for all systems, and therefore does not need to ever be changed.



• **Device Instance Page**

The device instance selection only affects units utilizing the BACnet® MS/TP communication protocol because other protocols do not use device instance as an identifier. Device instance is a unique identifier for an individual unit on the BACnet® MS/TP network. CarnesLink allows values between 0-9999 as device instance values and the option to select device instance will only appear if the communication protocol selection is BACnet® MS/TP.



• **Parity Selection Page**

The parity selection only affects units utilizing the Modbus® RTU communication protocol because all other protocols are fixed at no parity with 1 stop bit. When using the Modbus® RTU protocol the parity selection must match that of the main controller or the unit will not be able to communicate properly. The parity can be adjusted by entering into the parity selection page and choosing from the list of options. The parity selection option will only appear if the communication protocol selected is Modbus® RTU.



Table 9 - Network Device Parameters

Protocol	Address Range	Baud Rate Range	Polarity	Device Instance
BACnet® MS/TP	1 - 127	9600 - 115200	Fixed at: 0 = No Parity, 1 Stop Bit	0 - 9999
Modbus® RTU	1 - 247	2400 - 115200	0 = No Parity, 1 Stop Bit 1 = Odd Parity, 1 Stop Bit 2 = Even Parity, 1 Stop Bit 3 = No Parity, 2 Stop Bits	Not Applicable
Metasys® N2	1 - 255	Fixed at 9600	Fixed at: 0 = No Parity, 1 Stop Bit	Not Applicable
Siemens® FLN	1 - 98	2400 - 115200	Fixed at: 0 = No Parity, 1 Stop Bit	Not Applicable

Schedule Page

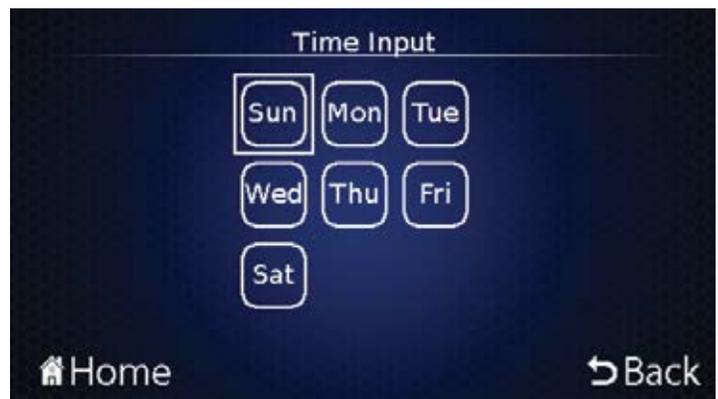
Important Note: The schedule function cannot run simultaneously with a BMS backend override; enabling one will automatically disable the other. That is not to say that the BMS communication cannot be active while the schedule function is active, just that the backend override functions cannot be active when the schedule function is active. This means that the BMS cannot control the unit on, off, or drain without disabling the schedule function also. This works both ways also, as in the schedule function activating will disable any backend override control that is currently active.

The schedule function gives the user the ability to control the humidifier based on an internal schedule. When the schedule function is enabled, the user is prompted to enter in a time value for the unit to track. The time is shown in the top center of the home screen when the schedule function is enabled. Each day contains 5 active timeslots for the user to program. If the humidity control selection is common humidistat the unit will either be on or off depending on the timeslot selection. If the humidity control selection is humidity sensor, the unit can control to different %RH setpoints in each timeslot and control to the default %RH setpoint when no timeslots are active.



Time Input Page

The time input page gives the user the ability to input the current day and time. The time input is required for the unit to function properly with the schedule function enabled. The time input does not sync with any outside parameters, so it is important that the user verify that the time and day are setup correctly. The time input does not allow for dates to be entered because the humidifier controls the schedule on a weekly basis, meaning that each week will control to the same timeslots saved for the previous week.



• **Day Pages**

Each day page gives the user the ability to enter in times (and %RH depending on the humidity control method) for when they would like their humidifier to be active during that specific day. Each day can hold up to 5 unique timeslots and each timeslot is saved into internal memory when entered, so the only way to stop a timeslot from running is to delete it from the queue on that specific day.



Pressing the plus button will take the user to a page where a start and stop time can be input. From here, pressing the start or stop buttons will allow the user to enter in a time. Once the correct times are entered, the timeslot can be saved by pressing the confirm button on the run time page. If the stop time and start time do not arrange chronologically you will not be allowed to save the timeslot.



Pressing the minus button from the day page will allow the user to delete timeslots. Once the minus button is pressed the outline of the timeslots will appear red with a red "X" at the end of each. Pressing the timeslot or the red "X" when they are outlined in red will delete that timeslot.



Pressing on an individual timeslot when they are outlined in white (not red, for when the delete selection is active) will give the user the ability to edit the selected timeslot. This action will take the user to the run time page where start and stop times can then be edited and saved if they are valid.

• **Schedule Function Control of %RH When Using a Humidity Sensor**

The schedule function has the ability to control the %RH setpoint individually in each timeslot if the humidity control method utilizes a humidity sensor over a humidistat. When the humidity sensor control mode is enabled there is an extra setting added to the run time page for adding the desired %RH setpoint for that specific timeslot. When a timeslot is not active and the humidity control method is humidity sensor, the unit will stay active with the common default %RH setpoint, unlike if the humidistat is the humidity control method selected, where the unit will turn off in between active timeslots.



Default Settings Page

The default settings page gives the user the ability to return all settings in the unit to its factory default value. The default settings are as followed...

- User Defined Maximum Output = Unit Nominal Maximum Output
- Fan Speed = 100%
- Settings Password Enabled
- Settings Password = 1212
- Boil Down Timer = 25 seconds
- Filling Timeout = 30 minutes
- Corrective Drain Length = 30%
- Reduced Setpoint Timeout = 24 hours
- Humidity Control Method = Humidistat
- Humidity Setpoint = 45%RH
- Communication Setup is unchanged
- Schedule function is disabled
- Drain valve pulse is disabled
- 72-hour drain is enabled
- Auto-Dim is enabled
- Units = Lb/Hr



Settings Toggle Page

The settings toggle page is located at the end of the settings pages when pressing the right arrow. The settings on the settings toggle page are described as follows.

