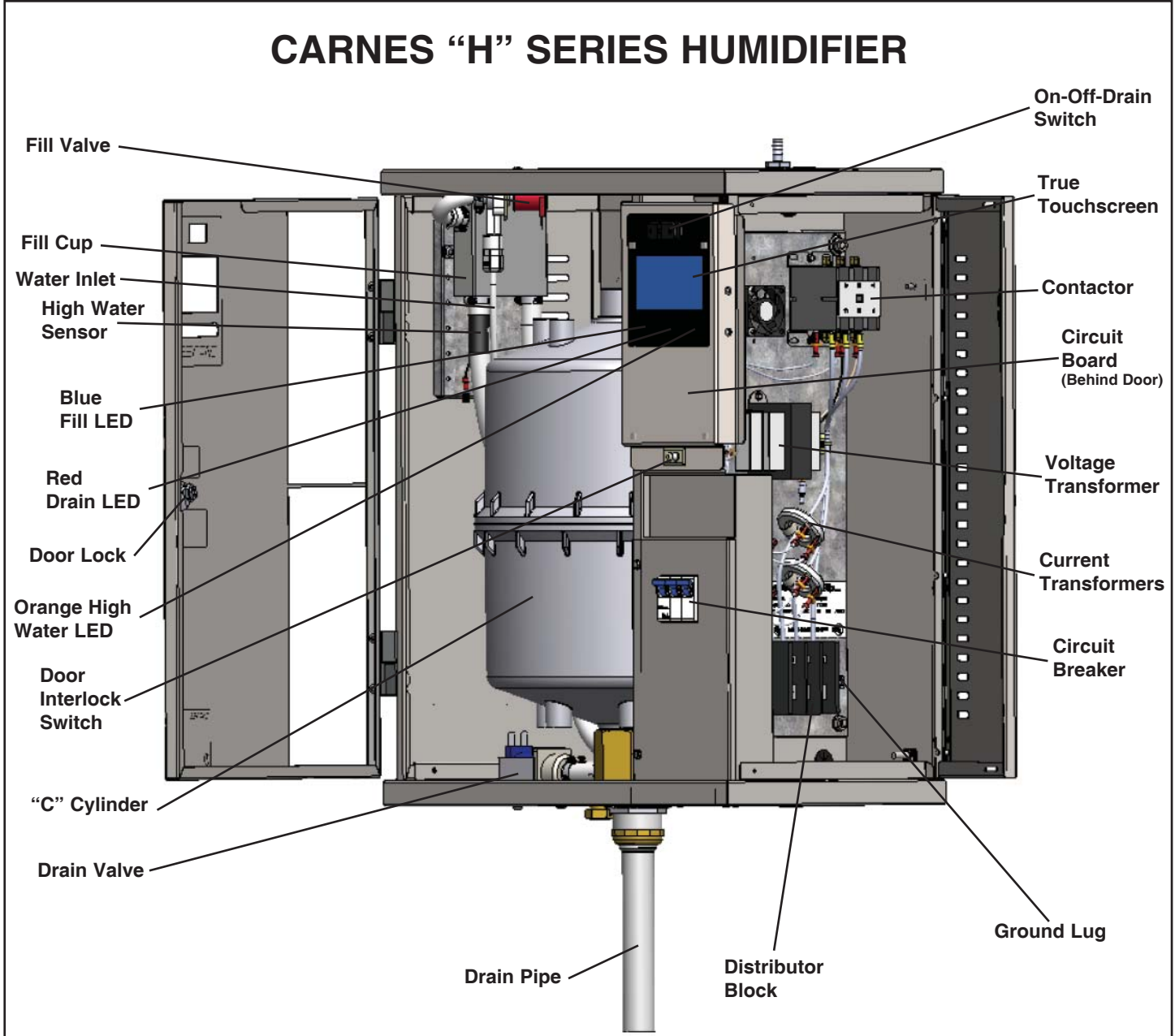


**TRUE TOUCHSCREEN CONTROLLED ELECTRODE STEAM HUMIDIFIER  
DESIGN SERIES "H"**

**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 HBGH Shown)**

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# 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.



*HCHH*



*HCAH*



*HBGH*



*HCDH*



*HRAB*

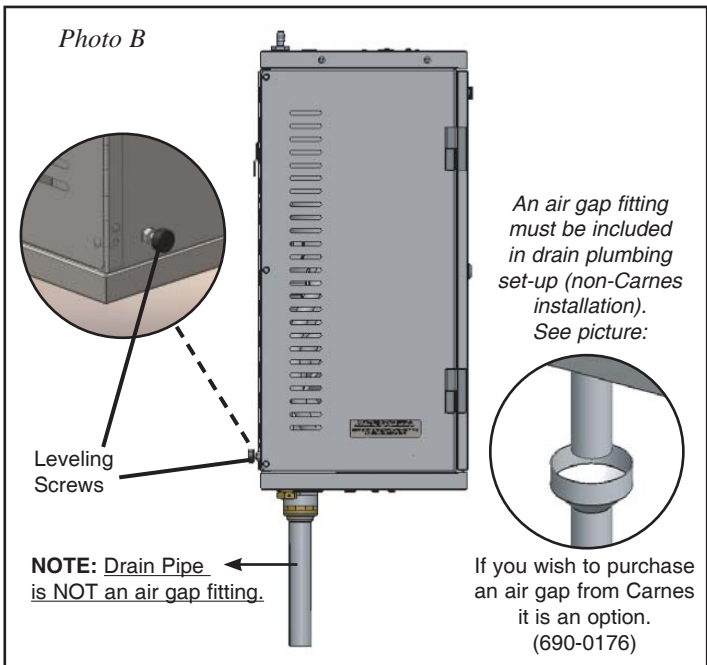
# INSTALLATION

## UNPACKING AND INSPECTION

1. Cabinet keys are attached, by ty-rap, to side of humidifier.
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.
5. Inside the cabinet is an envelope containing the following items:
  - A. Steam hose clamps.
  - B. Condensate return line clamps.
  - C. Drain pipe fitting.
  - D. Installation, operation and maintenance manual, yellow caution sheet for hose routing, replacement parts list and spec sheet.

## 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"-38" respectively, in front of cabinet for residential to dual cylinder unit, for door opening or when necessary, remove door with quick release pin. (Combo unit and dual cylinder unit have removable doors, residential does not.)



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

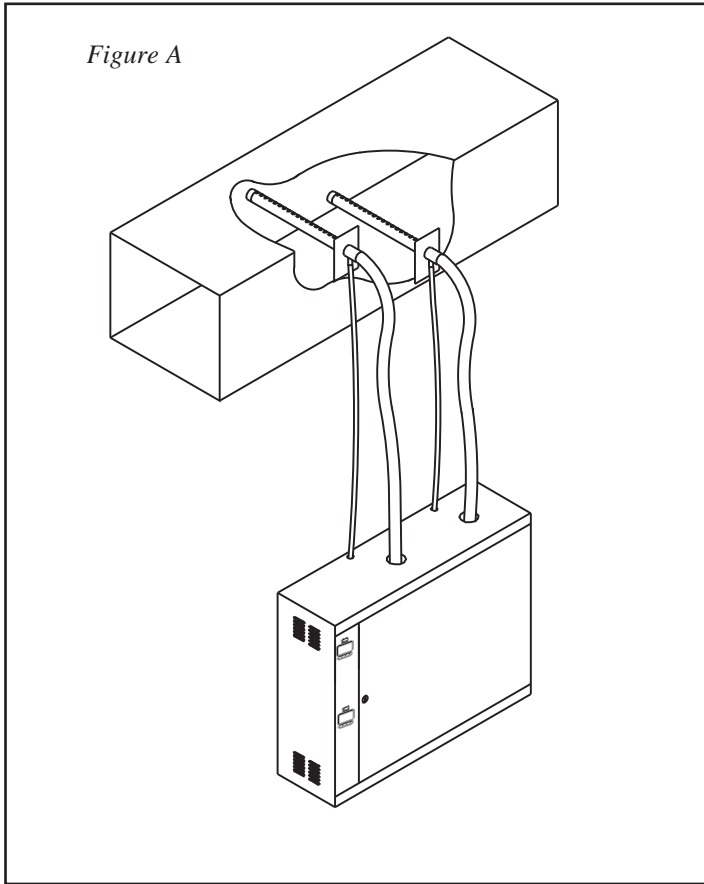
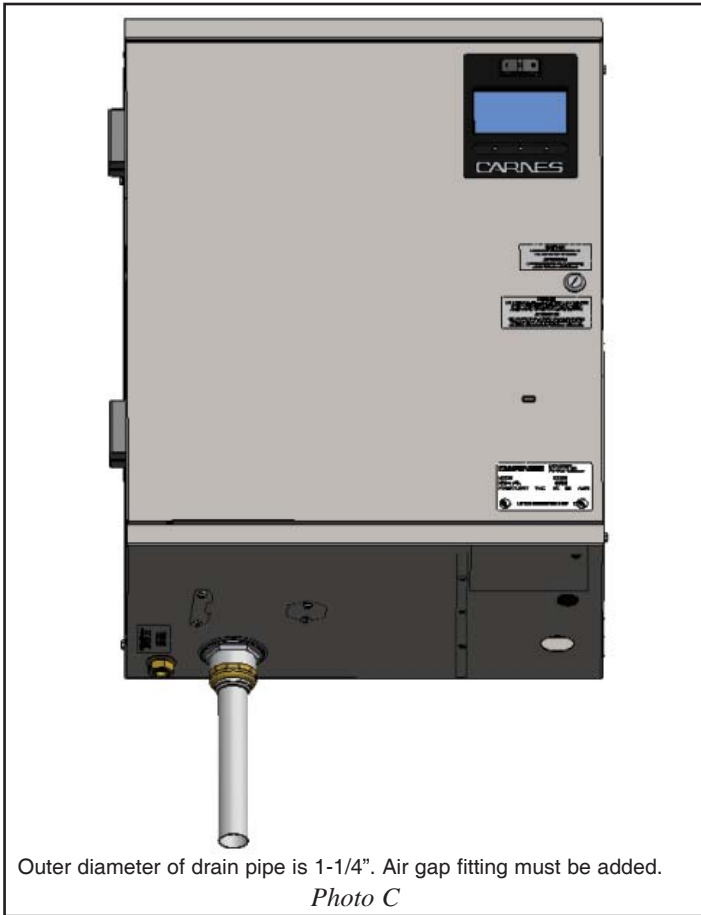
## WATER SUPPLY CONNECTION

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

## DRAIN LINE CONNECTION

1. Locate the drain pipe fitting in accessory bag in 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. Also, please 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.*



**STEAM DISTRIBUTOR PIPE LOCATION**

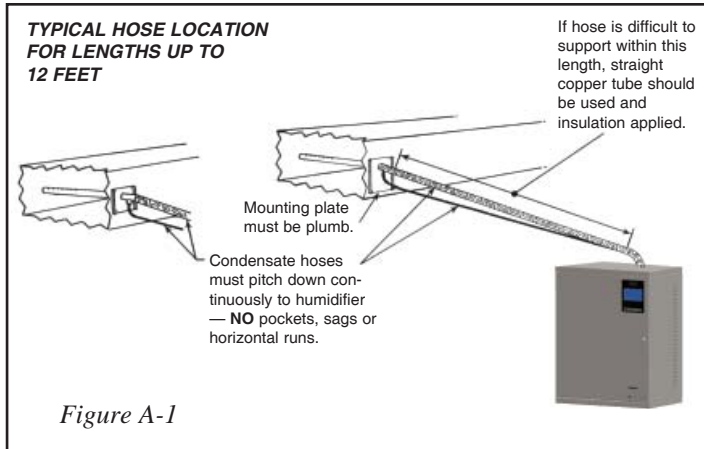
Each steam cylinder requires a separate distributor pipe, steam hose and condensate return line. A cylinder may supply more than one distributor pipe by using an accessory "T" fitting but the output cannot be controlled separately. In a typical installation the humidifier is located below the duct as 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. 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 lbs. per hour capacity.

