READ AND SAVE THESE INSTRUCTIONS

CARNES®

ELECTRONICALLY CONTROLLED STEAM HUMIDIFIER
DESIGN SERIES "G"

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

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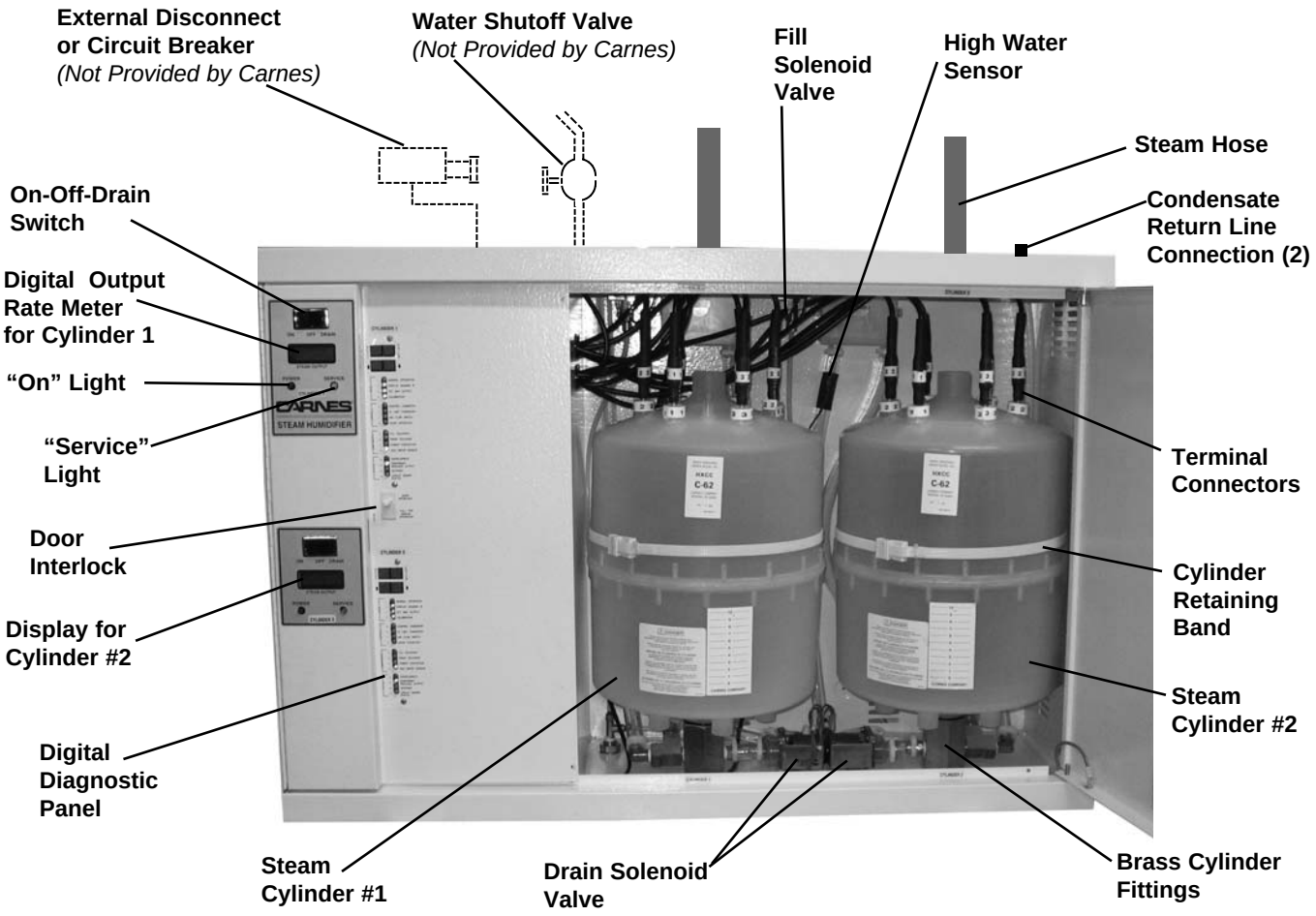


Photo A

(Model HCHG Shown)

FORM 16789-I
ISSUED: 04-12

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 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. Air gap drain fitting.
   D. Installation operation and maintenance manual, operation addendum, parts replacement catalog, customer satisfaction card, and parts order list card.

MOUNTING THE HUMIDIFIER

Locate the humidifier cabinet level and plumb on a surface as close to the steam distributor as possible at a convenient height for servicing. Allow 1" or more on the side for ventilation 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" in front of cabinet for door opening or when necessary, remove door with quick release pin. 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
HBAG, HCAG	80
HBDG, HCDG	85
HBGG, HCGG	105
HBHG, HCHG	185

Fasten the mounting bracket to wood studs or solid wood using fasteners shown in Table 2 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
HBAG, HCAG	4
HBDG, HCDG	4
HBGG, HCGG	4
HBHG, HCHG	6

WATER SUPPLY CONNECTION

Use ordinary tap water (20 to 120 psi) - **DO NOT use hot water, DI (deionized water), RO (reverse osmosis) water. If softened water is considered, please contact factory for further assistance.** A 3/8" FPT fitting is provided at the bottom of the humidifier for connection to tap water supply. A shutoff valve, not provided by Carnes, must be installed just ahead of this fitting.

DRAIN LINE CONNECTION

1. Locate the air gap fitting in accessory bag in unit. Have proper tooling available to attach fitting.
2. Connect the air gap drain fitting to the cabinet drain connection. It may be necessary to cut off some of the air gap fitting depending on available space.
3. Connect the drain or air gap fitting to S or P trap. Use plumbing material capable of handling hot water.
   Note: *If the drain water pump accessory package is used, follow instructions included with the drain water pump package.*

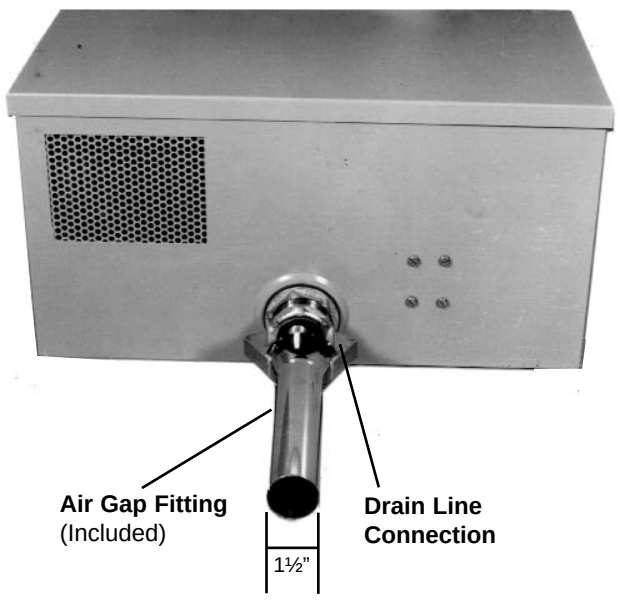


Photo B

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 length 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 then perfect conditions, (installation issues, routing problems for steam and condensate return hose and extreme steam hose lengths) it is possible to lose a certain amount of lbs. per hour capacity. See Table 3-A.

MAXIMUM STEAM HOSE LENGTH

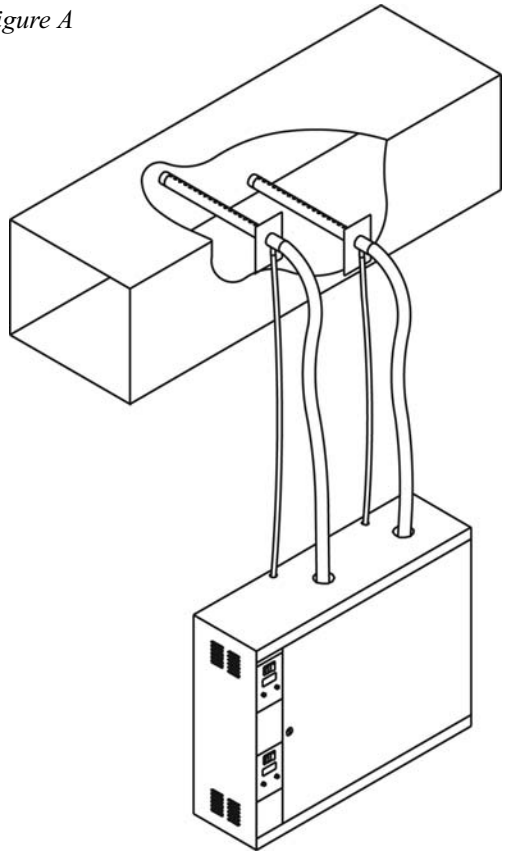
(Table 3)

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.

Figure A



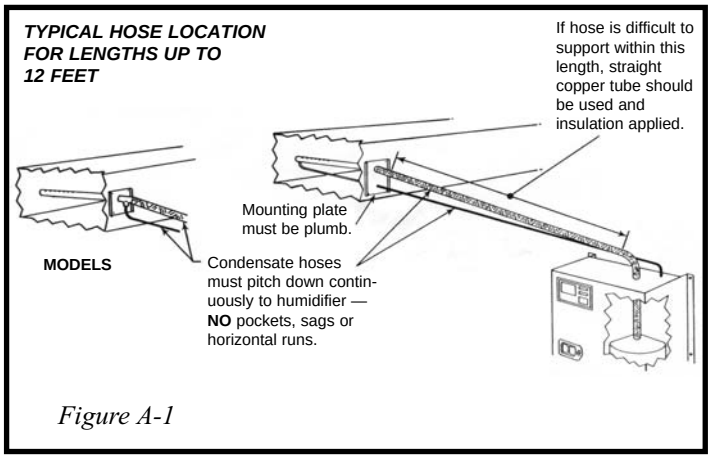


Figure A-1

The maximum length of steam hose that may be installed as shown in *Figure A* 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*.

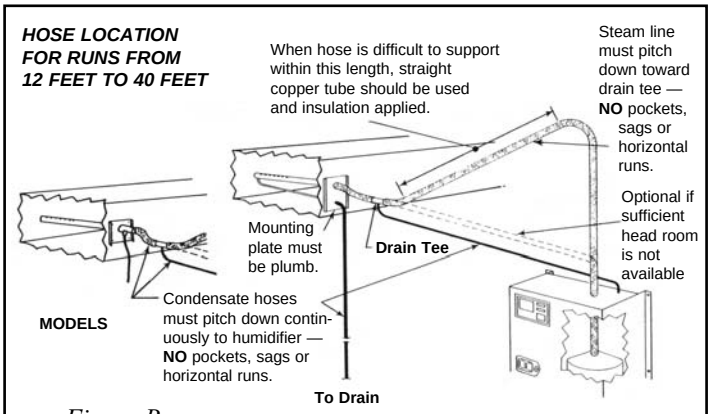


Figure B

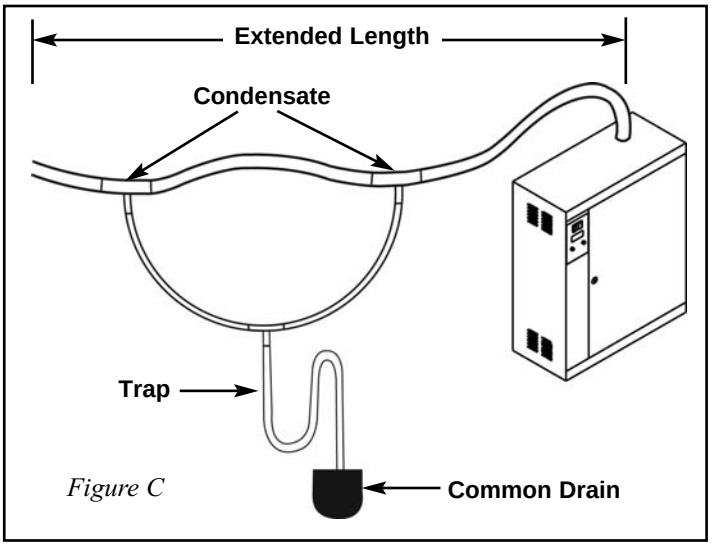
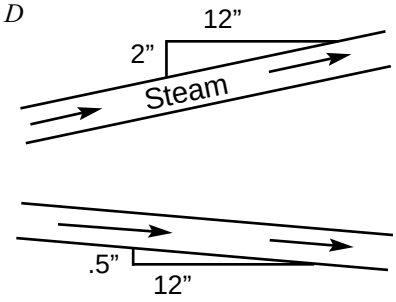


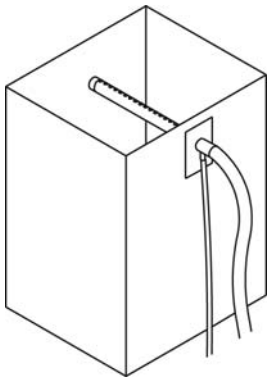
Figure C

Figure D



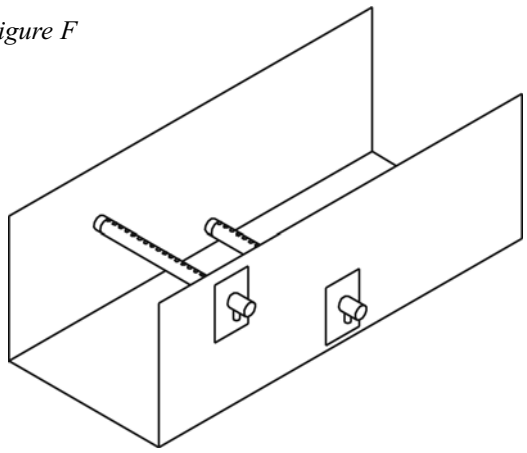
In a vertical duct with either upward or downward air flow the distributor pipe should be installed horizontally *(Figure E)*.

Figure E



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

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 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. <u>There must be *minimum* of six feet between the distributor and any fans, coils, filters, dampers, elbows or outlets downstream to reduce the possibility of condensation</u>.

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). <u>Duct air temperatures below 50-60°F may require a condensate drain pan supplied by others below the steam distributor pipe</u>.

