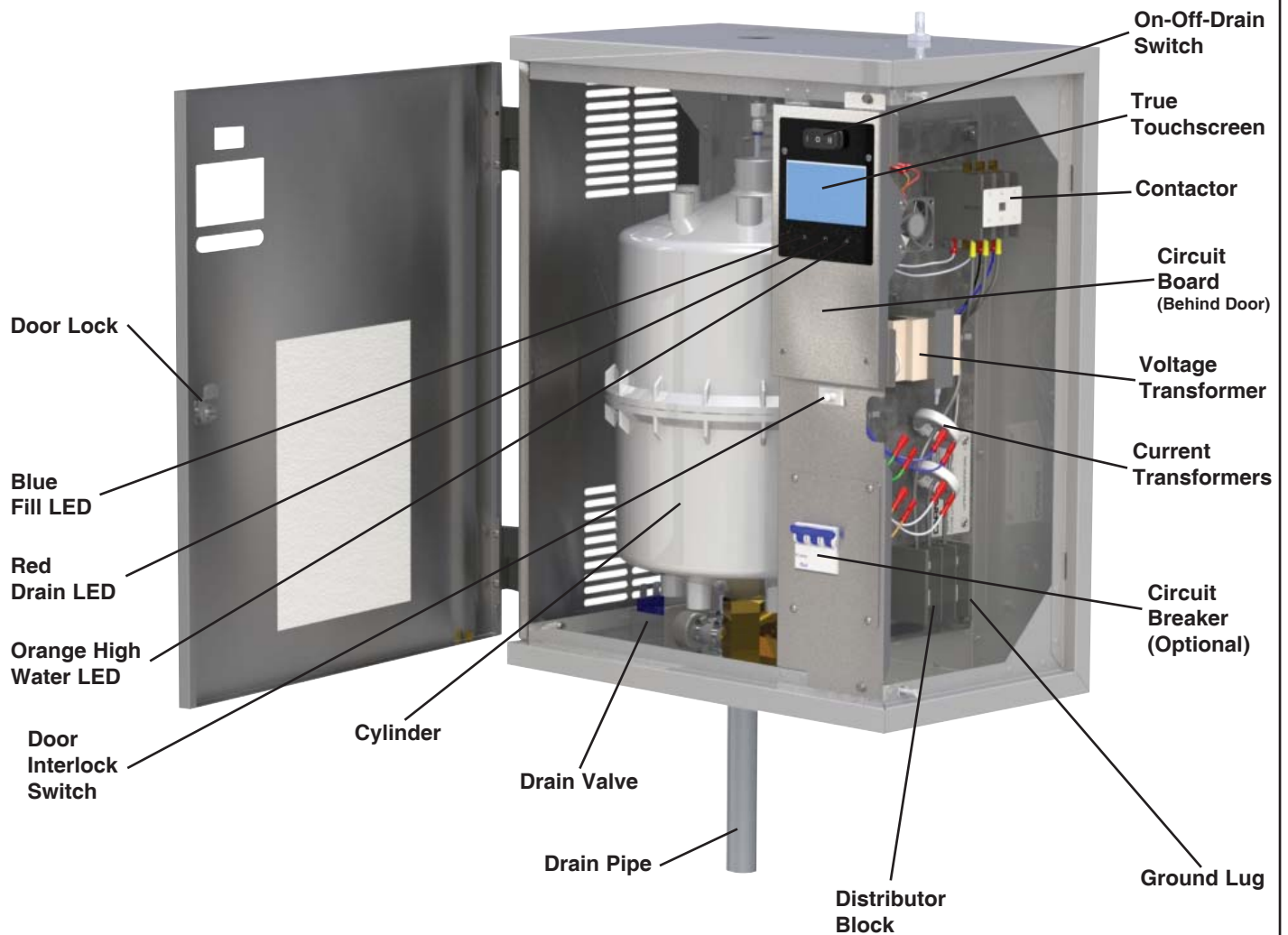


**TRUE TOUCHSCREEN CONTROLLED ELECTRODE STEAM HUMIDIFIER  
DESIGN SERIES "H"**

**INSTALLATION, OPERATION  
AND MAINTENANCE MANUAL**

CARNES COMPANY 448 S. Main St., P. O. Box 930040, Verona, WI 53593-0040 Phone: (608)845-6411 Fax: (608)845-6504 www.carnes.com

**CARNES "H" SERIES HUMIDIFIER**



*Photo A*  
**(Model HTGH Shown)**

# TABLE OF CONTENTS

Introduction - Cautions .....	3
Models .....	4
Installation .....	5-9
Electrical Data Sheet and Definition.....	10-12
Humidifier Component Listing - Combo Unit HT/SAH, HT/SDH & HT/SGH.....	13
Controls .....	14-19
Operation.....	20
True Touchscreen - Displays and Internal Control .....	21-27
Humidifier Mandatory Pre-startup Checklist.....	28
Humidifier Startup Checklist.....	29
Humidifier Startup and Operations.....	30
Fan Distribution Units .....	31-32
Distribution Pipes.....	33
Short Absorption Manifold .....	34-35
Troubleshooting - Symptom, Cause and Action .....	36-41
Humidifier Operational Specifications .....	42
Humidifier Maintenance Checklist.....	43
Preventative Maintenance .....	44
Extended Shutdown/Starting After Extended Shutdown.....	45
Replacement Cylinder .....	46
Removing the Cylinder .....	47
Installing the Cylinder .....	48
Replacement Cylinder Order Form .....	49
Replacement Parts.....	50-53
Warranty .....	54

# INTRODUCTION

## CAUTIONS

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

 **CAUTION** — *Perform all basic safety steps before starting unit.*

1. Proper mounting of unit cabinet to wall as described in following pages.
2. Make sure voltage and phase supply matches that of Product Identification Label located on left side of unit cabinet and located on back plane in electrical section.
3. Qualified installers should be used for electrical and plumbing installation, being aware of all current and corresponding codes.

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

The process of humidification, using an electrode style humidifier, creates steam through the boiling process. Temperatures of this boiling water and steam can reach 212°F (100°C). This system in turn, creates extremely hot surfaces (cylinder surface, steam hose, steam pipe, condensate hose/pipe, distribution piping) and hot water or 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 down completely.

  **WARNING** — **De-energize Electrical Supply**

Before any service or maintenance is performed make sure main power supply is disconnected and safety labeled (If Carnes unit is set up with a built-in circuit breaker, turn off circuit breaker and additionally turn off main power supply breaker). 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.



*HSHH*



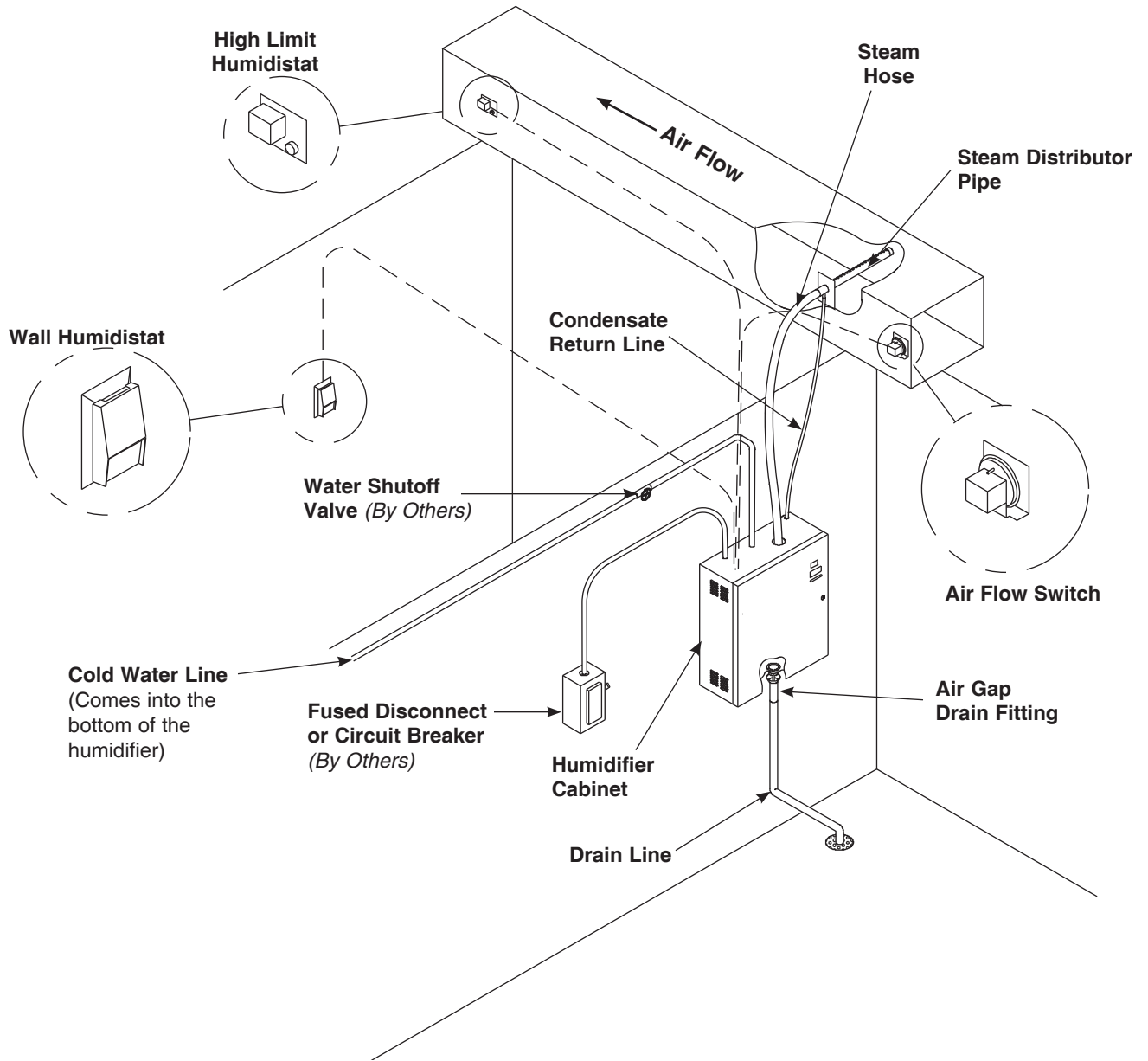
*HTGH / HSAH / HSDH*



*HRAB*

# TYPICAL INSTALLATION

Figure A



**WARNING:** THE HUMIDIFIER CABINET CONTAINS HIGH VOLTAGE WIRING AND HOT SURFACES. THE CABINET DOOR INCLUDES A LOCK AND ACCESS MUST BE LIMITED TO TRAINED AND QUALIFIED PERSONNEL ONLY. THE DOOR MUST BE LOCKED AND KEY MUST BE KEPT IN A SECURE LOCATION AWAY FROM THE HUMIDIFIER.

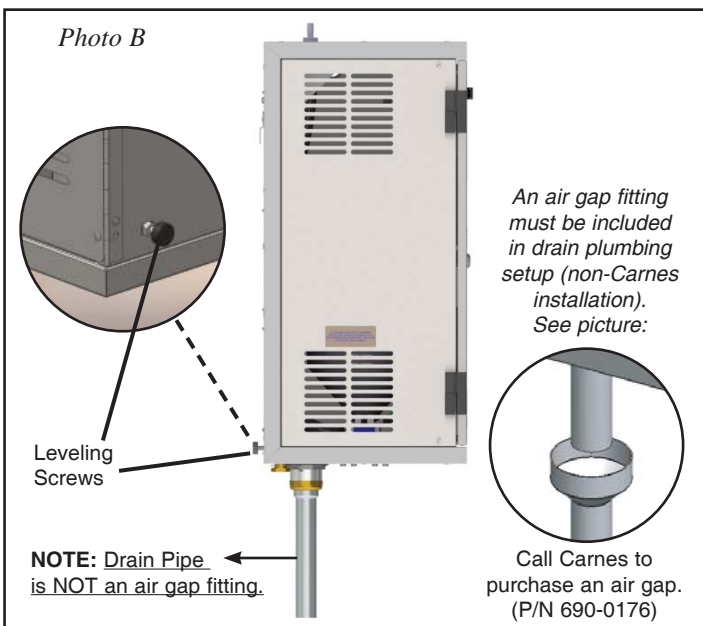
# INSTALLATION

## UNPACKING AND INSPECTION

1. Inside the cabinet is an envelope containing the following items:
  - A. Keys to the humidifier cabinet
  - B. Steam hose clamps
  - C. Condensate return line clamps
  - D. Drain pipe fitting
  - E. Installation, operation and maintenance manual, yellow caution sheet for hose routing, replacement parts list and spec sheet
  - F. Keys to unlock the humidifier cabinet
2. Open the cabinet and check for concealed shipping damage. Report any damage immediately to the carrier who delivered the shipment.
3. The following components are packed in a shipping carton for connection when installing the humidifier.
  - A. Distribution pipe
  - B. Steam hose
  - C. Condensate return line
4. Optional accessories may be packed with the cabinet or in the same shipping carton. Large accessories may ship in separate cartons.

## MOUNTING THE HUMIDIFIER

Locate the humidifier cabinet level and plumb, using the level screws (*Photo B*) on a surface as close to the steam distributor as possible at a convenient height for servicing. Allow 12" or more on each side for panel access and 16" from the bottom of the unit to floor to allow for drain connections. If there is no common drain within close proximity of humidifier, a drain pump (Carnes HXWA) may be required to accommodate this distance. Allow 18" in front of single cylinder cabinets and 38" for dual cylinder cabinets to allow for opening and removal of the cabinet door.



The humidifier must never be located outside or where it may be exposed to freezing temperatures unless a heated, ventilated weather proof enclosure by others is provided. Do not mount humidifiers on a hot or vibrating surface.

Table 1 - MAXIMUM OPERATING WEIGHT

Model	Pounds
H_AH	61
H_DH	72
H_GH	110
H_HH	203

Fasten the mounting bracket to wood studs or solid wood using fasteners shown in fastener recommendation below. Place the mounting flange on the humidifier cabinet over the mounting bracket. A sheet metal screw should be installed through the back of the humidifier cabinet to secure the humidifier to the mounting bracket. Fasteners are not provided by Carnes.

Table 2 - FASTENER RECOMMENDATION\*

\*1/4" Lag Screw, 1" Minimum Length

Model	Fasteners Required
H_AH	4
H_DH	4
H_GH	4
H_HH	6

## SUPPLY WATER CONNECTION

A 3/8" FPT fitting is provided at the bottom of the humidifier for connection to tap water supply (top of the humidifier for HRAA). A shutoff valve, not provided by Carnes, must be installed just ahead of this fitting.

## SUPPLY WATER GUIDELINES

Use ordinary cold tap water (20 to 120 psi) - **DO NOT use hot water, DI (deionized water), RO (reverse osmosis) water. Using mechanically softened water, or tap water with conductivity over 800 Micromhos is not recommended.** Supply water quality is a very important factor on how a humidifier functions and how often it will need to be maintained. There are many substances in untreated water. When water is boiled into steam, it creates a scale build-up that is left behind in the cylinder. These substances left behind continue to change the properties of the supply water. Having corrosive supply water can decrease the service life of the humidifier and the cylinder. Also using excessively hard supply water can increase maintenance requirements. It's recommended using a water supply that has a total water hardness between 50-120 (ppm) parts per million. Corrosion caused by high amounts of chlorides or other corrosive substances in the supply water can cause damage and rapid corrosion to the cylinders electrodes and humidifier. It's recommended using a water supply that has < 50 ppm of measured chlorides.

## DRAIN LINE CONNECTION

1. Locate the drain pipe fitting in the accessory bag included with the unit. Have proper tooling available to attach the drain pipe.
2. Connect the drain pipe fitting to the cabinet drain hole on the bottom of the unit (Refer to *Photo B*).
3. Connect the drain pipe fitting to an S or P trap. Use plumbing material capable of handling hot water. Include a 1" air gap fitting as part of the drain plumbing. See *Photo B*.

**Note:** If the drain water pump accessory package is used, follow instructions included with the drain water pump package.

Photo C



Outer diameter of drain pipe is 1-1/4".  
Air gap fitting must be added.

**STEAM DISTRIBUTOR PIPE LOCATION**

It is critical to provide proper routing of flexible hose and hard tubing to maximize efficiency and effectiveness. See *Figure B-E*. Not following the instructions in this Installation, Operation, and Maintenance Manual could void all warranties, unless you have consulted with the factory and have prior written approval. Each steam cylinder requires a separate distributor pipe, steam hose, and condensate return line. A cylinder may supply more than one distributor pipe by using an accessory "T" fitting but the output cannot be controlled separately. In a typical installation the humidifier is located below the duct as shown in *Figure A*. **The distance between the humidifier cabinet and the steam distributor pipe should be the minimum distance possible.** Refer to *Table 3* for maximum length that may be installed based on duct static pressure and pound output. Under less than perfect conditions, (installation issues, routing problems for steam and condensate return hose, and extreme steam hose lengths) it is possible to lose significant amounts of output. **The use of 90° elbows add approximately three feet of equivalent length when hard tubing is used, thus negatively affecting capacity, efficiency, and can cause back pressure issues and cylinder arching.**

**MAXIMUM STEAM HOSE LENGTH** (*Table 3*)

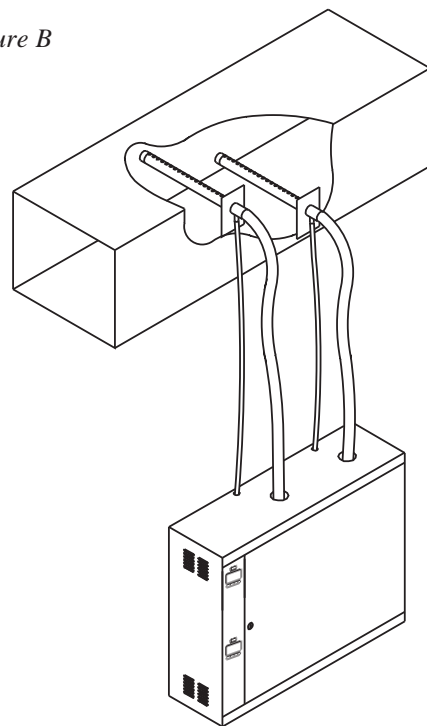
Duct Static Pressure "wg"	0	1	2	3	4	5
Maximum Steam Hose Length (Ft.)	40	35	30	25	15	10

For a residential unit (HRAB) the maximum length of steam hose that may be installed is 10 feet.

**AFFECT ON CAPACITY DETERMINED BY STEAM HOSE LENGTH** (*Table 3-A*)

Distance	Loss
10 Ft.	1.0 lb./hr.
20 Ft.	2.0 lb./hr.
25 Ft.	2.5 lb./hr.
40 Ft.	4.0 lb./hr.

Figure B



**TYPICAL HOSE LOCATION FOR LENGTHS UP TO 12 FEET**

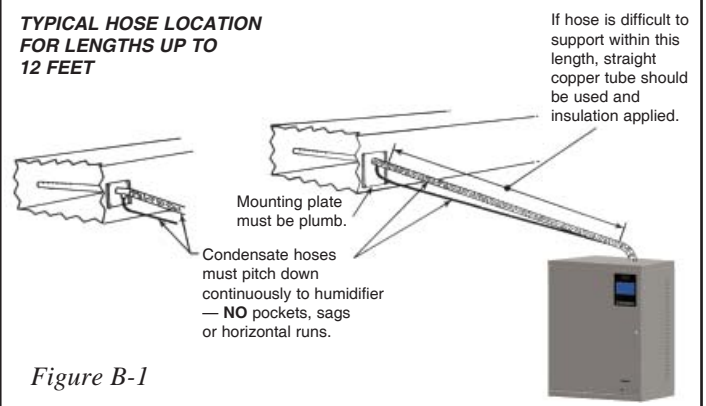
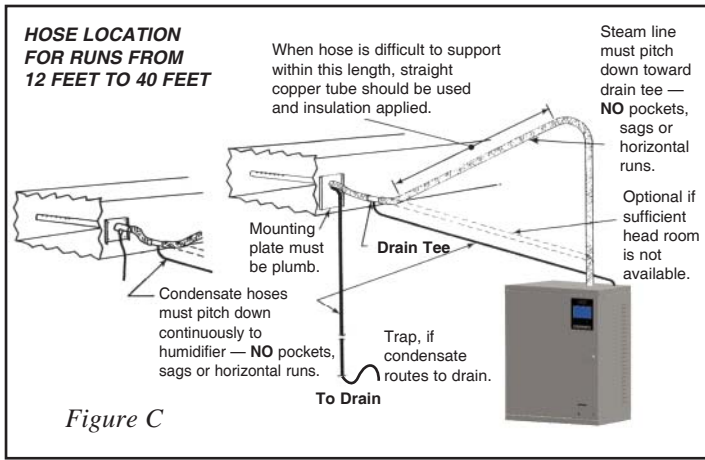


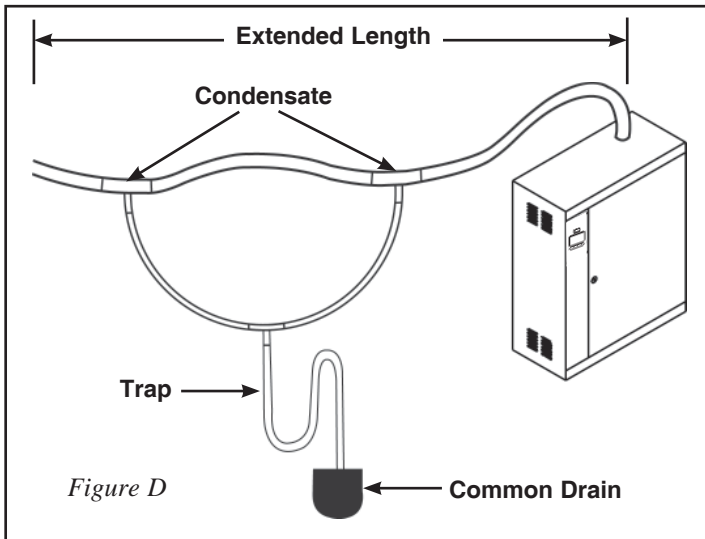
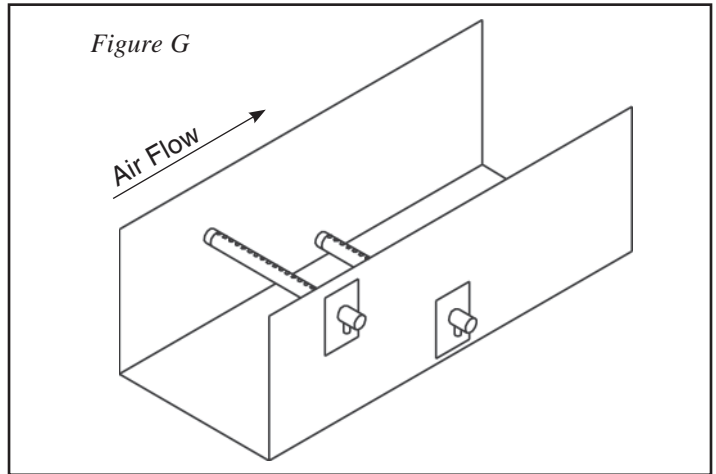
Figure B-1

The maximum length of steam hose that may be installed as shown in *Figure B & B-1* is 12 feet. For a steam hose length over 12 feet refer to *Figure D*. A drain "T" must be used to remove condensation that occurs in steam hose lengths over 12 feet. It is preferable to have the steam hose rise vertically from the cabinet and then slope downward to the distributor pipe as shown. If sufficient headroom is not available it is possible to install with an upward slope but the rise should be 2" in 12" to allow for proper condensate drainage and steam flow. Carnes electrode steam humidifiers are non-pressurized, maximum of 1/2 psi. Every application is different. Hose lengths for small capacity units will be considerably shorter than larger units. All variables must be taken into consideration.