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

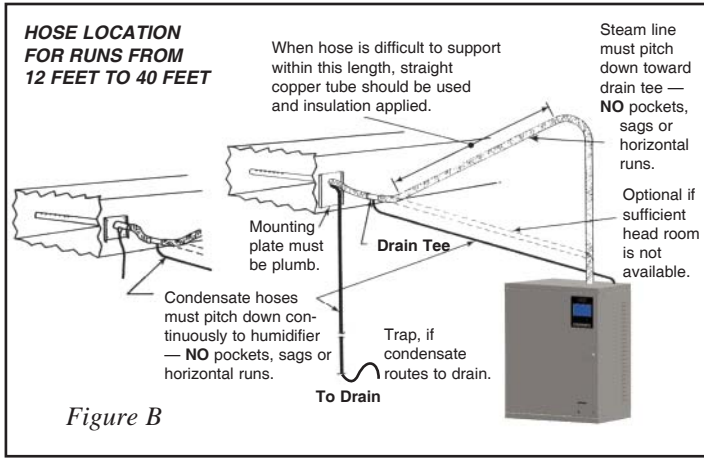
Duct Static Pressure "wg"	0	1	2	3	4	5
Maximum Steam Hose Length (Ft.)	40	35	30	25	15	10

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

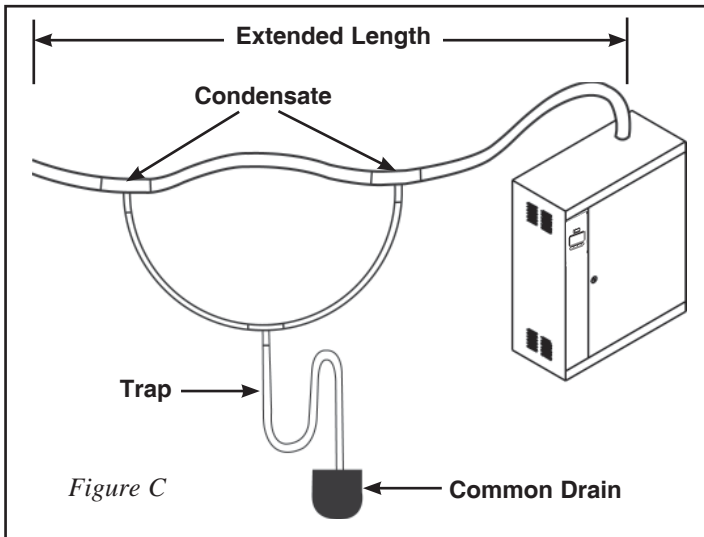
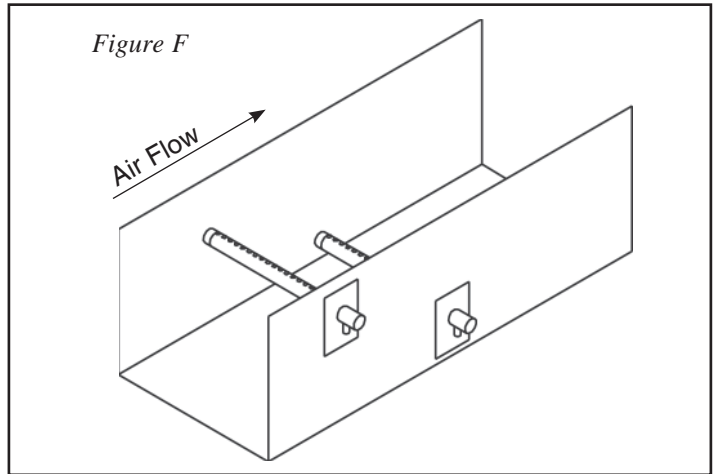
Distance	Loss
10 Ft.	1.0 lb./hr.
20 Ft.	2.0 lb./hr.
25 Ft.	2.5 lb./hr.
40 Ft.	4.0 lb./hr.



The maximum length of steam hose that may be installed as shown in Figure A & A-1 is 12 feet. For a steam hose length over 12 feet refer to Figure B. 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. It is critical to provide proper routing of flexible hose and hard tubing to maximize efficiency and effectiveness. See Figure D. Every application is different. Hose lengths for small capacity units will be considerably shorter than larger units. All variable must be taken into consideration.



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



**STEAM DISTRIBUTOR PIPE LOCATION (Continued)**

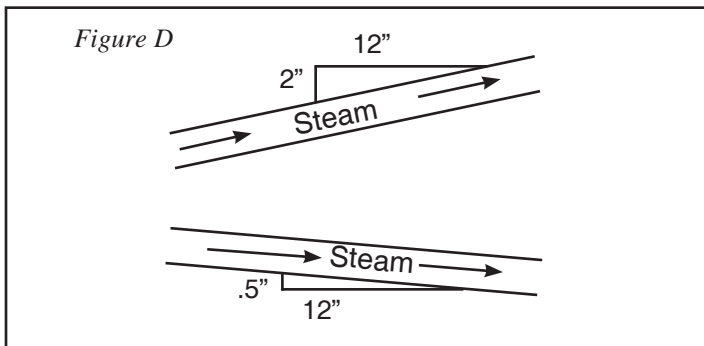
Steam distributor pipes must be located on a plumb surface so condensate that forms will run back into the return line. The pipe should be located in the center of the duct to insure distribution of steam into the airstream. A minimum clearance of 4" must be maintained between the top of the duct and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

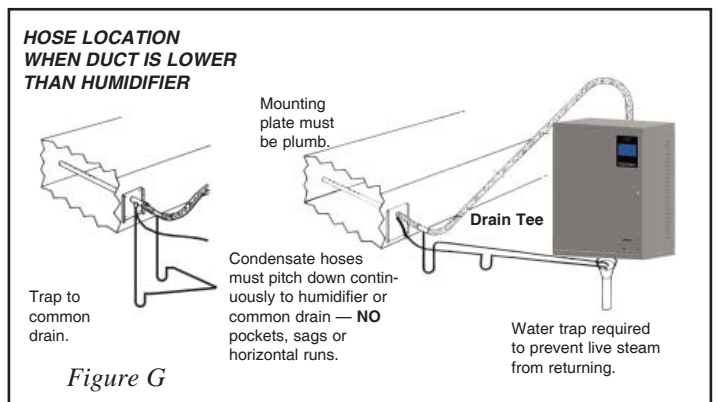
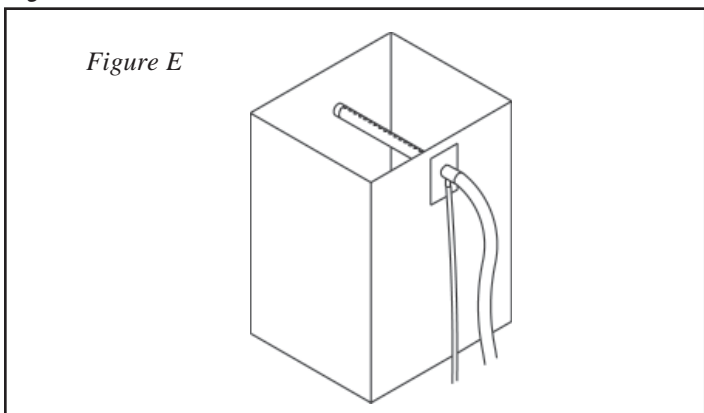
It is important to locate the distributor pipe as far upstream as possible from any obstructions in the ductwork so that air can absorb moisture before it impinges on a surface and accumulates. There must be a minimum of six feet between the distributor and any fans, coils, filters, dampers, elbows or 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 50-60°F may require a condensate drain pan supplied by others below the steam distributor pipe.

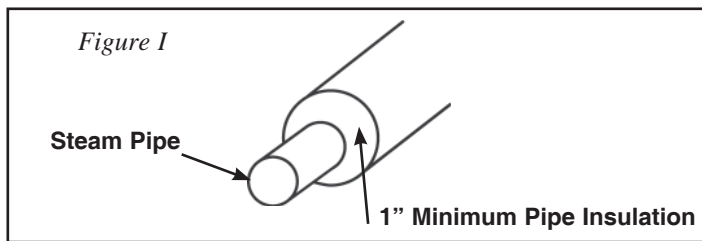
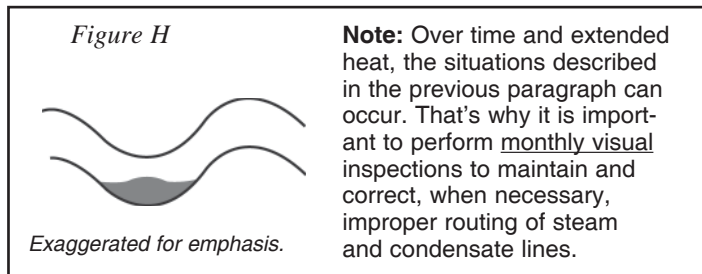
The distributor pipe may be located below the humidifier if the installation is made in accordance with *Figure G*. A trap may be necessary to prevent steam from flowing back through the condensate return line.



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



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 enter the duct work by way of back up in distributor pipe.



If it is difficult to install the steam hose to prevent sags, it is recommended that copper tube be used as a substitute. If copper tube is used, a minimum of one inch of insulation must be applied to prevent excessive condensation (See Figure I). 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. Length restrictions shown in the Maximum Steam Hose Length Table also apply to installations where copper tube is used and any use of 90° elbows add approximately three feet of equivalent length, thus negatively affecting loss of capacity, efficiency and effectiveness.

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

### INSTALL STEAM DISTRIBUTOR PIPE

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

1. Steam distributor pipe must be mounted on a plumb surface. When on a plumb surface the standard distributor pipe is 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 provided by Carnes.
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 H.
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 over the outlet stub on the top of the cylinder. Fasten 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 C.

### 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 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 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 temperature in duct is 55° to 60°F or less, recommended 10 feet of distance be used.
3. Under normal and average conditions, most absorption distances will probably fall into the 4 to 5 feet length. This is true, whether the unit is a 30 lb./hr. or less capacity or 30 lb./hr. or more capacity.
4. If distance recommended can not be possible, then a drain pan with drain capability may be required.
5. If the air in the duct can not hold the volume of steam, the only recourse may be to lower the maximum output of the unit.
6. If shorter absorption distances are required, 3 ft. or less, multiple distributor pipes could be used. 2 pipes split off one steam hose or 2 pipes from a dual cylinder unit.
7. If even shorter absorption distances are required, 2 ft. or less, then multi tube short absorption manifolds may be required.

You must keep in mind that there are a lot of variables involved in proper steam distribution and absorption distances (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). Since this is important to successful humidification, proper planning must be a pre-requisite to good performance.



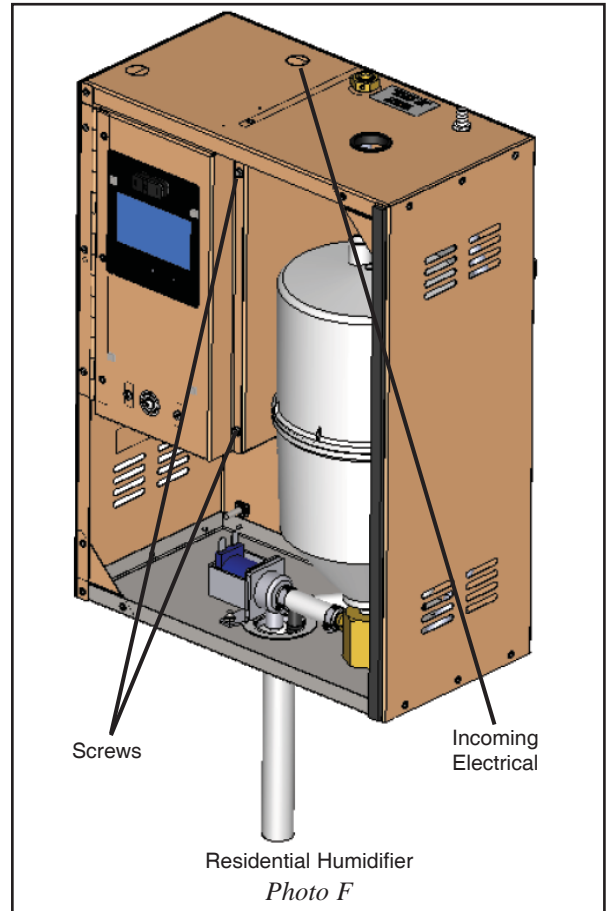
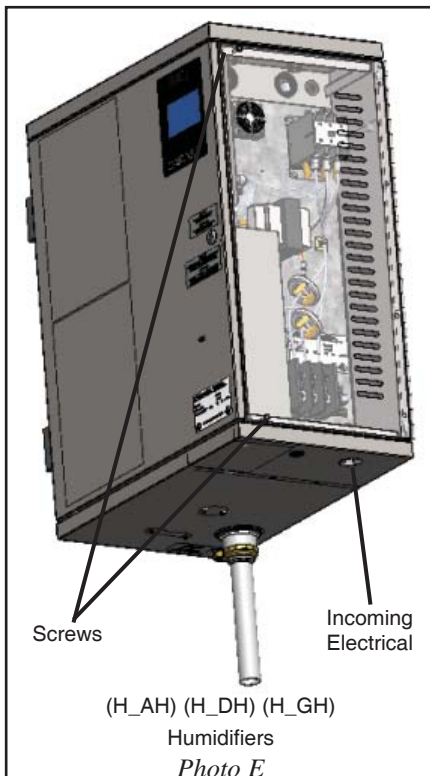
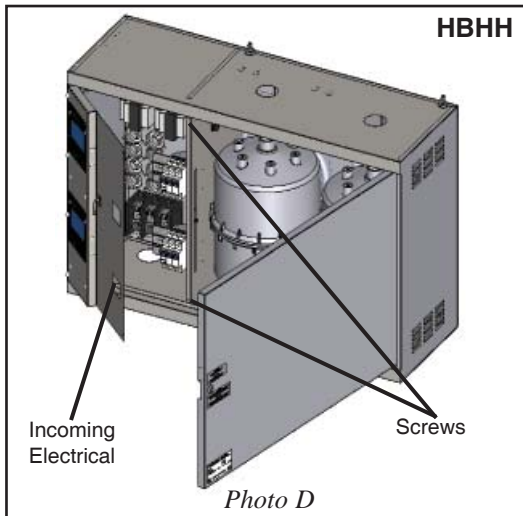
## ELECTRICAL CONNECTIONS

POWER MUST BE OFF BEFORE MAKING ANY ELECTRICAL CONNECTIONS.

Check unit electrical characteristics on label outside of cabinet. It must agree with power provided to the unit. If it does not, contact your Carnes Representative.

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, offered as an accessory, installed in the humidifier, is **NOT** for use as a replacement for the required external disconnect switch, but as a maintenance convenience addition.