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.

HOSE LOCATION WHEN DUCT IS LOWER THAN HUMIDIFIER

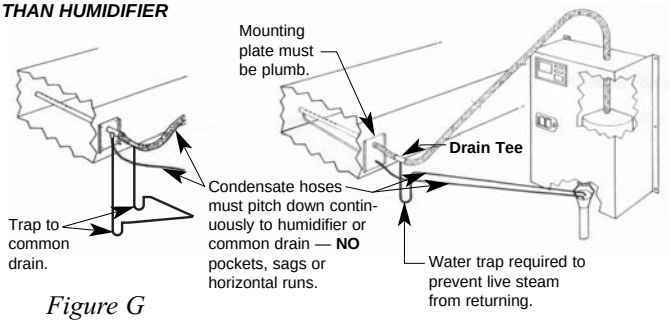


Figure G

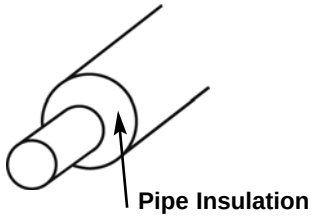
It is very important that both the steam hose and condensate return line, whether flexible or hard tubing, be installed so there are no sags, low points, dips or horizontal runs. The steam is at a very low pressure and it cannot overcome any resistance caused by accumulating water standing in the steam 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.

Figure H

Exaggerated for emphasis.

Note: Over time and extended heat, the situations described in the previous paragraph can occur. That’s why it is important to perform <u>monthly visual</u> inspections to maintain and correct, when necessary, improper routing of steam and condensate lines.

Figure I



If it is difficult to install the steam hose to prevent sags, it is recommended that copper tube be used as a substitute. <u>If copper tube is used, a minimum of one inch of insulation must be applied to prevent excessive condensation</u>. 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 Table 3 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.

<u>Hose lengths of no longer then 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</u>.

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 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 house 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.

STEAM DISPERSION CRITERIA *(Continued)*

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 humidifier/s, distance between humidifier/s to distribution point and so on). Since this is important to successful humidification, proper planning must be a pre-requisite to good performance - PRIOR PREPARATION PREVENTS POOR 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.
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.

NOTES: Identifying and explaining the following electrical data and unit detail sheet

"Model" and **"Optional Circuit Breaker"** columns designate presence, quantity and amp rating of optional circuit breakers. All models have overload protection provided by the electronic circuit board. In addition, as an option, internally mounted, switchable on-off, circuit breakers are available in models preceded by **"HB"**.

"Maximum Lb./Hr." designates maximum capacity of 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.

"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.

"kW" ratings shown is at maximum output rate. If a unit is reset for less than maximum output, the kW is reduced proportionally.

"Line Amp" and **"Disc. Size"** are amp ratings shown for use in selecting electrical service requirements.

"Steam Cylinder" column shows the quantity and the model of steam generating cylinders mounted in the humidifier. Each cylinder requires its own steam distribution pipe, steam hose and condensate return line.

"Digital Display Code" column shows the code that will appear on the digital display when in the "Calibration" function. The calibration function of the circuit board can be checked for accuracy with the model shown on the rating label.

"J4 (Set) & J5 (GND) Vdc" - test lead rating of circuit board when in calibration mode. Consult factory for procedures.

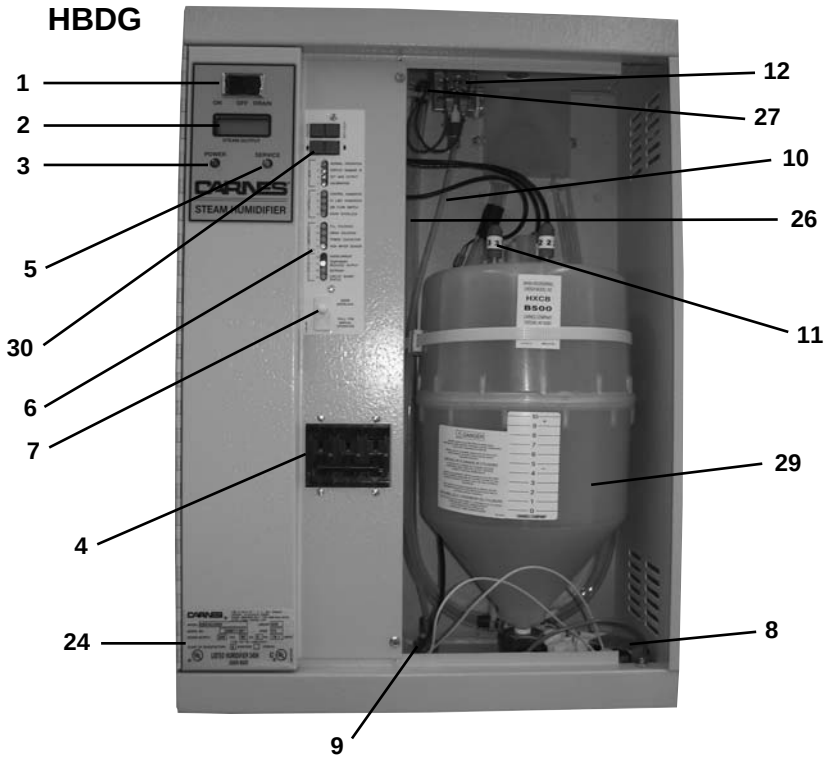
"Cylinder Wire Current" - as a process of troubleshooting, it may be necessary to confirm current flow through individual cylinder wires during operation. Match humidifier with electrical data.

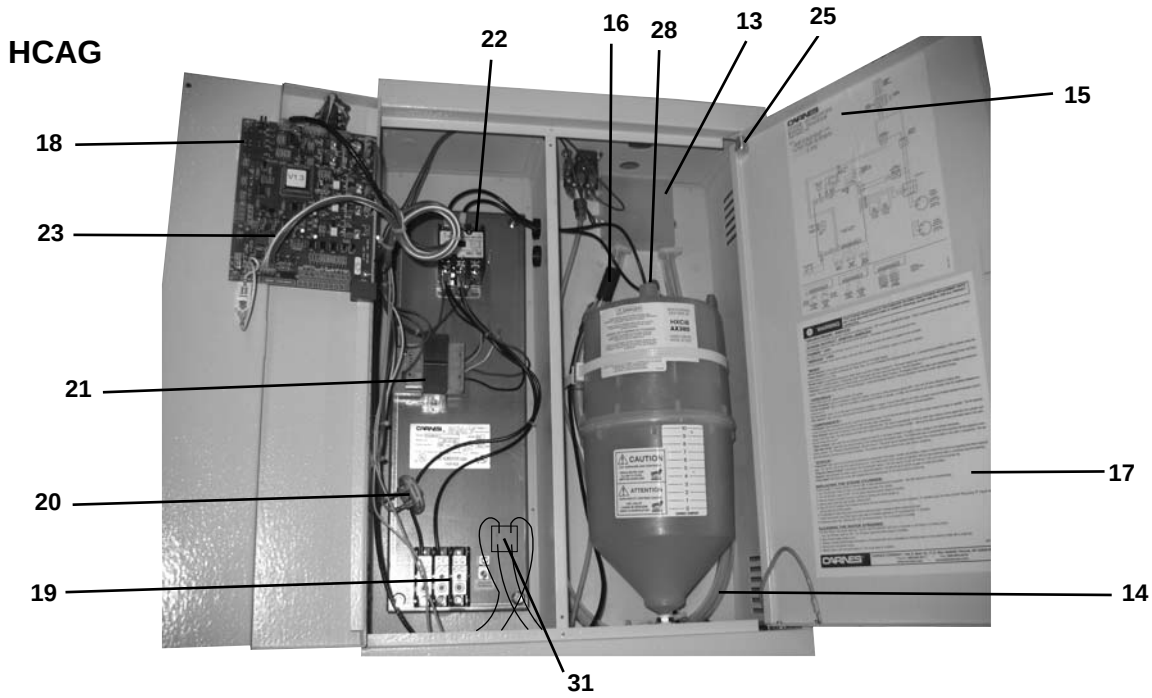
"Minimum Output Settings" - the minimum setting that a maximum output can be adjusted to and still maintain normal effective and efficient operation.

ELECTRICAL DATA AND UNIT DETAIL SHEET - *Table 4*

Model	Maximum Lb/Hr.	Voltage	Phase	kW	Line Amp	Disc. Size	Optional Circuit Breaker	Steam Cylinder	Digital Display Code	J4-J5 VDC	Cyl. Wire Current	Min. Output Setting
HCAGA	5	120	1	1.7	14.4	20	1-20 Amp	1-AX220	0005	3.89	14.4	1
HCAGB	5	208	1	1.7	8.3	15	1-15 Amp	1-AX380	1005	2	8.3	1
HCAGD	5	230	1	1.7	7.5	15	1-15 Amp	1-AX380	3005	1.61	7.5	1
HCAGF	5	277	1	1.7	6.2	15	1-15 Amp	1-AX380	5005	1.26	6.2	1
HCAGM	5	460	1	1.7	3.7	15	1-15 Amp	1-AX700	8005	0.52	3.7	1
HCAGN	5	575	1	1.7	3.0	15	1-15 Amp	1-AX700	9005	0.35	3	1
HCAGA	10	120	1	3.4	28.7	40	1-40 Amp	1-AX220	0010	8.72	28	2
HCAGB	10	208	1	3.4	16.6	25	1-25 Amp	1-AX380	1010	4.6	16	2
HCAGD	10	230	1	3.4	15.0	20	1-20 Amp	1-AX380	3010	4.06	15	2
HCAGF	10	277	1	3.4	12.4	20	1-20 Amp	1-AX380	5010	3.23	12.4	2
HCAGM	10	460	1	3.4	7.5	15	1-15 Amp	1-AX700	8010	1.7	7.5	2
HCAGN	10	575	1	3.4	6.0	15	1-15 Amp	1-AX700	9010	1.2	6	2
HCDGB	20	208	1	6.9	33.1	45	1-45 Amp	1-B500	1020	10.24	33.1	4
HCDGD	20	230	1	6.9	29.9	40	1-40 Amp	1-B500	3020	9.1	30	4
HCDGF	20	277	1	6.9	24.9	35	1-35 Amp	1-B500	5020	7.41	24.9	4
HCDGM	20	460	1	6.9	15.0	20	1-20 Amp	1-B700	8020	4.06	15	4
HCDGN	20	575	1	6.9	12.0	15	1-15 Amp	1-B700	9020	3.09	12	4
HCDGC	20	208	3	6.9	19.1	25	1-25 Amp	1-B500	2020	5.42	19.1	4
HCDGE	20	230	3	6.9	17.3	25	1-25 Amp	1-B500	4020	4.83	17.3	4
HCDGG	20	460	3	6.9	8.6	15	1-15 Amp	1-B700	6020	2	8.7	4
HCDGH	20	575	3	6.9	6.9	15	1-15 Amp	1-B700	7020	1.5	6.9	4
HCDGC	30	208	3	10.3	28.7	40	1-40 Amp	1-B500	2030	8.63	28.7	6
HCDGE	30	230	3	10.3	25.9	35	1-35 Amp	1-B500	4030	7.73	25.9	6
HCDGG	30	460	3	10.3	13.0	20	1-20 Amp	1-B700	6030	3.42	13	6
HCDGH	30	575	3	10.3	10.4	15	1-15 Amp	1-B700	7030	2.56	10.4	6
HCGGB	30	208	1	10.3	49.7	70	2-35 Amp	1-C62	1030	7.42	24.8	6
HCGGD	30	230	1	10.3	44.9	60	1-60 Amp	1-C62	3030	14.2	22.4	6
HCGGF	30	277	1	10.3	37.3	50	1-50 Amp	1-C62	5030	11.53	18.6	6
HCGGM	30	460	1	10.3	22.5	30	1-30 Amp	1-C65	8030	6.53	22.4	6
HCGGN	30	575	1	10.3	18.0	25	1-25 Amp	1-C65	9030	5.15	17.9	6
HCGGC	40	208	3	13.8	38.2	50	1-60 Amp	1-C62	2040	11.82	19.1	8
HCGGE	40	230	3	13.8	34.6	45	1-50 Amp	1-C62	4040	10.5	17.2	8
HCGGG	40	460	3	13.8	17.3	25	1-25 Amp	1-C65	6040	4.77	17.2	8
HCGGH	40	575	3	13.8	13.8	20	1-20 Amp	1-C65	7040	3.65	13.8	8
HCGGC	50	208	3	17.2	47.8	70	2-35 Amp	1-C62	2050	7.12	23.9	10
HCGGE	50	230	3	17.2	43.2	60	1-60 Amp	1-C62	4050	13.54	21.6	10
HCGGG	50	460	3	17.2	21.6	30	1-30 Amp	1-C65	6050	6.29	21.6	10
HCGGH	50	575	3	17.2	17.3	25	1-25 Amp	1-C65	7050	4.77	17.3	10
HCGGC	60	208	3	20.7	57.4	80	2-40 Amp	1-C62	2060	8.58	28.7	12
HCGGE	60	230	3	20.7	51.9	70	2-40 Amp	1-C62	4060	7.74	26	12
HCGGG	60	460	3	20.7	26.0	35	1-40 Amp	1-C65	6060	7.74	26	12
HCGGH	60	575	3	20.7	20.8	30	1-30 Amp	1-C65	7060	5.98	20.8	12
HCGGC	80	208	3	27.5	76.5	100	2-60 Amp	1-C62	2080	11.91	38.2	16
HCGGE	80	230	3	27.5	69.2	90	2-50 Amp	1-C62	4080	10.5	34.6	16
HCGGG	80	460	3	27.5	34.6	50	1-50 Amp	1-C12	6080	10.5	17.3	16
HCGGH	80	575	3	27.5	27.7	40	1-40 Amp	1-C12	7080	8.12	13.8	16
HCGGC	100	208	3	34.4	95.6	125	2-60 Amp	1-C62	2100	14.95	47.8	20
HCGGE	100	230	3	34.4	86.4	125	2-60 Amp	1-C62	4100	13.54	43.2	20
HCGGG	100	460	3	34.4	43.2	60	1-60 Amp	1-C12	6100	13.54	21.6	20
HCGGH	100	575	3	34.4	34.6	45	1-50 Amp	1-C12	7100	10.5	17.3	20
HCHGC	125	208	3	43	119.5	175	4-40 Amp	2-C62	2125	9.01	29.8	12 ea.
HCHGE	125	230	3	43	108.0	150	4-40 Amp	2-C62	4125	8.08	27	12 ea.
HCHGG	125	460	3	43	54.0	75	2-40 Amp	2-C12	6125	8.08	13.5	12 ea.
HCHGH	125	575	3	43	43.2	60	2-30 Amp	2-C12	7125	6.32	10.8	12 ea.
HCHGC	150	208	3	51.7	143.4	200	4-50 Amp	2-C62	2150	10.97	35.8	15 ea.
HCHGE	150	230	3	51.7	129.7	200	4-50 Amp	2-C62	4150	9.97	32.4	15 ea.
HCHGG	150	460	3	51.7	64.8	90	2-50 Amp	2-C12	6150	9.97	16.2	15 ea.
HCHGH	150	575	3	51.7	51.9	75	2-35 Amp	2-C12	7150	7.71	13	15 ea.
HCHGC	175	208	3	60.3	167.3	250	4-60 Amp	2-C62	2175	13.06	41.8	17 ea.
HCHGE	175	230	3	60.3	151.3	225	4-60 Amp	2-C62	4175	11.66	37.8	17 ea.
HCHGG	175	460	3	60.3	75.6	110	2-60 Amp	2-C12	6175	11.66	18.9	17 ea.
HCHGH	175	575	3	60.3	60.5	90	2-50 Amp	2-C12	7175	9.17	15.1	17 ea.
HCHGC	200	208	3	68.9	191.2	300	4-60 Amp	2-C62	2200	14.95	47.8	20 ea.
HCHGE	200	230	3	68.9	172.9	250	4-60 Amp	2-C62	4200	13.54	43.2	20 ea.
HCHGG	200	460	3	68.9	86.4	125	2-60 Amp	2-C12	6200	13.54	21.6	20 ea.
HCHGH	200	575	3	68.9	69.2	100	2-50 Amp	2-C12	7200	10.5	17.2	20 ea.