If multiple pipes are used they should be staggered as shown in **Figure G**.



**STEAM DISTRIBUTOR PIPE LOCATION (Continued)**

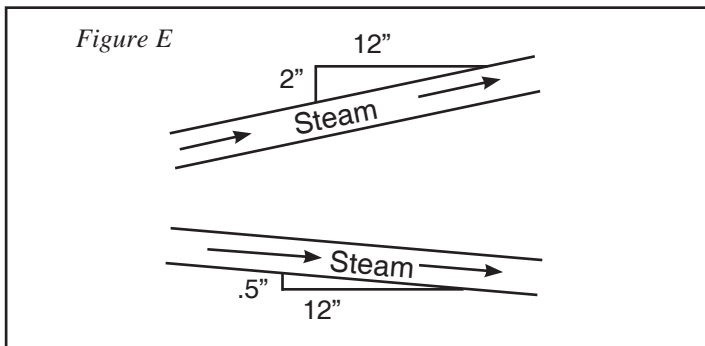
Steam distributor pipes must be located on a plumb surface so condensate that forms will run back into the return line. The pipe should be located in the center of the duct to insure distribution of steam into the airstream. A minimum clearance of 4" must be maintained between the top of the duct and the distributor pipe.

The steam distributor pipes are usually located in the supply duct downstream of the fan. When installed in packaged units the distributor should be mounted just downstream of the fan discharge.

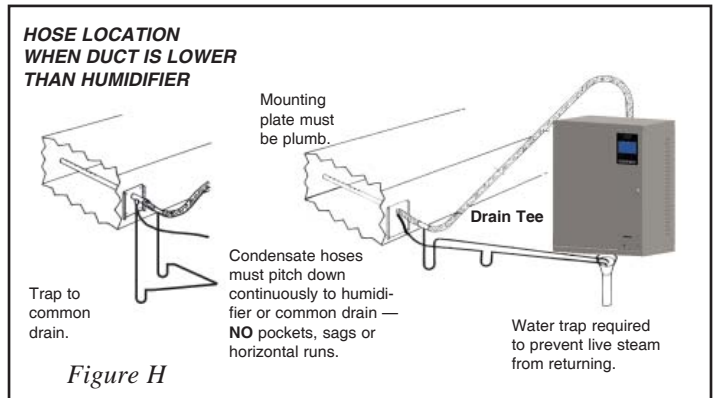
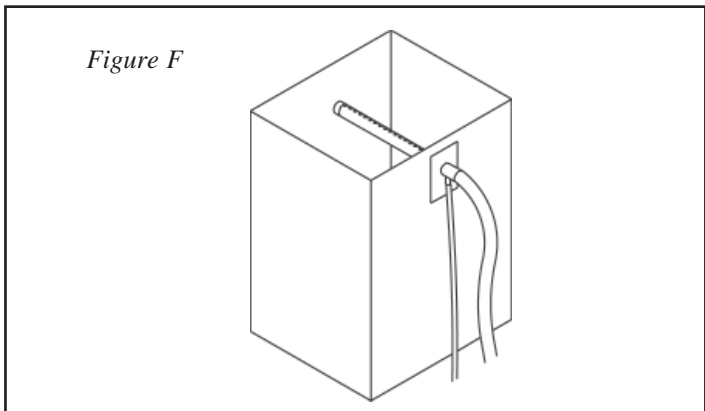
It is important to locate the distributor pipe as far upstream as possible from any obstructions in the ductwork so that moisture can be absorbed before it contacts a surface and accumulates. There must be a *minimum* of six feet between the distributor and any fans, coils, filters, dampers, elbows, or outlets downstream to reduce the possibility of condensation.

It may be possible to minimize the absorption distance by using multiple distributor pipes, or for extremely short absorption distances, a manifold may be required (See Short Absorption Manifold Section in this manual). Duct air temperatures below 60°F may require a condensate drain pan below the steam distributor pipe. Always avoid locating the distribution pipe upstream from any insulation in the duct as excess moisture may cause damage.

The distributor pipe may be located below the humidifier if the installation is made in accordance with **Figure H**. A trap may be necessary to prevent steam from flowing back through the condensate return line.

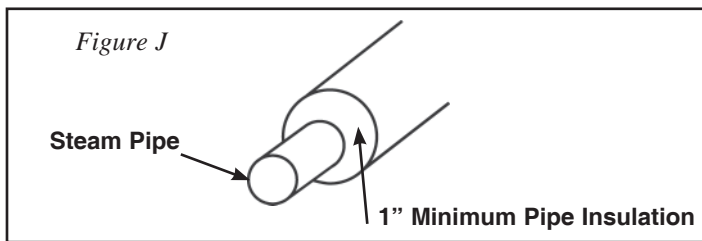
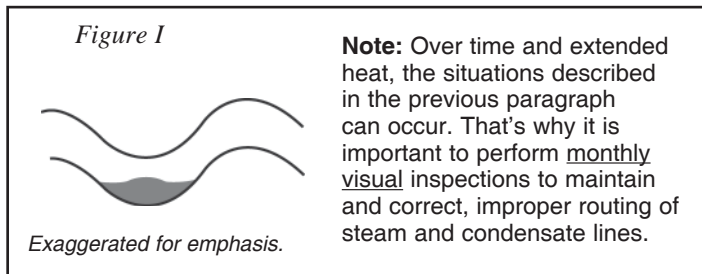


In a vertical duct with either upward or downward air flow the distributor pipe should be installed horizontally as shown in **Figure F**.





**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.



If it is difficult to install the steam hose 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 (See Figure J). 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 tube (with 7/8" steam hose) can be used with steam cylinders having output rates up to 30 pounds per hour. Size 1-1/2" copper tube (with 1-5/8" steam hose) should be used with steam cylinders having output rates over 30 pounds per hour.

Hose lengths of no longer than 10-20 feet and proper inclines or routing, as expressed in this manual, will provide the best chance of having a proper operating humidifier with efficient and effective steam dispersion.

**STEAM DISTRIBUTOR PIPE INSTALL**  
**EACH CYLINDER REQUIRES SEPARATE STEAM HOSE, CONDENSATE RETURN LINE, AND STEAM DISTRIBUTOR PIPE.**

1. The steam distributor pipe must be mounted on a plumb surface and inclined upward. This is required so the condensate which forms in the distributor pipe will drain to the return line and back to the unit, or to a common drain.
2. Insert distributor pipe into duct and secure with four sheet metal screws (not included).
3. Special distributor pipes are shipped with specific instructions on how to mount them.
4. If the optional fan distribution unit is to be used, follow the instructions included with the unit.

**CONNECT THE STEAM HOSE**  
**COPPER OR BRASS TUBE IS THE ONLY ACCEPTABLE SUBSTITUTE FOR CARNES STEAM HOSE OR CONDENSATE HOSE.**

1. The steam hose should be installed so there is a continuous rise from the humidifier to the distributor pipe. Support the steam hose at intermediate points to prevent dips, pockets, sags, or horizontal runs. *See Figure I.*
2. Any turns should have a minimum radius of 8" to prevent the hose from kinking. Fasten the steam hose to the distributor pipe with one of the hose clamps provided.
3. Push the steam hose through the opening on the top of the humidifier cabinet and slip it over the outlet stub on the top of the cylinder. Fasten with the hose clamp provided.
4. If long lengths of steam hose or hard tubing are used, the use of periodic "T's" to drain condensate should be used. *See Figure D.*

**CONDENSATE RETURN LINE**

1. Fasten the condensate return line to the distributor pipe with the hose clamp provided.
2. Follow the steam hose to the humidifier cabinet and secure the return line to the steam hose.
3. Connect the return line to the condensate return inlet with a hose clamp provided.
4. If it is impossible to maintain a drop to the top of the cabinet, it is necessary to run the condensate return line directly to the air gap drain fitting or some other drain.
5. A trap of sufficient size may be necessary to prevent loss of steam through the return line and reduce the temperature of condensate water to the common drain. Do not install a trap if condensate is returned to the top of the cabinet.

**STEAM DISPERSION CRITERIA**

1. Distributor pipe location must be at a minimum of 6 feet upstream from any elbows, splits, coils, turning vanes, grilles, diffusers, etc.
2. If duct temperature is 60°F or less, 10 feet is recommended.
3. Under normal conditions, most absorption distances will be approximately 4 to 5 feet.
4. If distance recommended is not possible, then a drain pan may be required.
5. If the air in the duct cannot accommodate the steam output, the only recourse may be to lower the maximum output of the unit.
6. If shorter absorption distances are required, 3 feet or less, multiple distributor pipes could be used. Two pipes split off one steam hose or two pipes from a dual cylinder unit.
7. If even shorter absorption distances are required, 2 feet or less, then multi tube short absorption manifolds may be required.

It is important to keep in mind that there are a lot of variables involved in proper steam distribution and absorption distances such as duct length downstream from the dispersion method, required absorption distance determined by design, capacity of humidification, velocity of air flow, temperature of air flow, location of humidifiers, distance between humidifiers to distribution point, and so on. Proper planning is a prerequisite to good performance.

## ELECTRICAL CONNECTIONS



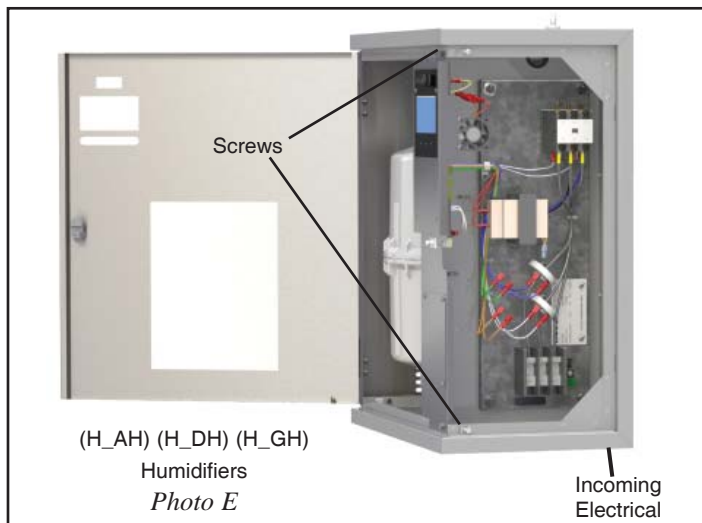
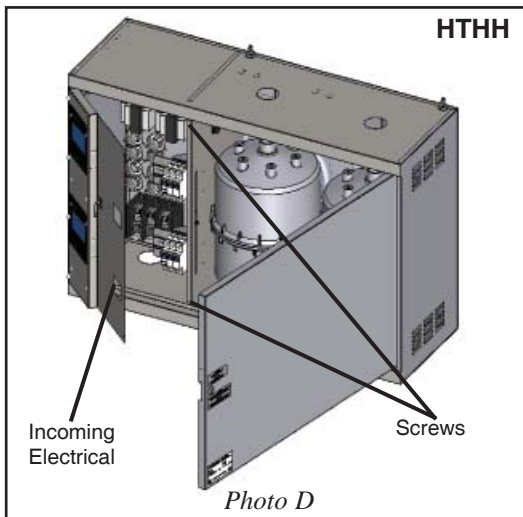
**WARNING: BEFORE MAKING ANY ELECTRICAL CONNECTIONS SWITCH POWER OFF AT SERVICE PANEL, FUSED DISCONNECT OR CIRCUIT BREAKER AND LOCK THE DISCONNECTING MEANS TO PREVENT POWER FROM BEING SWITCHED ON ACCIDENTALLY.**

POWER MUST BE OFF BEFORE MAKING ANY ELECTRICAL CONNECTIONS.

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

A fused disconnect or circuit breaker, not provided by Carnes, **MUST** be installed per local and national codes. See *Table 4* for recommended circuit ratings. The optional circuit breaker switch installed in the humidifier is **NOT** for use as a replacement for the required external disconnect switch but as a maintenance convenience.

1. Remove screws securing hinged panel for access to wiring. See *Photos D, E and F* for different electrical locations.
2. An opening is provided on the bottom of the electrical section. Bring electrical power lines through this opening and connect to electric power terminals.
3. Connect cabinet ground terminals to an independent ground. **DO NOT** use the neutral of a four-wire power supply.
4. Replace electrical cover panel.



## 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.

**ELECTRICAL DATA AND UNIT DETAIL SHEET - Table 4**

	Model	Max Lb/Hr	Voltage	Phase	kW	Line Amp	Disc. Size	Optional Circuit Breaker*	Steam Cylinder	Cyl Wire Current
HSAH HTAH	H_AHAU	5	120	1	1.725	14.4	25	1-20 Amp	AX220	14.4
	H_AHBU	5	208	1	1.725	8.3	15	1-15 Amp	AX380	8.3
	H_AHDU	5	230	1	1.725	7.5	15	1-20 Amp	AX380	7.5
	H_AHFU	5	277	1	1.725	6.2	15	1-15 Amp	AX380	6.2
	H_AHLU	5	380	1	1.725	4.5	15	1-15 Amp	AX600	4.5
	H_AHQU	5	415	1	1.725	4.2	15	1-15 Amp	AX600	4.2
	H_AHMU	5	460	1	1.725	3.7	15	1-15 Amp	AX700	3.7
	H_AHNU	5	575	1	1.725	3.0	15	1-15 Amp	AX700	3
	H_AHAU	10	120	1	3.45	28.7	45	1-40 Amp	AX220	28.7
	H_AHBU	10	208	1	3.45	16.6	25	1-25 Amp	AX380	16.6
	H_AHDU	10	230	1	3.45	15.0	25	1-25 Amp	AX380	15
	H_AHFU	10	277	1	3.45	12.4	20	1-20 Amp	AX380	12.4
	H_AHLU	10	380	1	3.45	9.1	15	1-15 Amp	AX600	9.1
	H_AHQU	10	415	1	3.45	8.3	15	1-15 Amp	AX600	8.3
	H_AHMU	10	460	1	3.45	7.5	15	1-15 Amp	AX700	7.5
	H_AHNU	10	575	1	3.45	6.0	15	1-15 Amp	AX700	6
HSDH HTDH	H_DHBU	20	208	1	6.9	33.1	50	1-45 Amp	B380	33.1
	H_DHDU	20	230	1	6.9	29.9	45	1-40 Amp	B380	30
	H_DHFU	20	277	1	6.9	24.9	40	1-35 Amp	B380	24.9
	H_DHLU	20	380	1	6.9	18.1	30	1-30 Amp	B600	18.1
	H_DHQU	20	415	1	6.9	16.6	25	1-25 Amp	B600	16.6
	H_DHMU	20	460	1	6.9	15.0	25	1-25 Amp	B700	15
	H_DHNU	20	575	1	6.9	12.0	20	1-15 Amp	B700	12
	H_DHCU	20	208	3	6.9	19.1	30	1-25 Amp	B500	19.1
	H_DHEU	20	230	3	6.9	17.3	30	1-25 Amp	B500	17.3
	H_DHTU	20	380	3	6.9	10.4	20	1-20 Amp	B600	10.4
	H_DHWU	20	415	3	6.9	9.6	20	1-20 Amp	B600	9.6
	H_DHGU	20	460	3	6.9	8.6	15	1-15 Amp	B700	8.6
	H_DHHU	20	575	3	6.9	6.9	15	1-15 Amp	B700	6.9
	H_DHCU	30	208	3	10.3	28.7	45	1-40 Amp	B500	28.7
	H_DHEU	30	230	3	10.3	25.9	40	1-35 Amp	B500	25.9
	H_DHTU	30	380	3	10.3	15.6	25	1-25 Amp	B600	15.6
	H_DHWU	30	415	3	10.3	14.4	25	1-25 Amp	B600	14.4
	H_DHGU	30	460	3	10.3	13.0	20	1-20 Amp	B700	13
H_DHHU	30	575	3	10.3	10.4	20	1-15 Amp	B700	10.4	
HSGH HTGH	H_GHBU*	30	208	1	10.3	49.7*	80	2-35 Amp*	C62	24.8
	H_GHDU	30	230	1	10.3	44.9	70	1-60 Amp	C62	22.4
	H_GHFU	30	277	1	10.3	37.3	60	1-50 Amp	C62	18.6
	H_GHLU	30	380	1	10.3	27.2	45	1-40 Amp	C62	13.6
	H_GHQU	30	415	1	10.3	24.9	40	1-40 Amp	C62	12.5
	H_GHMU	30	460	1	10.3	22.5	35	1-30 Amp	C62	11.3
	H_GHNU	30	575	1	10.3	17.9	30	1-25 Amp	C62	9.0
	H_GHCU	40	208	3	13.8	38.3	60	1-60 Amp	C62	19.1
	H_GHEU	40	230	3	13.8	34.6	60	1-50 Amp	C62	17.2
	H_GHTU	40	380	3	13.8	20.9	35	1-35 Amp	C65	20.9
	H_GHWU	40	415	3	13.8	19.2	30	1-30 Amp	C65	19.2
	H_GHGU	40	460	3	13.8	17.3	30	1-25 Amp	C65	17.3
H_GHHU	40	575	3	13.8	13.8	25	1-20 Amp	C65	13.8	

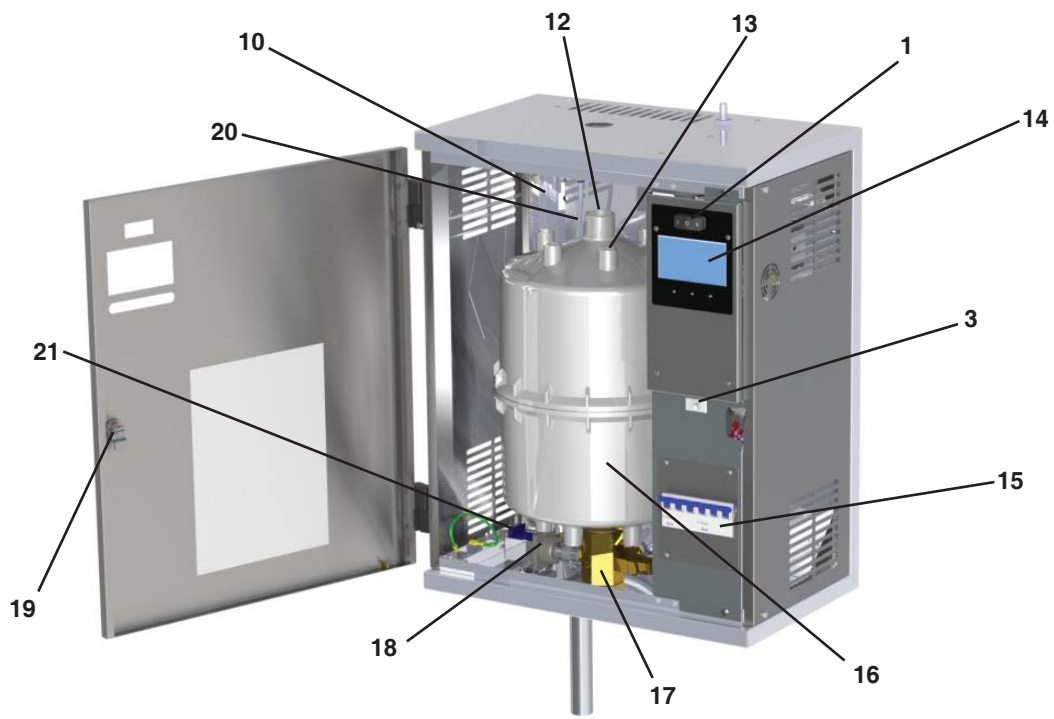
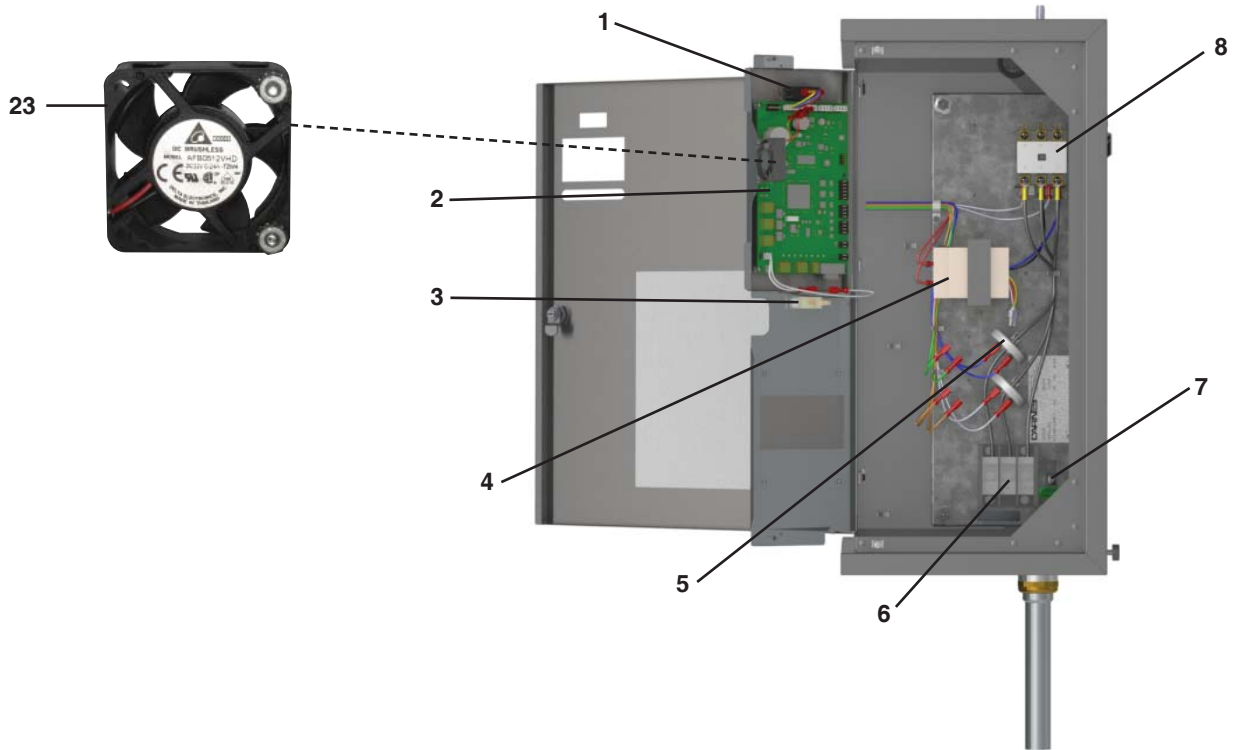
\* = Circuit Breaker is REQUIRED per NEC 48 amp guideline.

**ELECTRICAL DATA AND UNIT DETAIL SHEET - Table 4 (continued)**

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

\* = Circuit Breaker is REQUIRED per NEC 48 amp guideline.