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** column designates the presence, quantity and amp rating of optional circuit breakers (except for select models over 48 amps). In addition, as an option, internally mounted, switchable on-off, circuit breakers are available in models with an 'HB' prefix.
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 25% of maximum capacity.
3. **Voltage and Phase** designate 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
HBAH HCAH 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_AH DU	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_AH LU	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_AH MU	5	460	1	1.725	3.7	15	1-15 Amp	AX700	3.7
	H_AH NU	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_AH DU	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_AH LU	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_AH MU	10	460	1	3.45	7.5	15	1-15 Amp	AX700	7.5
	H_AH NU	10	575	1	3.45	6.0	15	1-15 Amp	AX700	6
HBDH HCDH HSDH HTDH	H_DHBU	20	208	1	6.9	33.1	50	1-45 Amp	B380	33.1
	H_DH DU	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_DH LU	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_DH MU	20	460	1	6.9	15.0	25	1-25 Amp	B700	15
	H_DH NU	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_DHG U	20	460	3	6.9	8.6	15	1-15 Amp	B700	8.6
	H_DH HU	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_DHG U	30	460	3	10.3	13.0	20	1-20 Amp	B700	13
H_DH HU	30	575	3	10.3	10.4	20	1-15 Amp	B700	10.4	
HBGH HCGH HSGH HTGH	H_GHBU*	30	208	1	10.3	49.7*	80	2-35 Amp*	C62	24.8
	H_GH DU	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_GH LU	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_GH MU	30	460	1	10.3	22.5	35	1-30 Amp	C62	11.3
	H_GH NU	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_GHG U	40	460	3	13.8	17.3	30	1-25 Amp	C65	17.3
H_GH HU	40	575	3	13.8	13.8	25	1-20 Amp	C65	13.8	

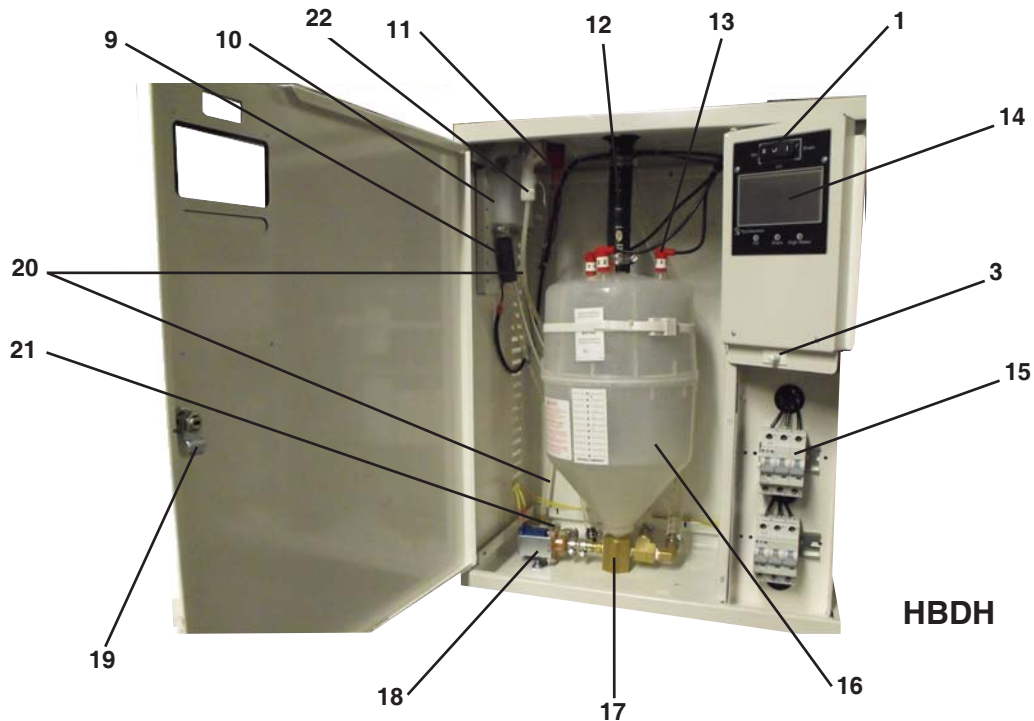
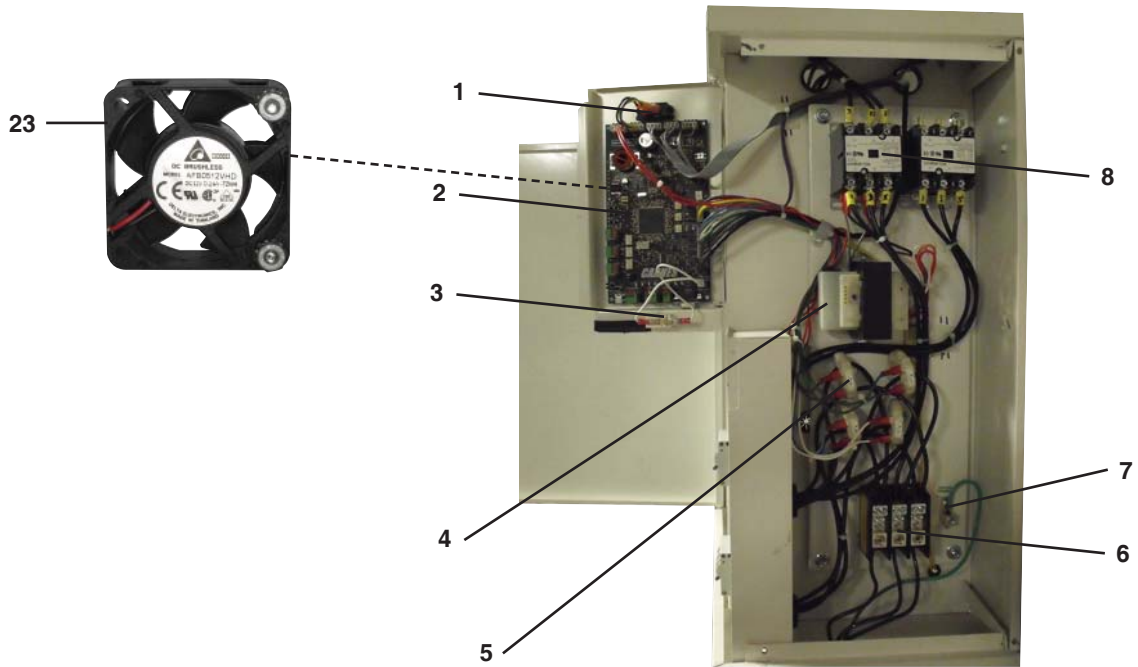
\* = Circuit Breaker is REQUIRED per NEC 48 amp guideline.

**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
HBGH HCGH 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	
HBHH HCHH 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.

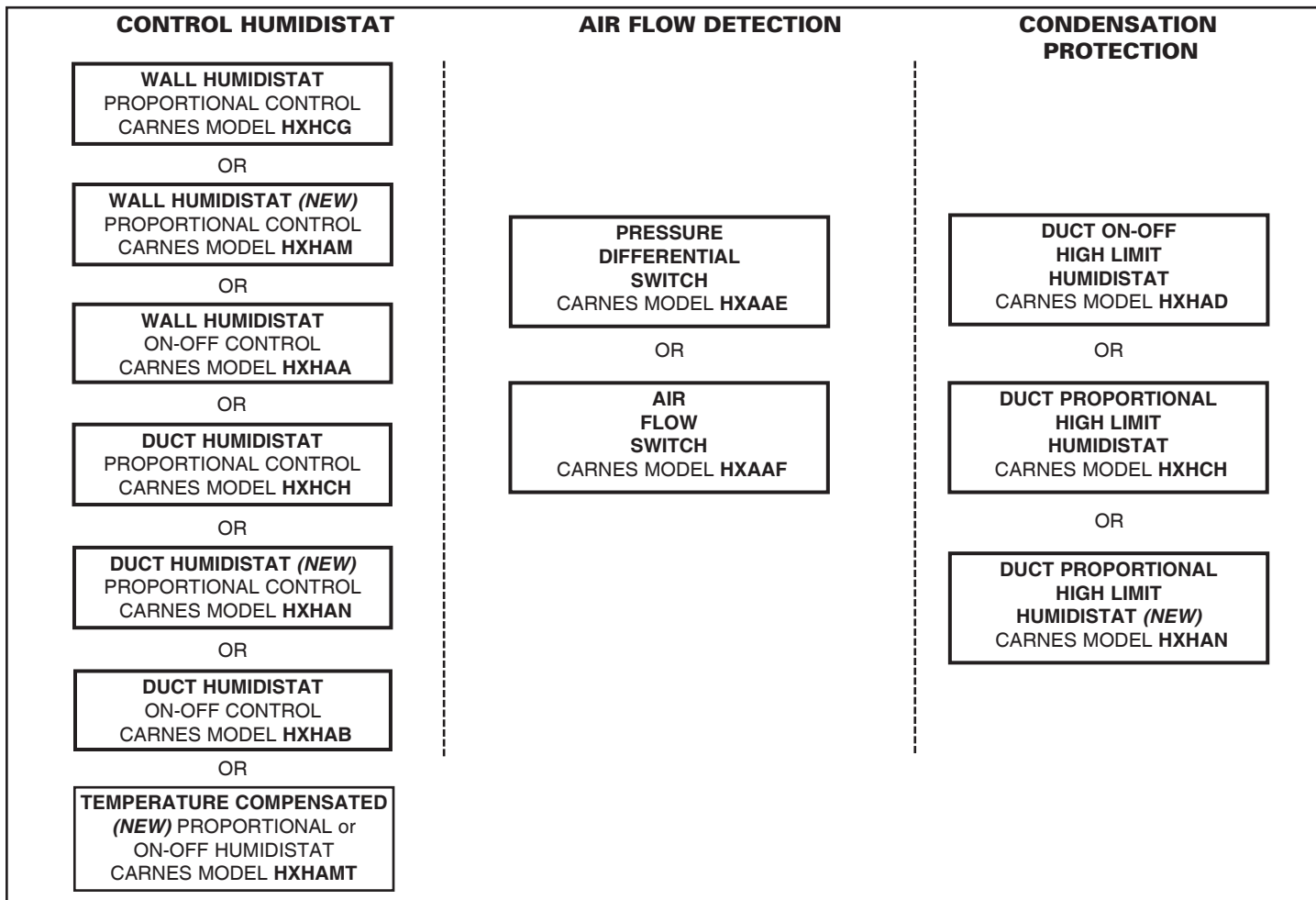
**HUMIDIFIER COMPONENT LISTING - Figure J**



- |                            |                               |  |
|----------------------------|-------------------------------|--|
| 1. On / Off / Drain Switch | 9. High Water Sensor          | 17. Cylinder Fitting                     |
| 2. Circuit Board           | 10. Fill Cup                  | 18. Drain Valve                          |
| 3. Door Interlock Switch   | 11. Fill Valve                | 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 |
| 7. Ground Lug              | 15. Circuit Breakers (Option) | 23. Cooling Fan                          |
| 8. Contactor               | 16. Cylinder                  |  |

# CONTROLS

CONTROL OPTIONS - Figure K



## 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 in the range of 25-100% using the True Touchscreen options.

If Carnes proportional humidistat is used the humidifier will automatically vary the steam output rate in the range of 20-100% of the humidifiers 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.

Either 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 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 are 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.

## 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 set-point. 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.

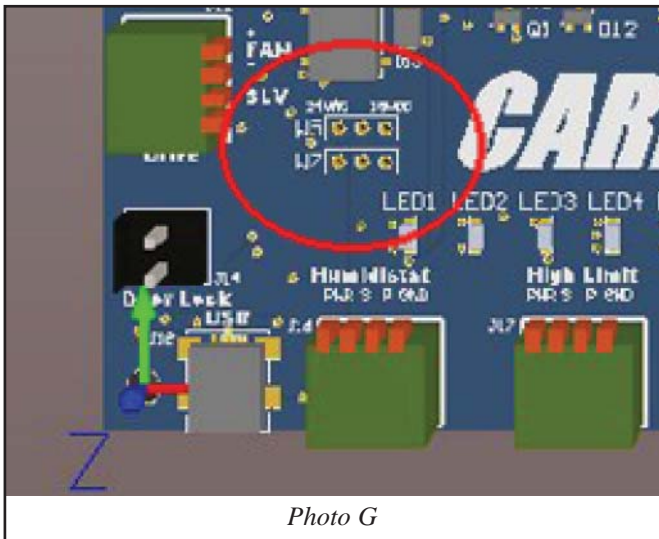
Either an on-off or proportional control high limit humidistat may be used with Carnes humidifiers. If a proportional humidistat is used the output of the humidifier will automatically be decreased to reduce the possibility of condensation. Two proportional humidistats may be used to control Carnes humidifiers if desired, one in the area to be humidified or return duct and another 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

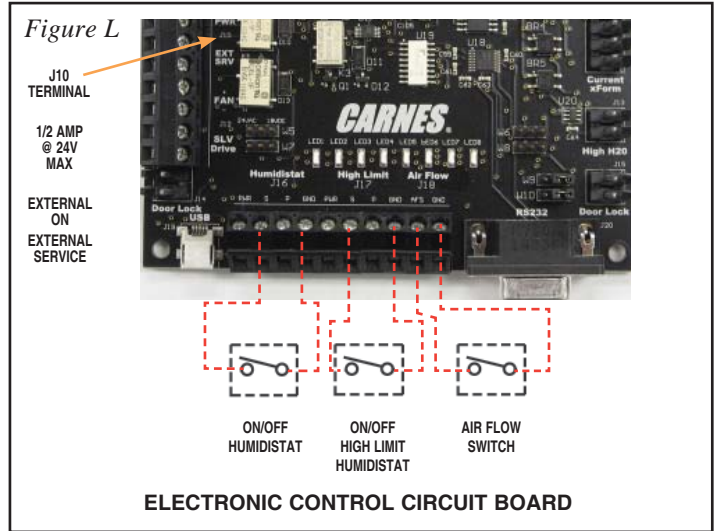
If your application has a requirement for an outdoor temperature compensation feature, the HXHAT, or HXHMT would satisfy. Both controls will provide monitoring of RH percentage and outdoor temperature, along with automatically adjusting the RH set-point as outdoor temperature changes. The HXHAT is a dry contact on-off humidistat, where as the HXHMT provides a 0-10V signal in either a proportional or on-off configuration.