HUMIDIFIER COMPONENT LISTING - *Figure J*

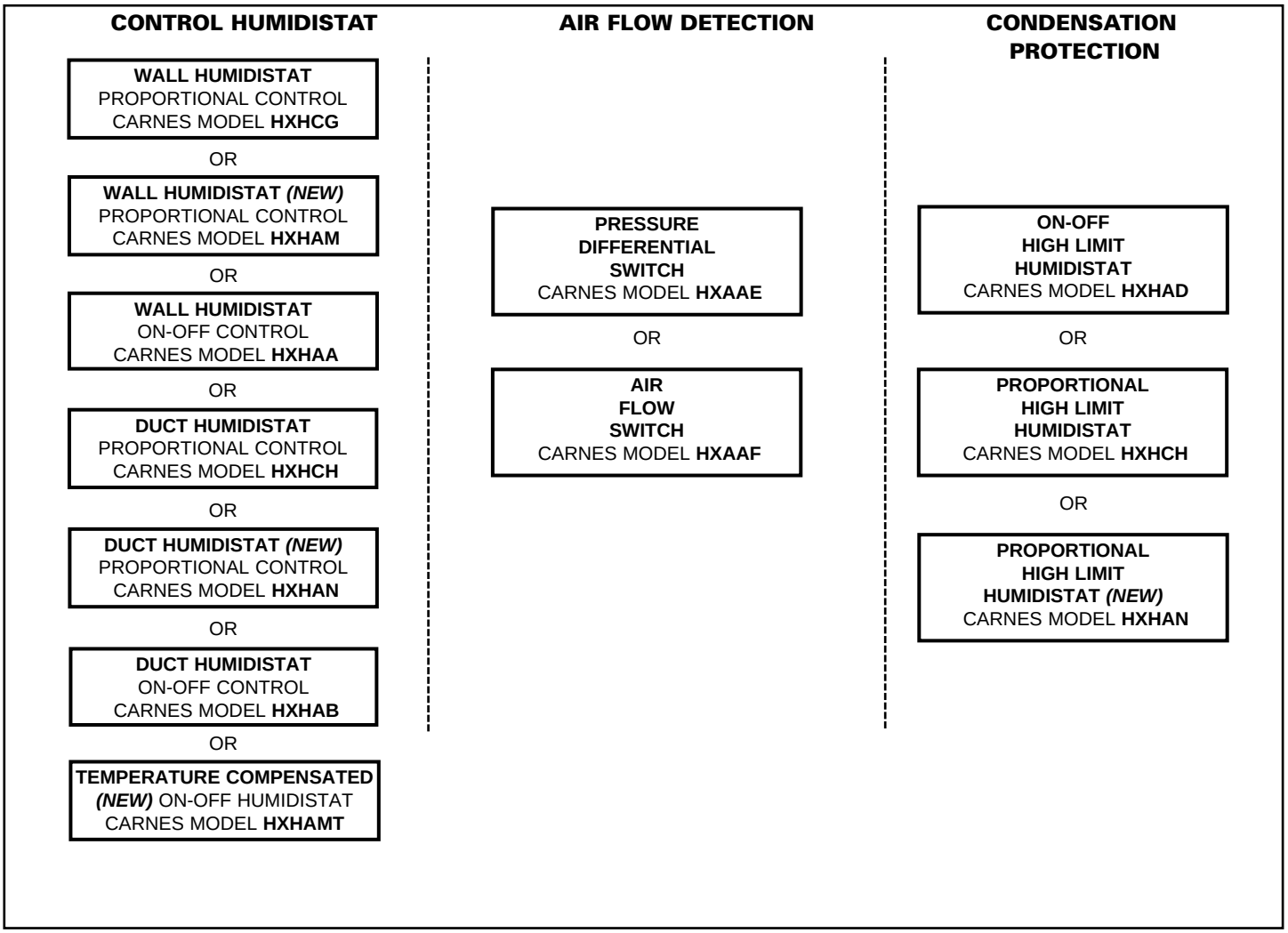




1. On / Off / Drain Switch
2. LCD Display
3. Power “On” Light
4. Optional Circuit Breaker
5. Service & Fault Light
6. Diagnostic Panel
7. Door Interlock Switch
8. Drain Solenoid Valve
9. Fill Water Inlet Fitting
10. Water Fill Tube Sub-Assembly
11. Red Terminal Connector (Connector could be black for larger output units)
12. Fill Solenoid Valve
13. Molded Fill Cup
14. Internal Water Hose (Clear) 5/8” ID
15. Unit Specific Wiring Diagram
16. High Water Sensor
17. Operational Instructions
18. Circuit Board
19. Power Distribution Block
20. Current Sensing Transformer
21. Power Transformer
22. Contactor
23. Low Voltage Wiring Harness
24. Unit Identification Tag
25. Door Pivot Release
26. Condensate Return Hose
27. Condensate Return Hose Connection Fitting From Distributor Pipe
28. Steam Hose Connection Point
29. Cylinder — Specific to Model
30. Diagnostic Panel Calibration Buttons (Up, Down, Mode, Enter)
31. Bridge Rectifier

CONTROLS

CONTROL OPTIONS - *Figure K*



CONTROL HUMIDISTAT

If an on-off humidistat is used the humidifier will generate steam at the preset 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 push buttons on the front of the electronic control panel.

If Carnes proportional humidistat is used the humidifier will automatically vary the steam output rate in the range of 25-100% of the humidifiers maximum rating in response to the signal from the humidistat. 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. A combination return air duct on-off humidistat and sail switch is available but care must be taken during installation to insure proper operation.

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.

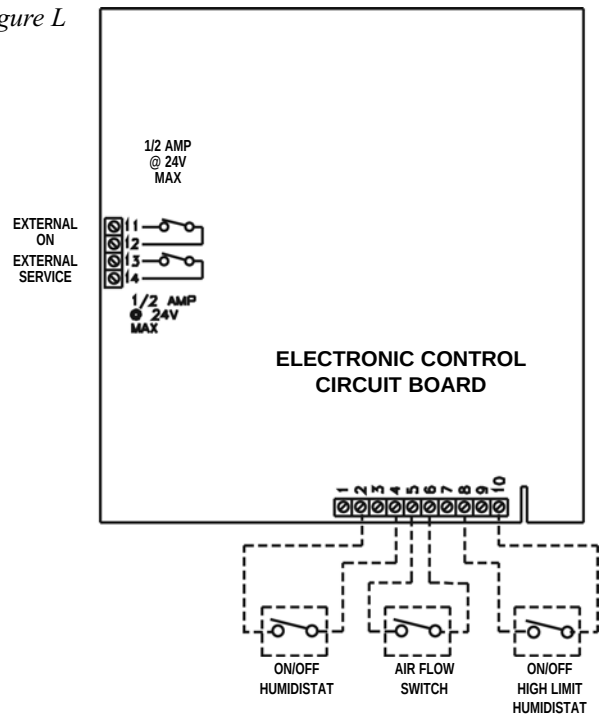
CONTROL HUMIDISTAT / TEMPERATURE COMPENSATED

If your application has a requirement for an outdoor temperature compensation feature, the HXHAT control is what would be needed. This control will provide monitoring of RH percentage and optionally outdoor temperature, automatically adjust RH set-point as outdoor temperature changes, automatic or manual operating mode, display RH or outdoor temperature, installed on the duct or within the space, relay contacts control humidity for on/off control, can be wired for activation with heating or any time, easy to read LCD display with blinking RH symbol when humidifier is activated and outdoor sensor is included.

CONTROL CONNECTIONS

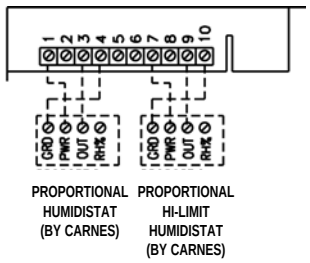
Two cylinder humidifiers may be wired for simultaneous or separate and independent operation. Controls should be connected to the terminals on the electronic circuit board as shown below using No. 18 AWG wire. Avoid running control wiring near high voltage primary wires, due to the possibility of interference and signal distortion.

Figure L



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.

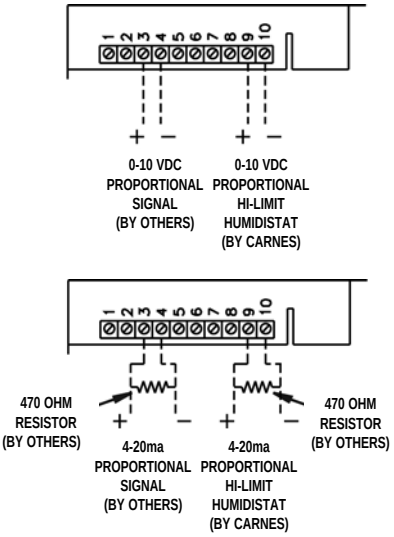
Figure M



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

Terminals 11 and 12, shown in *Figure L*, are provided for indicating operation of the humidifier at a remote location. When the unit is operating terminals 11 and 12 are closed. Terminals 13 and 14 are provided to indicate the need for service. When the output of the humidifier is less than 50% of set-point terminals 13 and 14 are closed. Each set of terminals are capable of switching 1/2 amp at 24 volts maximum.

NETWORKING

If multiple units are required due to high capacity demand (over 200 lbs. per hour, single unit), networking can be done. Units would be interconnected with parallel signal wiring. This set up is usually done to facilitate running multiple units from a single signal source. Other networking requirements please contact factory.

CONTROL CONNECTIONS

IMPORTANT: *TURN OFF POWER AT EXTERNAL DISCONNECT BEFORE MAKING ANY CONNECTIONS TO PREVENT POSSIBLE DAMAGE TO ELECTRONIC CIRCUIT BOARD.*

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

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

2. If an air flow switch or high limit humidistat is not used jumpers must be installed before the humidifier will operate.

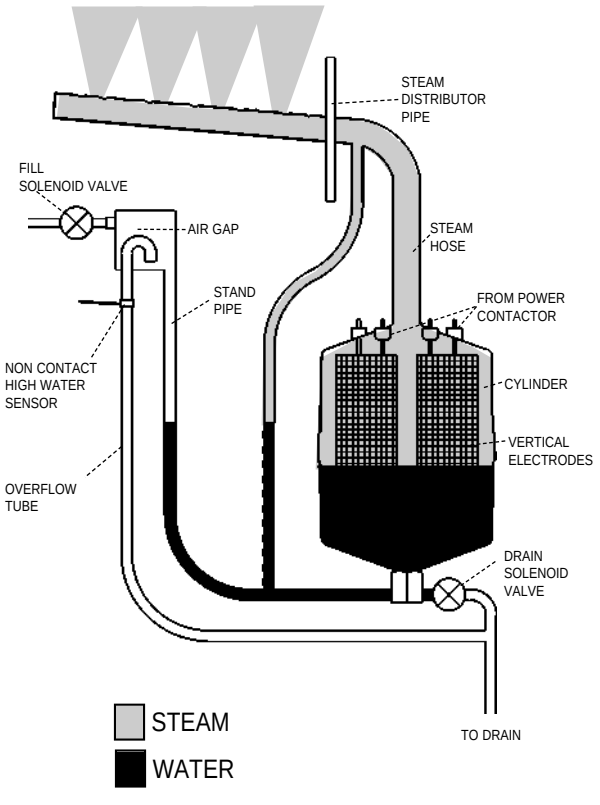
OPERATION

Upon a signal from external controls the circuit board opens 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 back flow into the water supply and prevents the cylinder from becoming a pressure vessel. The steam cylinder 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.

Figure O



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.

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. (Definition of **conditioned**: the stage of water in the cylinder is at a level of approximately 1/3 full, dependent upon the condition of water, the operation cycle has seen at least one drain and the unit is producing at full output capacity.)

ON INITIAL START UP...