- **Drain Valve Pulse:** The default is disabled, and enabling this setting will cause the drain valve to pulse whenever draining. This is especially helpful when it is common for the drain valve to get sediment stuck in the plunger system, and occurs when cylinders have significant scale and sediment buildup inside.
- **72-Hour Drain:** The default is enabled and this function will drain the unit if there is no activity for 72-hours. It is not recommended to disable this option as standing water in a cylinder can cause various conductivity and sanitary issues. Dirty water and rust can build up in a cylinder that is not periodically drained during times of inactivity.
- **LCD Auto-Dim:** The default is enabled and this function will allow the LCD screen to dim after a period of no user input. It is recommended to leave this function enabled as it will reduce risk of LCD backlight issues.
- **Steam Output Units:** The default is Lb/Hr and can be switched between Lb/Hr and Kg/Hr.



Change Unit Code Page

The user should never need to utilize the change unit code page because each unit is shipped configured properly from the factory. Changing the unit code without proper authorization can cause severe damage to the unit and surrounding equipment and result in personal injury or death. The change unit code page is password protected and under very rare circumstances does the user ever need to update the code (changing electrical sizing).



Start-Up Procedure:

1. Connect supply water, drain, steam hose, electrical power, and control wiring to the unit.
2. Verify the power and steam output on the unit sticker match the supplied power.
3. Verify that the steam cylinder is properly installed in the drain valve assembly, and that all wires and wire connectors are in the proper position and secure on the top of the cylinder.
4. Open valve allowing water to flow to the humidifier and check for leaks inside the humidifier cabinet.
5. Reattach the front and side panels.
6. Turn on main power to the unit.
7. Adjust the desired humidity setpoint on the humidistat or thermostat.
8. Press the on/off button on the front panel to turn the humidifier on.
9. The humidifier will run if the unit is turned on, the air flow is active, and the humidistat is measuring a humidity level that is lower than the user entered setpoint.
10. Press the drain button on the front display to verify the drain function is operating properly. The fill valve and drain valve will open in sync to lower the water temperature from the unit to the drain.
11. Press the drain button again to enter back into the normal operation of the humidifier.

ELECTRODE STEAM HUMIDIFIER | Sequence of Operations

The humidifier is directly controlled by a humidistat/humidity sensor, a high limit humidistat, and an air flow switch. When all external control signals allow for the production of steam, the unit will start boiling water. The humidifier control board will read the control signals from the humidistat/humidity sensor and high limit humidistat, and vary the steam output to bring up the humidity level to the user entered setpoint. The humidifier will control the steam output by measuring the current flowing between the electrodes in the steam cylinder and varying the water level in the cylinder to allow for more or less current to flow. The current will range between $\pm 10\%$ of the max current set by the user from the maximum setpoint adjustment page. The water level in the cylinder will depend upon the overall hardness and conductivity of the supply water.

Operating Modes:

Off:

When the center toggle switch is in the middle position the unit will be in off mode. The steam output and steam menu buttons should both be white, as neither of them are currently active in off mode.

Manual Drain:

If the toggle switch is pushed to the right, the unit will enter into a manual drain state. The unit will drain until the user has turned the unit off, or 20 minutes of continuous draining has elapsed.

On/Standby:

If the front toggle switch is pushed to the left, the unit will transition into a standby mode. In standby mode, the unit will not generate steam; it will wait and continuously check for demand signals from the external controls. The steam menu button on and the steam output on the main screen will both be red, signaling to the user that the unit is on but not allowed to generate steam due to the external controls. Once the humidifier senses a call for humidity, the unit will transition to a 5 second drain and then move to the steady state sequence.

Steady State:

In steady state mode the unit will close the power relay and begin generating steam. The steam menu icon will appear as white, along with a steam output measurement greater than zero, signaling to the user that the unit is generating steam. The unit will continue to stay in steady state mode as long as there is demand from the external controls and the measured current does not go below or exceed allowable electrical current thresholds, pre-programmed into the humidifier controller board. If the measured current drops below -10% of the desired current setpoint, the unit will transition to the fill state, where current will go up due

to water being introduced into the cylinder. Likewise, if the measured current exceeds $+10\%$ of the current setpoint, the unit will transition to the drain state, where current will go down due to water leaving the cylinder.

Fill:

In the fill state the unit continues to generate steam with the power relay energized, but will open the fill valve, allowing water to flow into the cylinder. The blue "Fill" LED will illuminate, signaling to the user that the unit is filling. If the measured current exceeds the current setpoint by $+5\%$, the unit will transition back into steady state.

Automatic Drain:

In the automatic drain state the unit continues to generate steam and will open the fill valve and drain valve, allowing for tempered water to flow out of the cylinder base. The blue "Fill" and red "Drain" LEDs will illuminate, signaling to the user that the unit is draining. If the measured current exceeds the current setpoint by $+15\%$, the unit will transition to off and illuminate the red service required light. Also if the measured current drops below $+5\%$ of current setpoint the unit will transition back into steady state.

Pulse Drain:

If the unit senses that the fill or drain valve are having trouble controlling the water level in the cylinder, the unit will enter a pulse-drain mode. The unit will pulse the drain on and off for 20 seconds, in attempt to dislodge any materials or sediment that may be causing issues with the drain valve assembly.

ELECTRODE STEAM HUMIDIFIER | Troubleshooting Guide

SYMPTOM	CAUSE	ACTION
Humidifier unit will not turn on	No electrical power to unit	Verify voltage of main power supply. Verify position of main power breaker. Check input power terminal block connections.
	No electrical power to humidifier control board	Verify that the output of the low voltage transformer is 24V _{AC} .
Cylinder not generating steam	Improper cylinder wiring	Verify proper electrical connections to the cylinder top.
	Electrode degradation	Visually inspect the cylinder for severe electrode degradation. If electrodes show signs of corrosion or are completely covered in mineral buildup, replace the cylinder.
	No demand for humidity from humidistat	Verify that controls are sending a demand signal for steam generation.
	Water conductivity too low	Verify water conductivity levels of incoming water meet the standards required for steam generation
Unit will not fill with water	Water supply issues	Verify proper connection to water supply.
		Verify that external water supply valve is open and allowing water to flow to unit.
		Check the fill valve input strainer for mineral deposits. If so, clean strainer or replace.
	Malfunctioning fill valve (cannot open)	Verify proper operation of fill valve by checking for obstructions in the valve assembly, verifying electrical connections to the valve, and verifying proper voltage levels (24V _{AC}) to the fill valve when it is being commanded on by the unit. The fill valve will receive an on command if the unit is put into manual drain mode, which is done by pressing the drain button on the front panel. Replace valve if needed.
Malfunction drain valve (stuck open)	Check for obstruction in drain valve assembly and remove.	
Unit will not stop filling with water	Issues with overflow indication	Check that the high water indication probe is functioning properly by allowing fill cup to overflow into the overflow tube. This can be done by removing the electrical connection to the drain valve and pressing the drain button on the front panel. This will cause the fill valve to turn on while the drain valve remains off, and the unit will eventually overflow with water.
	Malfunctioning fill valve (stuck open)	Verify there are no obstructions in the fill valve that could be causing issues with seating properly. If so clean or replace valve.
	Malfunctioning drain valve (cannot open)	Verify proper operation of drain valve by checking for obstructions in the valve assembly, verifying electrical connections to the valve, and verifying proper voltage levels (24V _{DC}) to the valve when it is being energized on by the unit. The drain valve will receive an on command if the unit is put into manual drain mode, which is done by pressing the drain button on the front panel. Replace valve if needed.