## CONTROL CONNECTIONS

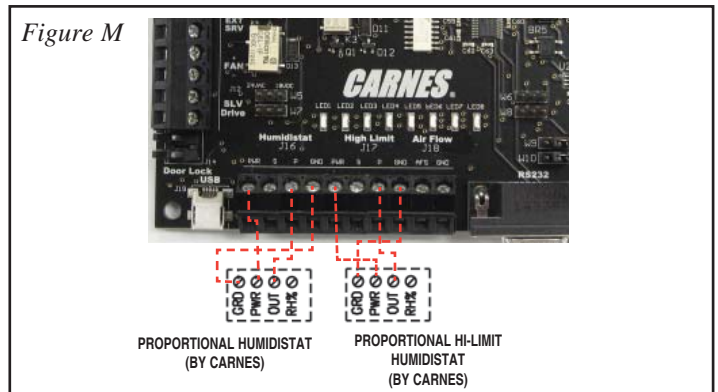
The circuit board can provide either a Carnes legacy 18VDC or an industry standard 24VAC, as a supply for those humidistats which require it. The supply for both the control humidistat and high-limit humidistat are output on pin1 of J16 and J17 respectively. **18VDC is set as the supply default**, but the jumpers on designators W5 and W7 can be moved to the left two pins to alternatively supply 24VAC as seen in *Photo G* (location of designators shown only, no pins or jumper).



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.

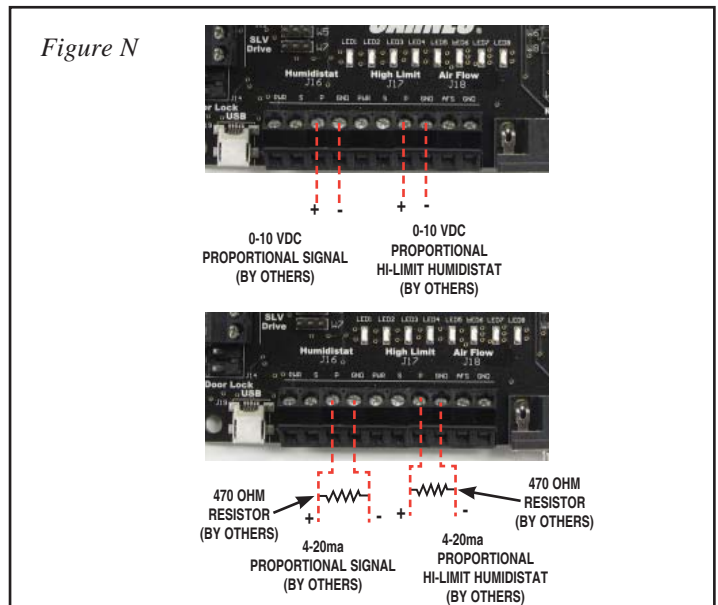


Connections shown in *Figure L* are for typical on-off controls. For Carnes proportional controls see the diagram *Figure M*. All controls are shipped with detailed wiring instructions.



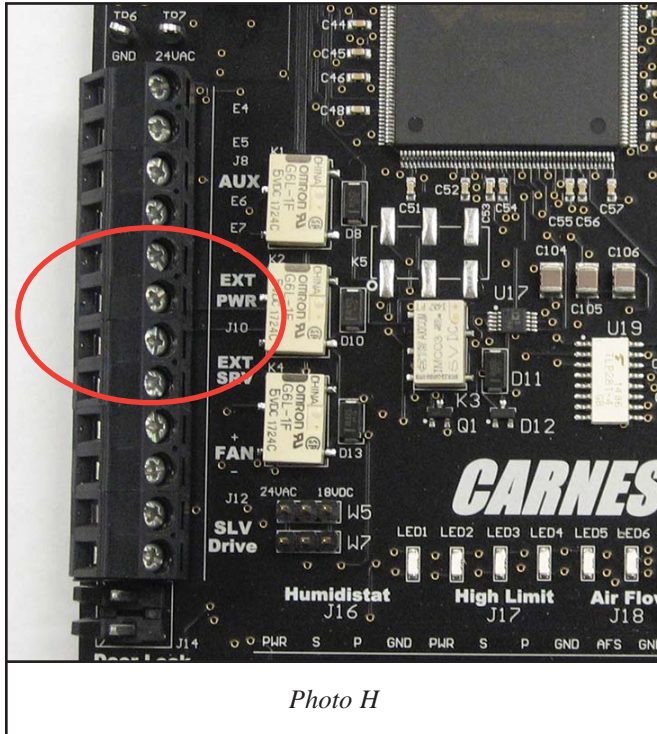
## EXTERNAL DDC CONTROL SIGNALS

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 N*).



## EXTERNAL MONITORING

Pins 1 and 2 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' button on the Home screen of the LCD will indicate the type of service that is needed. Both the EXT PWR and EXT SRV relays are rated at 125 Volts and 1 Amp maximum.



*Photo H*

## NETWORKING

If multiple units are required due to high capacity demand (over 200 lbs. per hour, single unit), networking can be done. Units can be interconnected with parallel signal wiring. This set up 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.**

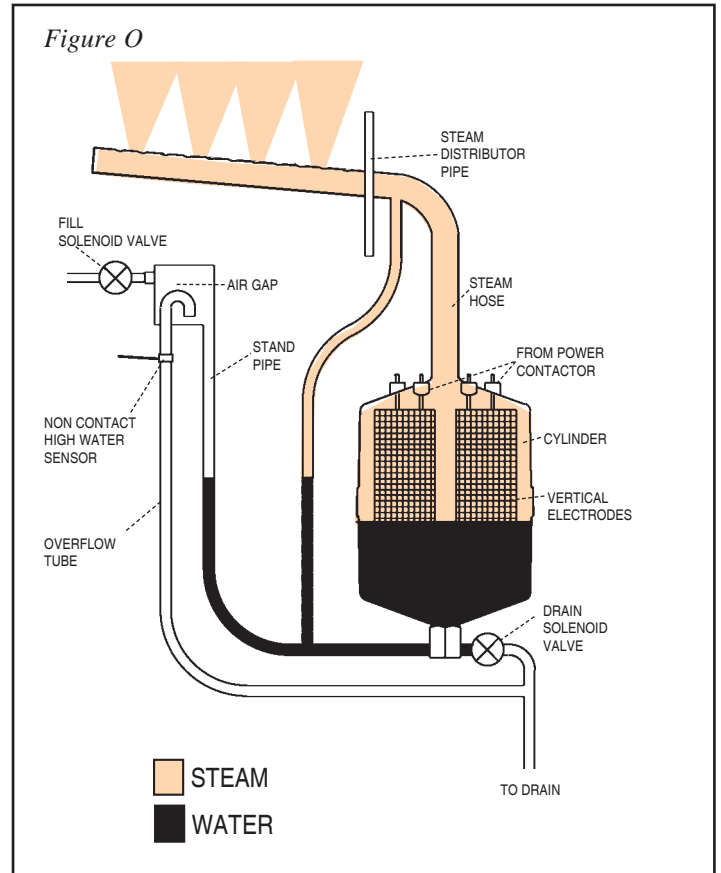
1. A 7/8" opening is provided on the bottom of the cabinet. The control wiring should pass through the opening to the provided connection points at J16, J17 and J18.
2. If an air flow switch or high limit humidistat is not used, jumpers must be installed before the humidifier will operate. On J17, jump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



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 the necessary interface to control and monitor many aspects of the humidifier. On the home screen is the current steam output in Lbs./Hr. (or Kg/Hr). To select either is available in the settings menu. A “Service Required” indicator and button outlining current service issues, indicators for the four basic controls necessary for operation (control humidistat, high limit humidistat, air flow switch and door interlock), and various buttons which navigate to other menu pages when pressed are also available on the home page screen. The menu pages and their capabilities are detailed further in “True Touchscreen Menu Pages” section of this document.

### “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 “Component Activity” menu.

### “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 “Component Activity” menu.

### “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 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 “Component Activity” menu. More information on troubleshooting High Water situations can also be found through the “Help” menu on the home screen.

### HUMIDIFIER TRUE TOUCHSCREEN MENU PAGES

The humidifier True Touchscreen user interface uses color conventions to help the user navigate the controls. The colors of different buttons indicate the following.

1. Gray —



Dim LCD is the only gray button. More information is available in the “home” page description.

2. Orange —



Orange buttons represent the object or subject described across the button. Most orange buttons have an indicator next to them, which can change in color, e.g. green, yellow or gray. Pressing orange buttons will bring you to a page which describes the object or subject in question.

3. Yellow —



Yellow buttons navigate a user to a new page dedicated to a set of functions. For example, the “Humidistat Demand” button brings the user to a page that shows what percentage demands both the Control and High Limit Humidistats are currently requesting, and details their functions. The bottom of each page, other than the home screen, has a square “Back” or “Home” button dedicated to directing the user back to their previous page.

4. White —



White buttons are used for confirming or entering data into the touchscreen. For example, they are used to confirm a change to the “Max Output” parameter, or entering a password to access the “Settings” menu.

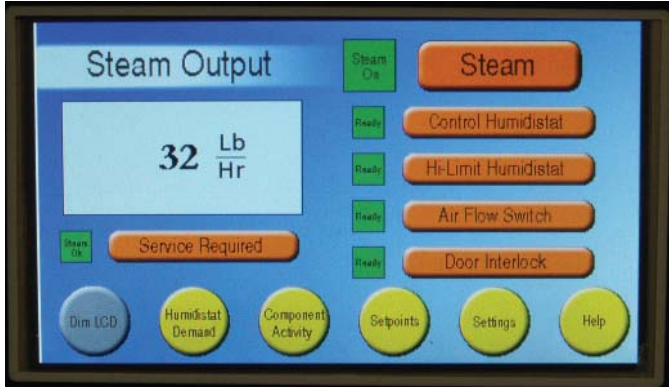


5. **Maize** —

How do I route my steam hose?

Help buttons are used exclusively in the “Help” page. These help buttons answer frequently asked questions about the operation, maintenance and troubleshooting of the humidifier. It is also a convenient place to look at humidifier electrical data when an IOM is not available.

“HOME” PAGE

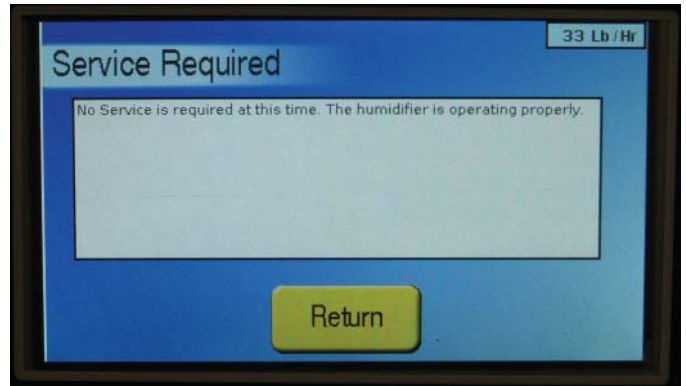


The home page is the main screen through which most other pages can be accessed. The large blue square to the left shows the steam output. The orange and yellow buttons on the home page are considered “Operational & Status” indicators. Touching any of these displays will show dialog explaining the subject or status of that button. The orange buttons also have indicator boxes to the left showing actual status. Green shows ready to operate.

1. **Dim LCD** (gray) - As a power saving feature, pressing the Dim LCD button will shut the backlight of the LCD off. Once off, pressing anywhere on the True Touchscreen will turn the backlight on. The humidifier can also automatically turn off the backlight after 15 minutes. See the “Settings” page for more information on enabling/disabling the Auto-Dim feature.
2. **Humidistat Demand** (yellow) - Brings the user to a page that shows what percentage demands both the Control and High Limit Humidistats are currently requesting, and further details their functions.
3. **Component Activity** (yellow) - Button lists the internal components used in the humidifier. Their respective indicators showing whether the components are activated or not. From this page, the user can view more information on the components and their functions.
4. **Setpoints** (yellow) - The three setpoints of the unit are listed on this page. The setpoint is the target Lb./Hr. output of the humidifier.
5. **Settings** (yellow) - Any settings of the humidifier, e.g. Max Output, Timers or Fan Speed, can be accessed through this page. This page is password protected. For more information, refer to the “Settings” page section.
6. **Help** (yellow) - Frequently asked questions about the humidifier can be answered through the Help page. It is a convenient resource to resolve many issues quickly and effectively.
7. **Service Required** (orange) - Invokes a page that describes what service is needed by the humidifier, if any. Indicator light to the left of the button turns red when service is needed, and will otherwise remain green. Refer to the separate “Service Required” page for more information.

8. **Steam** (orange) - Explains the status of the “Steam” indicator light. The humidifier will only produce steam if the “Steam” indicator light is green. The indicator will be brown when the On/Off/Drain switch is in the “Off” position. It will turn yellow if the switch is in the “On” position, but one or more of the four basic controls are not satisfied (Control Humidistat, High Limit, Air Flow, Door Interlock). The light will turn green if all of the above switches and controls are satisfied.
9. **Control Humidistat** (orange) - Explains the status of the Control Humidistat indicator light, and also shows the current demand of the Control Humidistat.
10. **High Limit Humidistat** (orange) - Explains the status of the High Limit Humidistat indicator light, and also shows the current demand of the High Limit Humidistat.
11. **Air Flow** (orange) - Explains the status of the Air Flow switch.
12. **Door Interlock** (orange) - Explains the status of the Door Interlock switch.

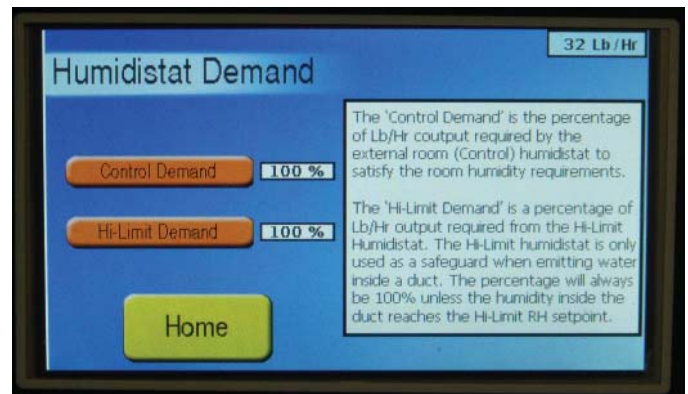
“SERVICE REQUIRED” PAGE



“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.