- THE STEAM CYLINDER IS EMPTY.
- NO WATER IN CONTACT WITH THE ELECTRODES MEANS NO CURRENT IS FLOWING.

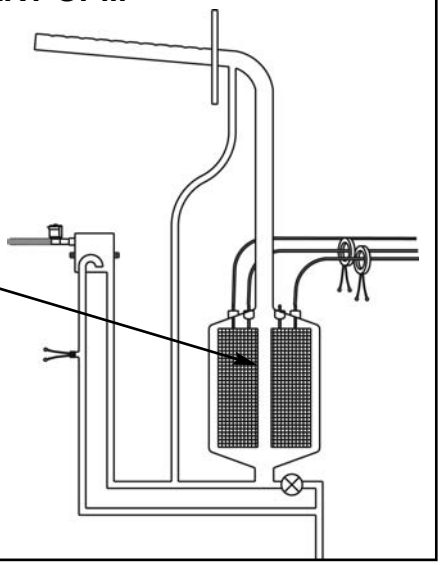


Illustration 1

ON A CALL FOR HUMIDITY...

- WATER FLOWS THROUGH A STRAINER IN THE FILL SOLENOID VALVE THAT REMOVES SEDIMENT FROM THE WATER.

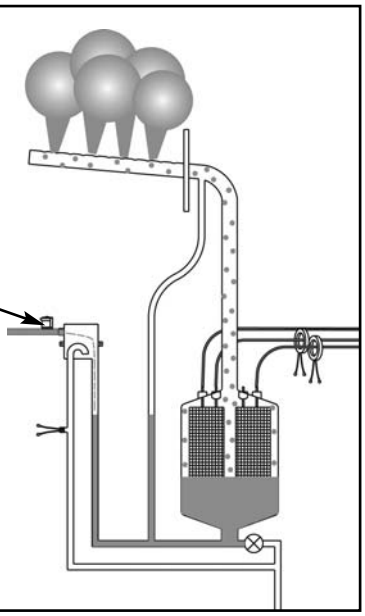


Illustration 2

ON A CALL FOR HUMIDITY...

- THE FILL SOLENOID VALVE OPENS.

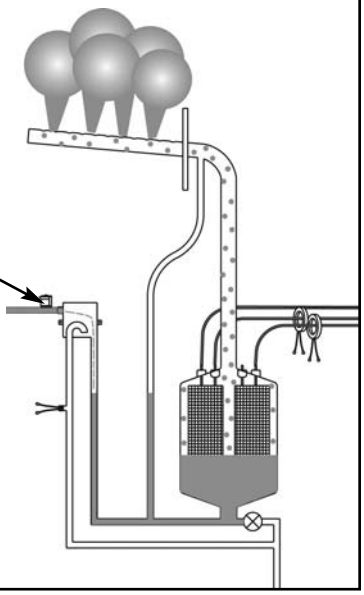


Illustration 3

ON A CALL FOR HUMIDITY...

- WATER FLOWS ACROSS A 1" AIR GAP.

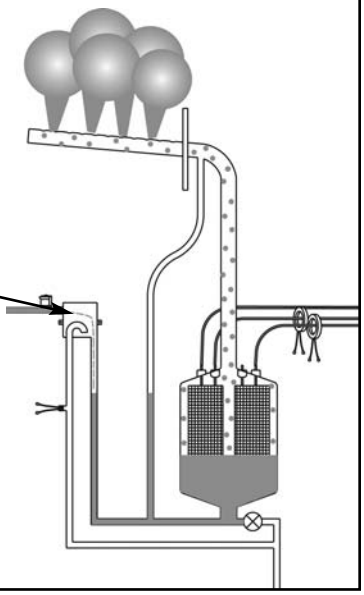


Illustration 4

ON A CALL FOR HUMIDITY...

- WATER FLOWS INTO A STANDPIPE CONNECTED TO THE BOTTOM OF THE STEAM CYLINDER.

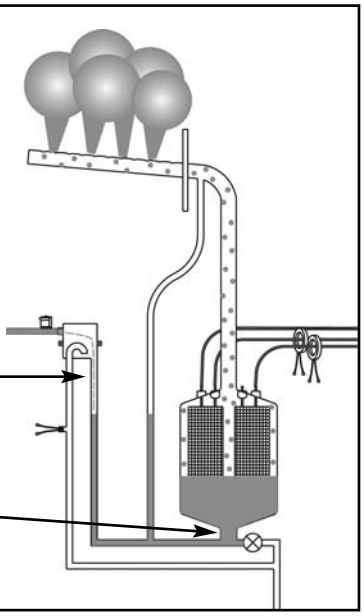


Illustration 5

ON A CALL FOR HUMIDITY...

- WATER RISES IN THE CYLINDER TO TRY TO EQUALIZE IN HEIGHT WITH THE WATER IN THE STANDPIPE.

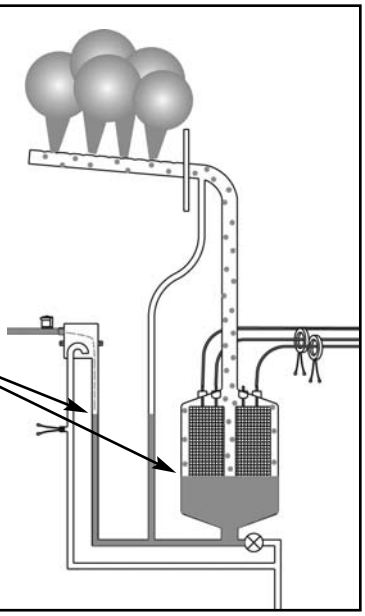


Illustration 6

ON A CALL FOR HUMIDITY...

- A POWER CONTACTOR IN THE ELECTRICAL SECTION CLOSES AND APPLIES LINE VOLTAGE TO THE TERMINALS ON TOP OF THE STEAM CYLINDER.

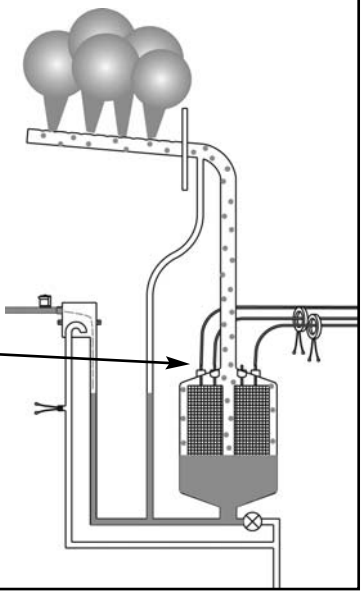


Illustration 7

ON A CALL FOR HUMIDITY...

- THE TERMINALS ARE CONNECTED TO VERTICAL ELECTRODES SEALED IN THE CYLINDER.

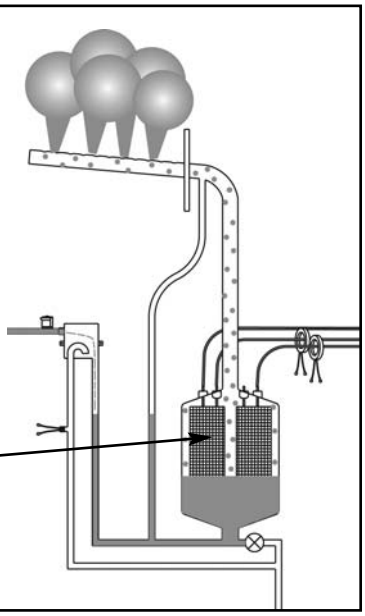


Illustration 8

ON A CALL FOR HUMIDITY...

- CURRENT FLOWS THROUGH THE WATER CREATING HEAT.

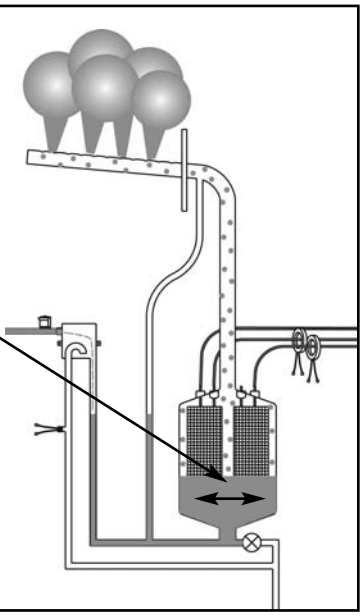


Illustration 9

ON A CALL FOR HUMIDITY...

- CURRENT TRANSFORMERS MONITOR THE AMPS FLOWING TO THE ELECTRODES AND SEND THE INFORMATION TO THE CIRCUIT BOARD.

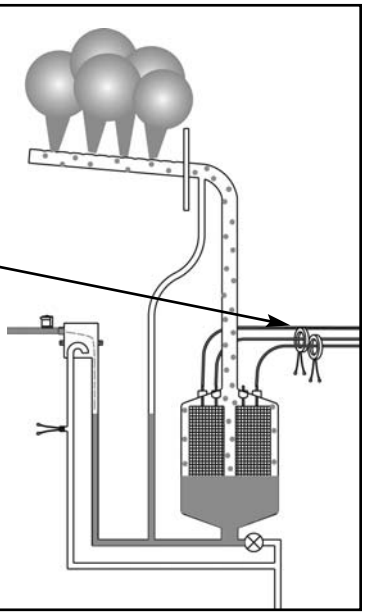


Illustration 10

CARNES EXCLUSIVE...

- US PATENT 4,692,591.
- MULTIPLE CURRENT TRANSFORMERS ELIMINATE THE NEED FOR INTERNAL FUSING ON EACH POWER LEAD. THE CIRCUIT BOARD SELECTS HIGHEST LEG TO DETERMINE PROTECTIVE ACTION.

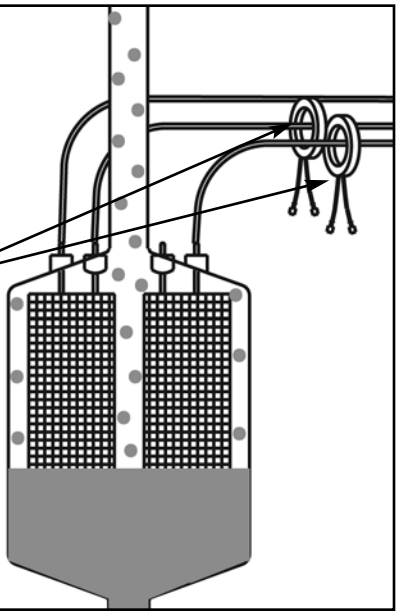


Illustration 11

ON A CALL FOR HUMIDITY...

- STEAM IS GENERATED AND LEAVES THROUGH THE STEAM HOSE CONNECTED TO THE TOP OF THE CYLINDER.

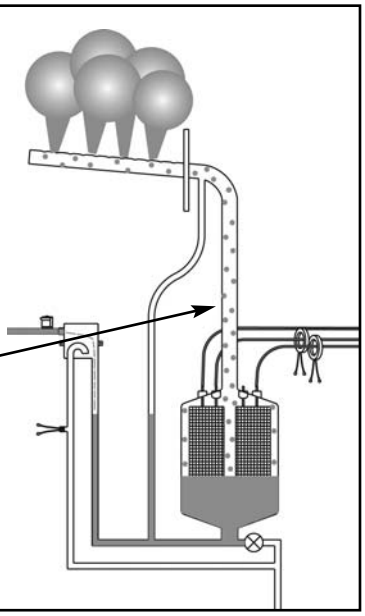


Illustration 12

ON A CALL FOR HUMIDITY...

- STEAM IS DISCHARGED THROUGH A DISTRIBUTOR PIPE.
- CONDENSATE IS RETURNED THROUGH A RETURN LINE TO TOP OF UNIT AND MIXES WITH FRESH WATER.

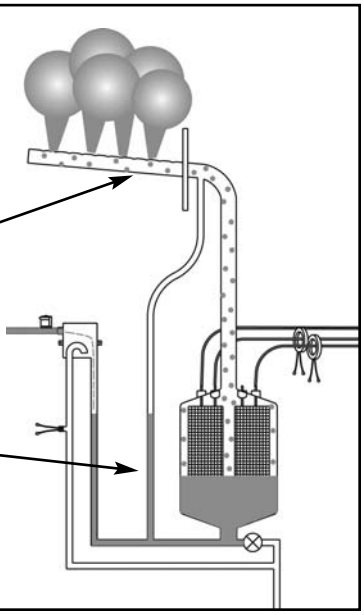


Illustration 13

AS MINERALS ACCUMULATE...

- WATER GRADUALLY RISES TO COVER UNUSED ELECTRODE SURFACE IN THE CYLINDER TO KEEP OUTPUT CONSTANT.

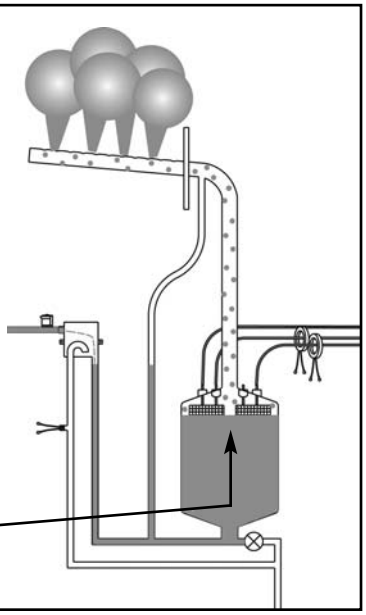
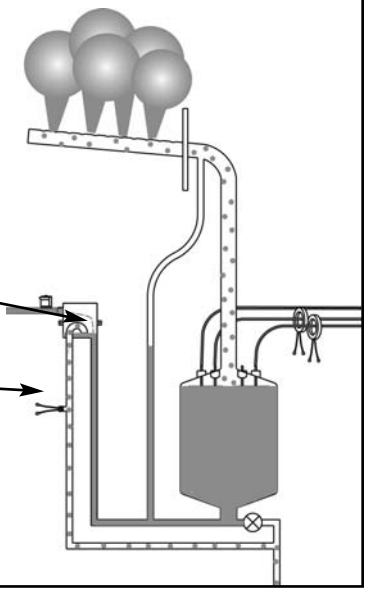


Illustration 14

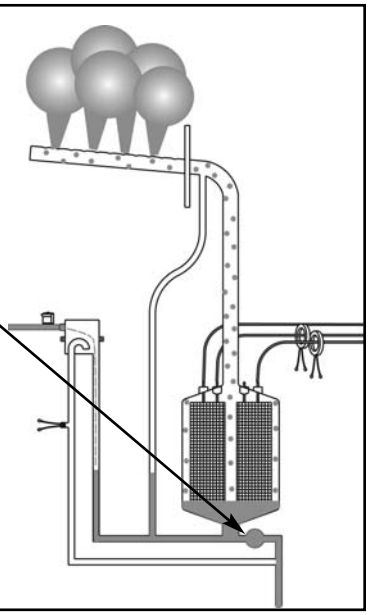
WHEN CYLINDER IS FULL...