# HUMIDIFIER COMPONENT LISTING - Figure K



- |                          |   |   |
|--------------------------|---|---|
| 1. On-Off-Drain Switch   | 9. High Water Sensor ( <i>behind cylinder</i> ) | 17. Cylinder Fitting  |
| 2. Circuit Board         | 10. Fill Cup                                    | 18. Drain Valve   |
| 3. Door Interlock Switch | 11. Fill Valve ( <i>not shown</i> )             | 19. Lock  |
| 4. Voltage Transformer   | 12. Steam Hose                                  | 20. Water Inlet Hose  |
| 5. Current Transformer   | 13. Electrode Connector                         | 21. Water Inlet Fitting                                       |
| 6. Distribution Block    | 14. LCD - True Touchscreen                      | 22. Fill Valve Inlet Push - On Connector ( <i>not shown</i> ) |
| 7. Ground Lug            | 15. Circuit Breakers (Option)                   | 23. Cooling Fan   |
| 8. Contactor             | 16. Cylinder                                    |   |

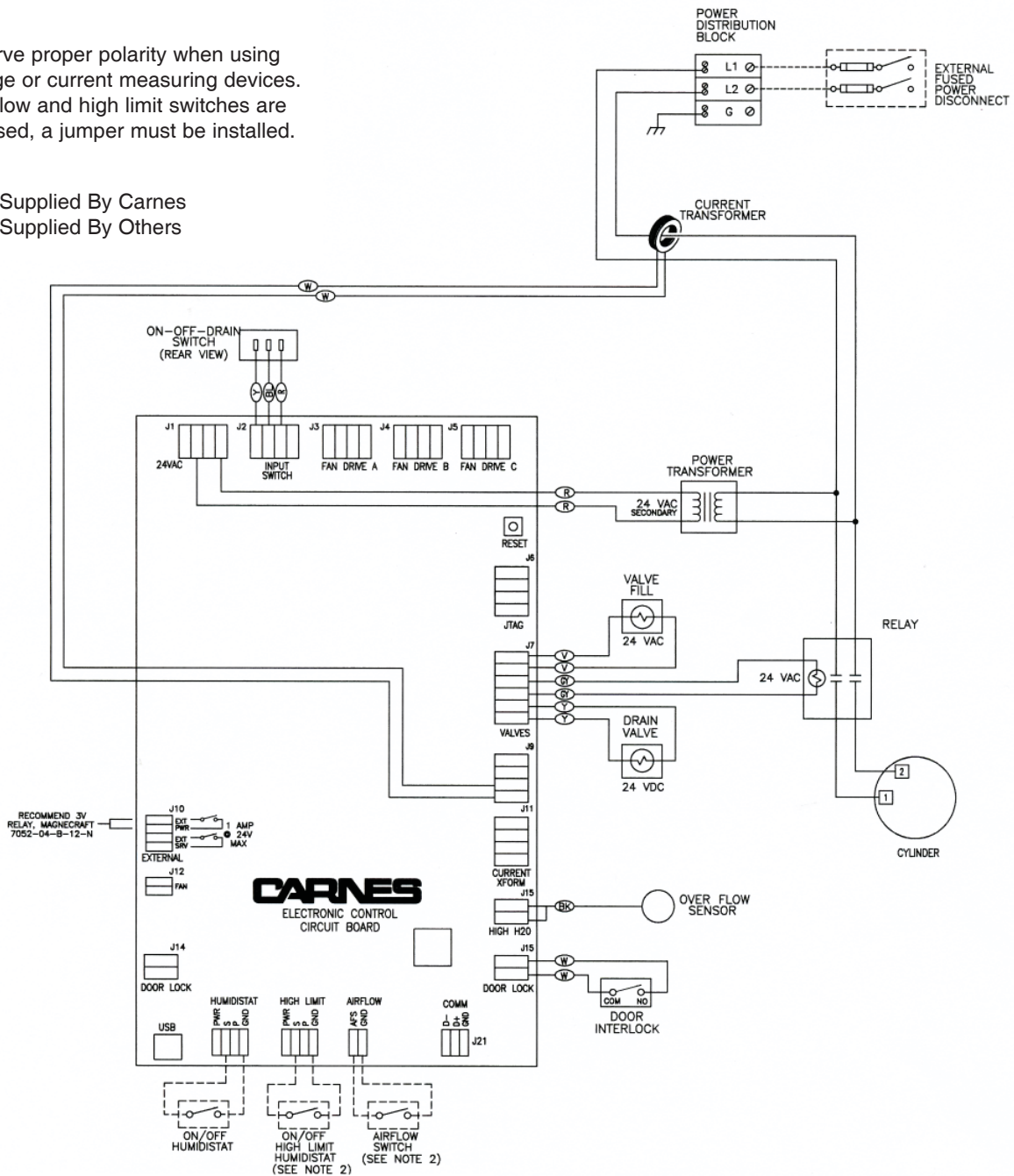


## CONTROL CONNECTIONS - Figure L

### NOTES:

1. Observe proper polarity when using voltage or current measuring devices.
2. If air flow and high limit switches are not used, a jumper must be installed.

————— Supplied By Carnes  
 ..... Supplied By Others



**WARNING:** BEFORE MAKING ANY ELECTRICAL CONNECTIONS SWITCH POWER OFF AT SERVICE PANEL, FUSED DISCONNECT OR CIRCUIT BREAKER AND LOCK THE DISCONNECTING MEANS TO PREVENT POWER FROM BEING SWITCHED ON ACCIDENTALLY.

1. A 7/8" opening is provided on top or bottom of the cabinet. The control wiring should pass through the opening to the terminal strip.

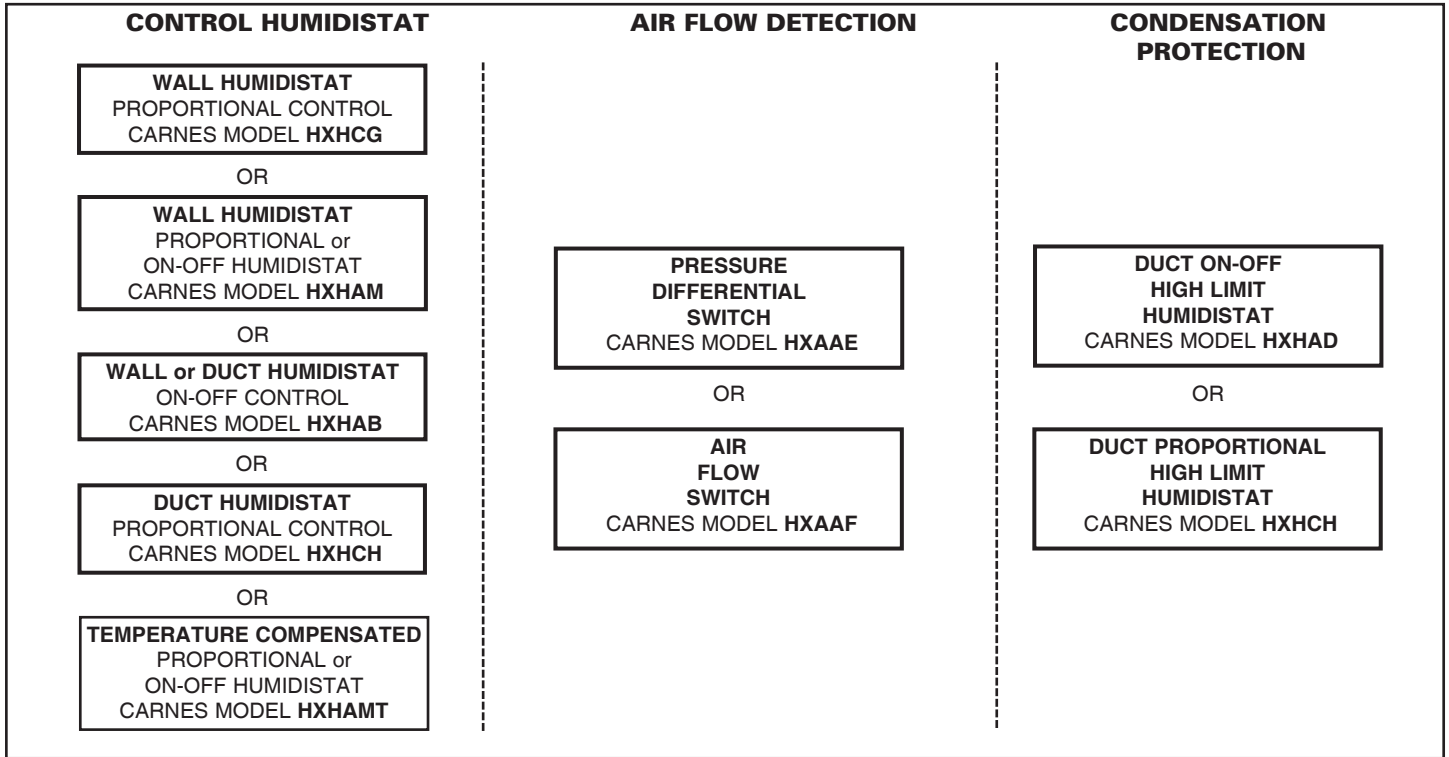
**NOTE:** A built-in transformer provides power for the control circuit. No outside power supply is required for the control circuit.

2. If an air flow switch or high limit humidistat is not used, jumpers must be installed before the humidifier will operate. Controls should be connected to the terminals on the circuit board as shown in *Figure L* using #18 AWG wire. Avoid running control wiring near high voltage wires.



# CONTROLS

CONTROL OPTIONS - Figure M



## CONTROL HUMIDISTAT

If an on-off humidistat 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 Carnes proportional humidistat 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 may 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 where it is accessible only to maintenance personnel.

## AIR FLOW DETECTION

The humidifier control circuit should include some method to determine air flow. If the steam distributor pipe is located in a duct where there is no air flow and the control humidistat is calling for humidity, steam would be discharged into the duct where it would immediately condense. Air flow may be detected by several methods. The humidistat circuit may be interlocked by using a fan relay if the fan is direct driven. A fan relay is not recommended if a belt driven fan is used as a broken belt would stop air flow even though the fan relay was closed.

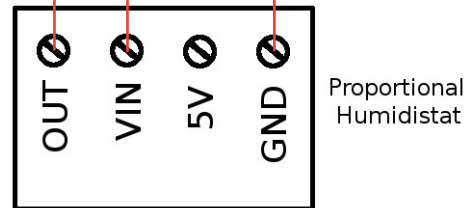
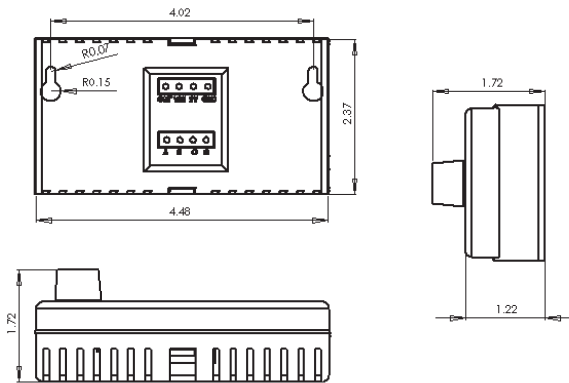
Among the alternatives is the use of a pressure differential switch that determines air flow by sensing a pressure differential caused by air movement in the duct. A paddle type switch is also available to determine air flow. The pressure differential switch is normally the preferred device as it is less susceptible to erratic operation caused by improper positioning in the duct system. Paddle switches require careful positioning in the duct to insure sufficient air flow to activate the switch.

# OPTIONAL ACCESSORY CONTROLS

## WALL HUMIDISTAT, 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).



## WALL/DUCT HUMIDISTAT, ON-OFF CONTROL

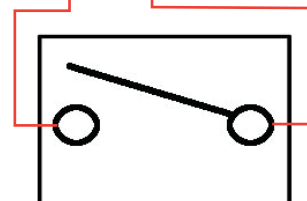
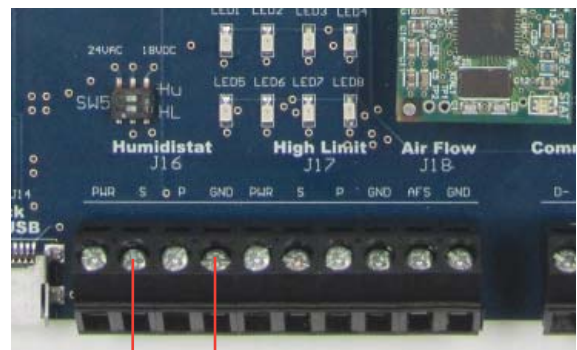


Unit may be installed on either a flush switch box, a surface switch box, or directly on a wall.

Mount with Number 6 screws provided for switch box mounting. Different screws are required for wall mounting (not included).

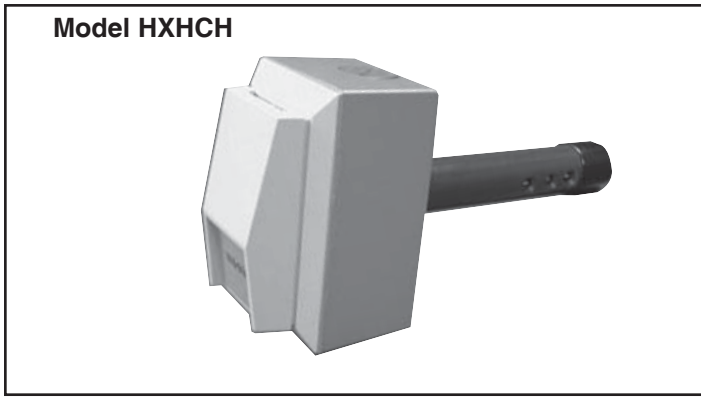
The Model HXHAB can be mounted to a wall or duct to provide automatic low voltage control for humidifiers in central heating and air condition systems. The inherent flexibility of this unit's size and installation make this the perfect fit for any number of rooms. They have a snap-acting and dust-proof SPST switch. Humidity scale range is from 20-80% RH. Case dimensions are 5" high, 3" wide and 3.86" length.

**NOTE:** Use rated 18-22 gauge wire. Leave approximately 6 inches of wire to properly connect the humidistat.

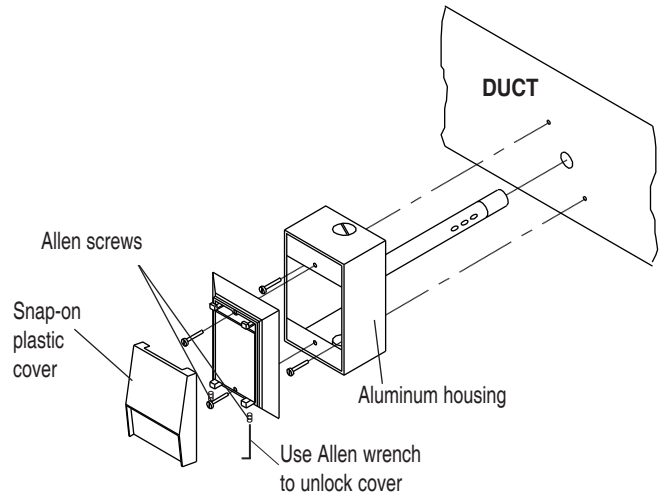


## DUCT HUMIDISTAT, PROPORTIONAL CONTROL

Model HXHCH



The Model HXHCH is an intelligent humidistat solution used exclusively for duct mounted installations. The humidistat is capable of providing both humidity and temperature measurements from inside the duct. The microprocessor control takes the temperature into consideration when calculating the humidity to provide an extra degree of precision.

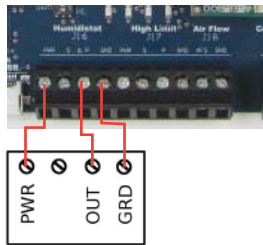


Remove any excess insulation from the duct that would prevent the probe from extending a minimum of 4" (106mm) into the air stream.

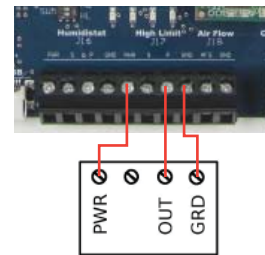
Make a 1-1/2" (38mm) hole in the duct for inserting the probe.

Use a gasket, sealer, or other means to seal the area between the unit and the duct to ensure proper operation.

### WHEN USED TO CONTROL ROOM RELATIVE HUMIDITY

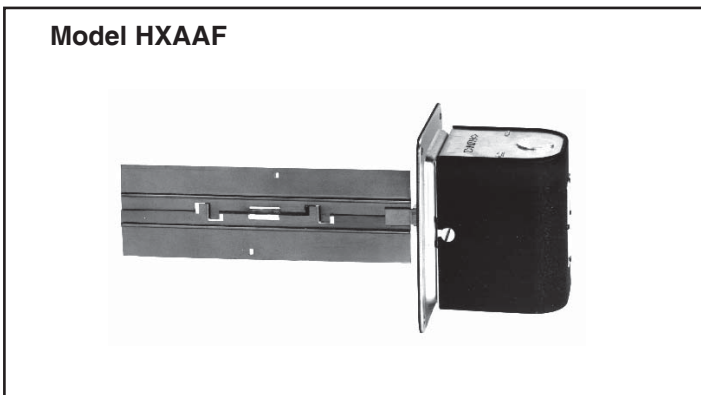


### WHEN USED AS HIGH LIMIT HUMIDISTAT

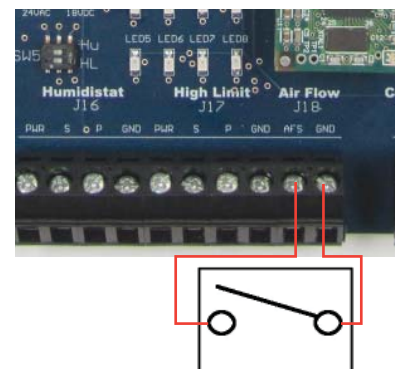


## AIR FLOW SWITCH, VELOCITY TYPE

Model HXA AF

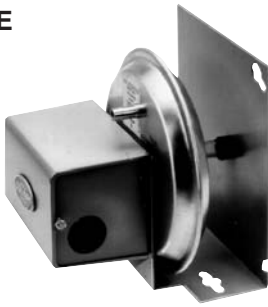


This air flow switch is installed in the duct to prevent humidifier operation when air flow is not occurring. This switch provides a positive and economical method to detect loss of air flow velocity. The switch may be installed on the side, top, or bottom of a horizontal duct. Installation can be made in a vertical duct if the air flow is upward. A horizontal flow velocity of 480 fpm or upward vertical flow of 910 fpm is required to operate the switch. Switch is **UL** listed. Case dimensions are 4-3/8 high, 3-13/16" wide. The paddle extends 7-23/32" into the duct.



## AIR FLOW SWITCH, PRESSURE DIFFERENTIAL TYPE

### Model HXAEE



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.

#### Setup:

**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 counterclockwise.

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,

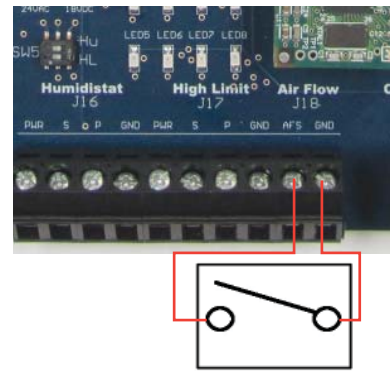
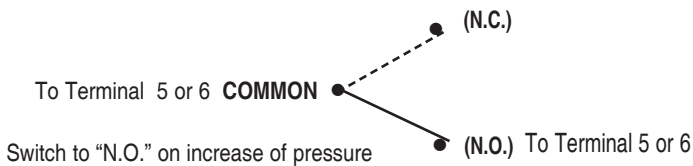
**Shipping** -40 to 140°F (-40 to 60°C).

**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



## HIGH LIMIT HUMIDISTAT

### Model HXHAD



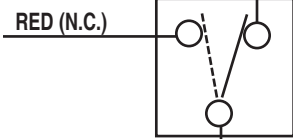
The Model HXHAD is available to reduce the potential of condensation occurring in the supply duct. The control must be mounted a minimum of 10 feet downstream of the steam distributor pipe. Setpoint range is 15-95% RH. Differential is 5% non-adjustable.

The HXHAD may be mounted in any position on the outside surface of the supply air duct where it is exposed to freely circulating air (horizontal mounting is preferred).

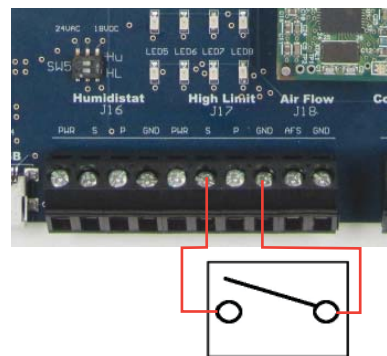
"N.C." (Red) is switched to common (Orange) during RH Rise.

"N.O." (Brown) is switched to common (Orange) during RH Drop.

BROWN (N.O.) To Terminal 8 or 10

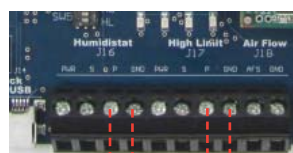


ORANGE (COMMON)  
To Terminal 8 or 10



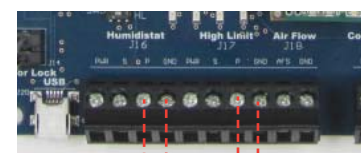
## EXTERNAL DDC CONTROL SIGNALS

The 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.



0-10 VDC PROPORTIONAL SIGNAL (BY OTHERS)

0-10 VDC PROPORTIONAL HIGH LIMIT HUMIDISTAT (BY OTHERS)



470 OHM RESISTOR (BY OTHERS)

4-20ma PROPORTIONAL SIGNAL (BY OTHERS)

4-20ma PROPORTIONAL HIGH LIMIT HUMIDISTAT (BY OTHERS)

470 OHM RESISTOR (BY OTHERS)



## CONDENSATION PROTECTION

A third device may be desirable to provide condensation protection in the duct system. A high limit humidistat may be installed ten feet downstream from the steam distributor pipe. This humidistat is normally set to 90-95% RH and 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.

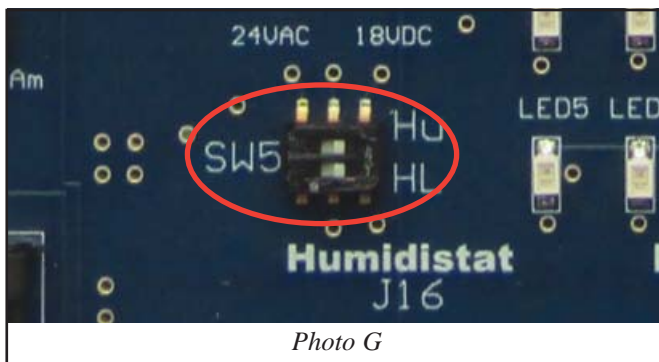
Either an on-off or proportional control high limit humidistat may be used with Carnes humidifiers. If a proportional humidistat is used the output of the humidifier will automatically be decreased to reduce the possibility of condensation. Two proportional humidistats may be used to control Carnes humidifiers 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.

## CONTROL HUMIDISTAT / TEMPERATURE COMPENSATED

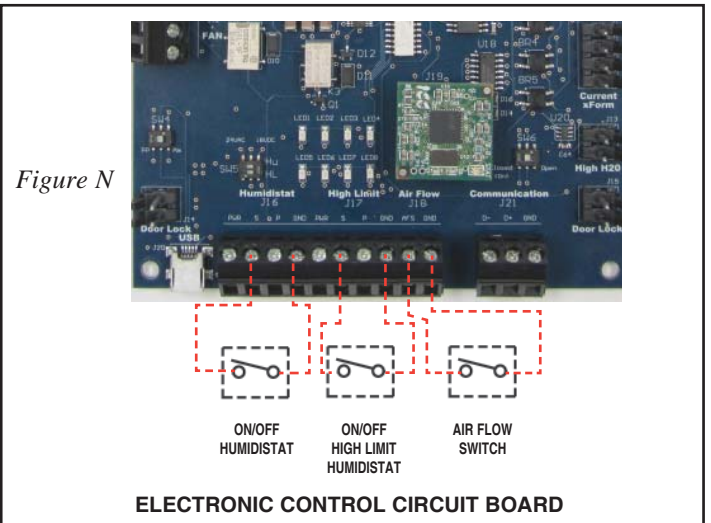
The HXHAMT can be used if your application has a requirement for an outdoor temperature compensation feature. Both controls will provide monitoring of RH percentage and outdoor temperature, along with automatically adjusting the RH setpoint as outdoor temperatures change. The HXHAMT provides a 0-10V signal in either a proportional or on-off configuration.