“HUMIDISTAT DEMAND” PAGE



The Humidistat Demand page lists both the Control Demand and the High Limit Demand of the humidifier. Each demand signal is represented by an orange button, and next to each button is a numerical box specifying the percentage of demand each humidistat is currently calling for.

The Control humidistat, which provides the Control Demand, is normally the humidistat 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 Hi-Limit Demand, is a safe-guard humidistat installed in the supply duct roughly 10-15 feet past the distribution tube. This 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.

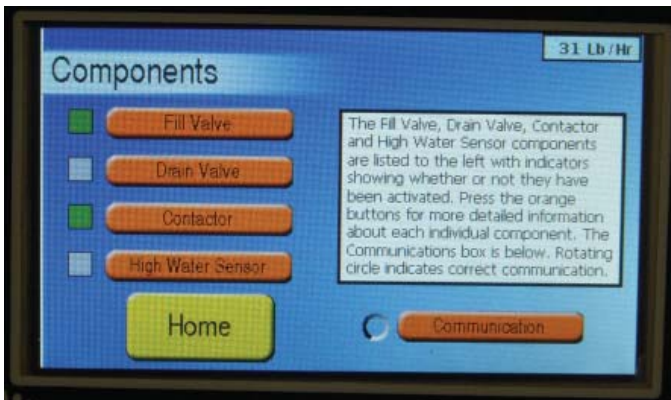
Both Control humidistats and High-Limit humidistats are wired in the same way, only Control humidistats are wired to port J16 of the circuit board and High-Limit humidistats are wired to port J17. Both ports have the same number of pins and connection layout.

**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 of the 0-10V DC variety. 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 DC variety, though a 4-20 mA control signal can be converted to a 0-10V signal by adding a 470 Ohm resistor between the 'signal' (pin 3) and 'ground' (pin 4).

### “COMPONENT ACTIVITY” PAGE

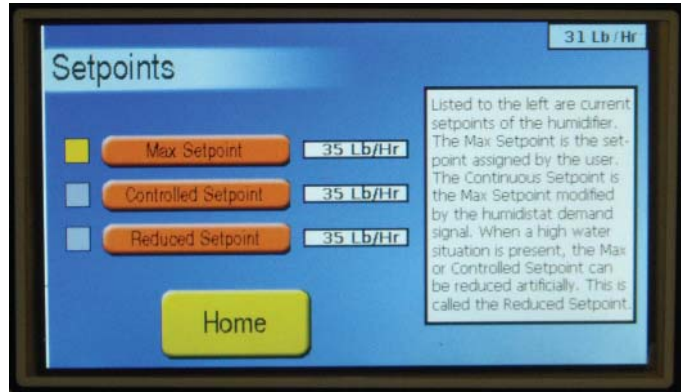


The Component Activity page lists all internal components that can switch on and off during operation. This includes the Fill Valve, Drain Valve, Contactor, and High Water Sensor. Each orange button in the component list is accompanied by a colored indicator representing whether or not the component is currently 'on'. Green indicates that the component is 'on', whereas gray indicates the component is 'off'. 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 the cylinder. The Contactor is on when 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 unit will

continue normal operation. High water sensors can be cumulative depending on the condition of the water.

The other item present on this screen is the Communication button. The Communication button has a rotating indicator that represents whether the True Touchscreen controller on the circuit board is properly communicating with the microcontroller. If this icon is not rotating and has a red 'X' through it, the information on the screen is invalid and you should contact the factory.

### “SETPOINTS” PAGE



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. For all setpoints, the following colors represent the status of the setpoints:

**Gray** – The setpoint is inactive because it is not currently necessary.

**Green** – The setpoint is active, and the humidifier is producing steam at or above the setpoint value.

**Yellow** – The setpoint is active, but the humidifier is producing steam below the setpoint value.

**Yellow/Black X** – The setpoint is inactive because it is being overridden by a setpoint with a higher priority.

The three different types of setpoint are as follows: The **Max Setpoint** is the user-specified setpoint 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 humidistat (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.

## “SETTINGS”



The Settings menu is the page where all operational values can be set. It is password protected by default, with a default password of '1212'.



The password can be disabled under the 'Settings Password' on the second Settings page. See 'Settings Password' section for more details.

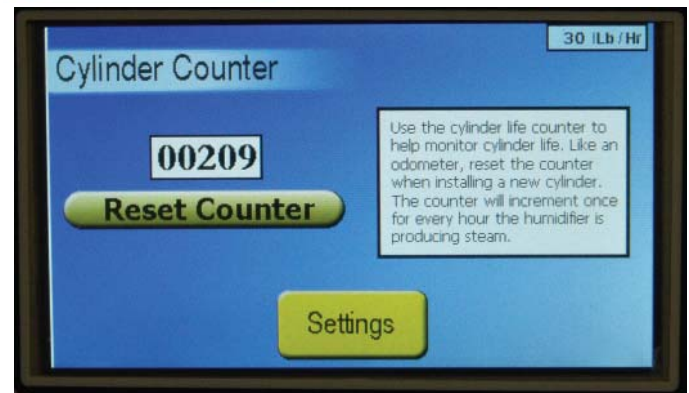
Any adjustment made to any setting can be done 'on-the-fly'. Which means when a change occurs, the humidifier will react accordingly without the need of shutting off the unit or even stopping steam output. In general, any page within the True Touchscreen system can be accessed, monitored, or changed 'on-the-fly'.

## Max Output Adjust –



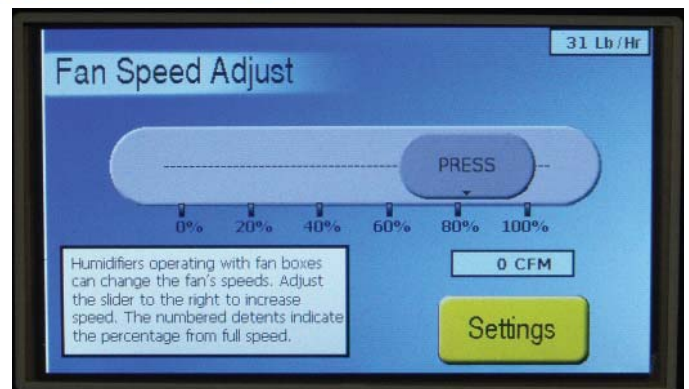
This page adjusts the Maximum Output of the humidifier. The Maximum Output can be adjusted lower from the nominal output value of the unit (set at the factory). The unit cannot be set lower than 20% of the nominal value of the humidifier. The Maximum Output value, when changed, also changes the Max Setpoint value on the Setpoints 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.

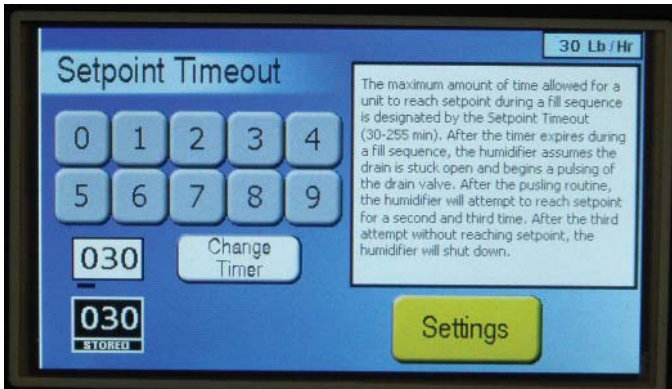
## Fan Speed Adjust –



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 –

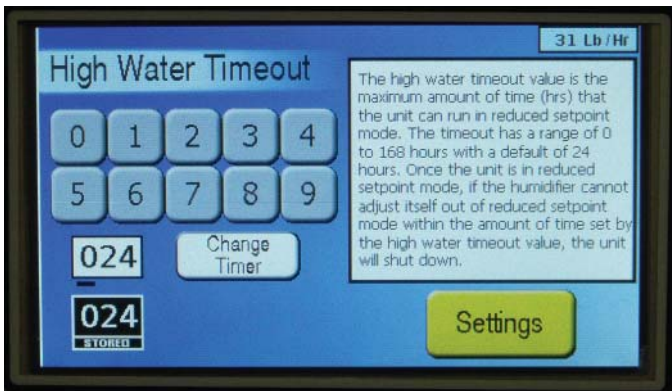
## Setpoint Timeout



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 –

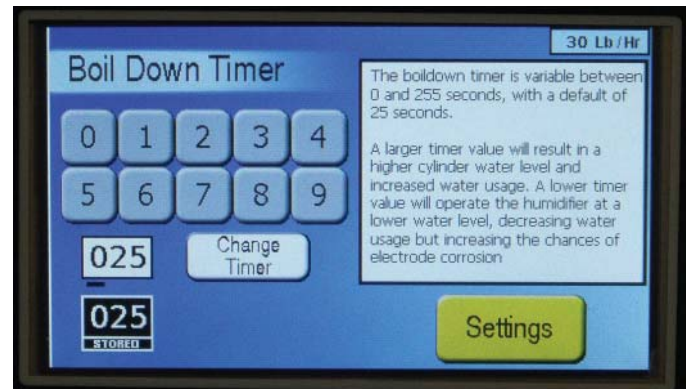
## High Water Timeout



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 work its way back up the normal max/controlled setpoint, the humidifier will shut down after the High Water Timeout value elapses.

### Boil Down Timer –

## Boil Down Timer



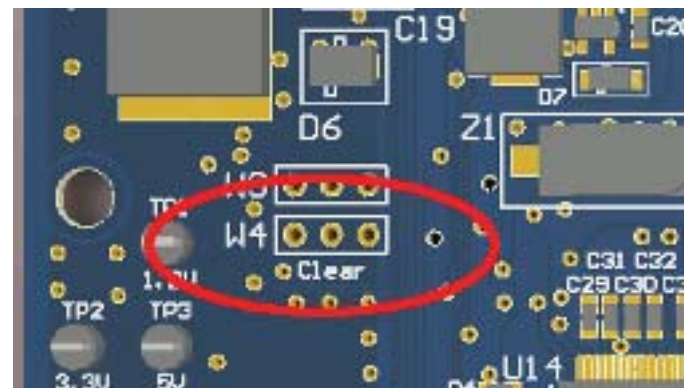
This page is where the Boil Down Timer is set. The Boil Down Timer is variable between 0 and 255 seconds, with a default value of 25 seconds. Setting the Boil Down Timer higher will result in an increased water level, and less-conditioned water. This may be helpful in reducing low water level induced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

### Settings Password –

## 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, it can be reset. To do this, remove power to the humidifier, move the jumper on W4 from pins '1 and 2' to '2 and 3', and power the unit back on.



Return the jumper to pins '1 and 2' afterward. Pins '1 and 2' are to the left, and pins '2 and 3' are to the right.

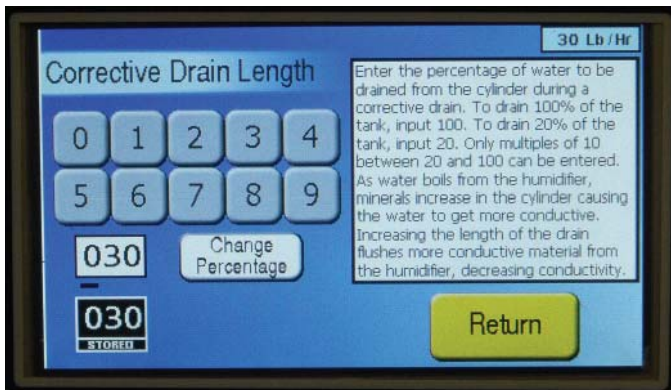
The different yellow buttons on both setting pages allow for the changing of different values. Below is a brief summary of each, and more information can be accessed within the page itself.

**Calibration Password –**



This page is where the Humidifier Unit Code, the four digit number identifying the humidifier, is programmed into the unit. This page is password protected, and number should not be modified by the end user. Contact the factory if further information is needed.

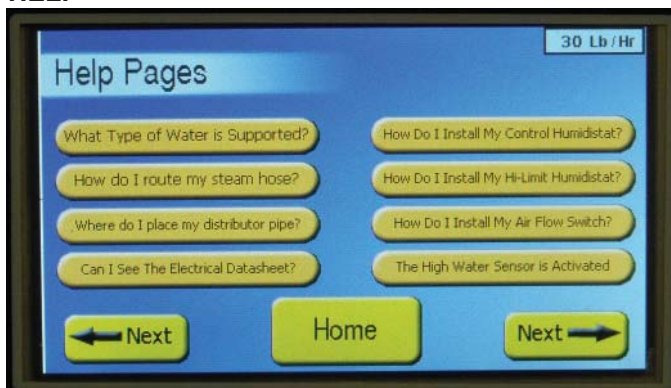
**Corrective Drain Length –**



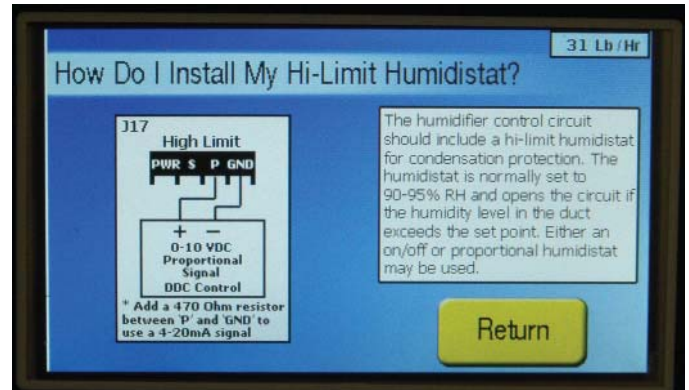
This page is where the Corrective Drain Length is set. This value represents how much water should be drained from the cylinder when the humidifier senses a corrective drain is needed. As water boils from the humidifier, minerals increase in the cylinder causing the water to get more conductive. Increasing 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 of the tank, input 100. 30 is the default value, and only multiples of 10 between 20 and 100 can be entered.