- WATER RISES IN THE STANDPIPE. WHEN IT OVERFLOWS A SENSOR SHUTS OFF FILL SOLENOID VALVE.

Illustration 15

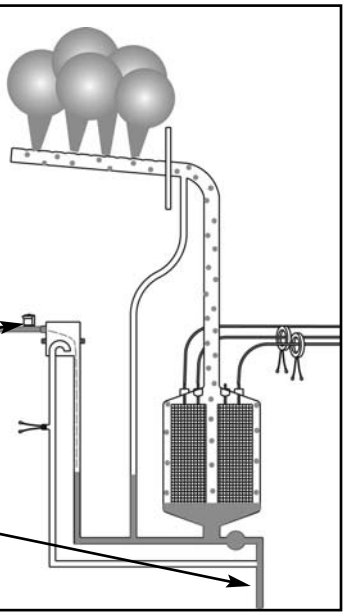
DRAIN SOLENOID OPERATION...



- THE CIRCUIT BOARD ONLY OPERATES THE DRAIN SOLENOID VALVE WHEN MAXIMUM MINERAL CONCENTRATION IN CYLINDER IS REACHED. THIS MAXIMIZES ENERGY EFFICIENCY.

Illustration 16

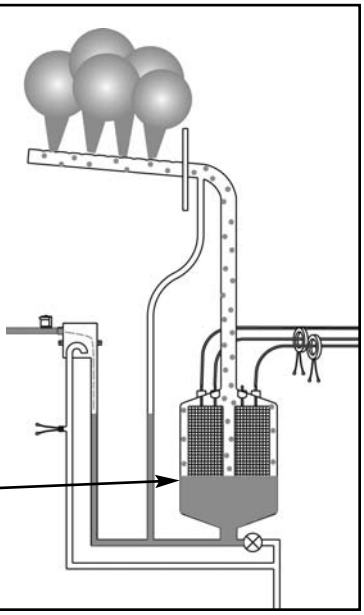
DRAIN SOLENOID OPERATION...



- WHENEVER THE DRAIN SOLENOID IS OPEN THE MAKE-UP WATER SOLENOID ALSO OPENS TO MIX COLD WATER TO LOWER THE DRAIN WATER TEMPERATURE.

Illustration 17

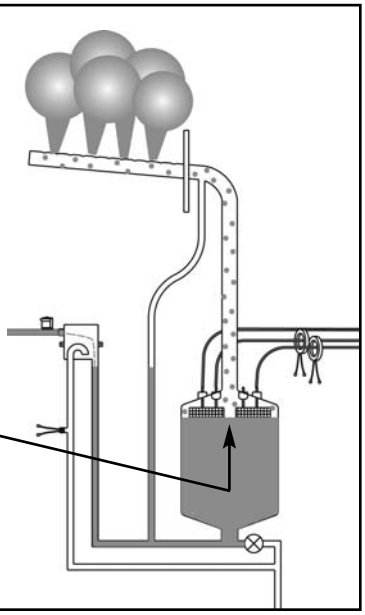
ON-OFF CONTROL...



- WHEN THE HUMIDISTAT IS SATISFIED THE POWER CONTACTOR IS OPENED AND VOLTAGE IS REMOVED FROM ELECTRODES.

Illustration 18

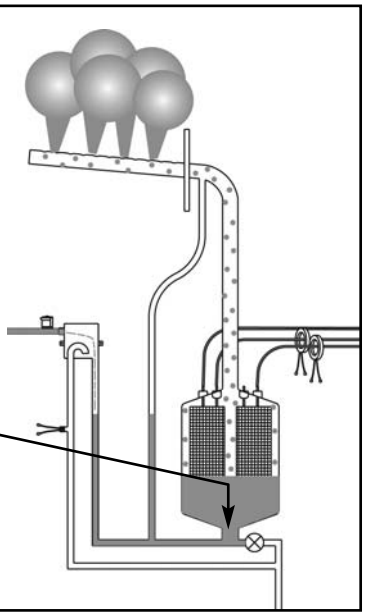
PROPORTIONAL CONTROL...



- TO INCREASE OUTPUT WATER IS FILLED TO A HIGHER LEVEL.

Illustration 19

PROPORTIONAL CONTROL...



- TO REDUCE OUTPUT WATER IS FILLED TO A LOWER LEVEL.

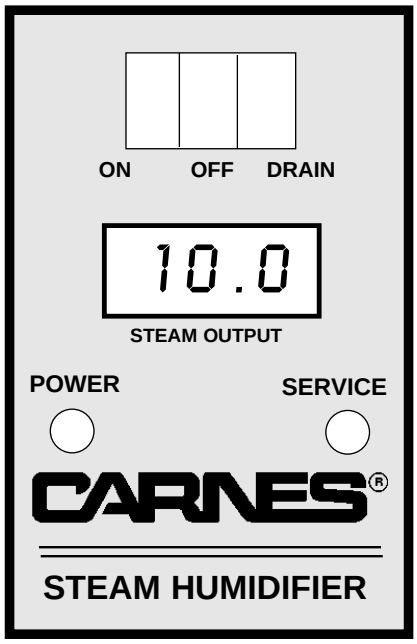
Illustration 20

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 digital display and the “Power” and “Service” 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.

DIGITAL DISPLAY

This LCD display shows the steam output rate during normal operation. The display is factory set for pounds per hour but may be reset for kilograms per hour by the switch on the electronic control circuit board.

“POWER” LED:

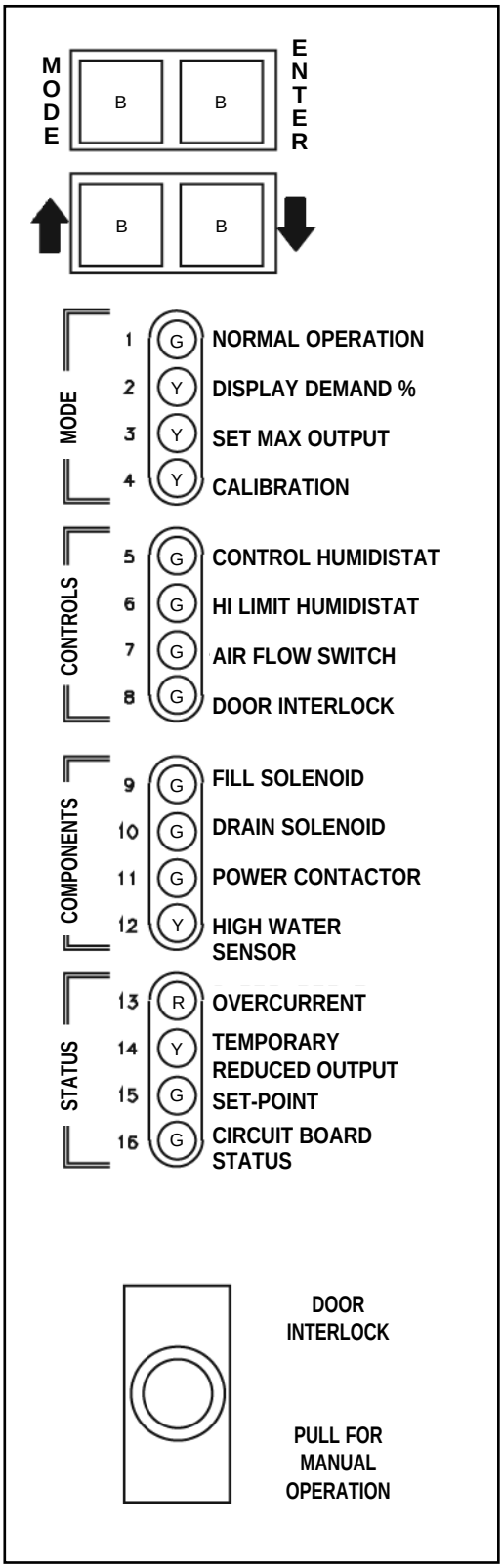
This LED is on whenever the “On-Off-Drain” switch is in the “On” position.

“SERVICE” LED

The “Service” is on whenever actual steam output is less than 50% of set-point.

Both “Power” and “Service” may be monitored remotely if desired. See “External Monitoring” on Page 9.

DIAGNOSTIC DISPLAY PANEL - *Figure Q*



B- Blue
G - Green
Y - Yellow
R - Red

PUSH BUTTONS:

“Mode” button switches between “Normal Operation”, “Display Demand %”, “Set Max Output” and “Calibration” functions. “Enter” button is used with “Mode” button to reset maximum steam output values. Up and Down buttons are used to increase or decrease maximum steam output when mode is in the “Set Max Output” function.

DIAGNOSTIC DISPLAY PANEL *(Continued)*

"MODE":

"Normal Operation" function shows steam output rate in pounds per hour on the digital display. Kilograms per hour may be selected by pulling up the button on the "Kg/Hr" switch on the circuit board.

"Display Demand %" function is selected by pressing the "Mode" button once. With the use of microprocessor chip 1.3, 1.4, 1.5, 1.6 or 1.7 the digital display will show xx.yy. The first two digits represent the control humidistat demand (0-99). The control humidistat signal is attached to terminals 1, 2, 3 or 4 of the circuit board. Specific combination of attachment is determined by the type of signal received (On/Off or proportional). The last two digits represent percentage of demand of high limit humidistat. Signals are attached to terminals 7, 8, 9 or 10 of the circuit board. Attachment combination determined by type of signal received (On/Off or proportional). See page 9 for attachment details.

"Set Max Output" function is selected by pressing the "Mode" button once from "Display Demand %" function. The steam output may be set to a new maximum limit by first pressing "Enter" and then pressing the UP or DOWN buttons. When the desired maximum rate is shown on the digital display pressing the "Enter" button again sets the value into the memory of the circuit board. The steam output is normally left in the factory set maximum capacity and only limited to prevent condensation in the duct if necessary.

"Calibration" function is selected by pressing the "Mode" button once from the "Set Max Output" function. The digital display then shows a four-digit code indicating the voltage and maximum capacity of the humidifier. See Table 4 for code numbers. Pressing "Mode" again returns to "Normal Operation". The function will automatically return to "Normal Operation" from any function after approximately five minutes.

"CONTROLS":

Separate LED's indicate that a signal is being received by the humidifier to operate. An unlit LED indicates that the specific control is not calling for humidity. All four LED's must be on before the humidifier will operate.

"Control Humidistat" LED lights if an on-off humidistat to terminals 2 and 4 is calling for humidity. It will also be on if a voltage from a proportional humidistat (Carnes) is connected to terminals 1, 3 & 4 or DDC control is connected to terminals 3 and 4 and the signal is above 3 volts DC. A 10 volt DC signal will call for maximum output and modulate proportionally down to 2 volts DC. The humidifier will be off below 2 volts DC.

"Hi Limit Humidistat" LED lights if an on-off high limit humidistat is connected to terminals 8 and 10 and is allowing the humidifier to operate. It will also be on if a voltage from a proportional high limit humidistat (Carnes) is connected to terminals 7, 9 & 10 or DDC control is connected to terminals 9 and 10 and the signal is above 3 volts DC. A 10 volt DC signal will call for maximum output and modulate proportionally down to 2 volts DC. The humidifier will be off below 2 volts DC. If a high limit humidistat is not used, a jumper must be installed between terminals 8 and 10.

"Air Flow Switch" LED lights if an air flow switch is connected to terminals 5 and 6 and is allowing the humidifier to operate. If an air flow switch is not used, a jumper must be installed between terminals 5 and 6.

"Door Interlock" LED lights if the door interlock switch has been activated by pulling the button out temporary manual operation or closing the door.

"COMPONENTS":

"Fill Solenoid" LED lights whenever the circuit board is sending 24 volts AC to the fill solenoid valve. The fill solenoid will cycle as necessary to provide the proper amount of water to operate. The fill solenoid is also open whenever the drain solenoid is activated to mix cooler water to lower the drain water temperature.

"Drain Solenoid" LED lights when the circuit board is sending 24 volts DC to the drain solenoid valve. The drain valve will operate when high water conductivity is reached in the steam cylinder. The valve is opened to drain some of the high mineral content water from the cylinder and replace it with fresh incoming water. This is not a preset repetitive cycle but is automatically determined by measurements made by the circuit board and only occurs when necessary to maintain proper conductivity in the steam cylinder. The drain solenoid also will open if the circuit board detects that high current is flowing to the steam cylinder. Opening the drain solenoid will lower the water level in the cylinder and reduce the current.

"Power Contactor" LED lights when the circuit board is sending 24 volts AC to the power contactor to supply primary voltage to the cylinder electrodes.

"High Water Sensor" LED lights when water has been detected by the sensor located on the overflow tube. This sensor detects water flowing through the tube by measuring a change in capacitance without making physical contact with the water. When overflow is detected, the fill solenoid valve is prevented from opening, or closed if already open, for approximately 5 minutes. The set-point is temporarily reduced to prevent water from reaching the top of the steam cylinder. The LED labeled "Temporary Reduced Output" will come on. Each time the TRO comes on, you will lose 3% of set-point. This cycle may be repeated several times if the incoming water is very low in conductivity. As minerals build up in the water in the cylinder, increasing its conductivity, the set-point will gradually increase, regaining the lose of percentage of set-point, until the full output capacity is reached. The length of this process will vary depending on the conductivity of the incoming water and may require several hours under certain conditions. The loss of set-point value will be quicker then the re-instatement of value.