## CONTROL CONNECTIONS

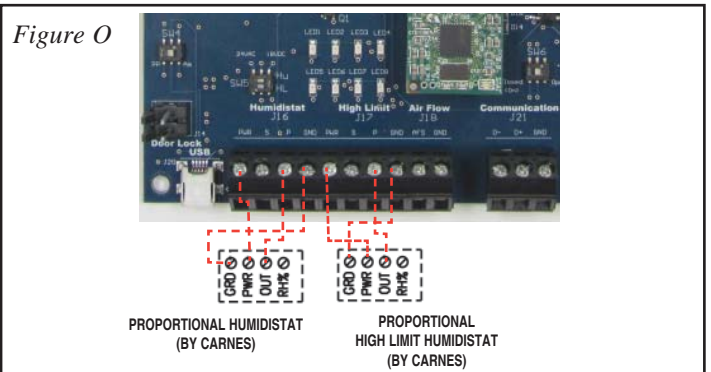
The circuit board can provide either a Carnes legacy 18VDC or an industry standard 24VAC, as a supply for those humidistats which require it. The supply for both the control humidistat and high limit humidistat are output on pin1 of J16 and J17 respectively. **18VDC is set as the supply default**, but the switches on designators SW5 can be flipped to the left to alternatively supply 24VAC as seen in *Photo G* for the H690-0107 circuit board (blue). The humidistat and high limit can be changed independently. The switch labeled Hu is switched for humidistat voltage output, and the switch labeled HL is switched for high limit humidistat voltage output. Switch(es) in the right position will supply 18VDC and switch(es) in the left position will supply 24VAC.



Two cylinder humidifiers may be wired for simultaneous or separate and independent operation. Controls should be connected to the terminals on the circuit board as shown below using No. 20 AWG wire. Attempting to use two wires in a single control connection will require a No. 22 AWG wire or less. See wiring diagram for parallel connections. Avoid running control wiring near high voltage primary wires due to the possibility of interference and signal distortion.

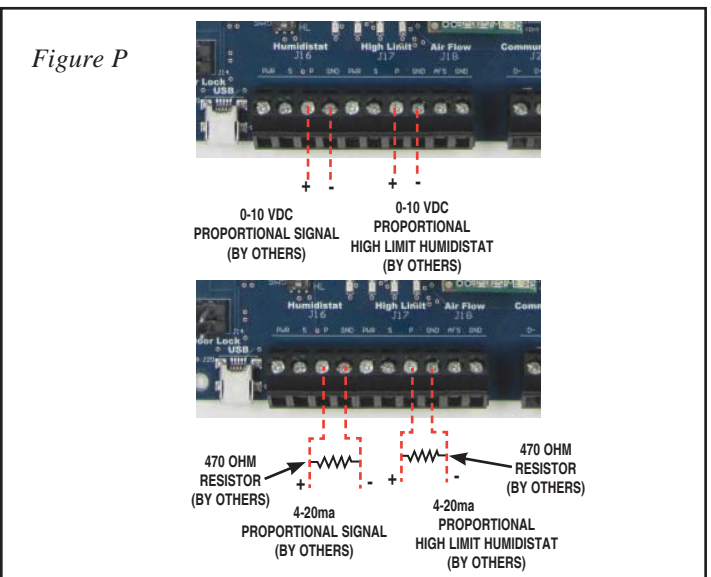


Connections shown in *Figure N* are for typical on-off controls. For Carnes proportional controls see the diagram *Figure O*. All controls are shipped with detailed wiring instructions.



## EXTERNAL DDC CONTROL SIGNALS

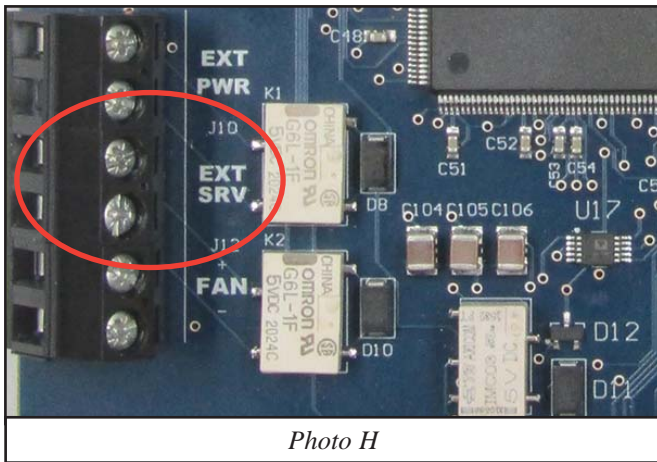
Carnes humidifiers can also accept a 0-10 volt DC signal to modulate the output of the humidifier. Polarity must be observed. Input impedance is 20K ohms. If a 4-20 mA input signal is provided to the humidifier a 470 ohm 1/4 watt resistor must be installed as shown below (*Figure P*).



## EXTERNAL MONITORING

Pins 1 and 2 of connector J10, shown in *Photo H*, are provided for indicating operation of the humidifier at a remote location. When the unit is operating, pins 1 and 2 (EXT PWR) are closed. Pins 3 and 4 of connector J10 (EXT SRV) are provided to indicate the need for service. A "Service Required" warning on the home screen of the LCD will indicate the type of service that is needed. Both the EXT PWR and EXT SRV relays have a maximum ratings of 0.3A at 125VAC or 1A at 24VDC maximum.

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.)



*Photo H*

## NETWORKING

If multiple units are required due to high capacity demand (over 200 lb. per hour, single unit), networking can be done. Units can be interconnected with parallel signal wiring. This setup is usually done to facilitate running multiple units from a single signal control (Humidistat, BMS System, etc.). For other networking requirements, please contact factory.

## CONTROL CONNECTIONS

**FOR SAFETY: MAKE SURE TO TURN OFF POWER AT THE EXTERNAL DISCONNECT BEFORE MAKING ANY INTERNAL CHANGES TO THE HUMIDIFIER.**

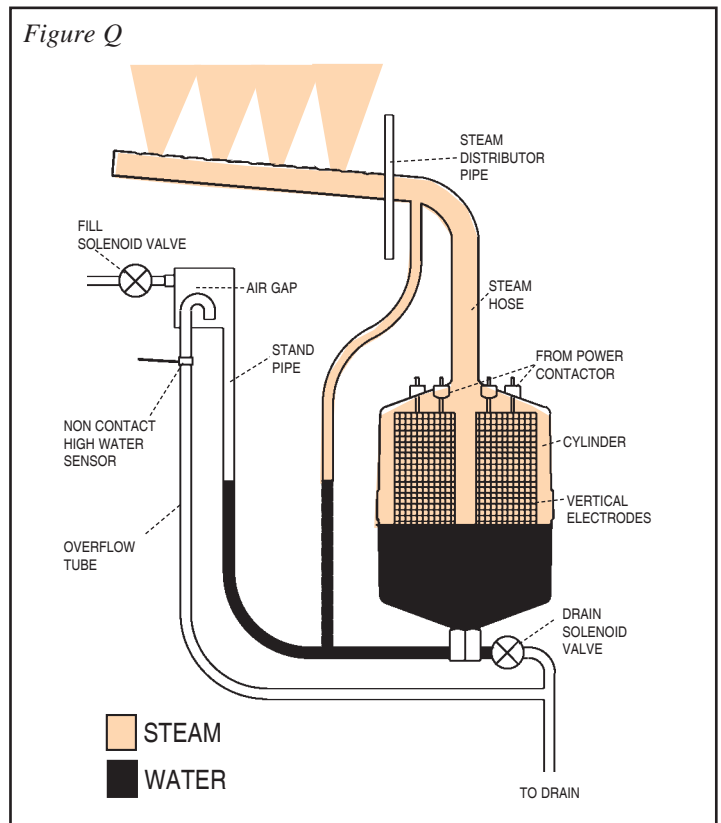
1. A 7/8" opening is provided on the top or bottom of the cabinet. The control wiring should pass through the opening to the provided connection points at J16, J17, and J18.
2. If an air flow switch or high limit humidistat is not used, jumpers must be installed before the humidifier will operate. On J17, jump terminals 2 and 4 together to bypass the high limit. On J18, jump terminals 1 and 2 together to bypass the air flow switch.

## OPERATION

When the circuit board verifies all four basic controls have been satisfied (control humidistat, high limit humidistat, air flow, door interlock), a signal is sent to open a fill solenoid valve, allowing water to flow across an air gap into a standpipe. The standpipe provides a column of water to be fed into the cylinder using gravity. The air gap prevents the cylinder from pressurizing. See *Figure Q*. The steam cylinder normally operates at a pressure of approximately 1/2 psi.

The circuit board also closes a power contactor allowing current to flow to vertical electrodes sealed inside the cylinder. Current flows between the electrodes using minerals in the water as a conductor. The water is heated to boiling and converted to steam which leaves the cylinder through the flexible steam hose which is connected to the steam distributor pipe.

The circuit board reacts to current flow between the electrodes and automatically opens the fill solenoid valve when more water is required to maintain the desired output rate and closes when the desired rate is reached. The operation of the drain solenoid valve is automatically controlled by the circuit board which responds to any changes in water conditions and drains the required quantity of water to provide stable operation and long cylinder life.



As mineral deposits build up within the cylinder the water level will slowly rise to uncovered electrode surfaces to maintain the desired steam output rate. When mineral deposits have covered all available electrode surfaces, current flow will be reduced to a level where the desired steam output cannot be reached and the service light will signal the need for maintenance. When the cylinder is filled with minerals it is easily changed in less than five minutes (not including cool down time).

**Important Note:** Due to the many variables effecting the operation of humidifiers (water condition, conductivity, hardness, etc.) it could take up to 24 hours of operation before a humidifier is truly operating normally and the water is completely conditioned. Conditioned water is a state where the amount of minerals dissolved within the water is at a steady state. Conditioned water is more conductive than new water from the fill valve.



## DISPLAYS AND INTERNAL CONTROLS

### FRONT PANEL DISPLAYS & 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 P

### “ON-OFF-DRAIN” SWITCH

In the “On” position the humidifier will operate if all controls are calling for humidity. 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. The fill solenoid valve will be on whenever the drain is activated to reduce the drain water temperature.

### LCD TRUE TOUCHSCREEN DISPLAY

This LCD True Touchscreen display offers a user friendly interface to control and monitor many aspects of the humidifier. The screen uses pressure sensitive technology. Depressing on the labeled buttons on the designated area of the screen will allow you to navigate through the different menu pages.

### “HOME SCREEN” PAGE

The “Home Screen” page is the main screen through which most other pages can be accessed. The “Home Screen” displays the current steam output in Lb./Hr. (or Kg/Hr., selected in “Settings”). The main “Home Screen” features four navigation buttons, Carnes Logo (providing contact info to the factory and the company website), Steam Menu, Menu, and Settings. The “Home Screen” will display a “Service Required” indicator when a current service issue is indicated. The “Service Required” and Steam Output number will illuminate red. Tap on “Service Required” to access the service required page which indicates what service issue is being detected.

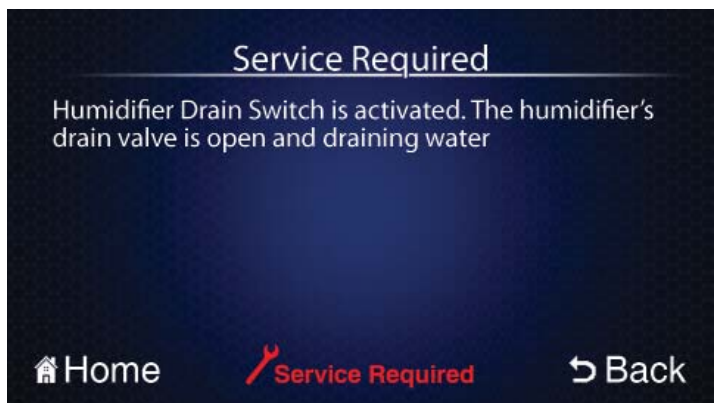


### “SERVICE REQUIRED” PAGE

The “Service Required” page outlines any service issues that are in need of being resolved. Many issues can be traced back to variability in water parameters, and often the solution can be dealt with through the changing of cylinders or modifying timer values within the “Settings” page. This page is used to alert the user and direct them on the right path towards resolution.



When CarnesLink is being used, the “Back End Override” indicator is displayed only when the connected building management system requests the unit to be set to “off” or “drain” while the unit is “on”. When selected more information is provided about the override.



### “FILL” LED

The FILL LED is a blue light illuminated when the Fill Valve is activated. An activated Fill Valve allows water to flow into the cylinder of the humidifier. An analogous indicator, and a description of its operation, is offered in the “Menu” screen under “Component Activity”.

### “DRAIN” LED

The DRAIN LED is a red light illuminated when the Drain Valve is activated. An activated Drain Valve allows water to drain from the humidifier. An analogous indicator, and a description of its operation, is offered in the “Menu” screen under “Component Activity”.

### “HIGH WATER” LED

The HIGH WATER LED is an orange light illuminated when the High Water Sensor is activated. An activated High Water Sensor indicates that the water has risen to the maximum allowable level in the cylinder. This can be a normal situation, particularly if the cylinder is being filled with mostly unconditioned water. An activated High Water Sensor can also be a sign that the cylinder is close to end-of-life and needs replacing, or in rarer cases, the water in the cylinder is not conductive enough for the fresh water entering the humidifier. An analogous indicator, and a description of its operation, is offered in the “Menu” screen under “Component Activity”. More information on troubleshooting High Water situations can also be found under the “Help” button, on the “Menu” screen.

### “CARNES®” LOGO

The Carnes logo on the “Home Screen” will take you to a page that displays the 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.

### “STEAM” MENU

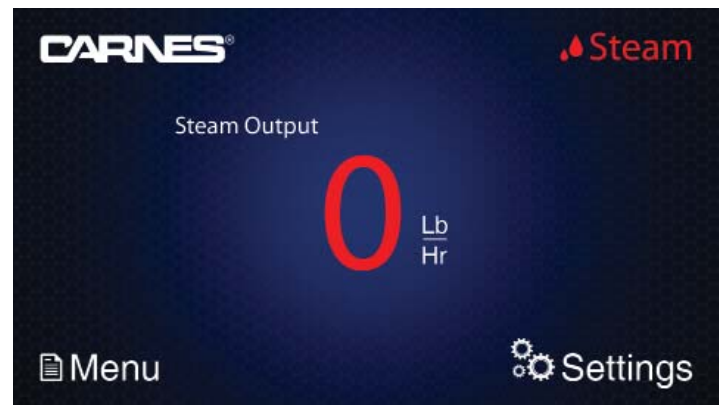


The “Steam Menu” page will display the status of the four basic controls (Control Humidistat, High Limit Humidistat, Air Flow Switch, and Door Interlock). The humidifier will only produce steam when the unit is switched into the “ON” position and if all four controls are satisfied.

A green “✓” will be displayed to indicate if the control is sending a signal and requesting humidification.



A Red “X” will be displayed to indicate if the control is not sending a signal indicating a need for humidification. If any one component is not satisfied, the “Home Screen” will indicate on the display using “RED” illumination on the Steam Output number and the “Steam” icon.



1. **Control Humidistat** - Explains the status and also shows the current demand of the Control Humidistat. The Control Humidistat must call for a demand greater than 20% for the humidifier to run. If needed, terminals ‘S’ and ‘GND’ on J16, on the main control board, can be wired together to force a 100% demand.



2. **High Limit Humidistat** - Explains the status and shows the current demand of the High Limit Humidistat. The High Limit must call for a demand greater than 20% for the humidifier to run. If needed, terminals 'S' and 'GND' on J17, on the main control board, can be wired together to force a 100% demand.

The Control Humidistat, which provides the Control Demand, is normally the humidistat located in the room being humidified. It is either installed in the room itself or the return air duct. The High Limit Humidistat, which provides the High Limit Demand, is a safe-guard humidistat, is usually set to a high level (80-90%), and will shut down the humidifier if the humidity gets too high in the supply duct. Without a High Limit Humidistat properly installed the supply duct could reach a humidity level where any steam entering the duct would readily condense. Both Control Humidistats and High Limit Humidistats are wired in the same way, only Control Humidistats are wired to port J16 of the circuit board and High Limit Humidistats are wired to port J17. Both ports have the same number of pins and connection layout.

**When using an on-off humidistat**, the percentage should be either 100% or below 20%. In this case, the control is either calling for full output or no output. On-Off humidistats are dry contact switches. They will have two wires; each connected to pins 2 and 4 (in no particular order/polarity).

**For a proportional humidistat**, any percentage value is possible between 0% and 100%. In this case, the humidifier can be modified to output any fraction of its max output. If the proportional control falls to 20% or below, the humidifier is shut off. The input signal of a proportional humidistat must be 0-10V DC. Proportional humidistats will have three wires, with 'power' going to pin 1, 'signal' to pin 3 and 'ground' to pin 4. **In lieu of a humidistat, a DDC signal** from a building management system may also be used. Here, the 'signal' should be connected to pin 3, and 'ground' to pin 4. In this case, 'power' can be ignored. A DDC signal must be of a 0-10V signal by adding a 470 ohm resistor between the 'signal' (pin 3) and 'ground' (pin 4).

3. **Air Flow** - Explains the status of the Air Flow switch. The Air Flow switch must sense proper air flow in order for the humidifier to activate. Insufficient air flow or an improperly installed air flow switch will cause the indicator to change to a red "X" and the unit will not operate. If needed, terminals 'AFS' and 'GND' on J18, on the main control board, can be wired together to force activation of the switch.
4. **Door Interlock** - Explains the status of the Door Interlock switch. The Door Interlock needs to be engaged for the unit to operate. This can be accomplished by either locking the door shut or pulling out the plunger for temporary operation while servicing the unit.

#### MENU



The "Menu" page displays four features: Setpoint, Component Activity, Dim LCD and Help. Tapping any of these buttons will show dialog explaining the subject or status of that button and display pictures.



#### "SETPOINTS"

The Setpoints page displays the Setpoints (the target steam output of the humidifier) associated with the unit. There are three different Setpoints, but only one Setpoint is active at any given time. Each Setpoint is accompanied by the current value of the Setpoint to the right, and an indicator that represents its status.

The **Max Setpoint** is the user-specified Setpoint that is active when no external controls or internal reduction is taking place. The Max Setpoint is always modifiable via the "Max Output Adjust" within the "Settings" menu.



The **Controlled Setpoint** is the Setpoint when a humidifier (Control or High Limit), reduces the target output of the humidifier due to changing room requirements.

The **Reduced Setpoint** is active when the unit requires a reduction in output due to a high water situation.

The Setpoints have the following priorities: The Reduced Setpoint has the highest priority and always overrides the Controlled Setpoint and the Max Setpoint when active. The Controlled Setpoint has the next highest priority, and always overrides the Max Setpoint. It should be noted that the Reduced Setpoint is always lower than or equal to the Max Setpoint (or Controlled Setpoint, if active) and the Controlled Setpoint is always lower or equal to the Max Setpoint.



**“HELP” MENU**

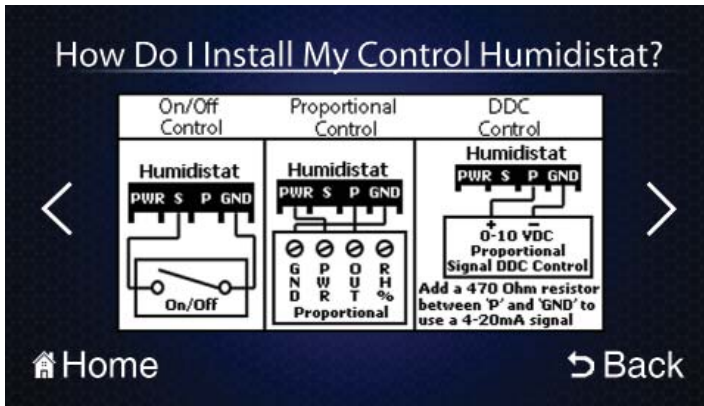


**“COMPONENT ACTIVITY”**



The Component Activity page lists all internal components that can switch on and off during operation. This includes the Fill Valve, Drain Valve, Contactor, High Water Sensor, and Board Communication. Each component listed is accompanied by a green “✓” or a red “X” indicator representing whether or not the component is currently ‘on’. The Fill Valve is on when the unit is either filling or draining the cylinder. The Drain Valve is on when the humidifier is draining and can be on while the humidifier is producing steam. The High Water Sensor is on when the humidifier has identified a high water situation. When in a high water situation, the fill valve is disabled for 5 minutes. At the end of 5 minutes the high water sensor light will go out, the fill valve will open, if there is a call for more humidity, and then the unit will continue normal operation. High water sensors can be cumulative depending on the condition of the water.

The other component in the “Component Activity” page is the Board Communication (Comm.) button. The Board Communication button represents whether the touchscreen controller on the circuit board is properly communicating with the microcontroller and that the microcontroller is properly communicating with the data communication chip, if present. The Communication indicator is a green “✓” when the LCD display is communicating properly with the control board. If there is a red “X”, the touchscreen has likely lost communication with the control board, and the information on the screen may be inaccurate. For troubleshooting, contact Carnes Company at 608-845-6411.



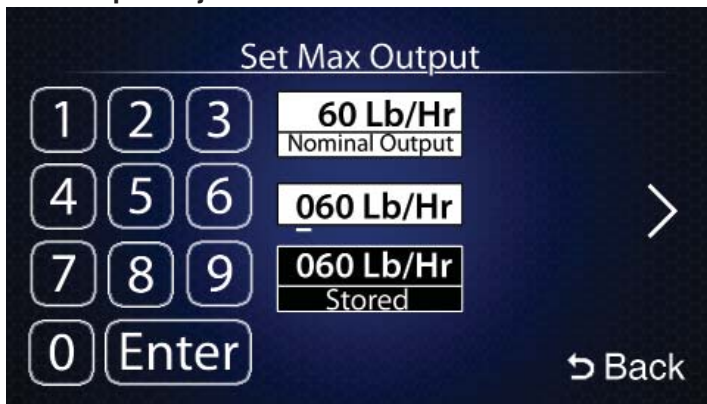
The help pages consist of buttons labeled with subjects. When a button is pressed, information will be given about the subject in question. A basic help page consists of text and/or diagrams to help the user through basic problems. For example, in the pictures above, the question “How Do I Install My Control Humidstat?” is answered with a diagram and corresponding text. Some pages consist of more buttons to help guide a user through different processes. These buttons can be used and referenced as needed.

### “SETTINGS” MENU



The “Settings” menu has pages where all operational values can be set. It is password protected by default, with a default password of ‘1212’. The default password can be changed or disabled under the “Change Password” page. See “Settings Password” page for more details.

### Max Output Adjust



The maximum steam output of the unit can be set on this page. The maximum output value cannot exceed the nominal output value of the unit and cannot be set below 20% of the nominal output. The nominal output of the unit is listed on the nameplate and the “Electrical Data” help page.

### Cylinder Life Counter



This page consists of a counter where the user can monitor the life, in hours, of the cylinder. When changing a cylinder, press the ‘Reset’ button on this page to reset the timer. The Cylinder Life Counter only counts the amount of actual runtime of the cylinder (the time when the contactor is pulled in). The counter value is saved even when the humidifier is powered down. The national average cylinder life is about 1150 hours, but this can vary greatly depending on individual water conditions.

### Fan Speed Adjust



This page consists of a slider bar that can change the speed of the fans when the humidifier is connected to an optional blower box. This slider bar will not affect the operation of the humidifier if no blower box is attached. The bar can change the speeds of the fans from 0 to 100% of the max fan speed. Also displayed on this page is an estimate of the current fan air output, in Cubic Feet per Minute (CFM). This adjustment is particularly useful if the humidifier is of a smaller capacity, and less noise from the fans is appreciated.