**“HELP”**

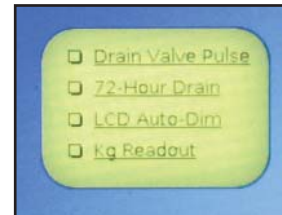


The help pages consist of maize color buttons labeled with questions. When a button is pressed, information will be given answering and/or giving information about the subject in question. A basic help page consists of text and/or diagrams to help the user through basic problems.



For example, in the picture above the question of how to install a high limit humidistat 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.

**Checkboxes –**



There are a few operational options that do not need separate pages, and therefore are only enabled/disabled via checkboxes on the main Settings 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 **Kg./Hr Readout** is disabled by default. This option, when enabled, will turn the steam readout on home page, and in the upper right hand corner of other pages, into Kg/Hr instead of Lb/Hr.

## START UP & OPERATION

### INITIAL START UP

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 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 Steam Indicator on the LCD should turn yellow or green.
6. The Steam indicator will turn green if all of the basic four controls on the home page are green. If not, the steam indicator will be yellow.
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 set-point. If water reaches top of the cylinder before set-point is reached, the "High Water Sensor" will be activated and the fill will close.
10. When starting with a new cylinder and fresh water, the fill and drain solenoid valve may cycle for brief periods until water has come to a compete 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 current reaches 10% above the active set-point, 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 95% of set-point.
3. The timer runs until steam output drops to 90% of set-point.
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 drain is not necessary.
6. Measurements are made during each cycle and a drain only occurs when necessary thereby maximizing energy efficiency.

#### REDUCING OVERCURRENT

1. If current to any electrodes in the cylinder reaches more than 20% above the set-point, 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, 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.

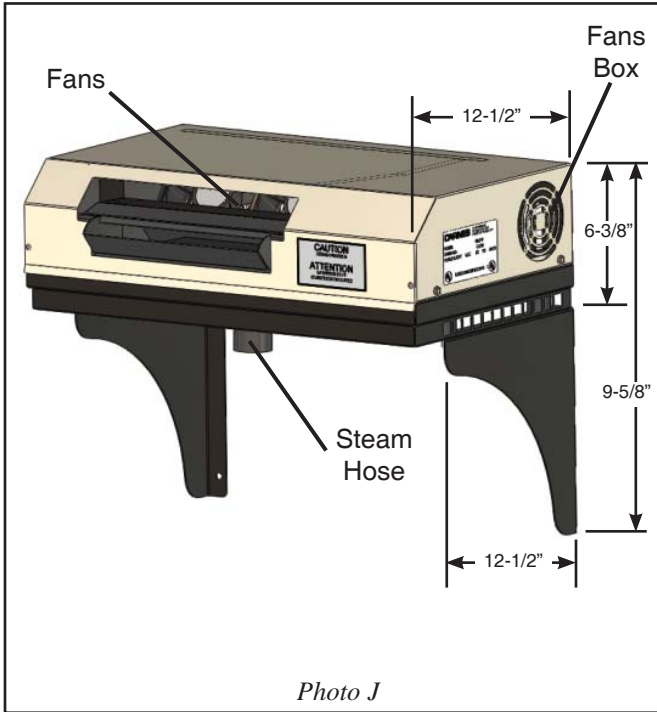


Photo J

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)

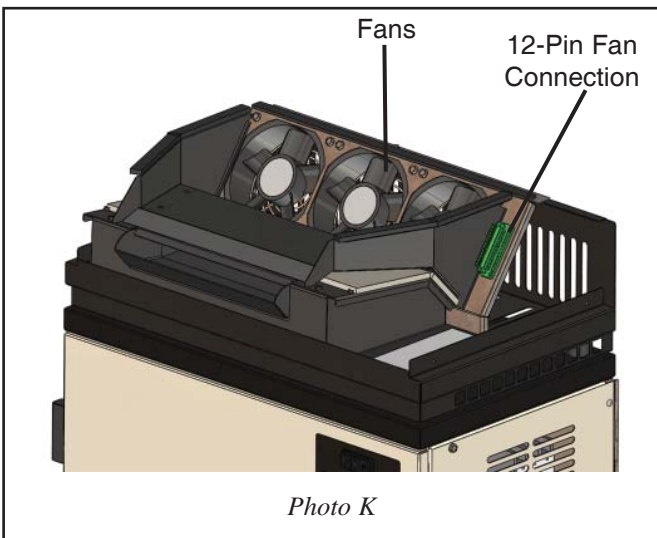


Photo K

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 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.

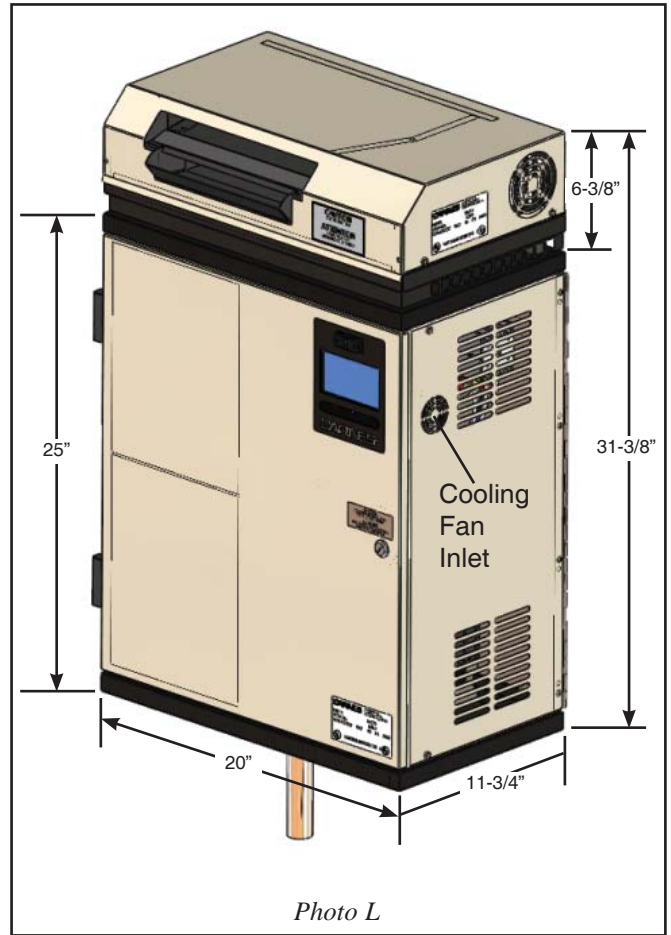
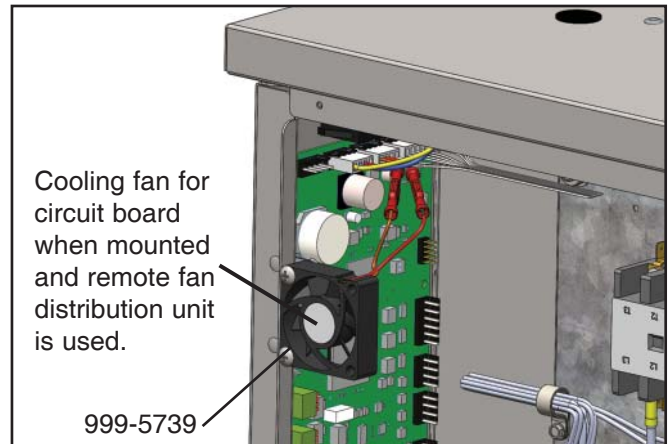


Photo L

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.

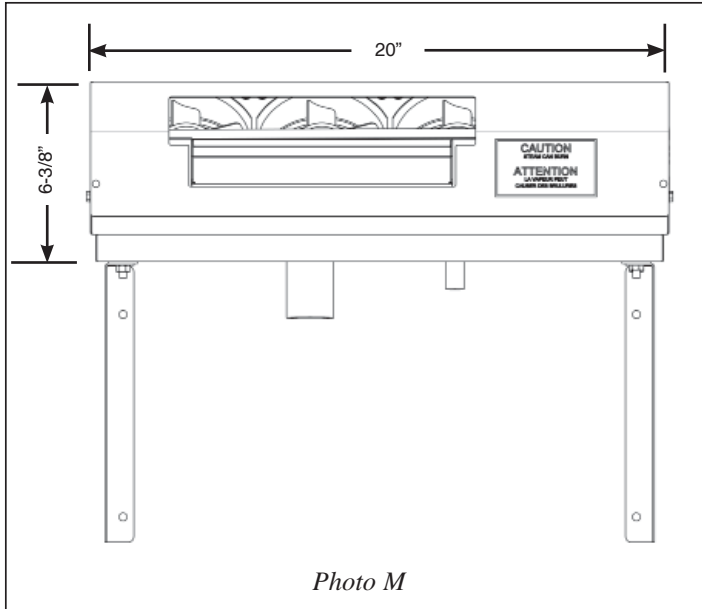


**Cooling Fan** included with all fan distribution units as well as with all other units manufactured (exception is residential). As soon as power is supplied, the fan will start to run from the 12 volt service from circuit board.

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 humidifier 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 6. 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



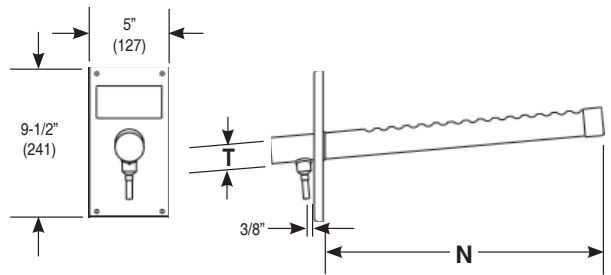
Distributor Pipes for Models: HBA, HCA, HBD, HCD

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

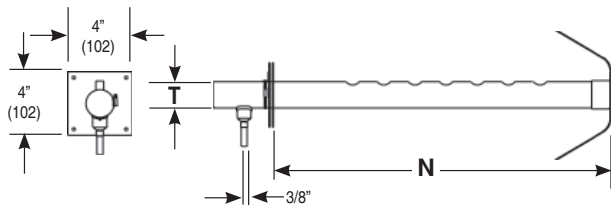
PIPE	Minimum**		T
	N	N	
HXPBB040S	35 (889mm)	38 (965mm)	7/8
HXPBB044S	39 (991mm)	42 (1067mm)	7/8
HXPBB048S	43 (1092mm)	46 (1168mm)	7/8
HXPBB052S	47 (1194mm)	50 (1270mm)	7/8
HXPBB056S	51 (1295mm)	54 (1372mm)	7/8
HXPBB060S	55 (1397mm)	58 (1473mm)	7/8
HXPBB064S	59 (1499mm)	62 (1575mm)	7/8
HXPBB068S	63 (1600mm)	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

\*\*See Note A

### Lengths 012-036



### Lengths 048-120



Distributor Pipes for Models: HBG, HCG, HBH, HCH

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	
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 position of mounting plate. An infinite variety of settings are available between the minimum and maximum. A mounting strap is provided on the end of the pipe to secure to the top or side of the duct for support.

### MATERIAL

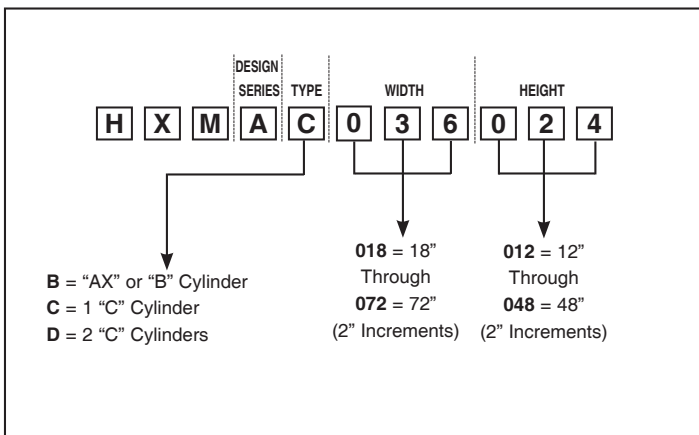
Standard distributor pipes are fabricated from stainless steel.

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

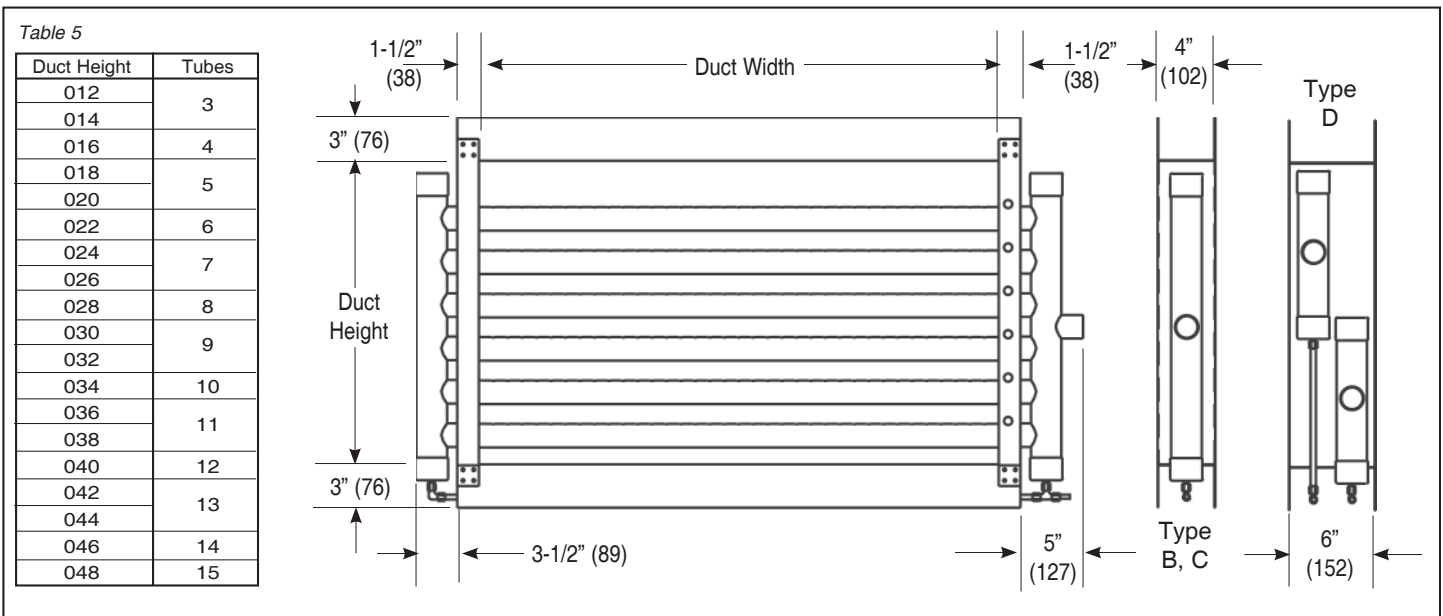


## SHORT ABSORPTION MANIFOLD

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.



