

# READ AND SAVE THESE INSTRUCTIONS

## ELECTRONICALLY CONTROLLED STEAM HUMIDIFIERS DESIGN SERIES "C" & "D"

# INSTALLATION, OPERATION AND MAINTENANCE MANUAL

CARNES COMPANY, P.O. Box 930040, 448 S. Main St., Verona, WI. 53593-1499 — Phone: 608/845-6411 Fax: 608/845-6470

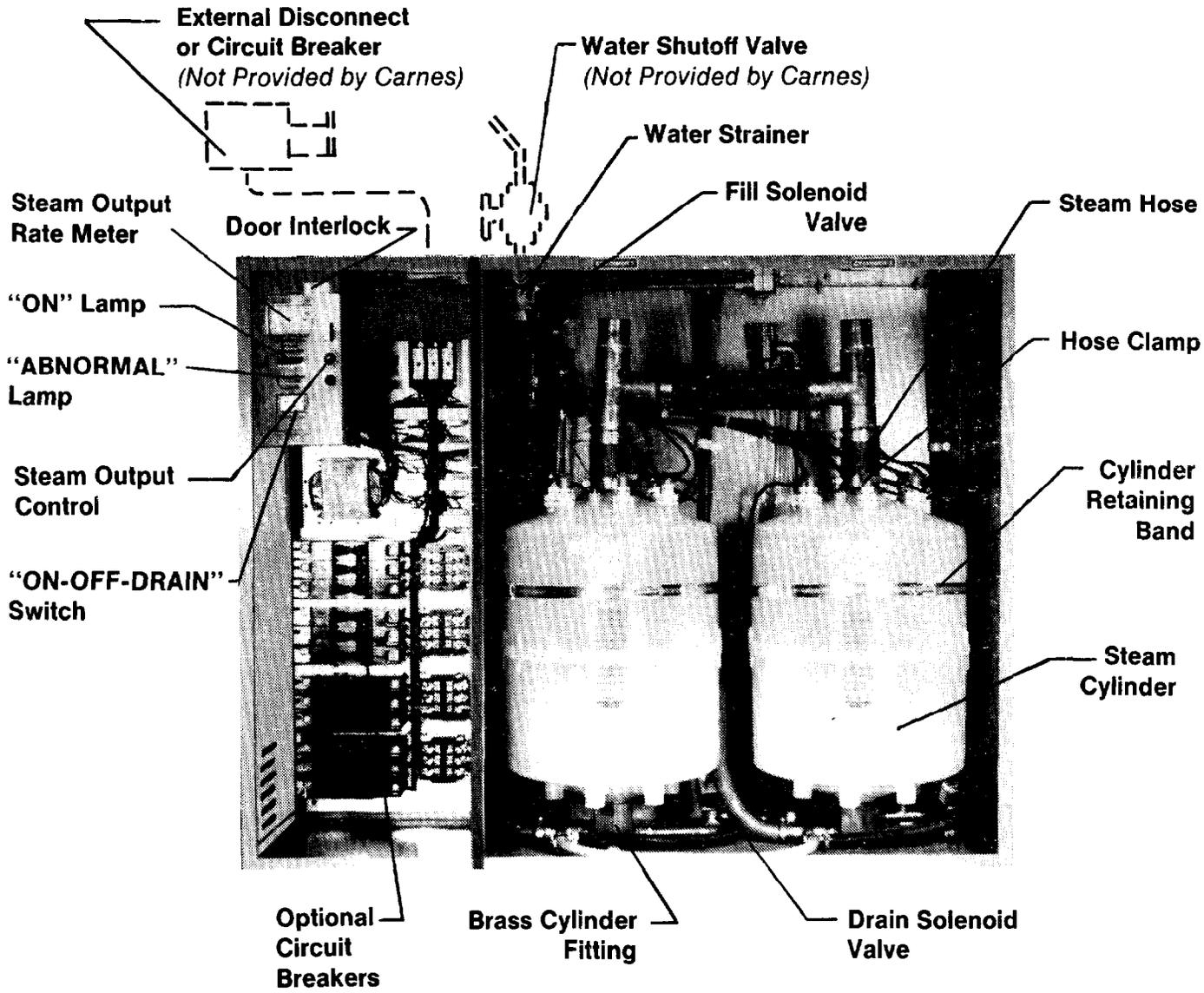


Photo A  
(MODEL HBHD SHOWN)

# INSTALLATION

## UNPACKING AND INSPECTION

1. An envelope attached to the outside of the cabinet contains one cabinet key.
2. Open the cabinet and check for concealed shipping damage. Report any damage immediately to the carrier who delivered shipment.
3. The following components are packed in a shipping carton for connection when installing humidifier:
  - A. Distributor 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 instructions.