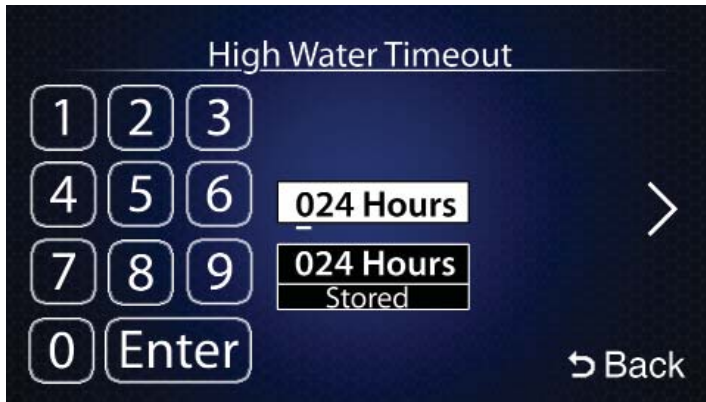


### Setpoint Timeout



This page is where the Setpoint Timeout value is set. The maximum amount of time allowed for the unit to reach Setpoint during a fill sequence is designated by the Setpoint Timeout. Its default value is 30 minutes, but can be set as high as 255 minutes. After the timer expires during a fill sequence, the humidifier assumes the drain valve is stuck open (due to sediment buildup), and begins pulsing the drain valve to attempt to unclog it. After the pulsing routine, the humidifier will attempt to reach Setpoint for a second and third time. After the third attempt without reaching Setpoint, the unit will shut down.

### High Water Timeout



This page is where the High Water Timeout value is set. This is the maximum amount of time allowed for the unit to run in a "Reduced Setpoint" mode (see Setpoints page). The timeout has a range from 0 to 168 hours, with the default being 24 hours. If the humidifier Setpoint is artificially reduced due to a high water situation, the humidifier will continue to run. If the humidifier cannot reach normal max/controlled Setpoint, the humidifier will shut down after the High Water Timeout value elapses.

### Boil Down Timer



This page is where the Boil Down Timer is set. The Boil Down Timer is variable between 0 and 255 seconds, with a default value of 25 seconds. Setting the Boil Down Timer higher will result in an increased water level, and less conditioned water. This may be helpful in reducing low water level induced arcing and corrosion of cylinders. More water is consumed by the humidifier when the Boil Down Timer value is increased.

### Settings Password

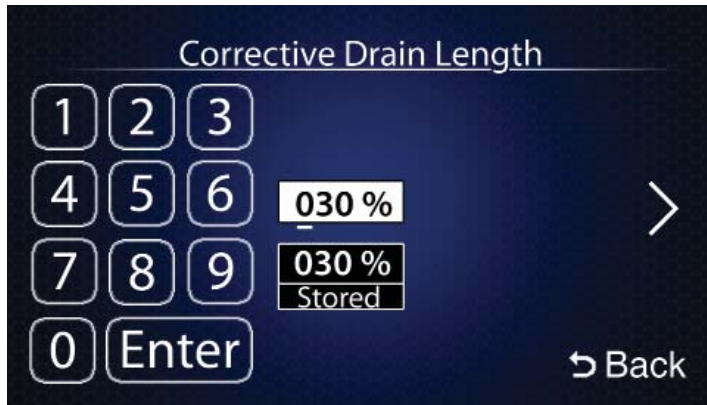


This page is where the password for the settings menu can be changed or disabled. If the password for the Settings menu is forgotten the it can be reset. To do this, remove power to the humidifier, flip the switch SW3's bottom "Clear" switch to the right and power the unit back on. Return the switch's afterwards from the right to the left.

The different buttons on both setting pages allow for the changing of different values. Below is a brief summary of each, and more information can be accessed within the page itself.



## Corrective Drain Length



This page is where the Corrective Drain Length is set. This value represents how much water should be drained from the cylinder when the humidifier senses a corrective drain is needed. As water boils from the humidifier, minerals increase in the cylinder causing the water to get more conductive. Increasing the length of the drain flushes more conductive material from the humidifier, decreasing the water conductivity. The input here is a percentage value. To set the Corrective Drain Length to drain 20% of the cylinder during a corrective drain, input 020. To drain all the tank, input 100. 030 is the default value, and only multiples of 10 between 20 and 100 can be entered.

## Default Settings



Selecting Default Settings on the settings page will allow for the restoration of factory default settings. The factory settings will be set to the following:

Setting	Default	Setting	Default
Max Output	Nominal Output	Comm. Setup	Unchanged
Fan Speed	100%	Drain Pulse	Off
Setpoint Timeout	30 Min.	72-Hour Drain	On
High Water Timeout	24 Hrs	LCD Auto-Dim	Off
Boil Down Timer	25 Sec	Steam Output Units	Lb
Corrective Drain Length	30%		

Restoring default settings can be helpful when troubleshooting an oddly behaving humidifier. Although some settings will stay visible on their respective screens after applying a factory reset, it is recommended to take note of all adjustments previously applied as some may be important for efficient operation given specific water conditions.

## CarnesLink Communication Protocol Setup



This page is where you can select and setup the communication protocol you will be using with your Building Management System (BMS) for full external monitoring capabilities. (See the CarnesLink Communication Protocol Installation, Operation and Maintenance Manual for further information.)

## ON/OFF Setting Buttons



There are a few operational options that do not need separate pages, and therefore are only enabled/disabled via the ON/OFF Buttons on the main “Settings” menu page. Their functionality is described as follows:

The **Drain Valve Pulse** option is enabled by default. This option allows the drain valve to pulse when the humidifier executes a corrective drain. This actuates the water within the drain piping, allowing for minerals buildup to be discharged more easily. Enabling this option will make the unit noisier whenever a corrective drain is executed.

The **72-Hour Drain** is disabled by default. This option, when enabled, allows the humidifier to drain the cylinder completely after 72 hours of idle operation.

The **LCD Auto-Dim** is disabled by default. This option, when enabled, will automatically turn off the backlight of the LCD after 15 minutes of idleness. This feature can save on energy consumed.

The **Steam Output Units** is disabled or set to “Lb.” by default. This option, when set to “Kg.”, will turn the steam readout on home page into Kg./Hr. instead of Lb./Hr.

# HUMIDIFIER MANDATORY PRE-STARTUP CHECKLIST

Unit Serial #: _____	No. of Humidifiers: _____
Model #: _____	Voltage: _____ V/ _____ Ph.      Steam Output: _____ lb./hr.
Customer/Job: _____	Address: _____

**WATER QUALITY:**

Well Water \_\_\_\_\_ City Water \_\_\_\_\_ Softened Water \_\_\_\_\_  
 Water Conductivity (if known): mhmos: \_\_\_\_\_ Hardness: \_\_\_\_\_ gr.

**HUMIDIFIER MOUNTING:**

Clearances around the unit

Front (door opens freely?)      yes  no   
 Top (steam lines)                      yes  no   
 Bottom (fill, drain, controls)      yes  no   
 Both Sides                                  yes  no

Acceptable

18" (Residential/Commercial)  
 38" (Dual Cylinder Cabinet)  
 12" (Residential/Commercial)  
 16" (Residential/Commercial)

**STEAM HOSE:**

Sloping up 2 in. every 12 in.      yes  no   
 Sloping down 0.5 in. every 12 in.      yes  no   
 Lengths/Size \_\_\_\_\_/\_\_\_\_\_  
 Material \_\_\_\_\_

Runs of hose over 12 ft.              yes  no   
 (if yes, drain T is needed, check IOM for details)  
 Can condensate be trapped  
 anywhere in the steam line?      yes  no

**CONDENSATE HOSE:**

Sloping back to drain                  yes  no   
 Condensate routes to drain?  
 Lengths/Size \_\_\_\_\_/\_\_\_\_\_  
 Material \_\_\_\_\_

Runs of hose over 12 ft.              yes  no   
 (if yes, drain T is needed, check IOM for details)  
 Can condensate be trapped anywhere  
 in the condensate line?              yes  no

**WATER SUPPLY LINE (do not use hot water):**

3/8 in. connection at fill              yes  no   
 Water supply shutoff within 6 ft.      yes  no

Water pressure 20-120 psi              yes  no   
 PVC      yes  no       Copper      yes  no

**DRAIN LINE:**

Connection pipe fitting to trap      yes  no

Slope to drain                              yes  no

**CYLINDER:**

Properly installed and secured      yes  no   
 Wire connectors pushed completely down on electrode rods?

Water pressure 20-120 psi              yes  no   
 yes  no

**WIRING:**

No lose wiring connections and connectors      yes

no

**CONTROLS:**

Humidistat location: \_\_\_\_\_  
 High limit location: \_\_\_\_\_

Humidistat to terminal J16              yes  no   
 High limit to terminal J17              yes  no   
 Air flow location: \_\_\_\_\_

\_\_\_\_\_   
 Air flow to terminal J18                  yes  no

**POWER:**

Voltage/current rating and fuse correspond to spec label  
 Disconnect switch located close to humidifier unit

yes  no   
 yes  no

Started by: \_\_\_\_\_

Date of Startup: \_\_\_\_\_

Company: \_\_\_\_\_

# HUMIDIFIER STARTUP CHECKLIST

**Unit Serial #:** \_\_\_\_\_ **No. of Humidifiers:** \_\_\_\_\_  
**Model #:** \_\_\_\_\_ **Voltage:** \_\_\_\_\_ **V/** \_\_\_\_ **Ph.**      **Steam Output:** \_\_\_\_\_ **lb./hr.**  
**Customer/Job:** \_\_\_\_\_ **Address:** \_\_\_\_\_

**PRELIMINARY:**

- Pre-startup Checklist completed   yes  no

If no, perform Pre-startup Checklist before starting humidifier.

**STARTUP PROCEEDURE:**

The prerequisites for the humidifier filling and contactor pulling in to make steam are as follows:

- Front door closed or door interlock switch pulled out                                 yes  no
- Water supply valve opened   yes  no
- Main disconnect switched on   yes  no
- Turn on the On-Off-Drain switch   yes  no

**CONTROLS:**

- Installed controls match configuration   yes  no
- Control setpoint   yes  no
- Proportional wall humidistat (HXHAM, HXHCH or HXHCG)                                 yes  no
- On/Off wall humidistat (HXHAA)   yes  no
- On/Off wall/duct humidistat (HXHAMT)   yes  no
- Air flow switch (HXAAE)   yes  no
- Pressure differential high velocity air flow switch (HXAAF)                                 yes  no
- Wall mounted high limit humidistat (HXHAD)   yes  no

The humidifier will undergo a self-diagnostic when the power is turned on activating the LED’s and other internal components.

If the above listed prerequisites are fulfilled, the humidifier will start filling the cylinder and begin normal operation.

**NOTE:** Most water does not contain enough conductivity for full boil on initial startup and after new cylinder replacement. Units will need to concentrate the water over a time period (up to 24 hours). It’s normal for the humidifier status to cycle between “Filling” and “High Water” (max water level) during this time period.

Started by: \_\_\_\_\_   Date of Startup: \_\_\_\_\_  
 Company: \_\_\_\_\_

# HUMIDIFIER STARTUP & OPERATION

Unit Serial #:	_____	No. of Humidifiers:	_____
Model #:	_____	Voltage:	_____ V/ _____ Ph.     Steam Output: _____ lb./hr.
Customer/Job:	_____ Address: _____		

### PRELIMINARY:

- Pre-startup Checklist completed   yes  no
- If no, perform Pre-startup Checklist before going to the starting procedure.
- Startup Checklist completed   yes  no
- If no, return to the Startup Checklist before going to the startup procedure.

### INITIAL STARTUP:

While the external disconnect is in the off position, be sure that the terminal connectors on the top of the cylinder are firmly secured and pushed completely down over the pins in the cylinder.

1. Open all the water supply valves external to the humidifier.
2. Turn external disconnect switch on.
3. Turn on optional circuit breakers if present.
4. For safety, door interlock disconnects power to cylinder(s) when the door is opened.

The humidifier may be operated for service purposes by pulling out the knob of the door interlock switch into a fixed, always on, position. **CAUTION: HIGH VOLTAGES ARE PRESENT.**

5. Turn the "On-Off-Drain" switch to the "On" position. The blue fill LED will turn on.
6. The Steam Indicator will turn red if any of the basic four controls on the home page are not ready, indicated with a red "X".
7. Adjust the controls as necessary to satisfy the requirements for steam output (see Controls and Home Page for more information). The humidifier will begin to operate if all four controls are satisfied.
8. As water slowly fills into the cylinder, the LCD Lb./Hr. output will begin to increase when water comes in contact with the electrodes.
9. Water will continue to fill until output is 10% above setpoint. If water reaches the top of the cylinder before setpoint is reached, the "High Water Sensor" will be activated and the fill will close.
10. When starting a new cylinder and fresh water, the fill and drain solenoid valve may cycle for brief periods until the water has come to a complete boil.
11. In areas with low conductivity water, full output may not be reached until the humidifier has conditioned the water by repeated cycles of filling, boiling, and refilling. The length of this process will vary but may require several hours, up to a day, under certain conditions.

### AUTOMATIC DRAIN CYCLE:

The circuit board automatically controls the operation of the drain valve to react to two situations:

#### Controlling mineral content:

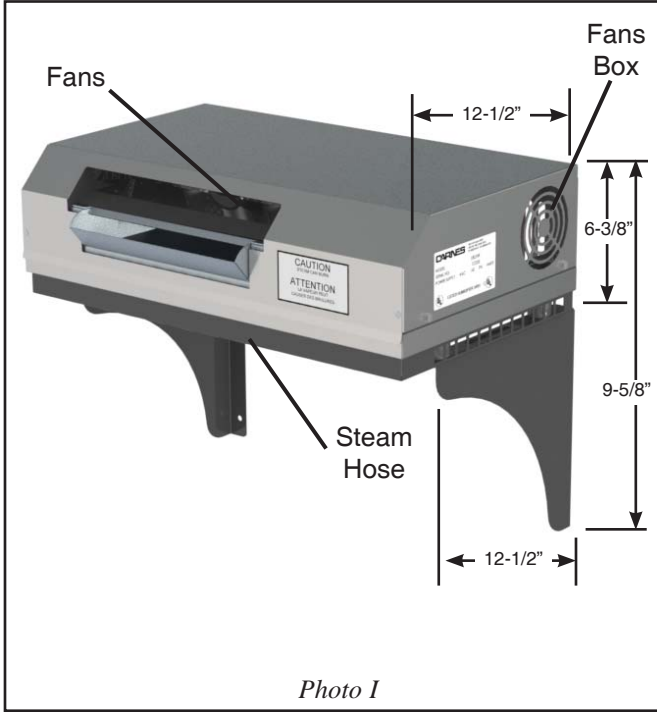
1. When the current reaches 10% above the active setpoint, the fill solenoid valve closes and water gradually boils away in the cylinder. Because the quantity of water covering the electrode surface is being reduced, current slowly falls.
2. An internal timer within the operation algorithm starts to count seconds when steam output drops to 90% of setpoint.
3. The timer runs until steam output drops to 90% of setpoint.
4. If steam output drops too rapidly during this transition, a corrective drain is necessary to reduce the mineral concentration of the water.
5. If the steam output changes slowly it indicates that mineral concentration is satisfactory and a corrective drain is not necessary.
6. Measurements are made during each cycle and a drain only occurs when necessary thereby maximizing energy and water usage efficiency.

#### Reduced Overcurrent

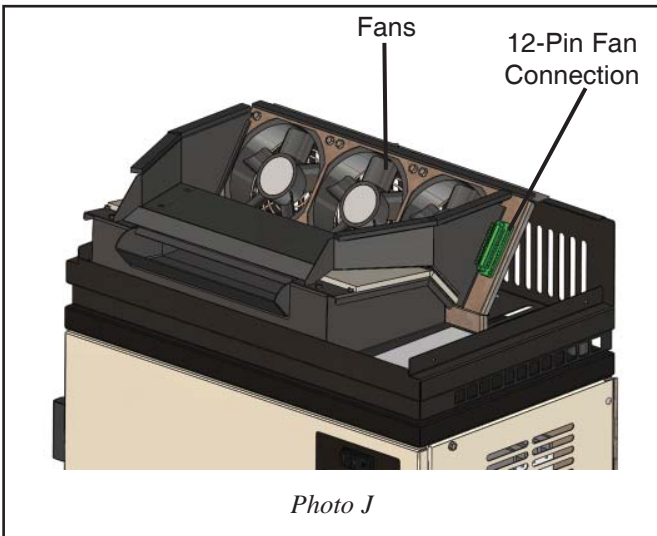
1. If current to any electrodes in the cylinder reaches more than 20% above the setpoint, the drain valve will open.
2. Draining water from the cylinder reduces current by covering less electrode surface.
3. If current is successfully reduced to acceptable levels normal operation continues.
4. If current is not reduced because of mineral blockage in the drain lines or solenoid valve, the power contactor will be opened for approximately 10 seconds while the drain valve remains open.
5. If current is successfully reduced, normal operation continues.
6. If current is not reduced the cycle is repeated 8 more times. If still unsuccessful, the humidifier is placed in an overcurrent shutdown mode and the "Service Required" page will be updated accordingly.

## FAN DISTRIBUTION UNITS

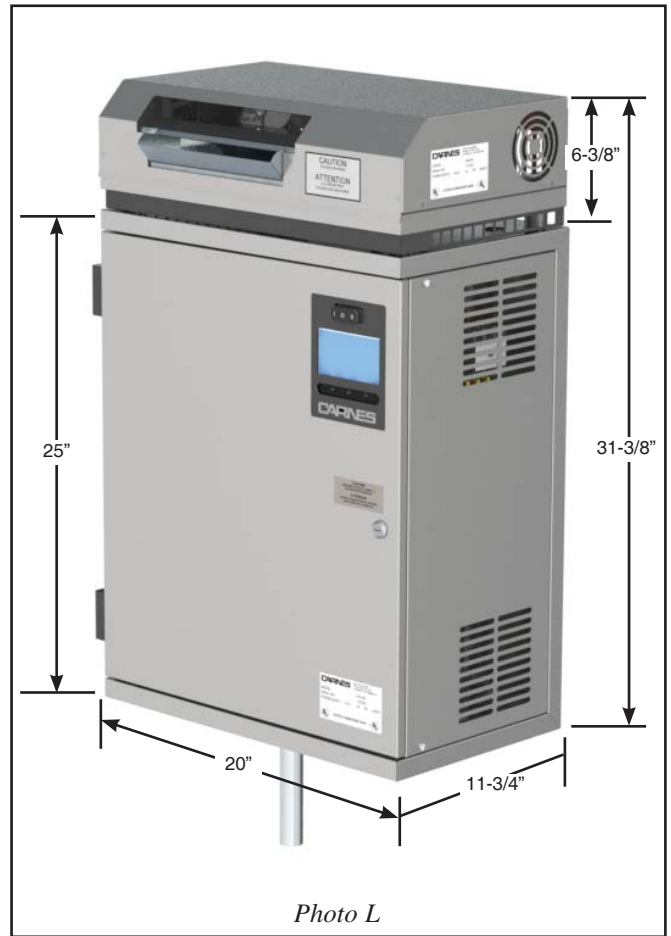
Fan distribution units are available for use in areas which do not have duct systems or where duct air temperatures are too low to provide sufficient humidification. For example, in computer areas, the desired relative humidity may not be possible in the conditioned space without causing condensation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



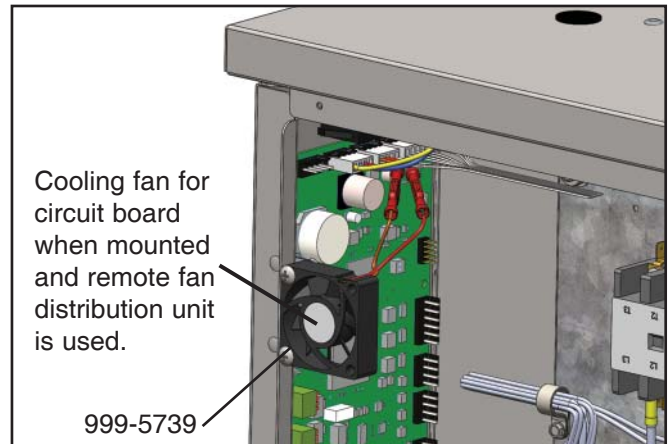
Humidifier Model	Nominal Steam Output Rate	Remote Mounted Fan Unit Model
H_AH	005, 010	HXBHB (1 Required)
H_DH	020, 030	HXBHB (1 Required)
H_GH	030, 040, 050, 060, 080, 100	HXBHC (1 Required)
H_HH	125, 150, 175, 200	HXBHC (2 Required)



Fan distribution units must be mounted securely on a level and plumb surface at least three feet below the ceiling for a Model HXBHB and at least four feet below the ceiling for a Model HXBHC to prevent steam condensing on the ceiling surface. Allow 20 feet in front of the HXBHB and 30 feet in front of the HXBHC 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 or spitting were to develop.



A **Mounted Fan Distribution Unit** and its associated humidifier are shipped as a complete assembled unit. In this case, a 12-wire connection is made from the circuit board to the 12-Pin fan connection (Green). This connection is already assembled in the factory.



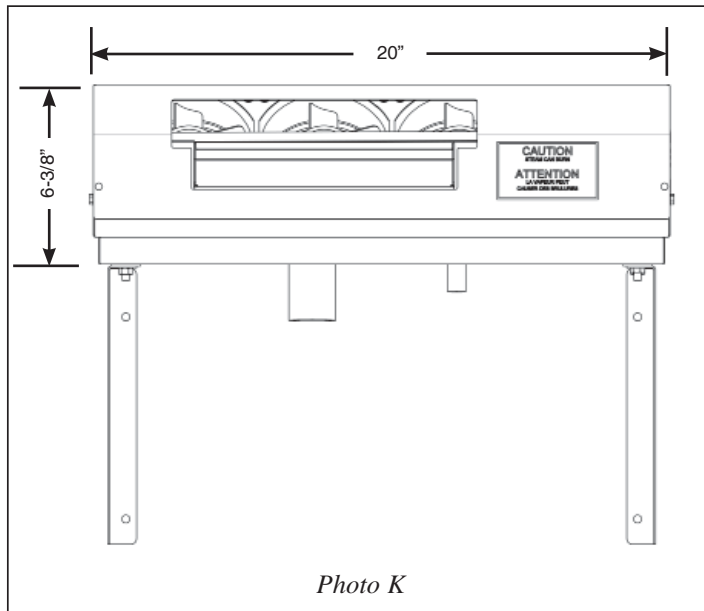
**Cooling Fan** included with all fan distribution units as well as with all other units manufactured. As soon as power is supplied, the fan will start to run from the 12 volt source from circuit board.



A **Remote Fan Distribution Unit** comes with two separate male plugs to connect 12-conductor wire 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 12 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. See *Table 3-A*, page 7. 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.