- 304 Stainless steel steam distribution tubes on three inch centers provide extremely short absorption distances
- 304 Stainless steel manifold with flexible EPDM connections for thermal expansion without use of "O" rings
- Strong galvanized flanged frame for easy and fast connection to duct
- Factory assembled for reduced installation costs.



**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 .5 psi or less so there are limitation 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 8*.

**MAXIMUM STEAM HOSE LENGTH**

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 A*. 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 B*. 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 C*. The steam manifold cannot be installed in a vertical duct.

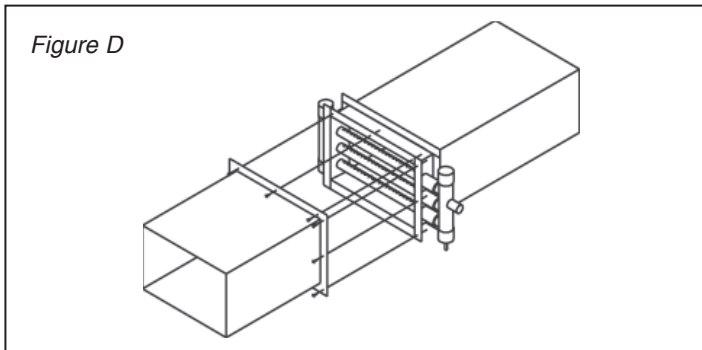
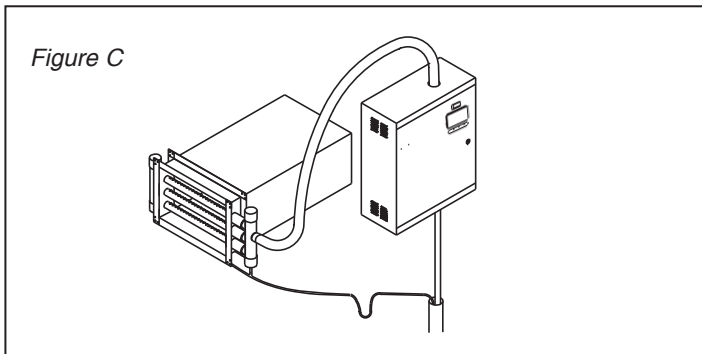
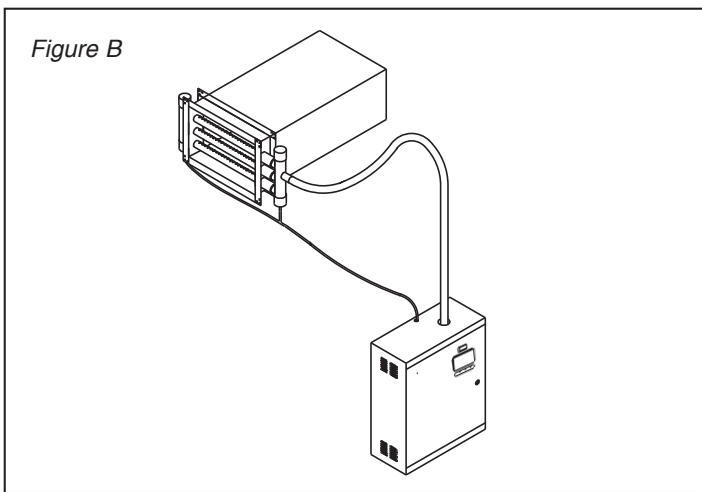
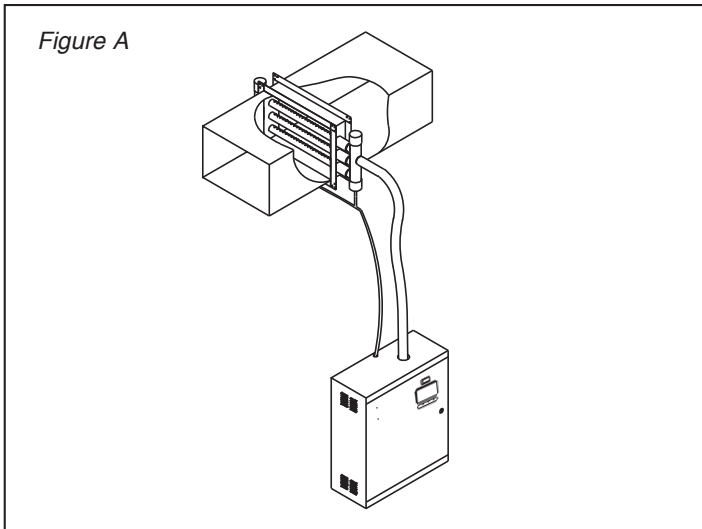
The manifold has an integral mounting flange for ease of installation. Separate mounting flanges, supplied by others, are needed to mate with the manifold. Refer to *Figure D*.

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 copper tube be used as a substitute. If 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.

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 8* 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 6

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 (gray fill valve 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 (green fill) valve indicator)</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 & condensate return hose do not have a continuous slope. Condensate accumulates and gets pushed out 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 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 ft. upstream from elbows, grilles, etc. If temp. in duct is 60°F or lower the distance should be 10 ft. If distance, as mentioned, is not possible, a drain pan may be required. If the air in the duct can not 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
<b>No LCD display</b>	*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.
	*24 VAC supply to circuit board is not available.	*Make sure the protection on the transformer is not tripped (fuse or breaker). Confirm the required 24 VAC is leaving transformer. Make sure connection to circuit board at J1 is intact. If situation does not resolve, replace circuit board.
<b>Humidifier unable to reach maximum output or required set-point</b>	*Capacity of unit is too low.	*Determine proper load calculation & 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. Located & correct issue.
	*Back pressure in steam hose too high.	*Too long of steam line runs, sags, dips, horizontal runs not allowing for proper condensate removal, improper sloping of steam lines & condensate line.
	*Foaming.	*Remove impurities inside the cylinder. If cleaning of cylinder was attempted, throw away.
	*Wrong cylinder.	*Make sure proper cylinder and configuration is used.

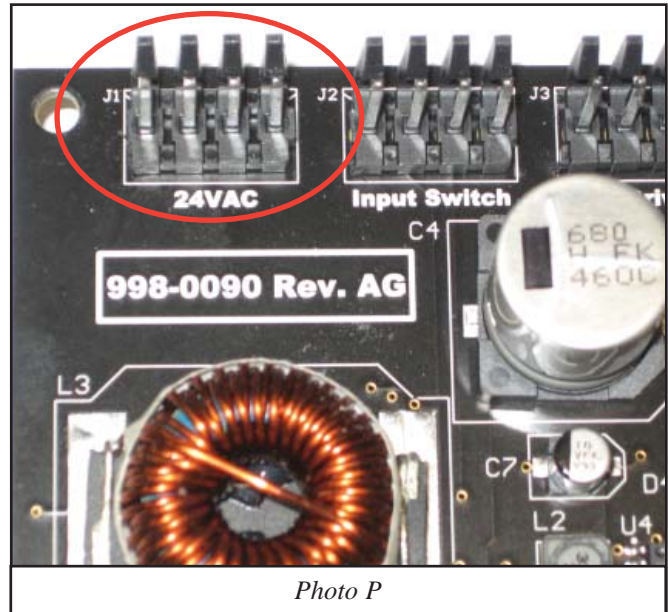
### WATER CONTROL

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-amping 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.

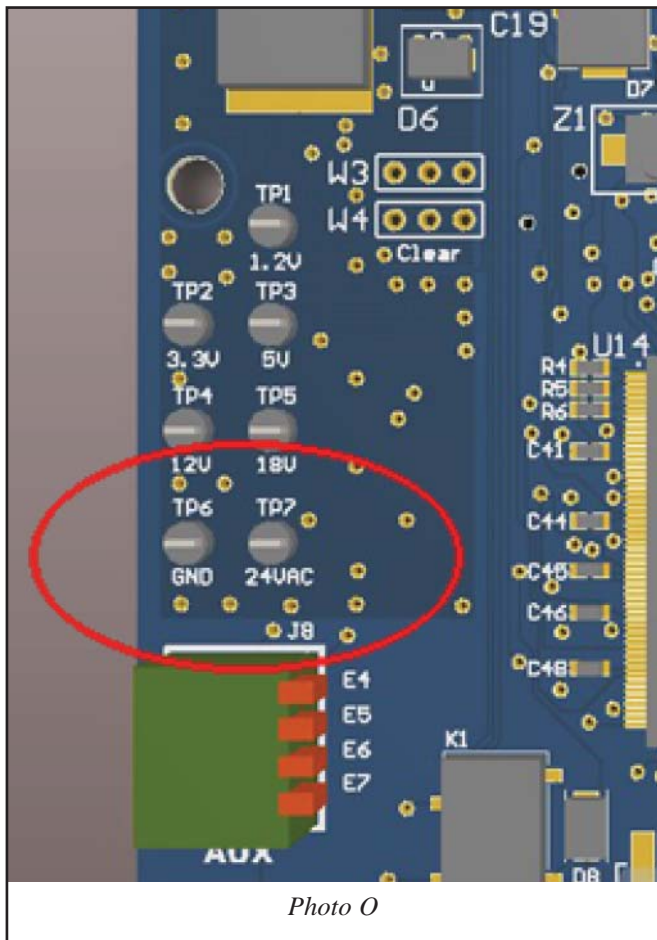
## TROUBLE SHOOTING

### SYMPTOM: LCD NOT ON

1. 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.
2. If humidifier is 3-phase, verify that all legs have power.
3. If the humidifier has optional internal circuit breakers, they must be on.
4. Verify LCD is not in dimmed mode by touching it.
5. Verify that 24VAC is being supplied by the voltage transformer by taking voltage reading between TP6 and TP7 (*Photo O*). Check the connection at J1 (*Photo P*).
6. If 24V AC is not present reset the overload protection (breaker or fuse) located on the transformer.
7. If 24V AC is present, the circuit board may be defective.



*Photo P*



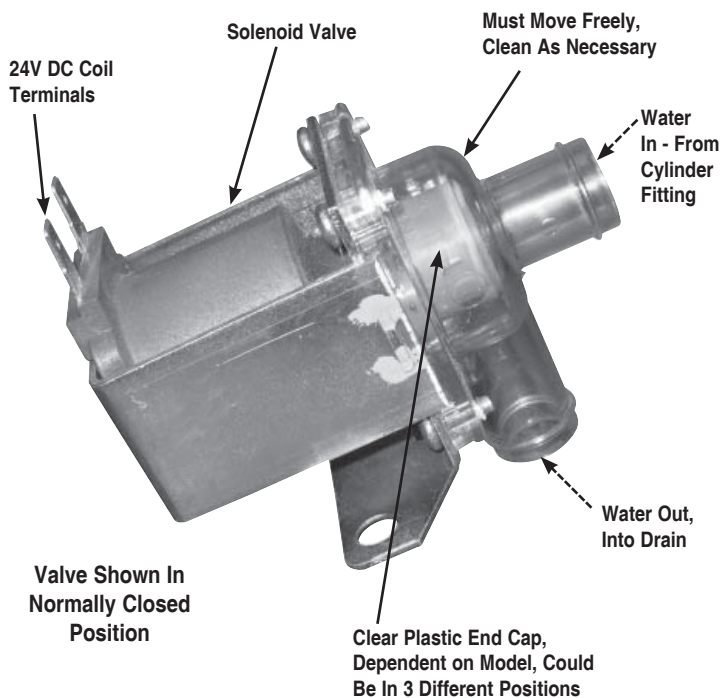
*Photo O*

### SYMPTOM: WATER DOESN'T FILL INTO CYLINDER

1. Confirm that indicators for the four basic controls are all lit green, and the humidifier is switched 'On'.
2. If all four indicators are not green, consult the "Controls" section of the IOM.
3. If all four indicators are green, and the 'Steam' indicator is green, check the service required page for a possible shutdown scenario.
4. If no service required information is available, check the Fill Valve indicator (or the Blue LED on the front). If 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.
5. If water is available, check the fill valve strainer for sediment. Strainer may be checked by removing brass nut from input of valve and reaching inside housing and pulling out strainer.
6. If 24VAC is present and strainer is clean, the fill valve may be defective.
7. If the High Water Sensor is activated, the fill valve will not be allowed to open. In this case the green indicator (and blue LED on front panel) will be off.
8. Make sure the drain solenoid is not partially open due to blockage, restriction or malfunction.

## SYMPTOM: DRAINS CONTINUOUSLY

1. 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 re-occurring issue, make sure the “Repetitive Drain Valve” option is enabled in the settings menu.
2. 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.
3. When the Drain Valve” LED is lit, the circuit board is sending 24VDC to the drain valve. If the indicator is gray but 24VDC is present at the drain valve, the circuit board may be defective.



## SYMPTOM: WATER IN THE DUCT

Note: 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.