ELECTRODE STEAM HUMIDIFIER | Troubleshooting Guide

SYMPTOM	CAUSE	ACTION
The unit cannot drain	Malfunctioning drain valve (cannot open)	Verify proper operation of drain valve by checking for obstructions in the valve assembly, verifying electrical connections to the valve, and verifying proper voltage levels (24V _{DC}) to the valve when it is being energized on by the unit. The drain valve will receive an on command if the unit is put into manual drain mode, which is done by pressing the drain button on the front panel. Replace valve if needed.
Humidifier output cannot meet desired humidity setpoint level	Humidifier is not receiving proper demand signal	Verify wiring of external controls.
	Humidifier output is not large enough to satisfy area	Increase output of humidifier by selecting a higher max current or by wiring unit to a higher voltage level, if possible.
		Check steam hose for leaks.
		Verify that there is not excessive internal steam pressure in the cylinder. This can be caused by improper installation of steam hose, absorption manifold or even high duct static pressures.
Look into upgrading to larger Carnes humidifier units.		
Humidifier output is higher than desired humidity setpoint level	Humidifier is not receiving proper demand signal	Verify wiring of external controls.
	Malfunctioning external controls	Verify the external controls are functioning properly.
	Improperly located external control	Relocate external controls to meet guidelines discussed in humidifier IOM.
Humidifier generating noise	Filling, draining, and power relay noise	It is normal for the unit to make small amounts of noise periodically. The fill and drain valves along with the power relay will all make a clicking sound when energized or de-energized, and the fill valve will hiss as water flows through the assembly.
		Loud buzzing noises indicates a poorly aligned valve steam and the valve will need to be replaced for proper operation.
Arcing	High conductivity water	Verify water conductivity levels of incoming water meet the standards required for steam generation.
	Flakes of debris in cylinder	Fill and drain cylinder a few times in attempt to return to proper operation. If problem persists, replace cylinder.
Service required indications	Persistent boil down issues have caused the unit to stop	If the cylinder is nearing end of life, replace the cylinder.
		Verify water conductivity levels of incoming water meet the standards required for steam generation.
		Adjust the boil down timer to a lower value to allow the unit to operate.
		Flush cylinder water by manually draining unit and try to run again.
	Extended reduced setpoint has caused the unit to stop	If the cylinder is nearing end of life, replace the cylinder.
		Update the user set maximum output of the unit.

ELECTRODE STEAM HUMIDIFIER | Troubleshooting Guide

SYMPTOM	CAUSE	ACTION
Service required indications <i>(Continued)</i>	High water while filling has caused the unit to stop	Verify water conductivity levels of incoming water meet the standards required for steam generation.
		Update the user set maximum output of the unit.
		Replace cylinder.
	State timeout has caused the unit to stop	Verify the fill and drain valve are functioning properly.
		Verify that there are no clogs in the exiting steam hose, overflow tubing, or drain line.
	High water while in steady state has caused the unit to stop	Verify that there are no clogs in the exiting steam hose or overflow tubing.
	High water while draining has caused the unit to stop	Verify that the drain valve assembly is functioning properly, with no clogs or debris
		Verify the fill valve, fill cup, and overflow tubing is functioning properly, with no clogs or debris.
	Over-current issues have caused the unit to stop	Verify water conductivity levels of incoming water meet the standards required for steam generation.
		Inspect the cylinder for excess debris, and run some manual drain cycles to clear out any remaining debris.
Replace cylinder.		
Water in duct or spitting from distributor pipe	Improper installation of steam or condensate hose	Verify routing of all hoses meet guidelines discussed in humidifier IOM.
	Malfunctioning condensate line	Verify condensate line is not blocked or kinked, allowing for water to flow freely.
	Improper installation of distributor pipe	Verify distributor pipe installation meets guidelines discussed in humidifier IOM.
Foaming	Foreign material or impurities in water supply.	Clean all water lines, replace if necessary.
		Replace cylinder.
		Reduce softening mix or concentration.
		Increase water volume by correcting any draining issues.
		Switching dual electrode configuration.

ELECTRODE STEAM HUMIDIFIER | Humidifier Operational Specifications

1. Provide self-contained electronically controlled steam generating humidifiers of the size(s) shown on plans as manufactured by Carnes Company, Verona, WI.
2. Carnes Humidifiers shall have the capacity to operate at 115, 208, 230, 277, 380, 415, 460 and 575 volt (or nominal value), 60 or 50 hz (cycle), single or 3 phase power. Specific combination of maximum output, voltage and phase for order application determined by electrical data chart.
3. The humidifier(s) shall be UL and cUL listed.
4. The humidifier(s) shall have a total Color "True Touchscreen" user interface. Features:
 - a. True Touchscreen navigation for all aspects of operation and information access.
 - b. Cylinder life counter for hours of operation. Found by accessing the "Settings" button.
 - c. With Fan Distribution Unit, there is a fan speed Slide Bar control with CFM indication. Found by accessing Settings button.
 - d. "Help" screen button.
 - e. "Service Required" button and indicator and corresponding screen explaining service issues and possible troubleshooting tips.
 - f. "Dim LCD" feature button.
 - g. "Settings" button - where all operational values can be set.
 - h. "Setpoints" button - target steam output of the humidifier.
5. Steam shall be generated from tap water or softened water (see factory representative) in a factory sealed cylinder containing electrodes. Cylinders shall not require setting of electrode spacing, cleaning or maintenance and shall be of the disposable type.
6. The humidifier(s) shall include an automatic drain cycle controlled electronically to maximize energy and water usage efficiency. Drain cycle shall adapt to variations in water conditions (high/low conductivity and high/low hardness) and not require manual setting. There is also a default setting for a pulsing drain action to assist in keeping drain lines open.
7. In the event of over-current, the humidifier shall signal that a fault condition exists by a message on the touchscreen.