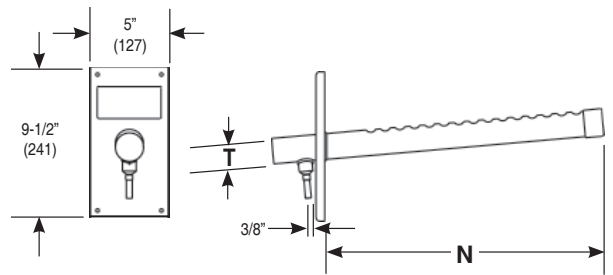




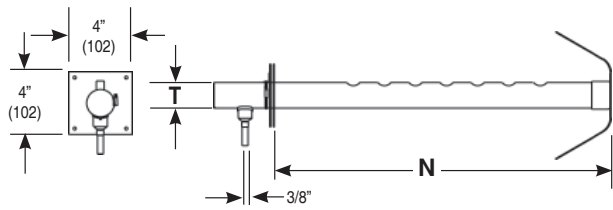
## STEAM DISTRIBUTOR PIPES



### Lengths 012-036



### Lengths 048-120



### Distributor Pipes for Models: HTA, HSA, HTD, HSD

PIPE	N	T
HXPBB012S	11-13/16 (300mm)	7/8
HXPBB018S	17-13/16 (452mm)	7/8
HXPBB024S	23-13/16 (605mm)	7/8
HXPBB030S	29-13/16 (757mm)	7/8
HXPBB036S	35-13/16 (910mm)	7/8

### Distributor Pipes for Models: HTG, HSG, HTH, HSH

PIPE	N	T
HXPBC012S	11-13/16 (300mm)	1-5/8
HXPBC018S	17-13/16 (452mm)	1-5/8
HXPBC024S	23-13/16 (605mm)	1-5/8
HXPBC030S	29-13/16 (757mm)	1-5/8
HXPBC036S	35-13/16 (910mm)	1-5/8

PIPE	Minimum**		T
	N	N	
HXPBB040S	35 (889mm)	38 (965mm)	7/8
HXPBB044S	39 (991mm)	42 (1067mm)	7/8
HXPBB048S	43 (1092mm)	46 (1168mm)	7/8
HXPBB052S	47 (1194mm)	50 (1270mm)	7/8
HXPBB056S	51 (1295mm)	54 (1372mm)	7/8
HXPBB060S	55 (1397mm)	58 (1473mm)	7/8
HXPBB064S	59 (1499mm)	62 (1575mm)	7/8
HXPBB068S	63 (1600mm)	66 (1676mm)	7/8
HXPBB072S	67 (1702mm)	70 (1778mm)	7/8
HXPBB076S	71 (1803mm)	74 (1880mm)	7/8
HXPBB080S	75 (1905mm)	78 (1981mm)	7/8
HXPBB084S	79 (2007mm)	82 (2083mm)	7/8
HXPBB088S	83 (2108mm)	86 (2184mm)	7/8
HXPBB092S	87 (2210mm)	90 (2286mm)	7/8
HXPBB096S	91 (2311mm)	94 (2388mm)	7/8
HXPBB100S	95 (2413mm)	98 (2489mm)	7/8
HXPBB104S	99 (2515mm)	102 (2591mm)	7/8
HXPBB108S	103 (2616mm)	106 (2692mm)	7/8
HXPBB112S	107 (2718mm)	110 (2794mm)	7/8
HXPBB116S	111 (2819mm)	114 (2896mm)	7/8
HXPBB120S	115 (2921mm)	118 (2997mm)	7/8

PIPE	Minimum**		T
	N	N	
HXPBC048S	43 (1092mm)	46 (1168mm)	1-5/8
HXPBC060S	55 (1397mm)	58 (1473mm)	1-5/8
HXPBC072S	67 (1702mm)	70 (1778mm)	1-5/8
HXPBC084S	79 (2007mm)	82 (2083mm)	1-5/8
HXPBC096S	91 (2311mm)	94 (2388mm)	1-5/8
HXPBC108S	103 (2616mm)	106 (2692mm)	1-5/8
HXPBC120S	115 (2921mm)	118 (2997mm)	1-5/8

#### \*\*NOTE A

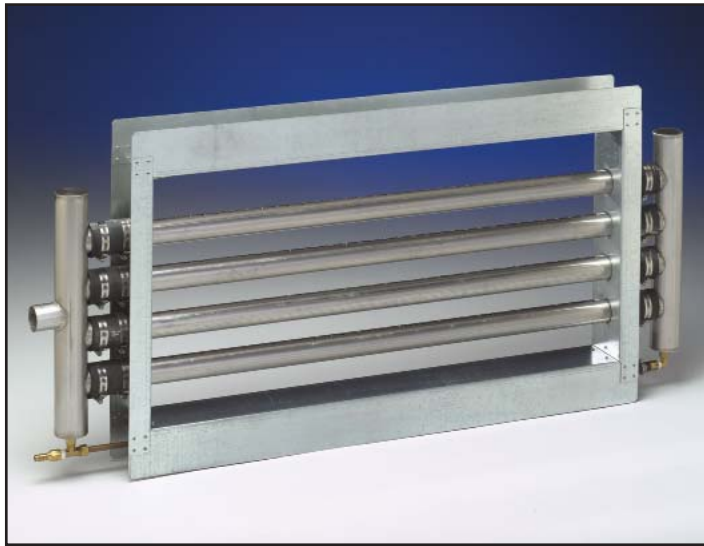
The mounting plate on these pipes is adjustable to compensate for slight variations in ductwork dimensions. The "N" dimension is shown at both maximum and minimum depending on the position of mounting plate. A mounting strap is provided on the end of the pipe to secure to the top or side of the duct for support.

#### MATERIAL

Standard distributor pipes are fabricated from stainless steel.

\*\*See Note A

**CARNES STEAM MANIFOLDS** reduce the non-wetting distance when required because of space constraints in duct system.

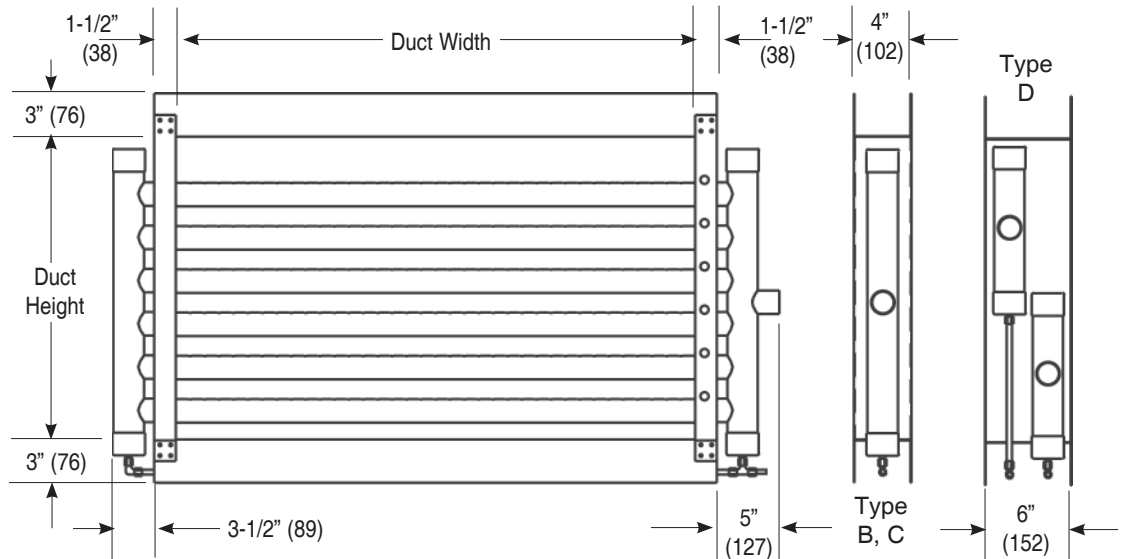


## SHORT ABSORPTION MANIFOLD

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.

Table 5

Duct Height	Tubes
012	3
014	3
016	4
018	4
020	5
022	5
024	6
026	6
028	7
030	7
032	8
034	8
036	9
038	9
040	10
042	10
044	11
046	11
048	12
048	12
048	13
048	13
048	14
048	14
048	15



**CARNES STEAM MANIFOLDS with strong galvanized flanged frames are factory assembled to reduce installation costs.**

**LOCATION OF MANIFOLD**

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.

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*.

**MAXIMUM STEAM HOSE LENGTH** (*Table 6*)

Duct Static Pressure "wg"	0	1	2	3	4	5
Maximum 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 R*. 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 S*. 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 T*. The steam manifold cannot be installed in a vertical duct.

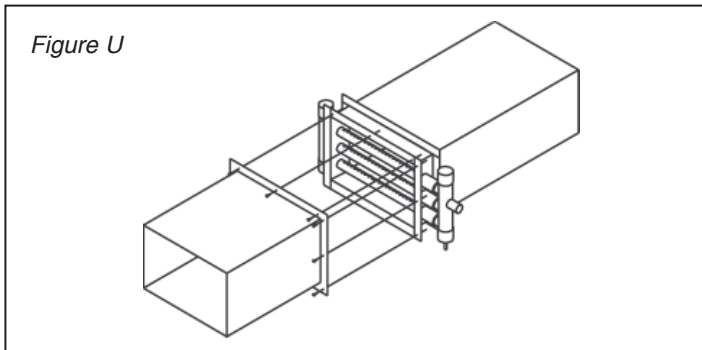
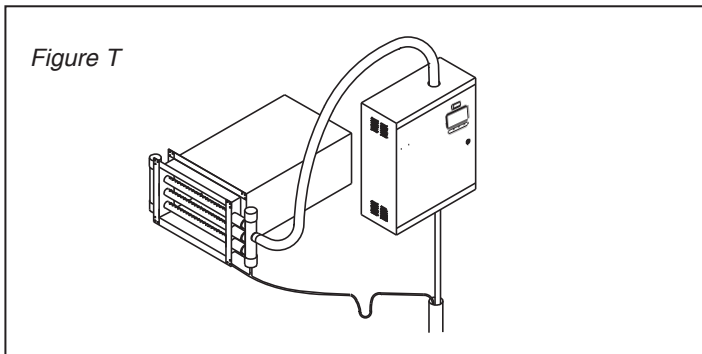
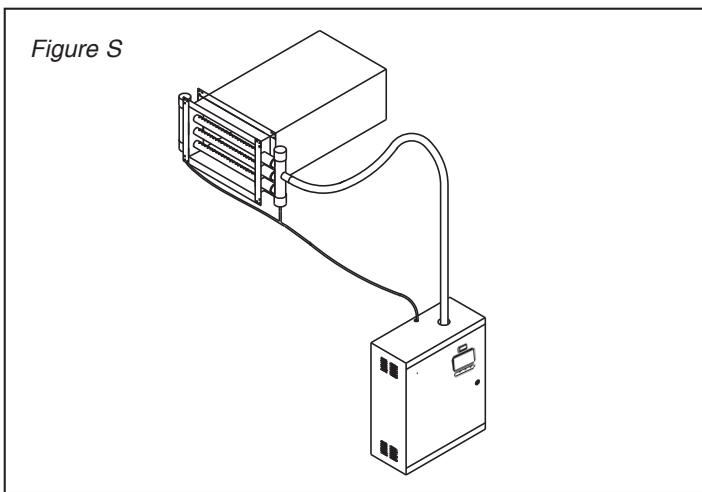
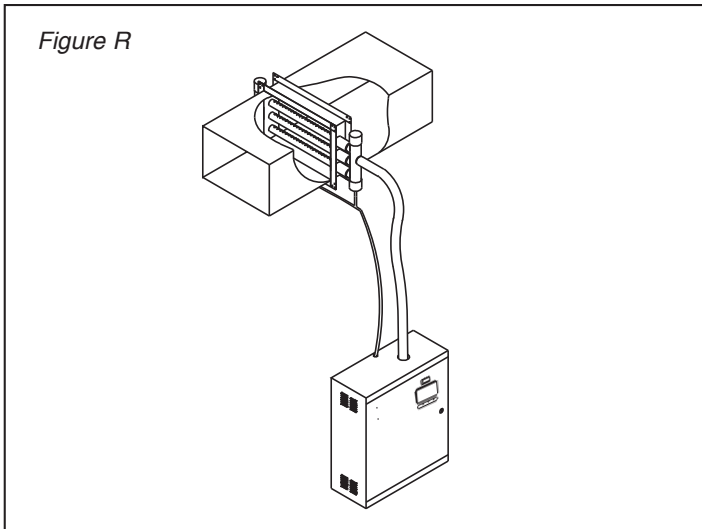
The manifold has an integral mounting flange for ease of installation. Separate mounting flanges, supplied by others, are needed to mate with the manifold. Refer to *Figure U*.

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.

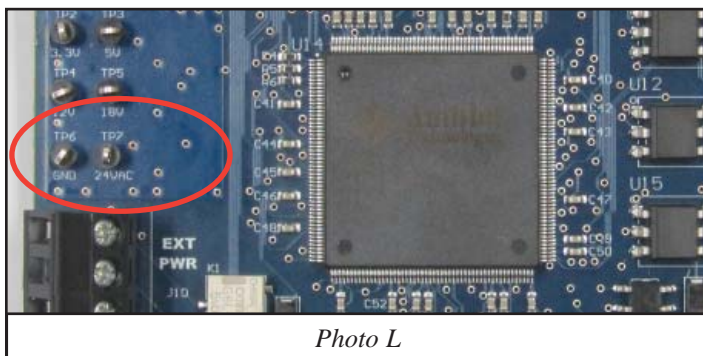


## TROUBLE SHOOTING - SYMPTOM, CAUSE AND ACTION - Table 7

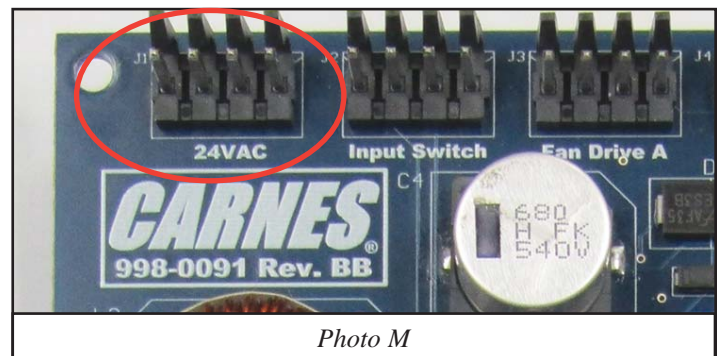
SYMPTOM	CAUSE	ACTION
<b>Arcing</b>	Naturally very high conductivity water.	Water may be too high in conductivity. Test water.
	Drain lines restricted causing low water levels.	Inspect & clean drain & tubing regularly.
	Defective drain solenoid valve.	Repair, clean, or replace as necessary.
	Insufficient flow of incoming water. Levels low.	Maintain 20 psi or above. Clean strainer, repair, clean, or replace fill solenoid as necessary.
	High back pressure in steam line.	Check kinks or severe bends in steam hose. Check system static pressure.
	Excessive lengths of steam hose and/or high static pressure.	Shorten distance between humidifier & dispersion, maintain proper incline in steam hose, eliminate as many 90° or 45° bends, insulate steam line as necessary.
	Attempted cleaning of cylinder by flushing or banging producing flakes causing restricted lines.	Do not use solutions to clean cylinders, dispose as necessary. Solutions could cause chemical reactions not conducive to good operation.
<b>“Service” indicator on</b>	Various.	See “Service Required” page for more information regarding the problem.
<b>Water doesn’t fill into cylinder (blue LED fill indicator)</b>	All 4 basic control signals not satisfied.	Make sure all control circuits are closed and the humidifier is ‘On’.
<b>Water doesn’t fill into cylinder (water level doesn’t rise in cylinder)</b>	Fill valve strainer is restricted.	Remove strainer from fill valve assembly and clean.
	Fill valve is defective.	Repair or replace as necessary.
	24 Volts AC not coming from circuit board.	Consult factory, replace circuit board.
<b>Humidifier drains continuously</b>	Piece of mineral is partially blocking drain so it will not close properly.	Cycle drain. If it does not clear, clean as necessary.
	Drain plunger is worn out, preventing drain valve from closing completely.	Repair or replace as necessary.
<b>Water in duct or spitting from distributor pipe</b>	Steam hose and condensate return hose do not have a continuous slope. Condensate accumulates and gets pushed out of distributor.	Improve routing of all hoses and/or install condensate drains as necessary. Add a trap in the steam hose in front of the distributor.
	Condensate return is blocked, kinked and prevents proper drainage of condensate water and accumulates in distributor pipe and pushed out into duct.	Eliminate restriction in hose and routes as required for proper flow of condensate water.
	Distributor pipe is not installed properly or manufactured properly, not allowing for a continuous backward slope to steam hose and condensate hose connection.	Re-assemble, repair, or replace as necessary.
	If condensate return hose has a drop less than 12”.	Route the condensate return to a common drain and include a trap.
	Condensate return is connected to top of unit, but a trap was installed too close to elbow, split, turning vane, grille, or diffuser.	Whenever condensate hose is returned to top of unit a trap is not required, remove it. Distributor pipe must be a minimum of 6 feet upstream from elbows, grilles, etc. If temperature in the in duct is 60°F or lower the distance should be 10 feet. If distance, as mentioned, is not possible, a drain pan may be required. If the air in the duct cannot hold the volume of steam, the only recourse is to reduce the maximum output of the unit. If very short absorption distances are required, a short absorption manifold can be installed.

## TROUBLE SHOOTING - SYMPTOM, CAUSE AND ACTION *(Continued)*

SYMPTOM	CAUSE	ACTION
No LCD display	The LCD has been dimmed.	Touch LCD screen.
	Voltage to the humidifier is not that which is required per rating label.	Change humidifier or make necessary changes to confirm compatibility.
	3 phase voltage but not all legs have power.	Check electrical connections and make necessary repairs or hook ups.
	Internal or external circuit breakers are not closed.	Close all circuit breakers.
	24VAC supply to circuit board is not available.	Make sure the protection on the transformer is not tripped (fuse or breaker). Confirm the required 24VAC is leaving transformer. Make sure connection to circuit board at J1 is intact. If situation does not resolve, replace circuit board.
Humidifier unable to reach maximum output or required setpoint	Capacity of unit is too low.	Determine proper load calculation and capacity of humidifier. Use properly sized unit.
	Too high of a system static pressure.	Supply air system must be evaluated if static pressure is too high. Locate and correct issue.
	Back pressure in steam hose is too high.	Check for the following: too long of steam line runs, sags, dips, horizontal runs not allowing for proper condensate removal, improper sloping of steam lines and condensate line.
	Foaming.	Remove impurities inside the cylinder. If cleaning of cylinder was attempted, throw away.
LCD not on		Verify that voltage being supplied to the humidifier is the same as that listed on the rating label on the front left hand corner of cabinet.
		If humidifier is 3 phase, verify that all legs have power.
		If the humidifier has optional internal circuit breakers, they must be on.
		Verify LCD is not in dimmed mode by touching it.
		Verify that 24VAC is being supplied by the voltage transformer by taking voltage reading between TP6 and TP7 ( <i>Photo L</i> ). Check the connection at J1 ( <i>Photo M</i> ).
		If 24VAC is not present reset the overload protection (breaker or fuse) located on the transformer.
		If 24VAC is present, the circuit board may be defective.



*Photo L*



*Photo M*



## TROUBLE SHOOTING - SYMPTOM, CAUSE AND ACTION *(Continued)*

SYMPTOM	CAUSE	ACTION
<b>Water doesn't fill into cylinder</b>		Confirm that indicators for the four basic controls all have green checkmarks in the "Steam" menu, and the humidifier is switched 'On'.
		If all four control requirements are checked green, consult the "Controls" section of the IOM.
		If all four control requirements are checked green, and the 'Steam' indicator is not red, check the service required page for a possible shutdown scenario.
		If no service required information is available, check the Fill Valve indicator (the blue LED on the front). If the LED is on, check for 24VAC at the coil of the fill valve. If 24VAC is present water should be flowing if water is available. Be sure all shut off valves ahead of the humidifier are open.
		If water is available, check the fill valve strainer for sediment. The strainer may be checked by removing the plastic nut from input side of the valve and reaching inside the housing with a non-sharp tool and pulling the strainer out.
		If 24VAC is present and strainer is clean, the fill valve may be defective.
		If the High Water Sensor is activated, the fill valve will not be allowed to open. In this case the blue LED on the front panel will be off.
		Make sure the drain solenoid is not partially open due to blockage, restriction, or malfunction.
<b>Drains continuously</b>		The most common cause is to have a piece of mineral in the drain solenoid valve that prevents the valve from closing properly. Simply cycling the "On-Off-Drain" switch back and forth between "Off" and "Drain" may dislodge the sediment. In extreme cases it may be necessary to disassemble drain lines to clean them. If mineral buildup is a reoccurring issue, make sure the "Repetitive Drain Valve" option is enabled in the settings menu.
		Check movement of the solenoid actuator to verify that the plunger moves freely in the coil. If the coil has overheated so that movement of the plunger is restricted, it will require replacement of the valve.
		When the Drain Valve" Red LED is lit, the circuit board is sending 24VDC to the drain valve. If the Red LED is on but 24VDC is present at the drain valve, the circuit board may be defective.