"STATUS":

"Overcurrent" LED lights when the circuit board has detected a series of overcurrent situations in the steam cylinder and has been unable to reduce the current by operating the drain solenoid valve. The humidifier is placed in a standby mode to prevent unsafe operation. The "Service" LED on the front panel will also be on to signal this condition. The "Overcurrent" LED is usually an indication that the drain solenoid valve or related plumbing is restricted and requires cleaning. A defective valve could also cause this failure.

"Temporary Reduced Output" LED is described in the "Components" section of this manual. This light may also be on with the "Service" LED at the end of steam cylinder life.

"Set-point" LED lights whenever the actual steam output is at or above the set-point of the humidifier or when the demand from a proportional humidistat or DDC control is reached. This light will be on and off during the normal operation cycle of the humidifier as water fills into the steam cylinder and is boiled away and filled again.

"Circuit Board" LED pulsing is normal and indicates that the microprocessor on the circuit board is functioning.

START UP & OPERATION

INITIAL START UP

While the external disconnect switch is off, 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 door is opened. Humidifier may be operated for service purposes by pulling out white button. **CAUTION:** *HIGH VOLTAGES ARE PRESENT*.
5. Turn "On-Off-Drain" switch to "On" position. Green "On" LED should now be on.
6. Unit will now begin to operate if external controls are calling for humidity. See "Controls" on page 9 for details.
7. As water slowly fills into cylinder the digital display will begin to increase when water contacts electrodes.
8. The "Service" LED may come on until sufficient water has entered cylinder to provide 50% of set-point.
9. Water will continue to fill until output is 10% above set-point. If water reaches top of cylinder before set-point is reached "High Water Sensor" will be activated and fill will stop. See "High Water Sensor" on page 15.
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 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 under certain conditions.

AUTOMATIC DRAIN CYCLE

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

CONTROLLING MINERAL CONTENT:

1. When current reaches 10% above set-point the fill solenoid valve closes and water gradually boils away in the cylinder. Because the quantity of water covering electrode surface is being reduced current slowly falls.
2. A timer in the electronic circuit board starts when current drops 95% of set-point.
3. The timer runs for a predetermined time or until 90% of set-point is reached.
4. If current changes too rapidly during the drop from 95 to 90% it indicates that a drain is necessary to reduce the mineral concentration of the water.
5. If current 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.
7. The circuit board opens to refill the cylinder to the proper level.

REDUCING OVERCURRENT

1. If current to any of the electrodes in the cylinder reaches more than 20% above the set-point the drain solenoid valve opens.
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 15 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 unit is placed in standby mode and "Overcurrent" LED lights. See "Status" on page 15.

ADJUSTING STEAM OUTPUT RATE

See "Set Max Output" on page 9 for additional details. To reset the maximum output value from the factory preset maximum follow the steps below:

1. Press the "Mode" button until "Set Max Output" LED lights.
2. Press "Enter" once.
3. Press either UP ⇑ or DOWN ⇓ buttons until desired new maximum setting is shown on the digital display.
4. Press "Enter" once.
5. Press "Mode" until "Normal Operation" LED lights.

FAN DISTRIBUTION UNITS - *Figure R*

REMOTE MOUNTED

Humidifier Model	Nominal Steam Output Rate	Remote Mounted Fan Unit Model
HBA, HCA	005, 010	HXBFB (1 Required)
HBD, HCD	020, 030	HXBFB (1 Required)
HBG, HCG	030, 040, 050, 060, 080, 100	HXBFC (1 Required)
HBH, HCH	125, 150, 175, 200	HXBFC (2 Required)

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.

HUMIDIFIER MOUNTED

Humidifier Model	Nominal Steam Output Rate	Humidifier Mounted Fan Unit Model
HBA, HCA	005, 010	AVAILABLE
HBD, HCD	020, 030	AVAILABLE
HBG, HCG	030, 040, 050, 060, 080, 100	AVAILABLE
HBH, HCH	125, 150, 175, 200	NOT AVAILABLE

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

OPTIONS

STANDARD MOUNTING: Mounted remote from humidifier.
OPTION: Factory attached to humidifier.
STANDARD FAN VOLTAGE: 115VAC, 3 amp maximum.
OPTION: Transformer mounted and wired for 208, 230, 277, 460 or 575VAC.
STANDARD AIR FLOW DETECTION: None.
OPTION: Air flow pressure switch*.
STANDARD HUMIDISTAT: None.
OPTION: Integral ON-OFF humidistat (HXHAA)* (HXHAM).
OPTION: Integral proportional humidistat (HXHCG)* (HXHAM).

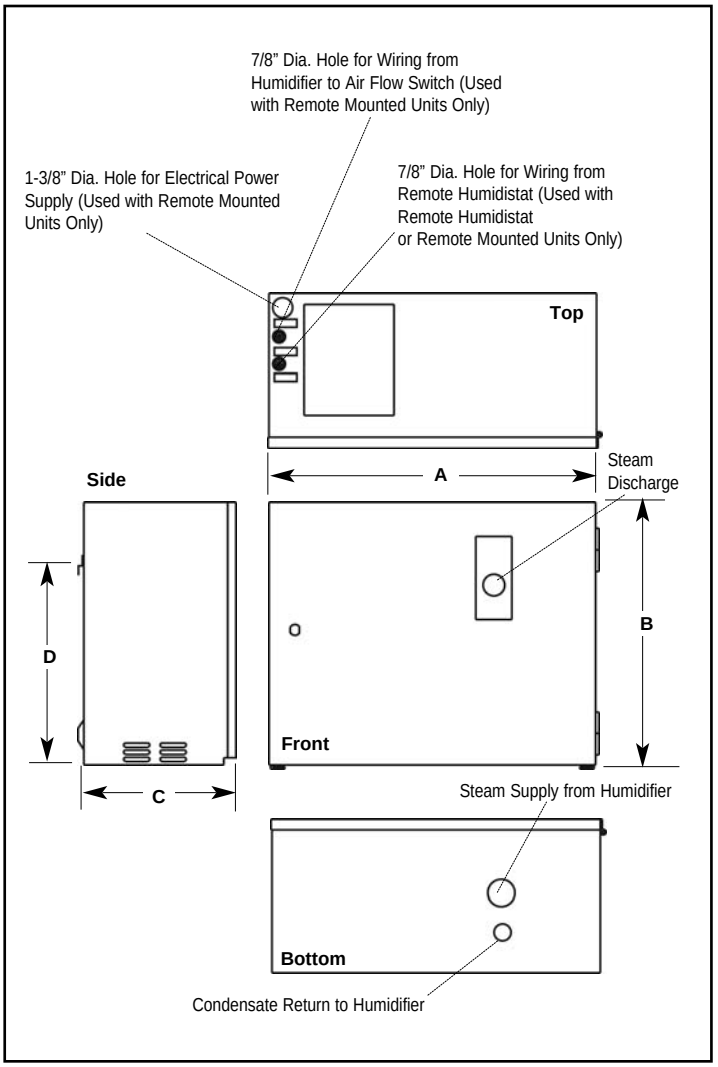
***NOTE:** *On humidifier mounted units factory attached controls, air flow switch, are factory wired to humidifier. Remote mounted units require field wiring between fan distribution unit and humidifier.*

DIMENSIONS (In Inches)

Model	A	B	C	D
HXBFB	18-1/2	16-1/2	9-1/2	14-1/2
HXBFC	24	18-1/2	12-1/2	16-1/2

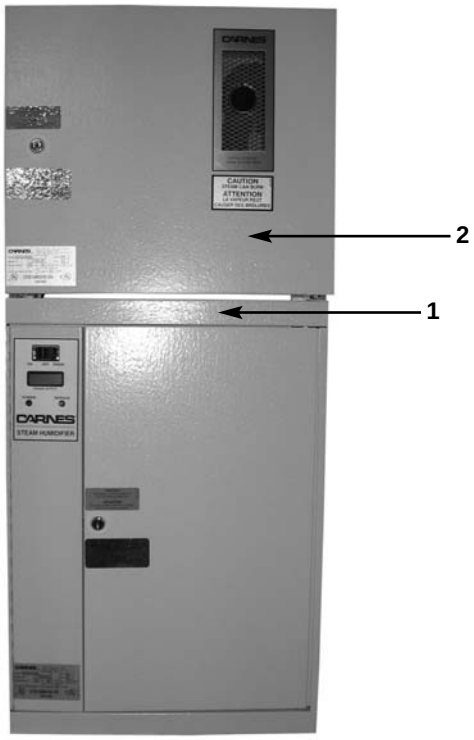
DIMENSIONS (In Millimeters)

Model	A	B	C	D
HXBFB	470	419	241	368
HXBFC	610	470	318	419

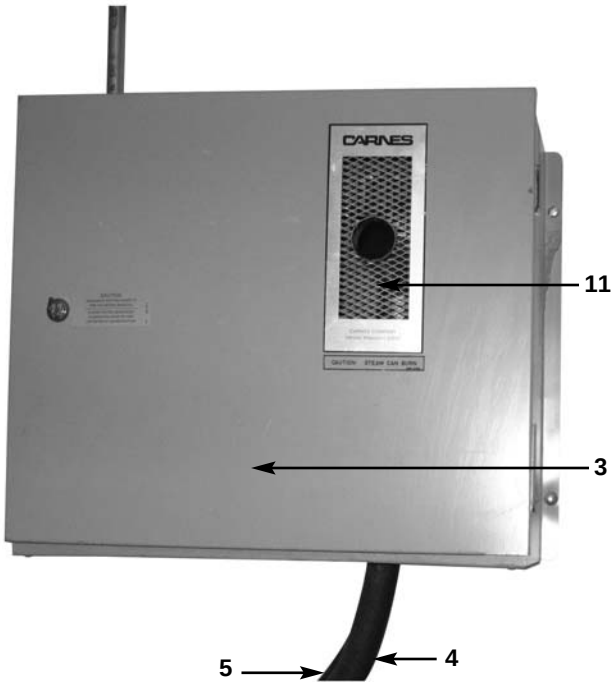


FAN DISTRIBUTION COMPONENTS - *Figure S*

Manufactured Fan Distribution Unit

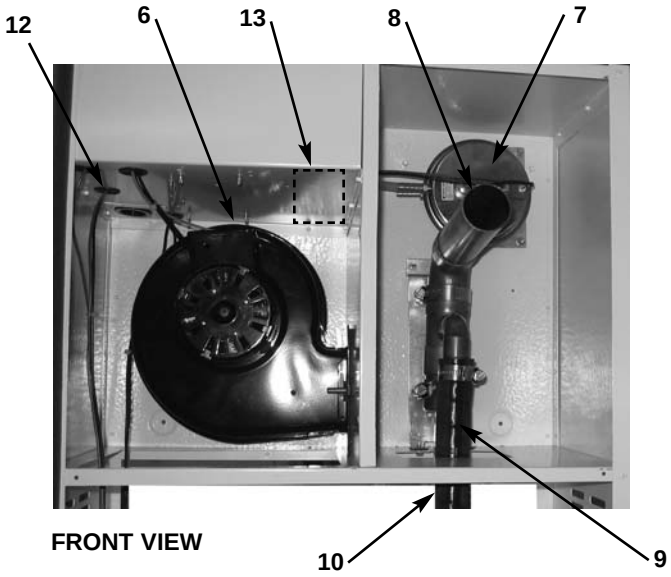


Fan Distribution "Remote"

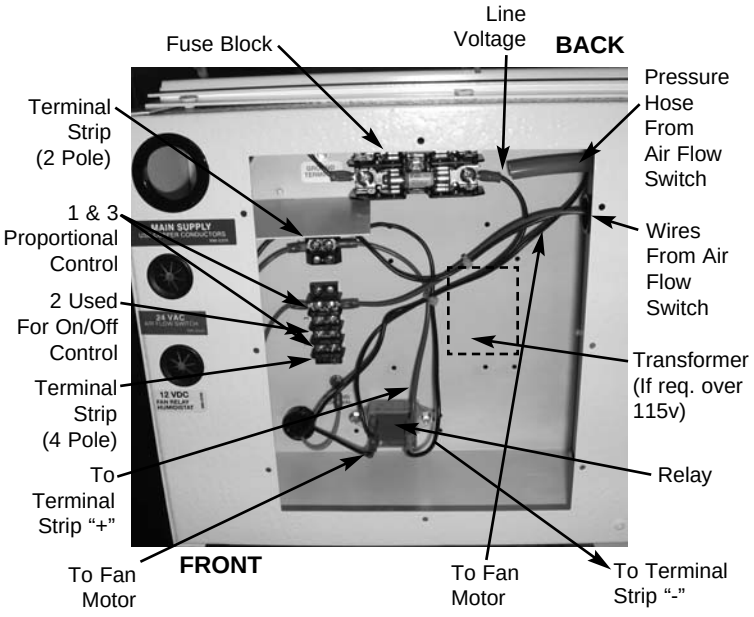


1. Support Humidifier Unit
2. Mounted Fan Distribution Unit
3. Remote Mounted Fan Distribution Unit
4. Steam Hose
5. Condensate Return Hose
6. Fan Motor
7. Air Flow Switch (Pressure Differential)
8. Steam Exhaust Manifold
9. Steam Hose Connection
10. Condensate Return Hose Connection
11. Air Flow Exhaust Screen
12. Associated Wiring to Control Panel Area
13. Control Humidistat (On/Off-HXHAA, Proportional-HXHCG, HXHAM) are no longer mounted inside, but relocated out side of Fan Distribution box on wall.