Option: Humidifier(s) shall also include secondary magnetic overload switches (circuit breakers) that shall be manually resettable and shall be of the type that positively disconnects power to the steam cylinder.
8. Humidifier(s) shall include a door interlock safety switch to disconnect power to steam cylinder(s) when cabinet door is opened.
9. The system shall include one steam distributor pipe for each steam generating cylinder mounting in the duct as shown on the plans. Steam distributing pipe(s) shall be of corrosion resistant design (stainless steel) and be designed to provide uniform distribution over the entire length of the pipe.

Option: Supply and install remote (or humidifier mounted) fan distribution units to discharge steam directly into the conditioned space.

Provide the following components:

 - a. Three 12VDC fans operated by the circuit board.
 - b. Integral steam manifold trap.

Option: When plans call for a specific short absorption distance from dispersion system, a multi-tube Short Absorption Manifold is available sized specifically to duct dimensions, with horizontal stainless steel cross tubes and vertical headers.
10. The system shall include flexible hose to connect the steam cylinder(s) to the steam distributor pipe(s). A separate condensate return line shall return condensate to the humidifier for reuse to minimize consumption. If due to specific routing issues or application of unit, condensate line cannot run back to unit, the line can go directly to the common drain, and the addition of a "circle" or "U" trap will be required (see IOM). Long distances from unit to common drain can be accommodated with accessory option Water Pump (HXWA). Hard tubing can be used for Steam Hose and Condensate Return to prevent sags, restrictions or obstructions (see IOM), but it is recommended a minimum of 12 inches of flexible hose be used from unit and before distributor pipe. We recommend a maximum distance of 10 feet from unit to distributor pipe(s) or short absorption manifold and proper routing and inclination of hoses and hard tubing be adhered to for proper, overall consistent and dependable operation.
11. The humidifier(s) shall incorporate a 1" air gap on the fill water line to prevent backflow. It is recommended that a drain air gap fitting be installed by a non-Carnes contractor to prevent backflow of water. Carnes offers an air gap fitting as a purchased option.
12. The humidifier cabinet(s) shall be constructed of 304 B 20 gauge stainless steel and shipped with a protective film. The cabinet door shall be hinged and provided with a lock and key. The main door is also provided with a quick release pin for removal to provide easy access to internals. The True Touchscreen Home Page will show a digital LCD steam output meter calibrated in pounds of steam per hour (kg of steam per hour selection is included as a built in option), fill cycle, drain cycle and high water indicator lights will be visible with the cabinet door closed.
13. The humidifier(s) shall be controlled by a humidistat which operates through the circuit board. Humidifier(s) shall incorporate terminals for connection of humidistat, air flow switch and high limit control humidistat.

Option: Provide the following accessory controls:

 - a. Wall mounted humidistat, on/off control.
 - b. Wall mounted humidistat, w/ LCD combo.
 - c. Duct mounted humidistat, on/off control.
 - d. Duct mounted humidistat, proportional control.
 - e. Duct mounted humidistat w/digital humidity and temperature, combo.
 - f. High limit duct mounted humidistat, on/off control.
 - g. High limit duct mounted humidistat, proportional control.
 - h. Pressure differential type air flow switch.
 - i. Paddle type air flow switch.
 - j. Wall or duct mounted temperature compensated, on/off or proportional control, digital display humidistat.
14. External Control Signals - All Carnes humidifiers will accept external DDC control signals of 0-10 volt DC. Signal to modulate the output of humidifier. Polarity must be observed and input impedance is 20 kilo-ohms. If 4-20 mA signal is provided a 470 ohm, 1/4 watt resistor must be installed. Humidifiers will also accept internal (BMS) building management system or (BAS) building automation system signal.

Option: CarnesLink offers the ability to monitor and control Carnes humidifier(s) ("H" Series and newer) by allowing the humidifier(s) to link to your Building Management System (BMS) using communication protocols; BACnet® (MS/TP), Modbus® (RTU), Metasys® (N2) and Siemens® (FLN). CarnesLink uses a communication chip that is factory installed on our electronic circuit board, mounted internally inside the humidifier(s) cabinet. The electronic circuit control board has a translucent protective conformal coating that protects the electronic components on the board. Features include: Oxidation Resistant, Ozone Resistant, Thermal Resistant, UV Resistant, Water Resistant, high temperature stable, low temperature stable and operational temperature range -45°C to 200°C.
15. The fill water line shall include a strainer to remove sediment from incoming water and a flow regulating control to automatically compensate for water pressures from 20-120 psi.
16. Humidifier(s) shall include a "Service Required" button (illuminated in RED) on the total "True Touchscreen" home page which shall explain service issues and possible troubleshooting tips. The light shall be visible with the cabinet door closed and terminals shall be provided for remote signal. Terminals are also provided to indicate normal operation to a remote location.
17. Dedicated buttons with indicator lights on the steam page of the total "True Touchscreen" shall indicate status of the control humidistat, high limit humidistat, air flow switch and door interlock switch. Operation of fill solenoid, drain solenoid, power contactor and high water sensor shall be shown after accessing the "Component Activity" button on the home page of the total "True Touchscreen".
18. The humidifier(s) electronic circuit board shall include automatic controls to compensate for varying water conditions without changing cylinders or electrode spacing. The control shall activate the fill and drain solenoid valves to automatically maximize efficiency. Unit will perform system self-correction procedures to assist in preventing unit shut-down due to any fault in operational sequence. A drain pulsing feature is included to assist in expelling any blockage that may occur during a self-correcting drain cycle. If self-correction procedures are unable to correct problems after specific cycles, unit will automatically shut-down.
19. The humidifier(s) shall include a non-water contact capacitance proximity high water sensor to prevent overflowing and loss of water.
20. The fill solenoid valve shall open whenever the drain solenoid is activated, whether in automatic or manual operation, to prevent discharge of boiling water into drainage system. Drain light shall indicate the switch is in drain position.
21. Humidifiers, dependent upon capacity, will have one (1) or two (2) cylinders for operation. If a capacity is desired of 125, 150, 175 or 200 lb./hr., the units will be equipped with two (2) cylinders, each independently and separately controlled by their own control signal.
22. Automatic Drain of cylinder water will take place when there is a demand signal loss for 72-hour drain setting is turned on. Unit will remain in stand-by in the event that a quick startup is required.