## TROUBLE SHOOTING - SYMPTOM, CAUSE AND ACTION *(Continued)*

SYMPTOM	CAUSE	ACTION
<p><b>Water in the duct</b></p>	<p><b>Note:</b> This is usually an installation problem. The first step is to determine whether water is spitting from the steam distributor pipe or if steam is condensing on some object downstream from the steam distributor pipe. If water is spitting from the steam distributor pipe there may be several causes.</p>	<p>The steam hose and condensate return line <b>MUST</b> have continuous slopes without any sags or low areas where water could accumulate. If water accumulates in the steam hose it may be suddenly pushed into the distributor pipe and the condensate return line may be unable to handle the large volume.</p>
		<p>Make sure that the condensate return line is not restricted anywhere. Areas where the hose bends or where it is tied using cable ties are often the problem.</p>
		<p>The distributor pipe must be installed so that the far end of the distributor pipe is higher than the incoming end where the condensate return connection is located. The mounting plate on the distributor pipes (with lengths up through 36") should be mounted on a plumb surface to automatically provide proper pitch. On longer pipes, it is necessary to support the pipe using the bracket on the end of the pipe to insure that proper slope is maintained.</p>
		<p>If the condensate return line has a drop of less than 12" from the distributor pipe to the top of the humidifier cabinet, it may be better to route the drain below the unit rather than connecting at the top of the cabinet.</p>
		<p>If the condensate return line is connected to the fitting at the top of the humidifier cabinet, make sure that traps have not been installed in the return line. A trap is only needed if the return line is routed to a separate drain and it is necessary to prevent steam from being discharged from the line.</p>
		<p>It may be beneficial, particularly on longer routes, to put a trap in the steam hose right before the distributor pipe. In this case, it is absolutely necessary to run the condensate at the bottom of the trap away to a separate drain.</p>
		<p>If water is condensing on an object in the duct or on the duct itself it will be necessary to take other steps.</p>
		<p>The distributor pipe must be a <b>minimum</b> of 6 feet upstream from any elbow, split, coil, turning vane, grille, or diffuser. The lower the air temperature is in the duct the further upstream the pipe must be located. If the air temperature is 60°F it may be necessary to have 10 feet between the pipe and any obstruction.</p>
		<p>If it is not possible to have the required distance from the distributor pipe to an obstruction a drain pan may be required to accommodate the water.</p>
		<p>It may be that air in the duct simply can't hold the volume of steam that is being added. Normally the only practical solution is to reduce the steam output of the humidifier, as it is usually not feasible to increase the air temperature or quantity.</p>

## TROUBLE SHOOTING - SYMPTOM, CAUSE AND ACTION *(Continued)*

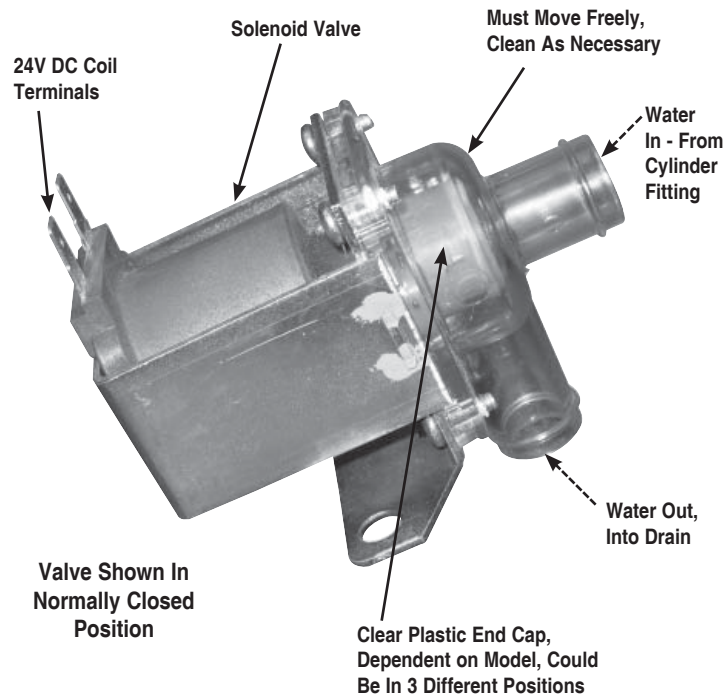
SYMPTOM	CAUSE	ACTION
<p><b>Arching in the steam cylinder</b></p>	<p>An occasional arc is not a problem. When a cylinder is restarted after a long period of off time arcing may occur as pieces of mineral flake off the electrode surface. During a drain cycle, arcing may occur if water is very low in the cylinder. Arcing is a problem if it occurs frequently or if it causes dark brown or red discoloration in the cylinder. The dark deposits are caused by deterioration of electrode material and must be prevented. Arcing may be caused by several conditions:</p>	<p>Incoming water may have high conductivity. Conductivity, the ability to conduct current, is measured in “micromhos”. In any electrode type humidifier there are maximum values of conductivity that may be used in the humidifier. It is very unusual for any naturally occurring water to have conductivity that is too high for operation. It is recommended that water conductivity be less than 900 micromhos. If water is treated by a water softener its conductivity will be higher than untreated water. As it is boiled away its conductivity also increases at a higher rate than untreated water. Softened water may be too high in conductivity to operate without arcing.</p>
		<p>Drain lines within the humidifier that have become restricted by mineral deposits prevent proper drain rates. This causes minerals to concentrate inside the cylinder, which in turn causes low water levels. Low water levels cause arcing. Drain lines should be inspected when cylinders are changed and thoroughly cleaned if necessary.</p>
		<p>A defective drain solenoid valve will prevent proper draining. The solenoid should be checked to verify that it moves freely when 24VDC is applied to the coil. When placed in the “Drain” position, both the drain and fill valves open and it is very important the water level falls in the cylinder.</p>
		<p>Insufficient flow of incoming fresh water will cause arcing by causing low water levels. Since an automatic drain is not initiated until setpoint is reached, a drain will not occur if the flow rate is too low. Therefore, if low water pressure at the humidifier (below 20 psi) or a clogged water strainer restricts the flow of water, arcing will result.</p>
		<p>High back pressure, which can be caused by an obstruction in the steam hose, prevents fresh water from entering the cylinder and results in arcing. Care must be taken to prevent kinking of steam hose when making bends.</p>
		<p>Excessive lengths of steam hose in conjunction with high duct static pressures cause low water levels and arcing.</p>
		<p>Frequent cleaning of the steam cylinder by removing and flushing or by striking the side of the cylinder potentially dislodges flakes that can build up a “dam” in the drain lines. It is not recommended that the cylinder be removed except for replacement.</p>
		<p>Chemicals should <b>never</b> be used to attempt to prevent mineral build up in the cylinder or to dissolve minerals that accumulate. Chemical treatment may affect conductivity. <b><i>Only untreated tap water is recommended for use in the humidifier.</i></b></p>

## TROUBLE SHOOTING - SYMPTOM, CAUSE AND ACTION *(Continued)*

SYMPTOM	CAUSE	ACTION
Foaming	Foaming is usually due to foreign matter or impurities getting into the cylinder through normal water supply. Detergents, cleaning agents used to clean dirty cylinders (cylinders are not to be cleaned, but to be disposed of at end of cylinder life), and water issues precipitated by very slow or fast drain cycles. It is important to note that when foam is generated it is as conductive as the conditioned water and could, if circumstances are right, force a high water level situation.	Clean all water lines, replace if necessary.
		Replace cylinder.
		Reduce softening mix or concentration.
		Increase water volume by correcting drain issues.
		Changing cylinder, but with a different electrode configuration to accommodate the water condition.

### WATER CONTROL

The water contained in the cylinder must be controlled, in order for the humidifier to function properly. The fill and drain rates must be maintained. Filling too quickly can cause over-current and automatic shutdown, circuit breaker tripping or blown fuses. Filling too slowly can cause insufficient steam output or insufficient humidity levels. Water supply pressure should be between 30 and 80 psig, ideally 55 to 60 psig. Draining too quickly can cause dangerous arcing and electrode corrosion. Draining too slowly can cause over-concentration and malfunction due to foaming. These are just some examples of what can go wrong if the fill and drain rates are not controlled and maintained.



## 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.
  - c. Remote mounted on/off, proportional control humidistat.

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 DDC 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.



# HUMIDIFIER MAINTENANCE CHECKLIST:

Unit Serial #: _____	No. of Humidifiers: _____		
Model #: _____	Voltage: _____ V/ _____ Ph.	Steam Output: _____	lb./hr.
Customer/Job: _____	Address: _____		

## CYLINDER/SYSTEM CHECK:

- “Service Required” warning (Cylinder Life Counter)                      yes  no
- Fault cylinder spent    yes  no   
 (If panel displays “Service Required” warning and the warning states “Cylinder near end of life” the cylinder will need to be replaced soon.)
- Orange LED on with high water warning    yes  no   
 (If orange LED is on with High Water Warning and cylinder is not new, cylinder may have to be replaced soon.)
- Other warnings or faults shown in display    yes  no   
 (See Troubleshooting chapter for actions to address warnings and faults if present.)

## REPLACE CYLINDER:

- Drain cylinder, first with water shutoff open    yes  no
- Drain cylinder, next with water shutoff closed    yes  no
- Disconnect open, On/Off switch is off, water shut off closed    yes  no
- Remove cylinder    yes  no
- Drain valve removed/cleaned/new O-ring    yes  no
- Optionally added lubricating sealant to O-ring (C series only)    yes  no
- Drain valve installed/ground wire attached    yes  no
- New cylinder installed and hose clamps tightened    yes  no

New cylinder model # \_\_\_\_\_

(Should be same as removed cylinder.)

- Cylinder plug numbers match cylinder numbers    yes  no
- Cylinder plugs snug and in good condition    yes  no
- Electrical wiring not loose and in good condition    yes  no
- Steam and condensate hoses in good condition/no kinks in hose    yes  no
- No signs of water leaking around humidifier, internal plumbing, steam line, condensate returns    yes  no
- Door replaced, water shut off valve opened, On/Off switch to on, disconnect closed    yes  no
- “Reset Cylinder Life Counter” in settings. (Settings password: 1212)    yes  no

Started by: \_\_\_\_\_ Date of Startup: \_\_\_\_\_  
 Company: \_\_\_\_\_

## PREVENTATIVE MAINTENANCE:

Unit Serial #:	_____	No. of Humidifiers:	_____		
Model #:	_____	Voltage:	_____ V/ _____ Ph.	Steam Output:	_____ lb./hr.
Customer/Job:	_____	Address:	_____		

### PREVENTATIVE MAINTENANCE: RECOMMENDED MONTHLY PREVENTATIVE MAINTENANCE FOR HUMIDIFIERS

Service contractor or maintenance agent - be prepared to:

1. Investigate and observe.
2. Recognize issues.
3. Determine procedures.
4. Implement solutions.
5. Inform customers.

Preventative maintenance is not intended to replace quality manufacturing and assembly from the company of origin. Products get older, wear and tear occurs, personnel changes and simple attention to detail sometimes become lax. Basic preventative maintenance for humidifiers should be required follow-up for continued proper operation of products. Preventative maintenance is a means to prevent future costly failures. The following are recommended preventative maintenance procedures for humidifiers on a monthly basis:

### PLEASE FOLLOW ALL REQUIRED SAFETY PROCEDURES BEFORE WORKING ON HUMIDIFIER UNITS.

1. Visually inspect steam hose(s) and condensate hose(s) for proper routing and installation from humidifier unit. Prevent sags, dips, or kinks in hoses. Eliminate horizontal runs. Make sure there is an adequate slope up for the steam hose and slope down for the condensate return. Correct as necessary. Recommend no hose lengths longer than 10 feet. Refer to earlier pages of this IOM.
2. Visually inspect steam hose and condensate attachment to dispersion pipe or short absorption manifold. Recommend periodic removal of dispersion systems for inspection (restricted dispersion holes, damage, plumb mounting, and clamping tightness).
3. Humidifier unit - inspect internal hoses for sediment build up or degradation. Clean or replace as necessary. Also, check tightness of hose clamps. Tighten as necessary.
4. Inspect fill valve strainer. Industrial/commercial unit fill valve strainer is located at the connection point of the water inlet hose to valve. Strainer is located inside the valve at the threads. Pop out using a non-sharp tool and inspect. Clean or replace as necessary.
5. Visually check operation of the drain solenoid valve, smooth operation and 100% seal when normally closed. If necessary, remove solenoid valve, disassemble and clean or replace as necessary.

6. Visually check the cylinder for extreme amounts of residue on the inside surface. Very high levels of water or the unit unable to provide full capacity may be an indication that the cylinder is at the end of its life. Do not attempt to clean out with chemicals; do not stick screwdrivers or other objects into cylinder to clean out sediment. These cylinders are made to be replaced at end of life cycle. Life cycle of a cylinder is often determined by the condition of the water used in the unit, especially hardness, % of max output, or run time (24/7, 8 hr./day, etc.). Refer to this IOM or main humidifier catalog for more information.
7. Visually and manually check all wires and connections inside the unit. Include inspecting the wire connections to the top of the cylinder. If a red 90° connector is used, be sure to check the inside of the connector for a set screw. This screw needs to be checked for tightness. Make sure control wires at the J16, J17 and J18 terminal connections, bottom of the circuit board, are tight.
8. Monthly - remove drain air gap and check for any sediment buildup that may block any free flow of water. These check points for the "H" series humidifier are basic, but significantly covers the entire unit.

Keeping a preventative maintenance record would be recommended to show maintenance performed and any observations made during inspection.

## EXTENDED SHUTDOWN/STARTING AFTER EXTENDED SHUTDOWN:

Unit Serial #:	_____	No. of Humidifiers:	_____
Model #:	_____	Voltage:	_____ V/ _____ Ph.      Steam Output: _____ lb./hr.
Customer/Job:	_____	Address:	_____

### EXTENDED SHUTDOWN

During long periods of humidification downtime, the cylinder should be completely drained and emptied.

1. Manually push the On/Off rocker switch to drain.
2. Wait until the humidifier is completely drained of water.
3. Turn the On/Off rocker switch to the "OFF" position.
4. Shut off the main external power to the humidifier unit.
5. Turn the supply water off at the shut-off valve.



### NOTE:

**CARNES RECOMMENDS THAT THE CYLINDER REMAIN EMPTY DURING EXTENDED SHUTDOWN PERIODS. THIS WILL PREVENT THE POSSIBILITY OF CORROSION OF THE ELECTRODES AND THE ACCUMULATION OF ALGAE AND BACTERIA GROWING IN THE CYLINDER.**

### STARTING AFTER EXTENDED SHUTDOWN

1. Inspect the humidifier for any damage. Check to make sure the mounting and installation has not been altered.
2. Turn on the main external power to the humidifier unit.
3. Turn the On/Off rocker switch to the "ON" position.
4. Review and follow the startup procedure in the IOM.

## REPLACEMENT CYLINDER:

Unit Serial #: \_\_\_\_\_ No. of Humidifiers: \_\_\_\_\_  
Model #: \_\_\_\_\_ Voltage: \_\_\_\_\_ V/ \_\_\_\_\_ Ph. Steam Output: \_\_\_\_\_ lb./hr.  
Customer/Job: \_\_\_\_\_ Address: \_\_\_\_\_

The label on the existing cylinder identifies the cylinder model. When ordering, please quote the 7, 8 or 9 digit model number from the cylinder label. You will also need to provide the humidifier model number and serial number (located on the sticker on the front of the unit).



### NOTE:

CARNES RECOMMENDS THAT THE CYLINDER REMAIN EMPTY DURING EXTENDED SHUTDOWN PERIODS. THIS WILL PREVENT THE POSSIBILITY OF CORROSION OF THE ELECTRODES AND THE ACCUMULATION OF ALGAE AND BACTERIA GROWING IN THE CYLINDER.

## REMOVING THE CYLINDER:

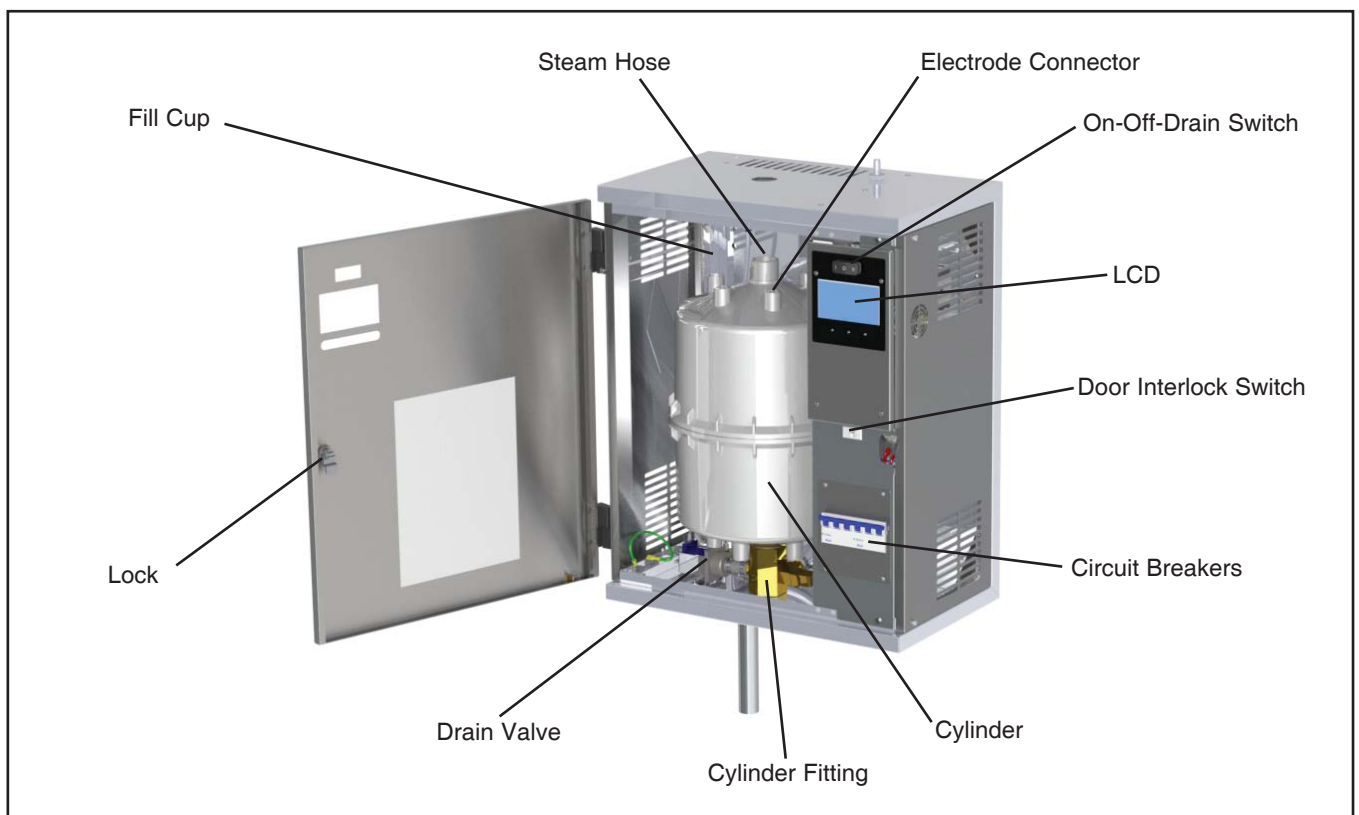
Unit Serial #: \_\_\_\_\_ No. of Humidifiers: \_\_\_\_\_  
Model #: \_\_\_\_\_ Voltage: \_\_\_\_\_ V/ \_\_\_\_\_ Ph. Steam Output: \_\_\_\_\_ lb./hr.  
Customer/Job: \_\_\_\_\_ Address: \_\_\_\_\_



### WARNING

- Disconnect power (external shut-off) before servicing.
- **CAUTION:** cylinder may be **hot**.
- Compartments contain high voltage wiring.

1. Completely drain the existing cylinder (flip On/Off rocker switch to "Drain").
2. Turn off water supply at the shut-off valve.
3. Turn the humidifier off (flip On/Off rocker switch to "OFF").
4. Turn main power "Off" at the external shut-off.
5. Remove all terminal plugs from the cylinder.
6. Loosen the steam hose clamp and remove the steam hose from the cylinder.
7. (Using a flat head screwdriver) Remove the cylinder strap, keeping the cylinder in place.
8. A and B sized cylinders are threaded. Unscrew the cylinder (counter clockwise) and lift up and out.
9. C sized cylinders are seated into the brass plumbing with an O-ring. Just lift up and out.





## INSTALLING THE CYLINDER:

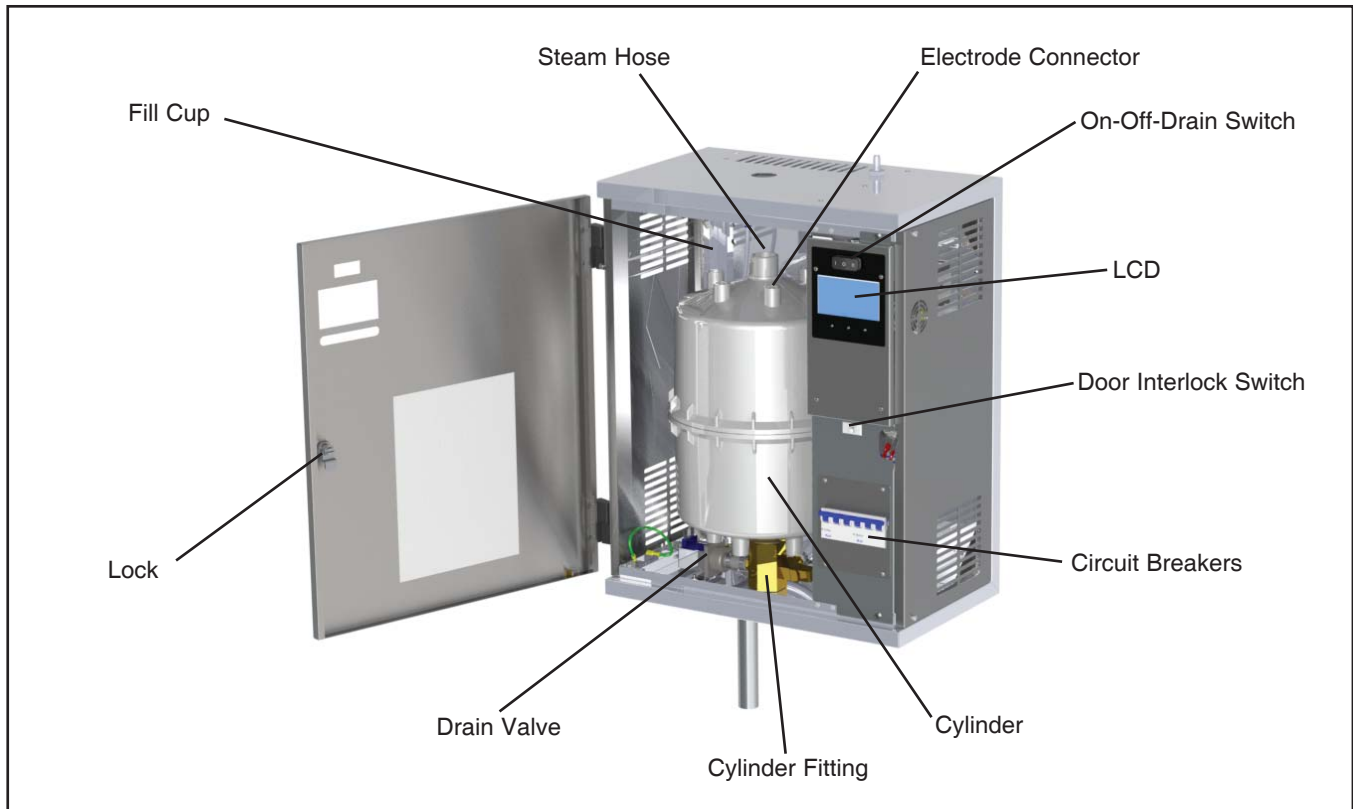
Unit Serial #: \_\_\_\_\_ No. of Humidifiers: \_\_\_\_\_  
Model #: \_\_\_\_\_ Voltage: \_\_\_\_\_ V/ \_\_\_\_\_ Ph. Steam Output: \_\_\_\_\_ lb./hr.  
Customer/Job: \_\_\_\_\_ Address: \_\_\_\_\_



### WARNING

- Keep power off (external shut-off) until cylinder is in place and reconnected.
- Compartments contain high voltage wiring.

1. Insert cylinder into brass cylinder fitting.
2. A and B style cylinders are threaded. Verify there is Teflon tape on the threads and do not over tighten.
3. C sized cylinders have no threading, verify the two O-rings are present and set the cylinder fully.
4. Secure the cylinder with the white cylinder straps (not labeled).
5. Do not over tighten as this may damage the cylinder.
6. Connect the terminal wires to the electrodes so that the numbers match those on the cylinder. Push the plugs onto the pins to ensure the electrode plugs are firmly in place.
7. Place the steam hose onto the steam outlet and tighten the steam hose clamp.
8. Turn main power "On" at the external shut-off.
9. Turn on the water supply at the shut-off valve.
10. Turn the humidifier on (flip On/Off rocker switch to "ON").





# WARNING

UNAUTHORIZED MODIFICATION OF THIS HUMIDIFIER OR USING UNAUTHORIZED REPLACEMENT PARTS MAY CAUSE MALFUNCTION WITH RISK OF SERIOUS PERSONAL INJURY AND WILL VOID ALL PRODUCT WARRANTIES.

## REPLACEMENT CYLINDER ORDER FORM

Name: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State/Province: \_\_\_\_\_ Code: \_\_\_\_\_

Phone: \_\_\_\_\_ Email: \_\_\_\_\_



**"AX" Cylinder**



**"B" Cylinder**



**"C" Cylinder**

Part #	Cylinder	Humidifier Specifications	Quantity
HXCBAX145	"AX"	<i>Contact Carnes Rep for more info.</i>	
HXCBAX220	"AX"	005/010 lb./hr. 120V 1 Ph.	
HXCBAX380	"AX"	005/010 lb./hr. 208-277V 1 Ph.	
HXCBAX500	"AX"	<i>Contact Carnes Rep for more info.</i>	
HXCBAX600	"AX"	005/010 lb./hr. 415-380V 1 Ph.	
HXCBAX700	"AX"	005/010 lb./hr. 460-575V 1 Ph.	
HXCBB380	"B"	<i>Contact Carnes Rep for more info.</i>	
HXCBB500	"B"	020/030 lb./hr. 208-277V 1 & 3 Ph.	
HXCBB600	"B"	020/030 lb./hr. 380-415V 1 Ph.	
HXCBB700	"B"	020/030 lb./hr. 460-575V 1 & 3 Ph.	
HXCBC12	"C"	080/200 lb./hr. 380-575V 3 Ph.	
HXCBC6F	"C"	<i>Contact Carnes Rep for more info.</i>	
HXCBC6X	"C"	<i>Contact Carnes Rep for more info.</i>	
HXCBC61	"C"	<i>Contact Carnes Rep for more info.</i>	
HXCBC62	"C"	030/100 lb./hr. 208-277V 1 & 3 Ph.	
HXCBC63	"C"	<i>Contact Carnes Rep for more info.</i>	
HXCBC64	"C"	<i>Contact Carnes Rep for more info.</i>	
HXCBC65	"C"	030/060 lb./hr. 380-575V 1 & 3 Ph.	