1. The steam hose and condensate return line **MUST** 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.

2. 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.
3. The distributor pipe must be installed so that far end of the distributor pipe is higher than the incoming end where condensate return connection is located. The mounting plate on distributor pipes 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.
4. 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.
5. 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.
6. 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.

If water is condensing on an object in the duct or on the duct itself it will be necessary to take other steps.

1. The distributor pipe must be a **minimum** 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.
2. 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.
3. 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.

## **SYMPTOM: ARCING IN THE STEAM CYLINDER**

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:

1. 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.
2. 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.
3. 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.
4. Insufficient flow of incoming fresh water will cause arcing by causing low water levels. Since an automatic drain is not initiated until set-point 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.
5. 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.
6. Excessive lengths of steam hose in conjunction with high duct static pressures cause low water levels and arcing.
7. 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.

8. Chemicals should not be used to attempt to prevent mineral build up in the cylinder or to dissolve minerals that accumulate. Chemical treatment may affect conductivity. Only untreated tap water is recommended for use in the humidifier.

## **SYMPTOM: 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.

1. Clean all water lines, replace if necessary.
2. Replace cylinder.
3. Reduce softening mix or concentration.
4. Increase water volume by correcting drain issues.
5. Changing cylinder, but with a different electrode configuration to accommodate the water condition.



## 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 (hours of operation. Found by accessing 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. "Humidistat Demand" indication button. Shows control humidistat and high-limit humidistat.
  - h. "Settings button - where all operational values can be set.
  - i. "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 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 message on touchscreen. Replacement type fuses are not acceptable.

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 (copper or 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 circuit board.
  - b. Integral steam manifold trap.

Option: When plans call for a specific short absorption distance from dispersion system, a multi-tube Short Absorption Manifold is available sized specifically to duct dimensions, with horizontal stainless steel cross tubes and vertical headers.
10. The system shall include flexible hose to connect the steam cylinder(s) to the steam distributor pipe(s). A separate condensate return line shall return condensate to the humidifier for reuse to minimize consumption. If due to specific routing issues or application of unit, condensate line can not 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 30 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 20 gauge steel with a stainless steel bottom pan, protected by a dipped electrostatic baked enamel undercoat with multi spec textured top coat with black accent architectural grade. 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 solid-state 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 (NEW).
  - c. Duct mounted humidistat, on/off control.
  - d. Duct mounted humidistat, proportional control.
  - e. Duct mounted humidistat w/digital humidity and temperature, combo (NEW).
  - f. High limit duct mounted humidistat, on/off control.
  - g. High limit duct mounted humidistat, proportional control.
  - h. Pressure differential type air flow switch.
  - i. Paddle type air flow switch.
  - j. Wall or duct mounted temperature compensated, on/off or proportional control, digital display humidistat.
14. External Control Signals - All Carnes humidifiers will accept external DDC control signals of 0-10 volt DC. Signal to modulate the output of humidifier. Polarity must be observed and input impedance is 20K 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.
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 with indication light 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 home 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 shutdown 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 shutdown.
19. The humidifier(s) shall include a non water contact capacitance proximity high water sensor to prevent overfilling 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 lbs./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 hours. Unit will remain in stand-by in the event that a quick start-up is required.

## PREVENTATIVE MAINTENANCE:

### RECOMMENDED MONTHLY PREVENTATIVE MAINTENANCE FOR HUMIDIFIERS

Servicing 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 becomes 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 of adequate slope up for steam hose and slope down for condensate return. Correct as necessary. Recommend no hose lengths longer than 30 to 35 feet. Refer to early 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 and inspect. Clean or replace as necessary. Residential Unit - disconnect inlet hose to solenoid valve assembly, remove solenoid valve from unit and visually check filter screen inside inlet port. Clean 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 cylinder for extreme amounts of residue on the inside surface. Very high level of water or unit unable to provide full capacity may be an indication of end of life cycle of the cylinder. 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 Cylinder is more often than not 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 wire and plug connections inside unit. Include 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 build up 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.



# 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.



### Models Available

HXCBAX145
HXCBAX220
HXCBAX380
HXCBAX500
HXCBAX600
HXCBAX700

Replacement humidifier cylinders can be ordered from your local Carnes Sales Representative. Please contact them directly or fill in the information below and either mail or fax (608/845-6504) to the Carnes Company. We will then have our Sales Representative contact you.

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"/>



### Models Available

HXCCB145
HXCCB220
HXCBB380
HXCBB500
HXCBB600
HXCBB700

*(Information requested above is on a label on the outside of the humidifier cabinet on the lower left corner)*

Steam Cylinder Model: \_\_\_\_\_

Quantity Required: \_\_\_\_\_

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

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

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

City: \_\_\_\_\_

State/Province \_\_\_\_\_ Code \_\_\_\_\_

Phone: ( \_\_\_\_\_ ) \_\_\_\_\_

Fax: ( \_\_\_\_\_ ) \_\_\_\_\_



### Models Available

HXCBC6F
HXCBC6X
HXCBC61
HXCCC62
HXCBC63
HXCBC64
HXCBC65
HXCBC12

*"Due to ongoing research and development CARNES reserves the right to change specifications without notice."  
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## TERMS, CONDITIONS AND WARRANTY

### 1. ACCEPTANCE, GOVERNING PROVISIONS AND CANCELLATION.

This writing constitutes the complete and exclusive statement of the terms and conditions of sale of the products and/or services described herein, and Seller's obligation to sell is expressly conditioned upon assent to these terms and conditions. Buyer will be deemed to have assented to these terms and conditions unless Seller receives written notice of any objection within 5 days of the date Buyer receives this writing. No additional or different specifications will be binding upon Seller unless specifically agreed to in writing; failure of Seller to object to provisions contained in any purchase order or other communication from the Buyer shall not be construed as a waiver of these terms and conditions nor an acceptance of any such provisions. No order accepted by Seller may be cancelled or altered by the Buyer except upon terms and conditions acceptable to Seller, as evidenced by Seller's written consent. In the event of such an approved cancellation by Buyer, Seller shall be entitled to payment for all finished and in-process goods, as well as any costs incurred in the preparation of Buyer's order to the date of cancellation.

### 2. DELIVERY, CLAIMS AND DELAYS.

Delivery of products to a carrier at Seller's plant or other loading point shall constitute delivery to Buyer; and regardless of shipping terms or freight payment, all risk of loss or damage in transit shall be borne by Buyer. Seller reserves the right to make delivery in installments, unless otherwise expressly stipulated herein, all such installments to be separately invoiced and paid for when due per invoice, without regard to subsequent deliveries. Delay in delivery of any installment shall not relieve Buyer of his obligations to accept remaining deliveries. Further, use of the products by the Buyer shall constitute a waiver of any claim for delay.

Claims for shortages or other errors in delivery must be made in writing to Seller within 10 days after receipt of shipment and failure to give such notice shall constitute unqualified acceptance and a waiver of all such claims by Buyer. Claims for loss or damage to products in transit should be made to the carrier and not to Seller.

Seller shall not be liable for any damage as a result of any delay due to any factor or event beyond Seller's reasonable control, including, without limitation, an act of God, act of the Buyer, embargo or other governmental act, regulation or request, fire, accident, strike, slowdown, a war, riot, delay in transportation, inability to obtain necessary labor, materials, or manufacturing facilities. All such factors and/or events shall extend the delivery date for a period equivalent to the time lost by reason of such factors and/or events, plus thirty (30) days.

### 3. CHANGES.

Seller may at any time make such changes in design and construction of products as shall constitute an improvement in the judgment of Seller. Seller may furnish suitable substitutes for materials unobtainable because of priorities or regulations established by governmental authority or nonavailability of materials from suppliers.

### 4. PAYMENT.

Unless otherwise expressly stated on the face hereof, all prices are subject to change without notice; and the price of products on order but unshipped will be adjusted to the price in effect at the time of shipment. Products are sold f.o.b. Seller's plant unless otherwise stated.

Full invoice amount is due in 30 days from date of invoice ("due date") unless otherwise expressly indicated on the reverse side, and a late payment charge of one and one-half percent (1-1/2%) per month may be added to any invoiced amounts unpaid when due if not prohibited by law, otherwise at the highest lawful contract rate. Buyer shall reimburse Seller, upon demand, for any costs of collection incurred by Seller, including reasonable attorneys' fees. Invoices may be submitted as partial shipments are made. If during the period of the contract the financial condition of Buyer does not justify the terms of payment specified, Seller may demand full or partial payment in advance before proceeding with the contract. If shipment is delayed beyond the scheduled date by Buyer, payment shall be due in full when Seller is prepared to make the shipment. If Buyer defaults in any payment when due, then the whole contract price shall immediately become due and payable upon demand, or Seller, at its option without prejudice to other lawful remedies, may defer delivery or cancel this contract.

### 5. SECURITY INTEREST.

Buyer hereby grants to Seller a security interest in the products and the proceeds thereof, to secure payment of all sums to become due the Seller hereunder, and any other indebtedness owing at any time by Buyer to Seller. The Seller shall have, upon a default in payment, all of the rights and remedies of a secured party under the Uniform Commercial Code. Buyer shall execute and deliver upon Seller's request financing statements to perfect the security interest, and Buyer shall take such further action as shall be necessary or desirable to preserve and protect Seller's security interest.

### 6. TAXES AND OTHER CHARGES.

Any manufacturer's tax, retailer's occupation tax, use tax, sales tax, excise tax, duty, custom, inspection or testing fee, or any other tax, fee or charge of any nature whatsoever imposed by any governmental authority, on or measured by the transaction between Seller and Buyer shall be paid by the buyer in addition to the prices quoted or invoiced. In the event the Seller is required to pay any such tax, fee or charge, Buyer shall reimburse Seller therefore; or, in lieu of such payment, Buyer shall provide Seller at the time the order is submitted with an exemption certificate or other document acceptable to the authority imposing the same.

### 7. WARRANTIES.

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.

### 8. NON-LIABILITY FOR DAMAGED APPARATUS.

Seller will not be responsible or liable for any damage resulting from improper storage or handling prior to placing the products in service and will not assume any responsibility, expense or liability for repairs made outside its works without proper written consent.

### 9. PATENTS.

Seller will, at its own expense, defend any suits that may be instituted by anyone against Buyer for alleged infringement of any United States patent relating to any products furnished by Seller hereunder, if such alleged infringement consists of the use of such products, or parts thereof, in Buyer's business for any of the purposes for which the same were sold, and provided Buyer shall have made all payments then due hereunder and shall give to Seller immediate notice in writing of any claim of infringement and of the institution of any such suit and transmit to Seller immediately upon receipt all processes and papers served upon Buyer and permit Seller through its counsel, either in the name of the Buyer or in the name of Seller, to defend the same and give all needed information, assistance and authority to enable Seller to do so. In case of a final award of damages in such suit Seller will pay such award but will not be responsible for any compromise made without its written consent. In addition to the foregoing, if at any time Seller determines that there is a substantial question of infringement or in the case any such product is judicially held to constitute infringement and the use of such product is enjoined, Seller may, at its expense, either procure for Buyer the right to continue using the product, or replace the product with non-infringing apparatus, or modify it so that it becomes non-infringing, or remove the product and refund the purchase price and the transportation and installation costs thereof. In no case, shall Seller pay any recovery based on Buyer's savings or profit through the use of the product, whether the use be special or ordinary.

The foregoing states the entire liability of Seller for patent infringement; and in no event shall Seller be liable if the infringement is based on the use of the product for a purpose other than that for which sold by Seller. As to any products furnished by Seller to Buyer manufactured in accordance with designs proposed by Buyer, Buyer shall indemnify Seller against any award made against Seller for any patent, trademark or copyright infringement.

### 10. CONSEQUENTIAL DAMAGES; INDEMNITY.

SELLER SHOULD NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL OR CONTINGENT DAMAGES WHATSOEVER.

Buyer shall indemnify the Seller against any and all losses, damages and expenses (including attorneys' fees and other costs of defending any action) that it may sustain or incur as a result of any claim of negligence, breach of implied warranty, strict liability in tort, or similar claims by Buyer, its successors and assigns and its customers whether direct or indirect, in connection with the use of products furnished hereunder, including, without limitation, such as may be caused by the negligence of the Seller.

### 11. SHIPPING WEIGHTS.

Seller shall not be responsible for the accuracy of shipping weights. Such weights are correct only within the limits necessary for estimating freight. For foreign shipments 20% should be added to approximate shipping weight.

### 12. STORAGE.

If the products are not shipped within 15 days after notification to Buyer that they are ready for shipping, for any reason beyond Seller's reasonable control, including Buyer's failure to give shipping instructions, Seller may store such products at Buyer's risk in a warehouse or yard or upon Seller's premises, and Buyer shall pay all handling, transportation and storage costs at the prevailing commercial rates upon submission of invoices therefor.

### 13. TECHNICAL INFORMATION.

Any sketches, models or samples submitted by Seller shall remain the property of Seller, and shall be treated as confidential information unless the Seller has in writing indicated a contrary intent. No use or disclosure of such sketches, models and samples, or any design or production techniques revealed thereby, shall be made without the express written consent of the Seller.

### 14. REMEDIES AND JURISDICTION.

Buyer agrees and understands that this agreement with the Seller shall be governed by and construed in accordance with the laws of the State of Wisconsin without giving effect to the conflict of law principles thereof. The Buyer irrevocably and unconditionally consent to submit to the exclusive jurisdiction of the courts of the State of Wisconsin and of the United States of America located in the State of Wisconsin for any action, suits or proceedings arising out of or relating to this agreement and the transaction contemplated hereby (and buyer agrees not to commence any action, suit or proceeding relating thereto except in such courts). Buyer agrees irrevocably and unconditionally to waive any objection to the laying of venue of any action, suit or proceeding arising out of this agreement or the transactions contemplated hereby, in the courts of the State of Wisconsin or the United States of America located in the State of Wisconsin and agrees not to plead or claim in any such court that any such action, suit or proceeding brought in any such court has been brought in an inconvenient forum.