ELECTRODE STEAM HUMIDIFIER | Replacement Parts List

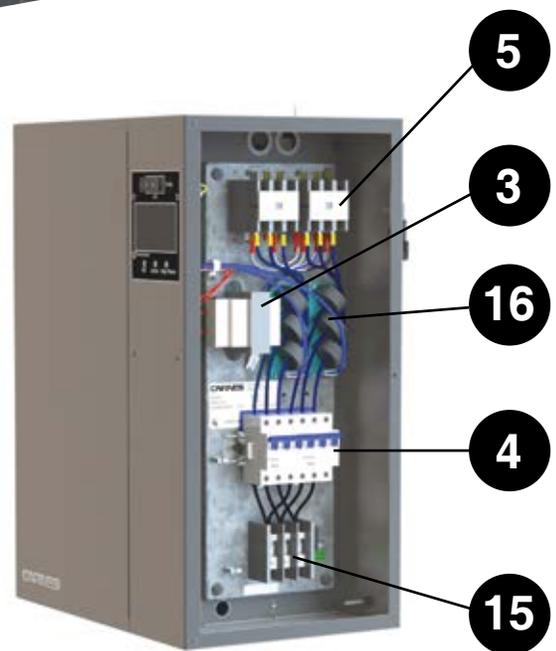
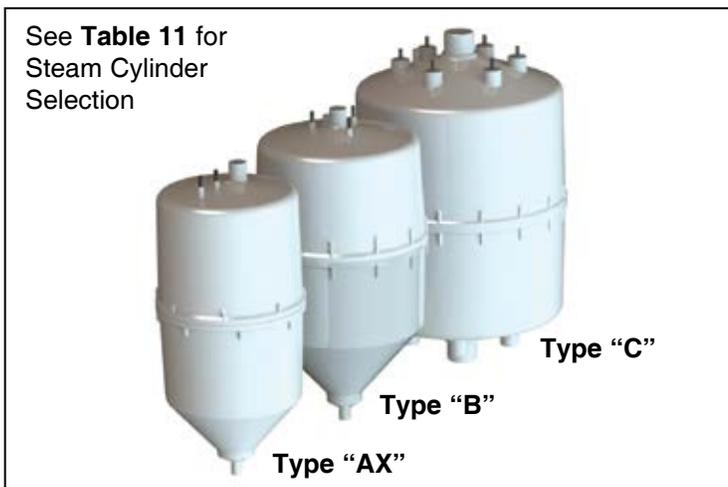
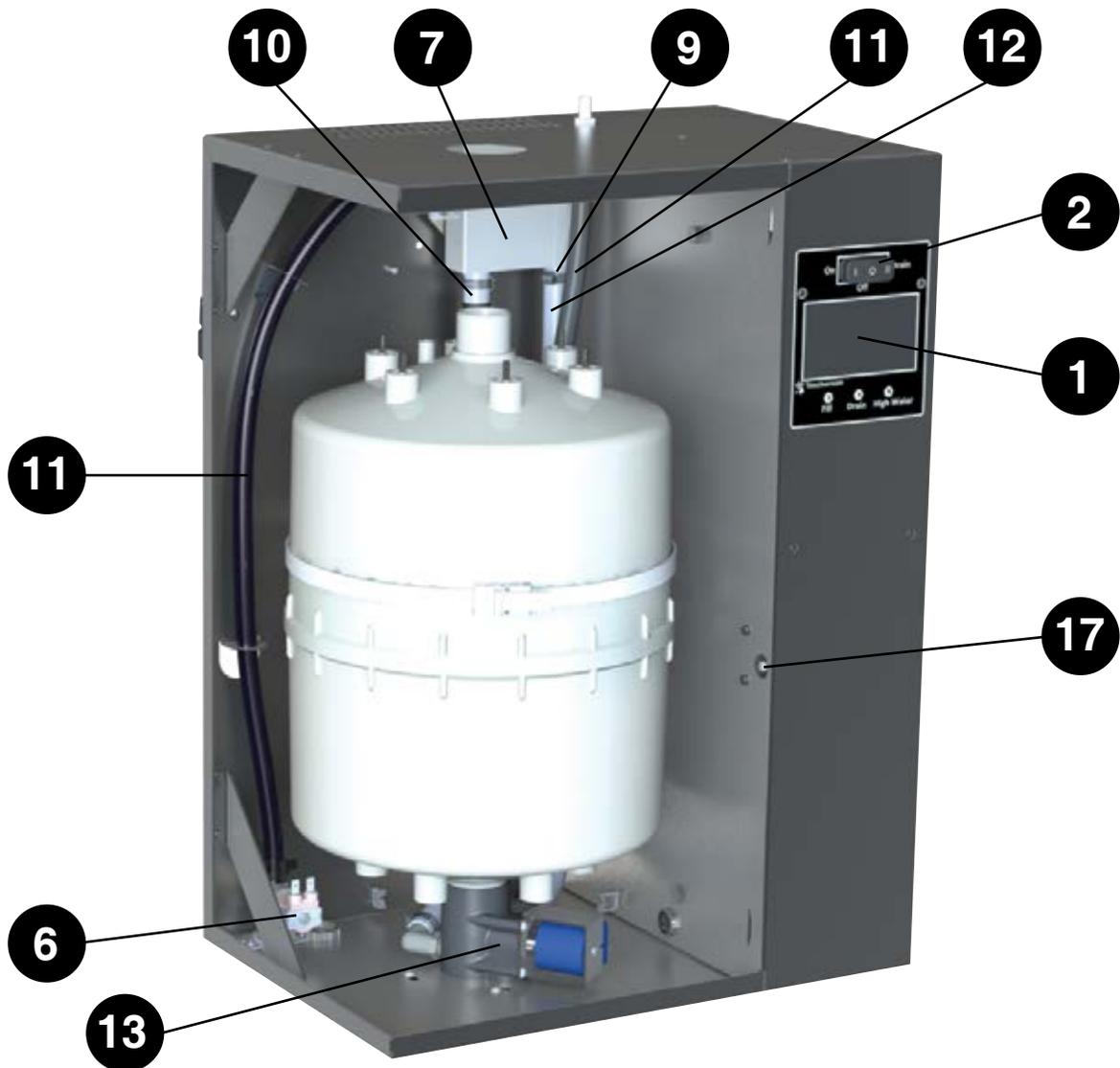