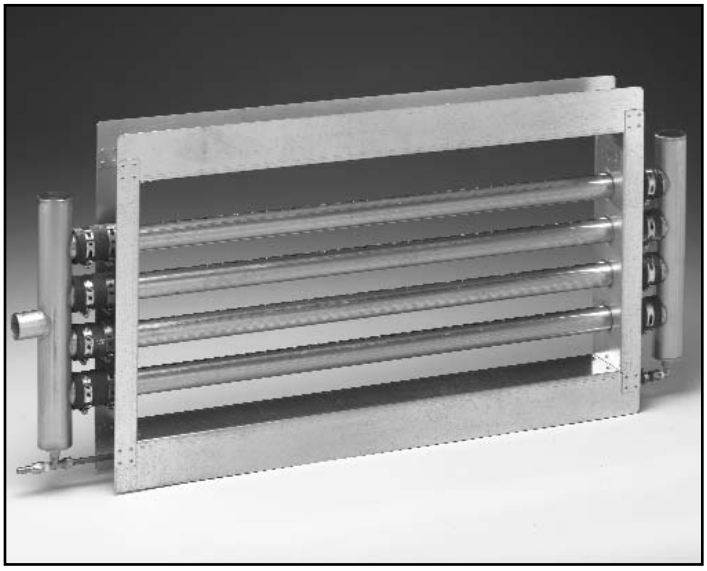
Fan Distribution Unit Mounting



Looking Down into Control Panel of Fan Distribution Unit From Front (w/o Transformer)



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.

- Stainless steel steam distribution tubes on three inch centers provide extremely short absorption distances
- 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.

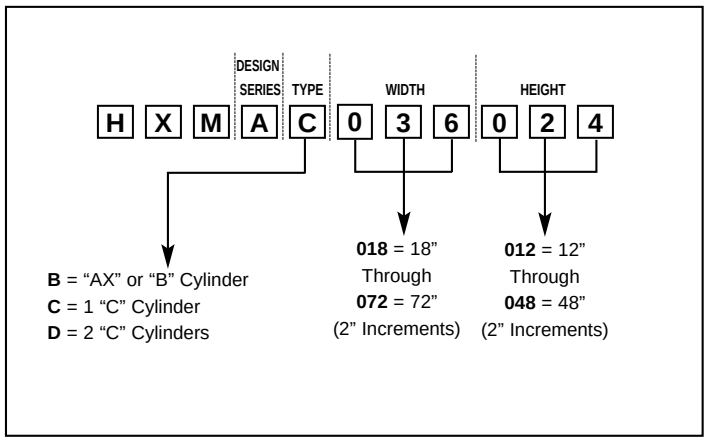
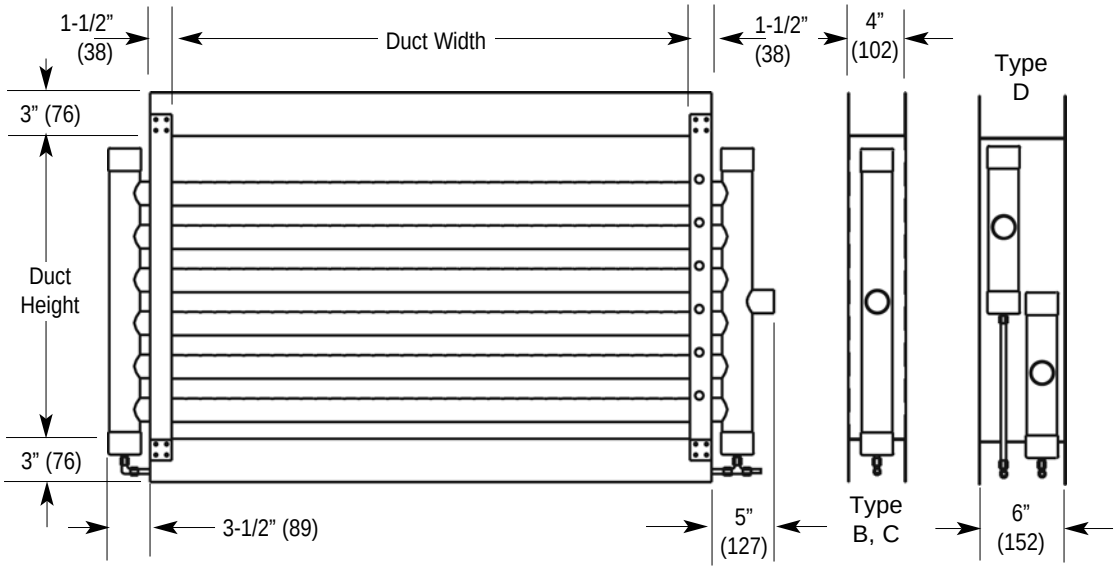


Table 5

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



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

LOCATION OF MANIFOLD

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

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

Carnes humidifiers operate at .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.

Figure A

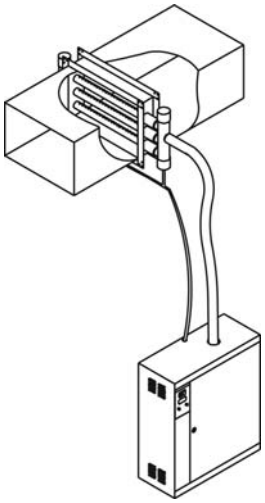


Figure B

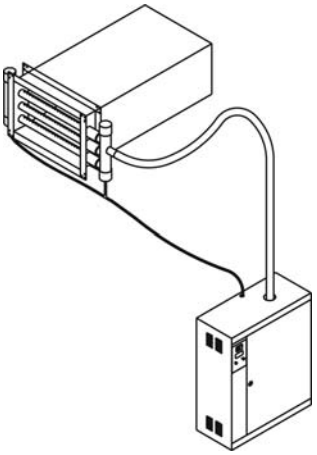


Figure C

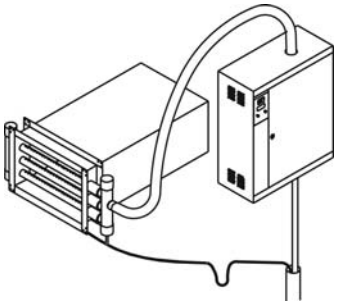
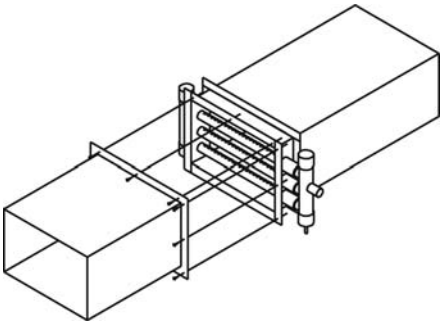


Figure D



TROUBLE SHOOTING - SYMPTOM, CAUSE AND ACTION - *Table 6*

SYMPTOM	CAUSE	ACTION
Arcing	*Naturally very high conductivity water.	*Water may be too high in conductivity. Water test.
	*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. Check system static pressure.
	*Excessive lengths of steam hose and/or high static pressure.	*Shorten distance between unit and 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.
“Service” light on	*Cylinder needs replaced, routine indication.	*Replace cylinder, match cylinder accordingly.
	*Low conductivity water, unit has not reached 50% of set-point within 10 minutes of start-up	*Allow unit to run. In low conductivity water conditions it may take 24 hrs. + to condition.
	*On-Off-Drain switch is in “Drain” position.	*Service is being done or change switch position.
	*“Service” & “Troubleshooting”, possible repairs are required for Red “Overcurrent” LED on, flashing “Overcurrent” Red LED, flashing Yellow “High Water Sensor” LED, flashing Green LED for “Set-point”.	*Red “Overcurrent” LED on-drain tubing is restricted or drain valve is defective. Clean and clear all drain tubing, clean or repair or replace drain solenoid. Flashing Red “Overcurrent” LED-Drain tubing is restricted or drain valve is defective, flashing LED usually occurs on lower side of operational cycle when water drains slow or not at all but water is coming in and the current increases. Flashing Yellow “High Water Sensor” LED-Excessive back pressure in system needs to be corrected (check steam hose blockage or kinks or severe bends). Drain valve or tubing blocked, correct as mentioned above. Replace cylinder. Flashing Green “Set-point” LED-Drain valve is stuck open (repair as necessary). Fill valve is not operating properly or fill valve strainer is restricted (repair, replace or clean as necessary).
Water doesn’t fill into cylinder	*All 4 control LED’s are not on.	*Make sure all control circuits are closed.
	*Fill valve strainer is restricted.	*Remove strainer from fill valve assy. and clean.
	*Fill valve is defective.	*Repair or replace as necessary.
	*If “High Water Sensor” LED is on, fill valve will be closed.	*Possibly normal operation in “High Water Sensor” mode. Valve will be closed for one (5) minute unless continuous high water is sensed. If so, just let unit run and it will self correct.
Drain continuously	*Piece of mineral is partially blocking drain so it will not close all the way.	*Cycle drain. If it does not clear, clean as necessary.
	*Drain actuator arm is not working properly, preventing drain valve from closing completely.	*Repair or replace as necessary.
	*If Drain LED is off but 24 VAC is present to perform drain function, circuit board may be bad.	*Replace circuit board.
Water in duct or spitting from distributor pipe	*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.
	*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.

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

SYMPTOM	CAUSE	ACTION
Water in duct or spitting from distributor pipe *(continued)*	*Distributor pipe not installed properly or manufactured properly, not allowing for a continuous backward slope to steam hose & condensate hose connection.	*Re-assemble, repair or replace as necessary.
	*If condensate return hose has a drop less then 12".	*Route condensate return to a common drain and include a trap.
	*Condensate return is connected to top of unit, but a trap was installed. Distributor pipe is 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° or lower the distance should be 10 ft. If distance, as mentioned, can not be 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 max output of unit. If very short absorption distances are required, a short absorption manifold can be installed.
No operational lights are on	*Voltage to unit is not that which is required per rating label or unit construction.	*Change unit 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 reset button on transformer is in proper position, power to unit and confirm the required 24 VAC is leaving transformer (replace transformer if defective), & make sure 24 VAC connection to J20 on circuit board is good. If situation is still the same, replace circuit board.
Power to unit (proper line voltage to unit, 24 VAC to circuit board), still does not start operating	*All 4 control signal LED's are not on (control humidistat, high limit humidistat, air flow switch door interlock).	*Confirm signal availability. Make sure if no High Limit signal is required, that a jumper is in place. If no Air Flow Switch signal is required, that a jumper is in place. If control door panel is open, make sure the door interlock button is pulled out for operation.
Unit unable to reach maximum output or required set-point	*Capacity of unit too low. *Too high of a system static pressure. *Too high of a back pressure. *Foaming. *Wrong cylinder. *Volume of water too low. *Volume of water too high.	*Determine proper load calculation & capacity of unit. Use properly sized unit.
		*Supply air system must be evaluated & determine if static pressure is too high. Located & correct issue.
		*Too long of steam line runs, sags, dips, horizontal runs not allowing for proper condensate removal, improper sloping of steam lines & condensate line.
		*Attempted cleaning of cylinder (throw away). Foreign matter in steam lines or excess impurities. Check drain timing.
		*Make sure proper cylinder and configuration used.
		*Read following water control statement.

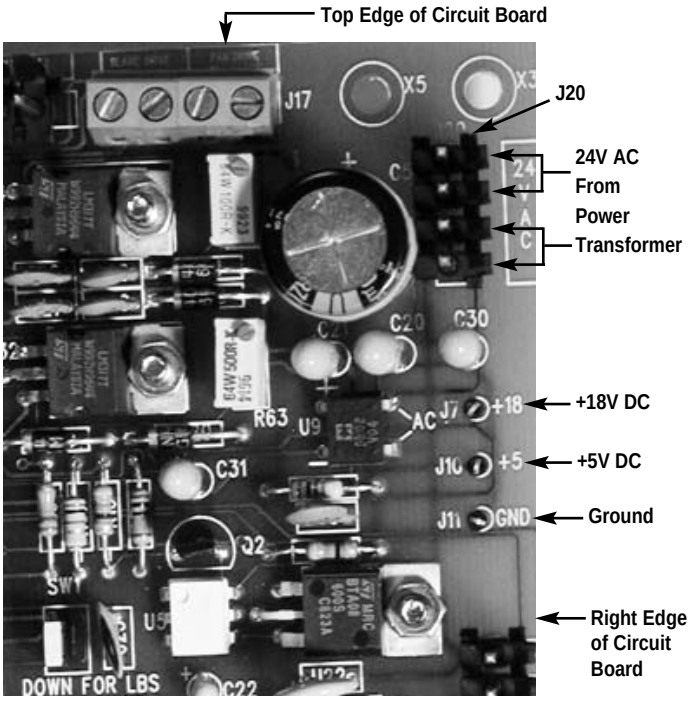
WATER CONTROL

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 to 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.

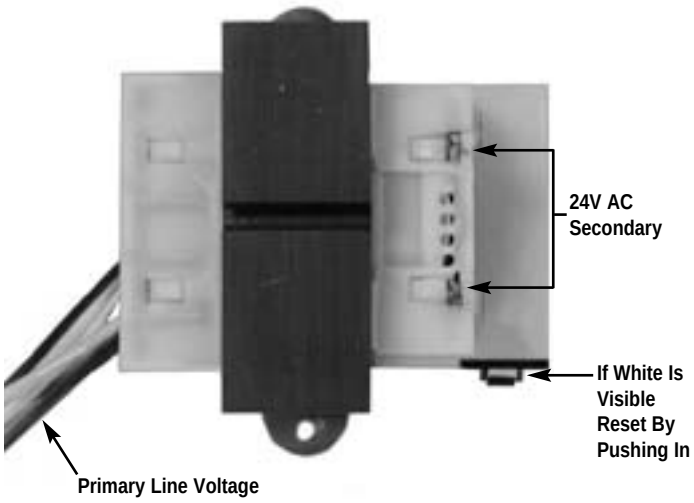
TROUBLE SHOOTING

SYMPTOM: NONE OF THE LIGHTS ARE ON

1. Verify that voltage being supplied to unit is same as listed on rating label on front left hand corner of cabinet.
2. If unit is three phase verify that all legs have power.
3. If unit has optional internal circuit breakers they must be on.
4. Verify that 24V AC is being supplied by power transformer by taking voltage reading at terminal strip J20 on two red wires coming from secondary of transformer. J20 is located on the top right hand corner of the electronic control board.