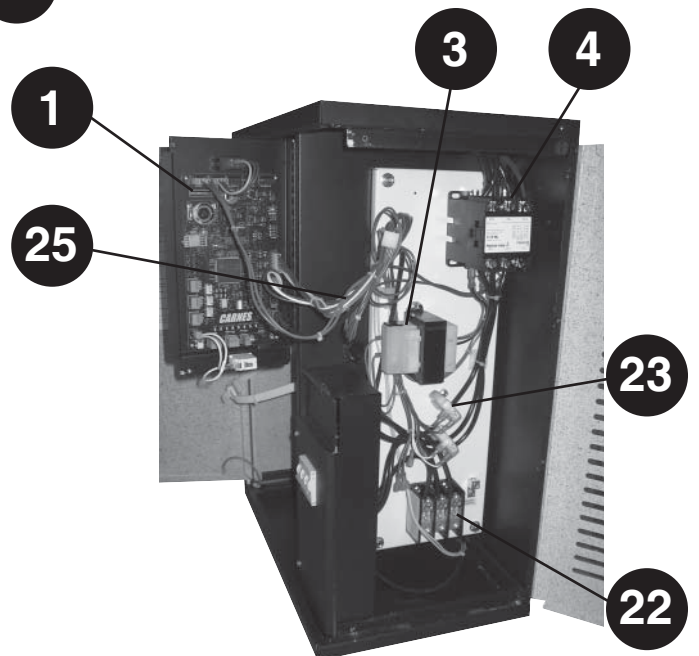
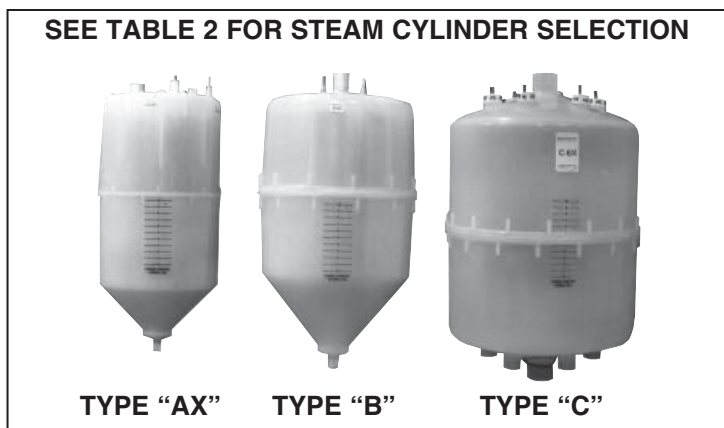
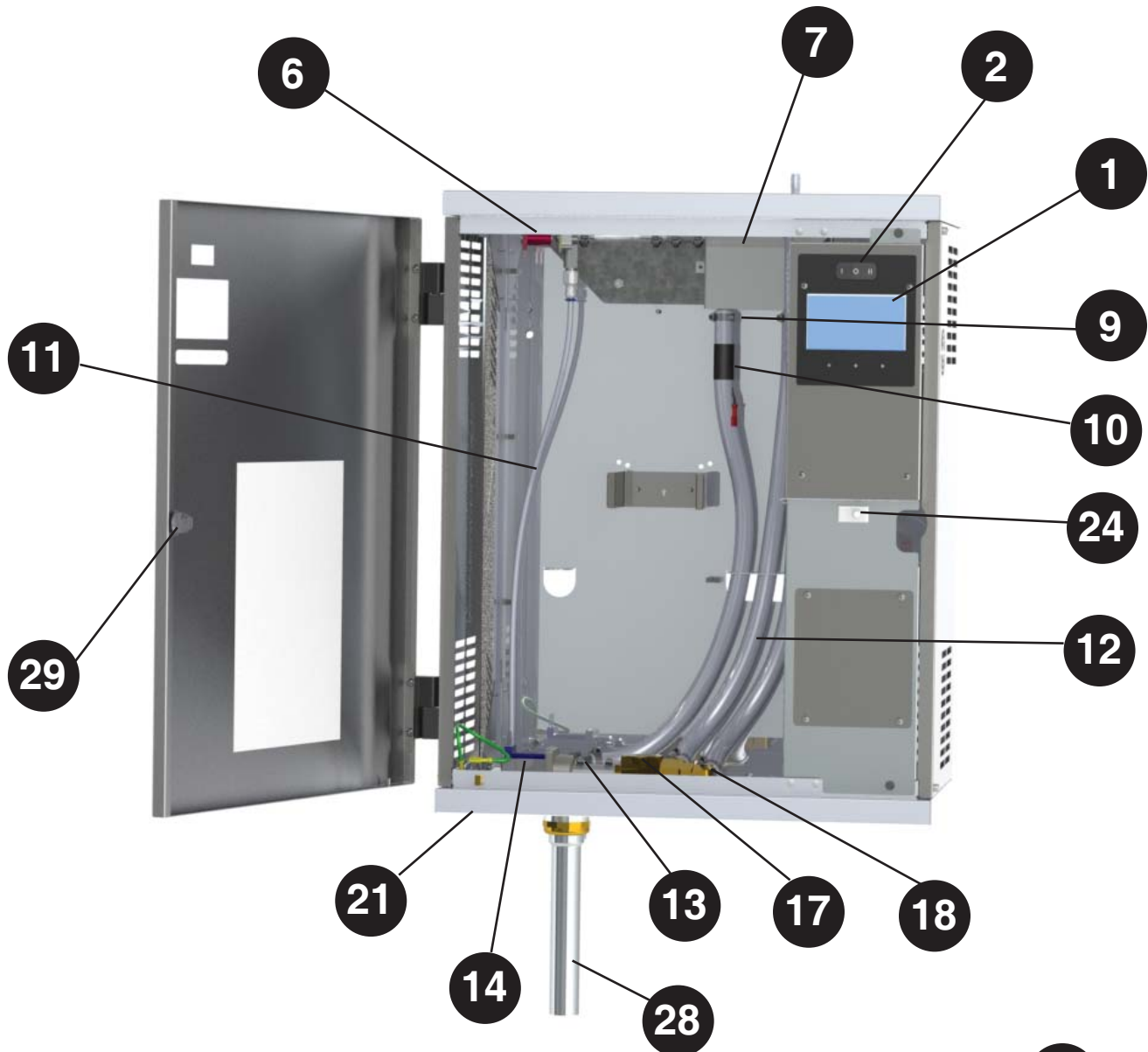
MODEL	<input type="text"/>	LBS/HR	<input type="text"/>
SERIAL NO.	<input type="text"/>	CODE	<input type="text"/>
POWER SUPPLY	<input type="text"/>	VAC	<input type="text"/>
		HZ	<input type="text"/>
		PH.	<input type="text"/>
		AMPS	<input type="text"/>

← Requested information is located on a label on the outside of the humidifier cabinet on the lower left corner.

Cylinders can be ordered directly from your local agent. You can also fill out this form and email it directly to Carnes at [carnes@carnes.com](mailto:carnes@carnes.com). We will have your agent contact you. Thank you for choosing Carnes Humidifiers.

*"Due to ongoing research and development CARNES reserves the right to change specifications without notice."  
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**REPLACEMENT PARTS**



**REPLACEMENT PARTS** (Table 8)

Item #	Description	Models Where Used	Part #
2	ON-OFF-DRAIN SWITCH	ALL	H-999-7331
3	POWER TRANSFORMER	ALL	SEE TABLE 9
4	CONTACTOR	ALL	SEE TABLE 9
5*	CIRCUIT BREAKER (optional)	HT MODELS ONLY	SEE TABLE 9
6	FILL SOLENOID VALVE WITH COIL AND STRAINER	ALL	H-999-7488
7	MOLDED FILL CUP	ALL	H-690-4138
8*	DOOR PIVOT RELEASE	ALL	H-999-9143
9	METAL HOSE CLAMP	ALL	H-999-7165
10	HIGH WATER SENSOR SUB-ASSEMBLY	ALL	H-690-1355
11	WATER FILL TUBE SUB-ASSEMBLY (Single Cylinder)	H_AH, H_DH, H_GH	H-690-1671
11	WATER FILL TUBE SUB-ASSEMBLY (Dual Cylinder)	H_HH	H-690-1672
12	CLEAR HOSE 5/8" ID	ALL	HXLA
13*	PLASTIC ELBOW 5/8" HOSE TO 5/8" HOSE	ALL	H-999-9690
14	DRAIN SOLENOID VALVE	H_GH	H-999-7448
14	DRAIN SOLENOID VALVE	H_HH	H-690-1091 R. H.
14	DRAIN SOLENOID VALVE	H_AH, H_DH, H_HH	H-690-1092 L. H.
17	"AX" CYLINDER FITTING	H_AH	H-998-5703
17	"B" CYLINDER FITTING	H_DH	H-998-5715
17	"C" CYLINDER FITTING	H_GH, H_HH	H-998-5716
18	BRASS ELBOW 3/8" NPT TO 5/8" HOSE BARB	ALL	H-999-3869
19*	PLASTIC "T" 5/8" HOSE TO 5/8" HOSE TO 5/8" HOSE	ALL	H-999-3863
20*	TERMINAL CONNECTOR WITH WIRE**	ALL	SEE TABLE 9
21	WATER INLET FITTING	ALL	H-999-4055
22	POWER DISTRIBUTION BLOCK	ALL	SEE TABLE 9
23	CURRENT SENSING TRANSFORMER	ALL	H-999-9429
24	DOOR INTERLOCK SWITCH	ALL	H-801-7801
25	LOW VOLTAGE WIRING HARNESS	H_AH, H_DH, H_GH (purchased after 9/1/15)	H-998-7024
25	LOW VOLTAGE WIRING HARNESS	H_AH, H_DH, H_GH (purchased prior to 9/1/15)	H-998-7025
25	LOW VOLTAGE WIRING HARNESS	H_HH	H-998-7029
26*	STRAIGHT BRASS FITTING 3/8" NPT WITH BARB	H_AH	H-999-4058
27*	PLASTIC "U" TUBE	H_AH, H_DH, H_GH	H-998-5699
27*	PLASTIC ELBOW	H_HH	H-998-5700
28*	DRAIN FITTING TUBE	ALL	H-999-6469
29	DOOR LOCK WITH KEY	ALL	H-999-9141
30*	FLEXIBLE CLEAR PLASTIC 5/8" ELBOW	ALL	H-999-9833
31*	FLEXIBLE CLEAR PLASTIC 5/8" "U" TUBE	ALL	H-999-9834

\* = Not Shown

**REPLACEMENT PARTS** (Table 9)

Model	Max. Lb./Hr.	Ph.	Volts	Steam Cylinder	Power Transformer Item #3	Contactor Item #4	Terminal Connector with Wire* Item #20	Circuit Breaker Item #5	Power Distribution Block Item #22
H_AHA	5	1	120	AX220	998-9537	999-7389	690-3019	999-7406	999-8035
H_AHB	5	1	208	AX380	998-9537	999-7389	690-3019	999-7405	999-8035
H_AHD	5	1	230	AX380	998-9537	999-7389	690-3019	999-7406	999-8035
H_AHF	5	1	277	AX380	998-9535	999-7389	690-3019	999-7405	999-8035
H_AHL	5	1	380	AX600	998-9535	999-7389	690-3019	999-7405	999-8035
H_AHQ	5	1	415	AX600	998-9535	999-7389	690-3019	999-7405	999-8035



**REPLACEMENT PARTS** (Table 9) - Continued

Model	Max. Lb./Hr.	Ph.	Volts	Steam Cylinder	Power Transformer Item #3	Contactor Item #4	Terminal Connector with Wire* Item #20	Circuit Breaker Item #5	Power Distribution Block Item #22
H_AHM	5	1	460	AX700	998-9537	999-7389	690-3019	999-7405	999-8035
H_AHN	5	1	575	AX700	998-9539	999-7389	690-3019	999-7412	999-8035
H_AHA	10	1	120	AX220	998-9537	999-7480	690-3019	999-7409	999-8035
H_AHB	10	1	208	AX380	998-9537	999-7389	690-3019	999-7407	999-8035
H_AHD	10	1	230	AX380	998-9537	999-7389	690-3019	999-7407	999-8035
H_AHF	10	1	277	AX380	998-9535	999-7389	690-3019	999-7406	999-8035
H_AHL	10	1	380	AX600	998-9535	999-7389	690-3019	999-7405	999-8035
H_AHQ	10	1	415	AX600	998-9535	999-7389	690-3019	999-7405	999-8035
H_AHM	10	1	460	AX700	998-9537	999-7389	690-3019	999-7405	999-8035
H_AHN	10	1	575	AX700	998-9539	999-7389	690-3019	999-7412	999-8035
H_DHB	20	1	208	B380	998-9537	999-7480	690-3019	999-7410	999-8035
H_DHD	20	1	230	B380	998-9537	999-7480	690-3019	999-7409	999-8035
H_DHF	20	1	277	B380	998-9535	999-7389	690-3019	999-7409	999-8035
H_DHL	20	1	380	B600	998-9535	999-7389	690-3019	999-7408	999-8035
H_DHQ	20	1	415	B600	998-9535	999-7389	690-3019	999-7407	999-8035
H_DHM	20	1	460	B700	998-9537	999-7389	690-3019	999-7406	999-8035
H_DHN	20	1	575	B700	998-9539	999-7389	690-3019	999-7412	999-8035
H_DHC	20	3	208	B500	998-9537	999-7389	690-3019	999-7407	999-8035
H_DHE	20	3	230	B500	998-9537	999-7389	690-3019	999-7407	999-8035
H_DHT	20	3	380	B600	998-9535	999-7389	690-3019	999-7405	999-8035
H_DHW	20	3	415	B600	998-9535	999-7389	690-3019	999-7405	999-8035
H_DHG	20	3	460	B700	998-9537	999-7389	690-3019	999-7405	999-8035
H_DHH	20	3	575	B700	998-9539	999-7389	690-3019	999-7412	999-8035
H_DHC	30	3	208	B500	998-9537	999-7480	690-3019	999-7409	999-8035
H_DHE	30	3	230	B500	998-9537	999-7389	690-3019	999-7409	999-8035
H_DHT	30	3	380	B600	998-9535	999-7389	690-3019	999-7407	999-8035
H_DHW	30	3	415	B600	998-9535	999-7389	690-3019	999-7406	999-8035
H_DHG	30	3	460	B700	998-9537	999-7389	690-3019	999-7406	999-8035
H_DHH	30	3	575	B700	998-9539	999-7389	690-3019	999-7412	999-8035
H_GHB*	30	1	208	C62	998-9537	999-7389 (2)	690-3019	999-7290	999-8035
H_GHD	30	1	230	C62	998-9537	999-7480	690-3046	999-7411	999-8035
H_GHF	30	1	277	C62	998-9535	999-7480	690-3046	999-7410	999-8035
H_GHL	30	1	380	C62	998-9535	999-7480	690-3046	999-7409	999-8035
H_GHQ	30	1	415	C62	998-9535	999-7389	690-3019	999-7409	999-8035
H_GHM	30	1	460	C62	998-9537	999-7389	690-3019	999-7408	999-8035
H_GHN	30	1	575	C62	998-9539	999-7389	690-3019	999-7414	999-8035
H_GHC	40	3	208	C62	998-9537	999-7480	690-3046	999-7411	999-8035
H_GHE	40	3	230	C62	998-9537	999-7480	690-3046	999-7410	999-8035
H_GHT	40	3	380	C65	998-9535	999-7389	690-3019	999-7408	999-8035
H_GHW	40	3	415	C65	998-9535	999-7389	690-3019	999-7408	999-8035
H_GHG	40	3	460	C65	998-9537	999-7389	690-3019	999-7407	999-8035
H_GHH	40	3	575	C65	998-9539	999-7389	690-3019	999-7413	999-8035
H_GHC	50	3	208	C62	998-9537	999-7389 (2)	690-3019	999-7409 (2)	999-8035
H_GHE	50	3	230	C62	998-9537	999-7480	690-3046	999-7411	999-8035
H_GHT	50	3	380	C65	998-9535	999-7480	690-3046	999-7409	999-8035
H_GHW	50	3	415	C65	998-9535	999-7389	690-3019	999-7409	999-8035
H_GHG	50	3	460	C65	998-9537	999-7389	690-3019	999-7408	999-8035
H_GHH	50	3	575	C65	998-9539	999-7389	690-3019	999-7414	999-8035
H_GHC*	60	3	208	C62	998-9537	999-7480 (2)	690-3046	999-7291 (2)	999-8035
H_GHE*	60	3	230	C62	998-9537	999-7389 (2)	690-3019	999-7291 (2)	999-8035
H_GHT	60	3	380	C65	998-9535	999-7480	690-3046	999-7410	999-8035
H_GHW	60	3	415	C65	998-9535	999-7480	690-3046	999-7409	999-8035
H_GHG	60	3	460	C65	998-9537	999-7389	690-3019	999-7409	999-8035

\*H-690-3019 INCLUDES #10 WIRE. FOR RED CONNECTOR ONLY ORDER H-998-1256.

H-690-3046 INCLUDES #8 WIRE. BLACK CONNECTOR ONLY IS NOT AVAILABLE.

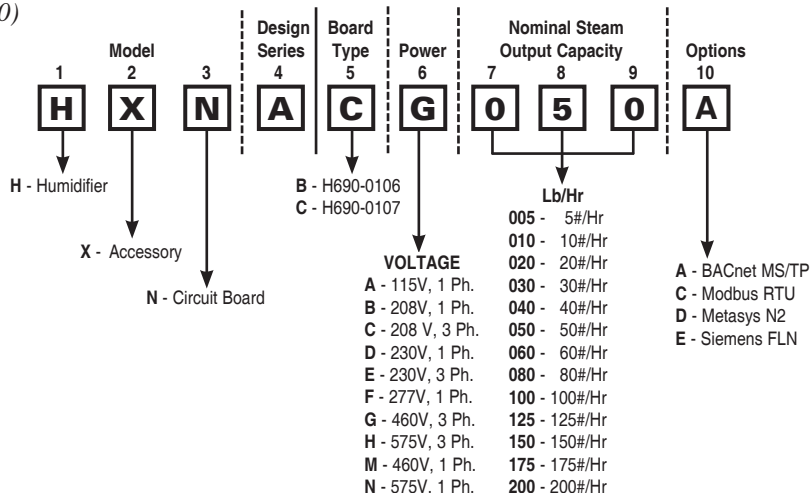
\* = Circuit Breaker is REQUIRED per NEC 48 amp guidelines.

**REPLACEMENT PARTS** (Table 9) - Continued

Model	Max. Lb/Hr	Ph.	Volts	Code	Steam Cylinder	Power Transformer Item #3	Contactor Item #4	Terminal Connector with Wire* Item #20	Circuit Breaker Item #5	Power Distribution Block Item #22
H_GHH	60	3	575	7060	C65	998-9539	999-7389	690-3019	999-7414	999-8035
H_GHC*	80	3	208	2080	C62	998-9537	999-7480 (2)	690-3046	999-7293 (2)	999-8035
H_GHE*	80	3	230	4080	C62	998-9537	999-7480 (2)	690-3046	999-7292 (2)	999-8035
H_GHT	80	3	380	3380	C12	998-9535	999-7480	690-3046	999-7411	999-8035
H_GHW	80	3	415	4380	C12	998-9535	999-7480	690-3046	999-7411	999-8035
H_GHG	80	3	460	6080	C12	998-9537	999-7480	690-3046	999-7410	999-8035
H_GHH	80	3	575	7080	C12	998-9539	999-7389	690-3019	999-7415	999-8035
H_GHC*	100	3	208	2100	C62	998-9537	999-7480 (2)	690-3046	999-7293 (2)	999-8035
H_GHE*	100	3	230	4100	C62	998-9537	999-7480 (2)	690-3046	999-7293 (2)	999-8035
H_GHT*	100	3	380	3300	C12	998-9535	999-7389 (2)	690-3046	Contact Factory	999-8035
H_GHW	100	3	415	4300	C12	998-9535	999-7389 (2)	690-3019	999-7409 (2)	999-8035
H_GHG	100	3	460	6100	C12	998-9537	999-7480	690-3046	999-7411	999-8035
H_GHH	100	3	575	7100	C12	998-9539	999-7480	690-3046	999-7416	999-8035
H_HHC*	125	3	208	2125	C62 (2)	998-9537	999-7480 (4)	690-3046	999-7291 (4)	999-8035
H_HHE*	125	3	230	4125	C62 (2)	998-9537	999-7480 (4)	690-3046	999-7291 (4)	999-9524
H_HHT*	125	3	380	3325	C12 (2)	998-9535	999-7480 (2)	690-3046	999-7416 (2)	999-8035
H_HHW*	125	3	415	4325	C12 (2)	998-9535	999-7480 (2)	690-3046	999-7416 (2)	999-8035
H_HHG*	125	3	460	6125	C12 (2)	998-9537	999-7480 (2)	690-3046	999-7415 (2)	999-8035
H_HHH	125	3	575	7125	C12 (2)	998-9539	999-7389 (2)	690-3019	999-7414 (2)	999-8035
H_HHC*	150	3	208	2150	C62 (2)	998-9537	999-7480 (4)	690-3046	999-7292 (4)	999-9524
H_HHE*	150	3	230	4150	C62 (2)	998-9538	999-7480 (4)	690-3046	999-7292 (4)	999-9524
H_HHT*	150	3	380	3315	C12 (2)	998-9535	999-7480 (2)	690-3046	999-7416 (2)	999-8035
H_HHW*	150	3	415	4315	C12 (2)	998-9535	999-7480 (2)	690-3046	999-7416 (2)	999-8035
H_HHG*	150	3	480	6150	C12 (2)	998-9537	999-7480 (2)	690-3046	999-7415 (2)	999-8035
H_HHH	150	3	575	7150	C12 (2)	998-9539	999-7389 (2)	690-3019	999-7414 (2)	999-8035
H_HHC*	175	3	208	2175	C62 (2)	998-9537	999-7480 (4)	690-3046	999-7293 (4)	999-9524
H_HHE*	175	3	230	4175	C62 (2)	998-9537	999-7480 (4)	690-3046	999-7293 (4)	999-9524
H_HHT*	175	3	380	3317	C12 (2)	998-9535	999-7480 (4)	690-3046	Contact Factory	999-9524
H_HHW*	175	3	415	4317	C12 (2)	998-9535	999-7480 (2)	690-3046	999-7416 (2)	999-9524
H_HHG*	175	3	460	6175	C12 (2)	998-9537	999-7480 (2)	690-3046	999-7415 (2)	999-8035
H_HHH	175	3	575	7175	C12 (2)	998-9539	999-7480 (2)	690-3046	999-7416 (2)	999-8035
H_HHC*	200	3	208	2200	C62 (2)	998-9537	999-7480 (4)	690-3046	999-7293 (4)	999-9524
H_HHE*	200	3	230	4200	C62 (2)	998-9537	999-7480 (4)	690-3046	999-7293 (4)	999-9524
H_HHT*	200	3	380	3321	C12 (2)	998-9535	999-7480 (4)	690-3046	Contact Factory	999-9524
H_HHW*	200	3	415	4321	C12 (2)	998-9535	999-7480 (4)	690-3046	Contact Factory	999-9524
H_HHG*	200	3	460	6200	C12 (2)	998-9537	999-7480 (2)	690-3046	999-7417 (2)	999-8035
H_HHH	200	3	575	7200	C12 (2)	998-9539	999-7480 (2)	690-3046	999-7416 (2)	999-8035

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

**CIRCUIT BOARD** (Table 10)



## WARRANTY

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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.