Table 10: Replacement Parts List

Item #	Description	Models Where Used	Part #
1	Circuit Board with Touch Screen Display	ALL	SEE TABLE
	"H" Series Retrofit Circuit Board with Touch Screen	ALL "H" Series Models	SEE TABLE
1	CarnesLink Expansion Board	All	H-690-0108
1	CarnesLink Pico Port (Chip)	All "H" and "J" Series	H-999-6120
2	On-Off-Drain Switch	ALL	H-999-7331
3	Power Transformer	ALL	SEE TABLE
4	Circuit Breaker (Optional)	"HT" Models Only	SEE TABLE
5	Contractor	ALL	SEE TABLE
6	Water Fill Valve ("AX"/"B" Cylinder .26GPM)	H_AJ, H_DJ	H-999-7172
6	Water Fill Valve ("C" Cylinder .53GPM)	H_GJ	H-999-7170
6	Water Fill Valve (Dual Cylinder .53GPM)	H_HJ	H-999-7171
7	Molded Fill Cup	ALL	H-690-4135
8	Fill Cup & Cylinder Bracket ("AX" Cylinder)	H_AJ	H-690-1641
8	Fill Cup & Cylinder Bracket ("B" Cylinder)	H_DJ	H-690-1642
8	Fill Cup & Cylinder Bracket ("C" Cylinder)	H_GJ, H-HJ	H-690-1645
9	Metal Hose Clamp	ALL	H-999-7165
10	High Water Sensor Sub Assembly ("AX" / "B" Cylinder)	H_AJ, H_DJ	H-690-1360
10	High Water Sensor Sub Assembly ("C" Cylinder)	H_GJ	H-690-1359
10	High Water Sensor Sub Assembly ("Dual" Cylinder)	H_HJ	H-690-1358
11	Water Fill Tube	ALL	H-999-6450
12	Clear Hose 5/8" ID (Per Foot)	ALL	HXLA
13	Drain Sub Assembly with Valve ("AX" Cylinder)	H_AJ	H-690-0542
13	Drain Sub Assembly with Valve ("B" Cylinder)	H_DJ	H-690-0543
13	Drain Sub Assembly with Valve ("C" Cylinder)	H_GJ	H-690-0544
13	Drain Sub Assembly with Valve ("Dual" Cylinder) LH	H-HJ	H-690-0545
13	Drain Sub Assembly with Valve ("Dual" Cylinder) RH	H-HJ	H-690-0546
14	Terminal Connector with Wire ("AX" / "B" Cylinder)	H_AJ, H_DJ	H-690-3781
14	Terminal Connector with Wire ("C" Cylinder)	H_GJ, H-HJ	H-690-3161
15	Power Distribution Block	ALL	SEE TABLE
16	Current Sensing Transformer (Sub Assembly 1)	ALL (H-998-0097)	SEE TABLE
16	Current Sensing Transformer (Sub Assembly 3)	ALL (H-998-0098)	SEE TABLE
17	Door Interlock Switch	ALL	H-801-7801
18	Wire Harness ("AX" / "B" Cylinder)	H_AJ, H_DJ	H-998-6997
18	Wire Harness ("C" Cylinder)	H_GJ	H-998-6998
18	Wire Harness ("Dual" Cylinder)	H_HJ	H-998-6999
19	Drain Cup	ALL	H-999-5690

* = Not Shown

Table 11: Replacement Parts List

Model	Max. Lb/ Hr	Ph.	Volts	Steam Cylinder	Power Transformer	Contactactor	Terminal Connector with Wire*	Circuit Breaker	Power Distribution Block	Current Sensing Transformer
H_AJA	5	1	120	AX220	998-9537	999-7389	690-3781	999-7406	999-8035	998-0097
H_AJB	5	1	208	AX380	998-9537	999-7389	690-3781	999-7405	999-8035	998-0097
H_AJD	5	1	230	AX380	998-9537	999-7389	690-3781	999-7406	999-8035	998-0097
H_AJF	5	1	277	AX380	998-9535	999-7389	690-3781	999-7405	999-8035	998-0097
H_AJL	5	1	380	AX600	998-9535	999-7389	690-3781	999-7405	999-8035	998-0097

ELECTRODE STEAM HUMIDIFIER | Replacement Parts List

Table 11: Replacement Parts List — Continued

Model	Max. Lb/ Hr	Ph.	Volts	Steam Cylinder	Power Transformer	Contactora	Terminal Connector with Wire*	Circuit Breaker	Power Distribution Block	Current Sensing Transformer
H_AJQ	5	1	415	AX600	998-9535	999-7389	690-3781	999-7405	999-8035	998-0097
H_AJM	5	1	460	AX700	998-9537	999-7389	690-3781	999-7405	999-8035	998-0097
H_AJN	5	1	575	AX700	998-9539	999-7389	690-3781	999-7412	999-8035	998-0097
H_AJA	10	1	120	AX220	998-9537	999-7480	690-3781	999-7409	999-8035	998-0097
H_AJB	10	1	208	AX380	998-9537	999-7389	690-3781	999-7407	999-8035	998-0097
H_AJD	10	1	230	AX380	998-9537	999-7389	690-3781	999-7407	999-8035	998-0097
H_AJF	10	1	277	AX380	998-9535	999-7389	690-3781	999-7406	999-8035	998-0097
H_AJL	10	1	380	AX600	998-9535	999-7389	690-3781	999-7405	999-8035	998-0097
H_AJQ	10	1	415	AX600	998-9535	999-7389	690-3781	999-7405	999-8035	998-0097
H_AJM	10	1	460	AX700	998-9537	999-7389	690-3781	999-7405	999-8035	998-0097
H_AJN	10	1	575	AX700	998-9539	999-7389	690-3781	999-7412	999-8035	998-0097
H_DJB	20	1	208	B381	998-9537	999-7480	690-3781	999-7410	999-8035	998-0097
H_DJD	20	1	230	B381	998-9537	999-7480	690-3781	999-7409	999-8035	998-0097
H_DJF	20	1	277	B381	998-9535	999-7389	690-3781	999-7409	999-8035	998-0097
H_DJL	20	1	380	B600	998-9535	999-7389	690-3781	999-7408	999-8035	998-0097
H_DJQ	20	1	415	B600	998-9535	999-7389	690-3781	999-7407	999-8035	998-0097
H_DJM	20	1	460	B700	998-9537	999-7389	690-3781	999-7406	999-8035	998-0097
H_DJN	20	1	575	B700	998-9539	999-7389	690-3781	999-7412	999-8035	998-0097
H_DJC	20	3	208	B500	998-9537	999-7389	690-3781	999-7407	999-8035	998-0097
H_DJE	20	3	230	B500	998-9537	999-7389	690-3781	999-7407	999-8035	998-0097
H_DJT	20	3	380	B600	998-9535	999-7389	690-3781	999-7405	999-8035	998-0097
H_DJW	20	3	415	B600	998-9535	999-7389	690-3781	999-7405	999-8035	998-0097
H_DJG	20	3	460	B700	998-9537	999-7389	690-3781	999-7405	999-8035	998-0097
H_DJH	20	3	575	B700	998-9539	999-7389	690-3781	999-7412	999-8035	998-0097
H_DJC	30	3	208	B500	998-9537	999-7480	690-3781	999-7409	999-8035	998-0097
H_DJE	30	3	230	B500	998-9537	999-7389	690-3781	999-7409	999-8035	998-0097
H_DJT	30	3	380	B600	998-9535	999-7389	690-3781	999-7407	999-8035	998-0097
H_DJW	30	3	415	B600	998-9535	999-7389	690-3781	999-7406	999-8035	998-0097
H_DJG	30	3	460	B700	998-9537	999-7389	690-3781	999-7406	999-8035	998-0097
H_DJH	30	3	575	B700	998-9539	999-7389	690-3781	999-7412	999-8035	998-0098
H_GJB*	30	1	208	C62	998-9537	999-7389 (2)	690-3781	999-7290	999-8035	998-0097(2)
H_GJD	30	1	230	C62	998-9537	999-7480	690-3161	999-7411	999-8035	998-0097
H_GJF	30	1	277	C62	998-9535	999-7480	690-3161	999-7410	999-8035	998-0097
H_GJL	30	1	380	C62	998-9535	999-7480	690-3161	999-7409	999-8035	998-0097
H_GJQ	30	1	415	C62	998-9535	999-7389	690-3781	999-7409	999-8035	998-0097
H_GJM	30	1	460	C62	998-9537	999-7389	690-3781	999-7408	999-8035	998-0097
H_GJN	30	1	575	C62	998-9539	999-7389	690-3781	999-7414	999-8035	998-0097
H_GJC	40	3	208	C62	998-9537	999-7480	690-3161	999-7411	999-8035	998-0098