5. If 24V AC is not present reset the overload located on the transformer and recheck.



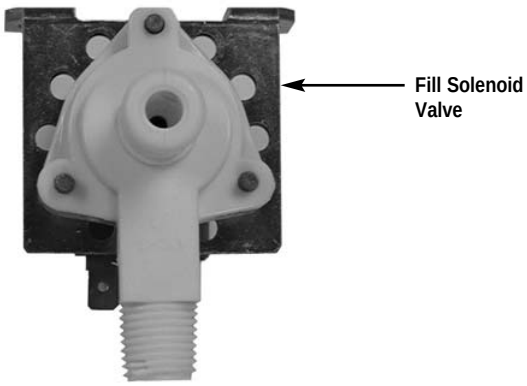
6. If 24V AC is present the electronic control board may be defective.

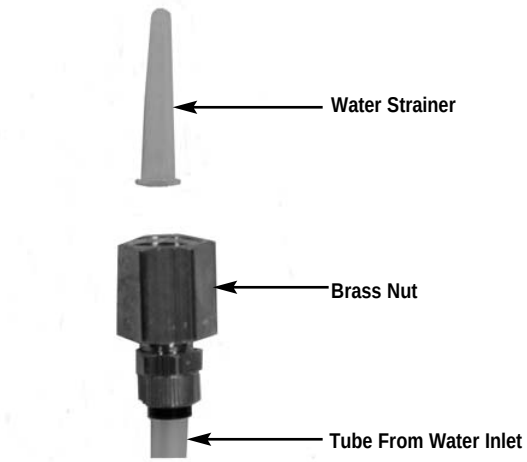
SYMPTOM: "SERVICE" LIGHT IS ON

Normal reason is time for steam cylinder replacement caused by gradual mineral build up on electrodes inside plastic cylinder. Water gradually rises to cover unused electrode surfaces until output begins to decline. If cylinder has been operating for an extended period of time and water is high replace with new cylinder. See page 16.

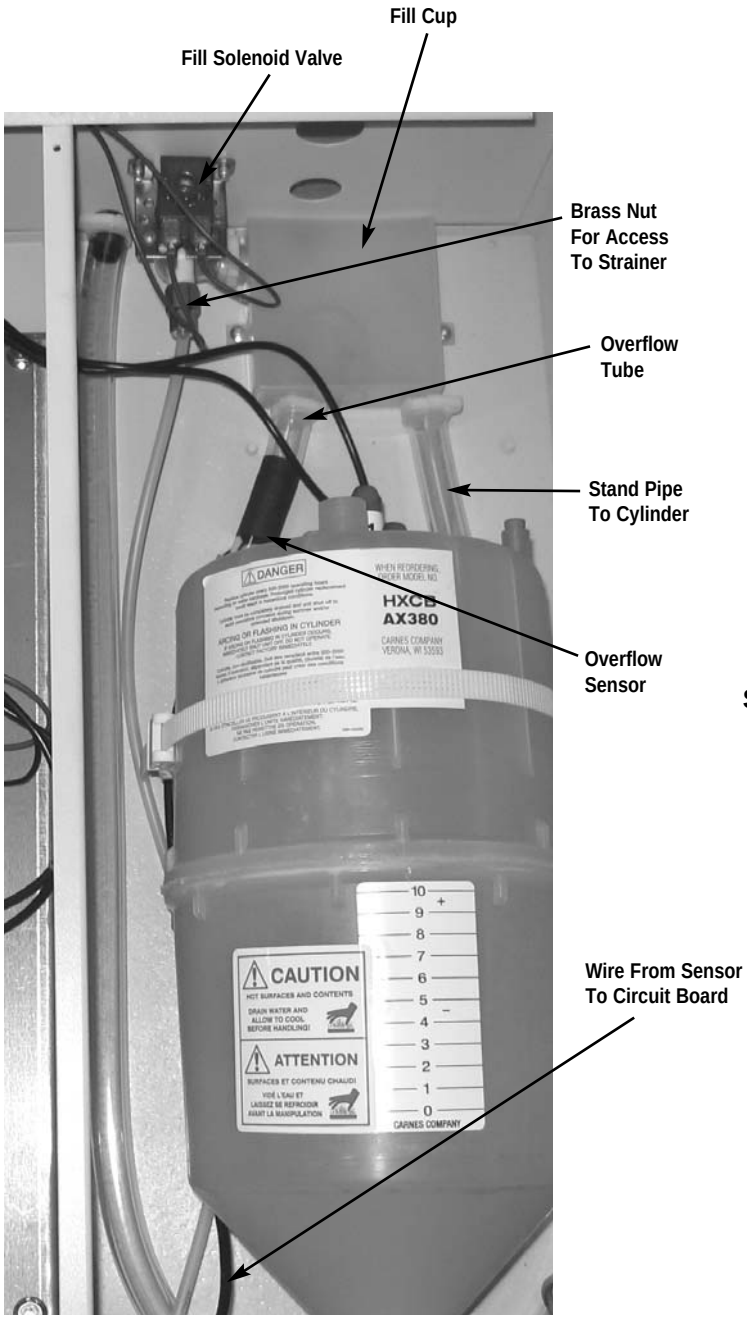
If cylinder is not at end of life other items to be checked:

1. Check "Overcurrent" LED. If on, switch "On-Off-Drain switch to "Drain". Verify water is draining freely from cylinder. Clean internal drain lines and drain solenoid valve if necessary.
2. If "Overcurrent" LED is off, check "Fill Solenoid" LED. If on, verify that water is flowing from fill solenoid valve to fill cup and then into standpipe connected to bottom of steam cylinder. If water is not flowing verify that all shut off valves ahead of unit are open. Check water strainer in fill solenoid valve and clean if necessary.





3. If water is flowing through fill solenoid, fill cup and standpipe but not into the steam cylinder check to determine if drain solenoid valve is partially open. See “Drains Continuously” section below.
4. If water is not flowing check “High Water Sensor” LED. If on, wait a minimum of one minute to check operation. Every 60 seconds the high water sensor resets and rechecks for water flow through the overflow tube. The sensor detects flow by measuring a change in capacitance so touching the wire or sensor will cause it to activate. If necessary to prevent inadvertent sensing, re-route the wire to avoid primary voltage electrical wires or water containing components.



5. If water is flowing through the overflow tube it can be caused by an obstruction blocking the inlet to the cylinder fitting. If water is low in the cylinder but overflow is occurring cleaning of the plumbing is recommended.
6. If water is near the top of the cylinder and overflow is occurring the cylinder may be in need of replacement.

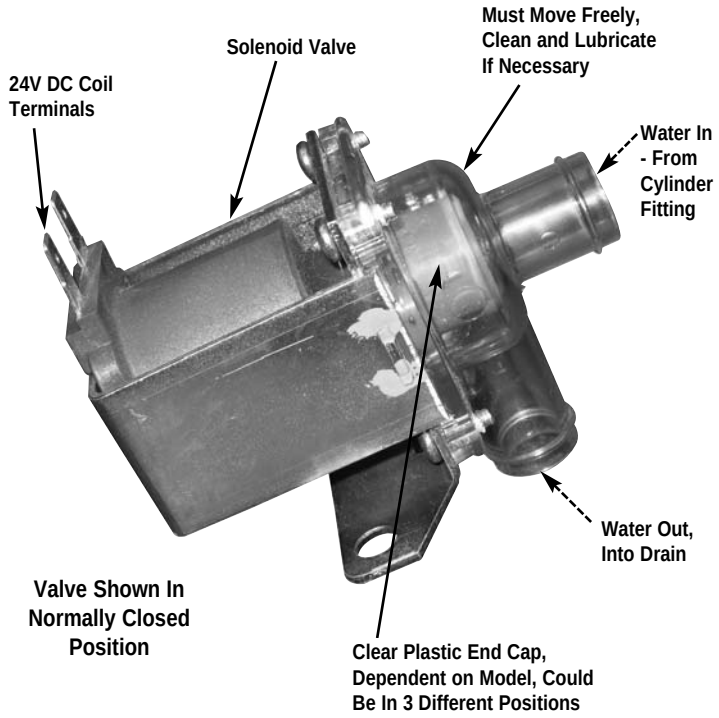
SYMPTOM: WATER DOESN’T FILL INTO CYLINDER

1. Confirm that four LED’s on “Control” section of diagnostic display are on.
2. If all four LED’s are not on consult “Controls” information of page 9.
3. If all four LED’s are on check LED labeled “Fill Solenoid”. If on, check for 24V AC at coil of fill solenoid valve. If 24V AC is present water should be flowing if water is available. Be sure all shut off valves ahead of unit are open.
4. If water is available check strainer on solenoid valve for sediment. Strainer may be checked by removing brass nut from input of valve and reaching inside housing and pulling out strainer.
5. If 24V AC is present and strainer is clean solenoid valve may be defective.
6. If “High Water Sensor” LED is on the “Fill Solenoid” LED and valve will be off for one minute. See “High Water Sensor” on page 10.
7. Check drain solenoid valve for 24 volt DC. Make sure valve is not partially opened 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 “On” and “Drain” may dislodge the sediment. In extreme cases it may be necessary to disassemble drain lines to clean them.
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.

(See photo on next page)



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.

3. The "Drain Solenoid" LED indicates if the electronic circuit board is sending 24V DC to the valve. If the LED is off but 24V DC is present at the drain solenoid coil 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.

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. See "Adjusting Steam Output Rate" on page 16 for procedure.

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. Maximum conductivities are shown in Carnes Catalog HB-02. 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 24V DC 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. See Table 3 on page 3 for maximum lengths of hose or piping in relation to static pressure.
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 usual due to foreign matter or impurities getting into the cylinder through normal water supply. Detergents, degree of softened water (if used), 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, to force an indication of water at a high water status.

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.

***** *THE FOLLOWING 2 CIRCUMSTANCES MAY BE OBSERVED WHILE FOLLOWING TROUBLESHOOTING GUIDELINES.*

1. Set-point LED, #15 on digital diagnostic panel, flashing or blinking. It is an indication of the drain valve stuck open. This is typically caused by large flakes or chunks of solid mineral deposits lodged in valve.

   Corrective action would be to manually rapid cycle the drain solenoid valve in an attempt to clear. If unable to clear, unit should be shut down, valve taken out and thoroughly cleaned.
2. High water LED, #12 on digital diagnostic panel, flashing or blinking indicates abnormal over flow. It is an indication of excessive back pressure, drain valve stuck closed or aged cylinder.

   Corrective action would be to identify and correct back pressure issues (steam hose), bad or blocked drain valve or replace cylinder with a new one.

USE OF SOFTENED WATER

With the use of a 1.4 - 2.0 version microprocessor chip located on the back of the circuit board and the replacement of the cylinder, a calibration can be preformed to provide compatibility between the humidifier unit and the use of softened water. **Contact the factory.** To reach and maintain efficient operation with softened water, it is imperative to prevent intermittent tap/potable water from getting into the water supply. This usually occurs when the water softened system is not cycling enough to maintain 100% output supply of the softened water.

If all required parameters are met with the usage of softened water, a significant positive result can be witnessed in the life cycle of the cylinder.

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, 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. 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.
5. 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.
6. Humidifier(s) shall include over-current protection as an integral function of the solid-state circuit board. In the event of over-current, the humidifier shall signal that a fault condition exists by an LED. Over-current protection shall be resettable. Replacement type fuses are not acceptable.
   Option: Humidifier(s) shall also include secondary magnetic overload switches that shall be manually resettable and shall be of the type that positively disconnects power to the steam cylinder.
7. Humidifier(s) shall include a door interlock safety switch to disconnect power to steam cylinder(s) when cabinet door is opened.
8. 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. 115 VAC fan motor
   b. Transformer for 208, 230, 277, 460 or 575 VAC to operate fan motor.
   b. Pressure differential type air flow switch.
   c. Integral On/Off control humidistat (remote mounted).
   d. Integral proportional control humidistat (remote mounted).

   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.
9. 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.
10. The humidifier(s) shall incorporate a 1” air gap on the fill water line to prevent backflow. An air gap fitting shall also be provided on the drain line to isolate the unit from any backflow coming from external drain pipes.
11. The humidifier cabinet(s) shall be constructed of 18 gauge steel, protected by a dipped baked enamel under coat with Epoxy top coat. The cabinet door shall be hinged and provided with a lock and key. A digital LCD steam output meter calibrated in pounds of steam per hour (kg of steam per hour switch included), power and service indicator lights and on-off-drain switch shall be accessible and visible with the cabinet door closed.
12. 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. Wall mounted humidistat, proportional control.
    d. Duct mounted humidistat, on/off control.
    e. Duct mounted humidistat combo w/digital humidity & temp.
    f. Duct mounted humidistat, proportional control.
    g. High limit duct mounted humidistat, on/off control.
    h. High limit duct mounted humidistat, proportional control.
    i. Pressure differential type air flow switch.
    j. Paddle type air flow switch.
    k. Wall or duct mounted temperature compensated, on/off control, digital display humidistat.
13. 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 a 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 building automation system (BAS).
14. 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.
15. Humidifier(s) shall include a service light which shall signal whenever the output of the unit is less than 50% of the desired rate. 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.
16. Individual LED’s shall indicate status of the control humidistat, high limit humidistat, air flow switch and door interlock switch. Operation of fill solenoid, drain solenoid, power contractor and high water sensor shall be shown.
17. 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. If self-correction procedures are unable to correct problems after specific cycles, unit will automatically shutdown.
18. The humidifier(s) shall include a non water contact capacitance proximity high water sensor to prevent overfilling and loss of water.
19. 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. Service light shall indicate the switch is in drain position.
20. 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 Diagnostic Control Panel.
21. 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.

! 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

Models Available
HXCCB145
HXCCB220
HXCBB380
HXCBB500
HXCBB600
HXCBB700

Models Available
HXCBC6F
HXCBC6X
HXCBC61
HXCCC62
HXCBC63
HXCBC64
HXCBC65
HXCBC12

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 _____ **LBS/HR** _____

SERIAL NO. _____ **CODE** _____

POWER SUPPLY _____ **VAC,** _____ **HZ** _____ **PH,** _____ **AMPS**

(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: (_____) _____

"Due to ongoing research and development CARNES reserves the right to change specifications without notice"