*H-690-3781 INCLUDES #10 WIRE.

H-690-3161 INCLUDES #8 WIRE.

* = Circuit Breaker is REQUIRED per NEC 48 amp guidelines.

ELECTRODE STEAM HUMIDIFIER | Replacement Parts List

Table 11: Replacement Parts List — Continued

Model	Max. Lb/ Hr	Ph.	Volts	Steam Cylinder	Power Transformer	Contactors	Terminal Connector with Wire*	Circuit Breaker	Power Distribution Block	Current Sensing Transformer
H_GJE	40	3	230	C62	998-9537	999-7480	690-3161	999-7410	999-8035	998-0098
H_GJT	40	3	380	C65	998-9535	999-7389	690-3781	999-7408	999-8035	998-0098
H_GJW	40	3	415	C65	998-9535	999-7389	690-3781	999-7408	999-8035	998-0098
H_GJG	40	3	460	C65	998-9537	999-7389	690-3781	999-7407	999-8035	998-0098
H_GJH	40	3	575	C65	998-9539	999-7389	690-3781	999-7413	999-8035	998-0098
H_GJC	50	3	208	C62	998-9537	999-7389 (2)	690-3781	999-7409 (2)	999-8035	998-0098
H_GJE	50	3	230	C62	998-9537	999-7480	690-3161	999-7411	999-8035	998-0098
H_GJT	50	3	380	C65	998-9535	999-7480	690-3161	999-7409	999-8035	998-0098
H_GJW	50	3	415	C65	998-9535	999-7389	690-3781	999-7409	999-8035	998-0098
H_GJG	50	3	460	C65	998-9537	999-7389	690-3781	999-7408	999-8035	998-0098
H_GJH	50	3	575	C65	998-9539	999-7389	690-3781	999-7414	999-8035	998-0098
H_GJC*	60	3	208	C62	998-9537	999-7480 (2)	690-3161	999-7291 (2)	999-8035	998-0098 (2)
H_GJE*	60	3	230	C62	998-9537	999-7389 (2)	690-3781	999-7291 (2)	999-8035	998-0098 (2)
H_GJT	60	3	380	C65	998-9535	999-7480	690-3161	999-7410	999-8035	998-0098
H_GJW	60	3	415	C65	998-9535	999-7480	690-3161	999-7409	999-8035	998-0098
H_GJG	60	3	460	C65	998-9537	999-7389	690-3781	999-7409	999-8035	998-0098
H_GJH	60	3	575	C65	998-9539	999-7389	690-3781	999-7414	999-8035	998-0098
H_GJC*	80	3	208	C62	998-9537	999-7480 (2)	690-3161	999-7293 (2)	999-8035	998-0098 (2)
H_GJE*	80	3	230	C62	998-9537	999-7480 (2)	690-3161	999-7292 (2)	999-8035	998-0098 (2)
H_GJT	80	3	380	C12	998-9535	999-7480	690-3161	999-7411	999-8035	998-0098
H_GJW	80	3	415	C12	998-9535	999-7480	690-3161	999-7411	999-8035	998-0098
H_GJG	80	3	460	C12	998-9537	999-7480	690-3161	999-7410	999-8035	998-0098
H_GJH	80	3	575	C12	998-9539	999-7389	690-3781	999-7415	999-8035	998-0098
H_GJC*	100	3	208	C62	998-9537	999-7480 (2)	690-3161	999-7293 (2)	999-8035	998-0098 (2)
H_GJE*	100	3	230	C62	998-9537	999-7480 (2)	690-3161	999-7293 (2)	999-8035	998-0098 (2)
H_GJT*	100	3	380	C12	998-9535	999-7389 (2)	690-3161	Contact Factory	999-8035	998-0098 (2)
H_GJW	100	3	415	C12	998-9535	999-7389 (2)	690-3781	999-7409 (2)	999-8035	998-0098 (2)
H_GJG	100	3	460	C12	998-9537	999-7480	690-3161	999-7411	999-8035	998-0098
H_GJH	100	3	575	C12	998-9539	999-7480	690-3161	999-7416	999-8035	998-0098
H_HJC*	125	3	208	C62 (2)	998-9537	999-7480 (4)	690-3161	999-7291 (4)	999-8035	998-0098 (4)
H_HJE*	125	3	230	C62 (2)	998-9537	999-7480 (4)	690-3161	999-7291 (4)	999-9524	998-0098 (4)
H_HJT*	125	3	380	C12 (2)	998-9535	999-7480 (2)	690-3161	999-7416 (2)	999-8035	998-0098 (2)
H_HJW*	125	3	415	C12 (2)	998-9535	999-7480 (2)	690-3161	999-7416 (2)	999-8035	998-0098 (2)
H_HJG*	125	3	460	C12 (2)	998-9537	999-7480 (2)	690-3161	999-7415 (2)	999-8035	998-0098 (2)
H_HJH	125	3	575	C12 (2)	998-9539	999-7389 (2)	690-3781	999-7414 (2)	999-8035	998-0098 (2)
H_HJC*	150	3	208	C62 (2)	998-9537	999-7480 (4)	690-3161	999-7292 (4)	999-9524	998-0098 (4)
H_HJE*	150	3	230	C62 (2)	998-9538	999-7480 (4)	690-3161	999-7292 (4)	999-9524	998-0098 (4)
H_HJT*	150	3	380	C12 (2)	998-9535	999-7480 (2)	690-3161	999-7416 (2)	999-8035	998-0098 (2)
H_HJW*	150	3	415	C12 (2)	998-9535	999-7480 (2)	690-3161	999-7416 (2)	999-8035	998-0098 (2)
H_HJG*	150	3	480	C12 (2)	998-9537	999-7480 (2)	690-3161	999-7415 (2)	999-8035	998-0098 (2)

* = Circuit Breaker is REQUIRED per NEC 48 amp guidelines.

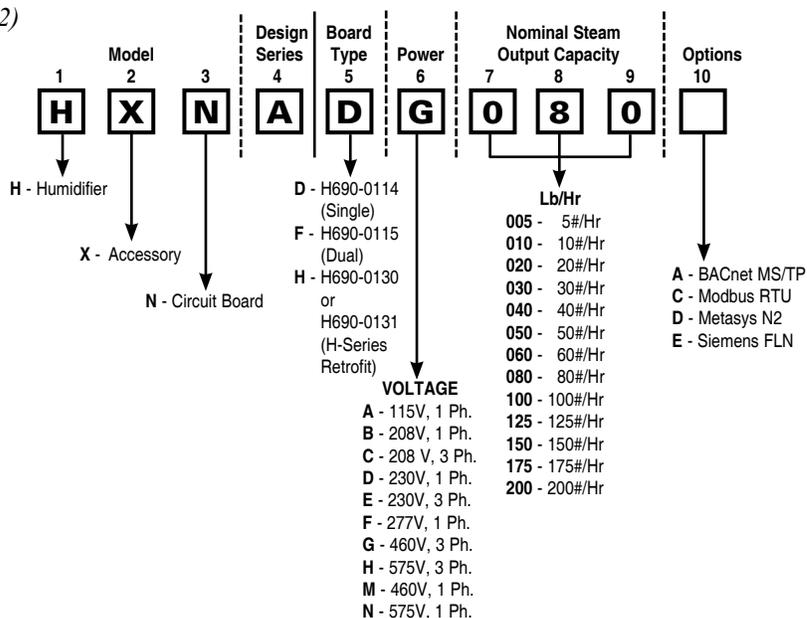
ELECTRODE STEAM HUMIDIFIER | Replacement Parts List

Table 11: Replacement Parts List — Continued

Model	Max. Lb/ Hr	Ph.	Volts	Steam Cylinder	Power Transformer	Contactora	Terminal Connector with Wire*	Circuit Breaker	Power Distribution Block	Current Sensing Transformer
H_HJH*	150	3	575	C12 (2)	998-9539	999-7389 (2)	690-3781	999-7414 (2)	999-8035	998-0098 (2)
H_HJC*	175	3	208	C62 (2)	998-9537	999-7480 (4)	690-3161	999-7293 (4)	999-9524	998-0098 (4)
H_HJE*	175	3	230	C62 (2)	998-9537	999-7480 (4)	690-3161	999-7293 (4)	999-9524	998-0098 (4)
H_HJT*	175	3	380	C12 (2)	998-9535	999-7480 (4)	690-3161	Contact Factory	999-9524	998-0098 (4)
H_HJW*	175	3	415	C12 (2)	998-9535	999-7480 (2)	690-3161	999-7416 (2)	999-9524	998-0098 (2)
H_HJG*	175	3	460	C12 (2)	998-9537	999-7480 (2)	690-3161	999-7415 (2)	999-8035	998-0098 (2)
H_HJH*	175	3	575	C12 (2)	998-9539	999-7480 (2)	690-3161	999-7416 (2)	999-8035	998-0098 (2)
H_HJC*	200	3	208	C62 (2)	998-9537	999-7480 (4)	690-3161	999-7293 (4)	999-9524	998-0098 (4)
H_HJE*	200	3	230	C62 (2)	998-9537	999-7480 (4)	690-3161	999-7293 (4)	999-9524	998-0098 (4)
H_HJT*	200	3	380	C12 (2)	998-9535	999-7480 (4)	690-3161	Contact Factory	999-9524	998-0098 (4)
H_HJW*	200	3	415	C12 (2)	998-9535	999-7480 (4)	690-3161	Contact Factory	999-9524	998-0098 (4)
H_HJG*	200	3	460	C12 (2)	998-9537	999-7480 (2)	690-3161	999-7417 (2)	999-8035	998-0098 (2)
H_HJH*	200	3	575	C12 (2)	998-9539	999-7480 (2)	690-3161	999-7416 (2)	999-8035	998-0098 (2)

* = Circuit Breaker is REQUIRED per NEC 48 amp guidelines.

CIRCUIT BOARD (Table 12)



Seller warrants products manufactured by it and supplied hereunder to be free from defects in materials and workmanship under normal use and proper maintenance for a period of twelve months from date of shipment. If within such period any such products shall be proved to Seller's reasonable satisfaction to be defective, such products shall be repaired or replaced at Seller's option. Seller's obligation and Buyer's exclusive remedy hereunder shall be limited to such repair and replacement and shall be conditioned upon Seller's receiving written notice of any alleged defects no later than 10 days after its discovery within the warranty period and, at Seller's option, the return of such products to Seller, f.o.b. its factory, when such return is feasible. Seller reserves the right to satisfy its warranty obligation in full by reimbursing Buyer for all payments it makes hereunder, and Buyer shall thereupon return the products to Seller. Seller shall have the right to remedy such defects.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES (EXCEPT TO TITLE) INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, PERFORMANCE, OR OTHERWISE, and in no event shall the Seller be liable for claims (based upon breach of express or implied warranty, negligence, product liability, or otherwise) for any other damages, whether direct, immediate, incidental, foreseeable, consequential, or special.