## MOUNTING THE HUMIDIFIER

Mount the humidifier cabinet securely on a level and plumb surface near the ductwork. Allow 6" or more on each side for proper ventilation and a minimum of 16" from the bottom of the cabinet to the floor to allow space for the drain connection. The humidifier must never be mounted outside or where it may be exposed to freezing temperatures. Maximum operating weights for the humidifiers are shown below.

Table 1 — MAXIMUM OPERATING WEIGHT

MODEL	POUNDS
HBAC, HCAC, HBAD, HCAD	80
HBDC, HCDC, HBDD, HCDD	85
HBGC, HCGC, HBGD, HCGD	105
HBHC, HCHC, HBHD, HCHD	185
HBJC, HCJC, HBJD, HCJD	260

Table 2 — FASTENER RECOMMENDATION

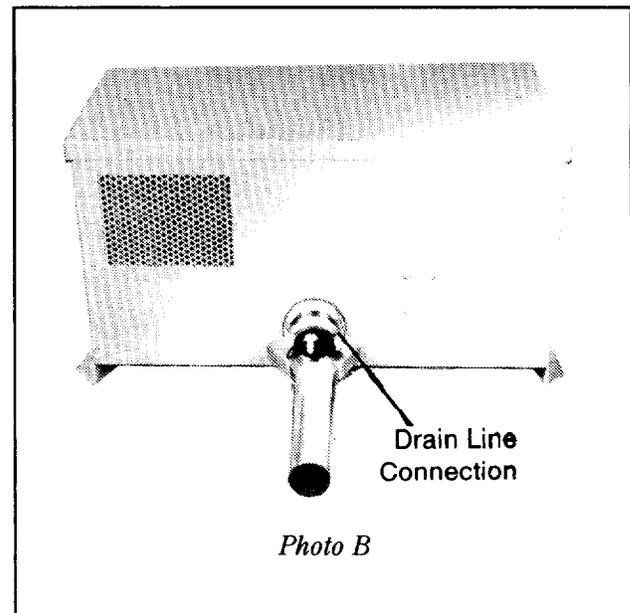
TYPE OF WALL	6 FASTENERS REQUIRED (Models HBAD, HCAD, HBDD, HCDD, HBAC, HCAC, HBDC, HCDC)
	8 FASTENERS REQUIRED (All Other Models)
Wood Studs or Solid Wood	1/4" Lag Screws, 1" minimum length
Hollow Plaster	1/4" Molly Bolts or Toggle Bolts, 3" minimum length
Sheet Metal	1/4" Thread Forming Screws, 1/2" minimum length
Cement or Masonry	1/4" Lead Type Anchor and Bolts, 1 1/2" minimum length

## WATER SUPPLY CONNECTION

Use ordinary tap water (20 to 120 psi) — **DO NOT use hot water, deionized water, or water that has been treated by a water softener without consulting the factory.** A 3/8" FPT fitting is provided at the top of the humidifier for connection to tap water supply. A shut-off valve, not provided by Carnes, must be installed just ahead of this fitting.

## DRAIN LINE CONNECTION

1. Remove the large nut and plastic gasket located on the fitting on the bottom of the cabinet (*Photo B*). The nut and gasket may be used with standard type drain fitting if an air gap drain fitting is not required by local codes.
2. Connect the air gap drain fitting to the cabinet drain connection. Drop plastic insert into the top of the air gap drain fitting before connecting. 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.*



## STEAM DISTRIBUTOR PIPE LOCATION

Each steam cylinder in multi-cylinder units requires a separate steam distributor pipe, steam hose and condensate return line. The distributor pipes from one humidifier are intended to serve one duct or multiple ducts if the pressures are the same. Only one humidistat is required for each humidifier as all circuits in multi-cylinder units operate simultaneously.

In a typical installation the humidifier is located below the duct as shown in *Figure A*. It is recommended that the length between the humidifier cabinet and the steam distributor pipe in the duct be the minimum possible distance. Refer to *Table 3* for maximum lengths that may be installed. The maximum length of steam hose that may be installed as shown in *Figure A* is 12 feet. For steam hose lengths over 12 feet refer to *Figure B*.

A drain "T", as shown in *Figure B*, 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 toward the distributor pipe as shown. If sufficient head room is not available it is possible to install with an upward slope to the hose.

The standard distribution pipe must never be installed vertically. If air flows are vertical, the steam distributor pipe should be installed horizontally (*Figure C*). In multi-cylinder units the pipes should be staggered as shown in *Figure D*.

Steam distributor pipes must be located on a plumb surface. This is required so the condensate which forms in the distributor pipe will drain to the return line and back to the unit.

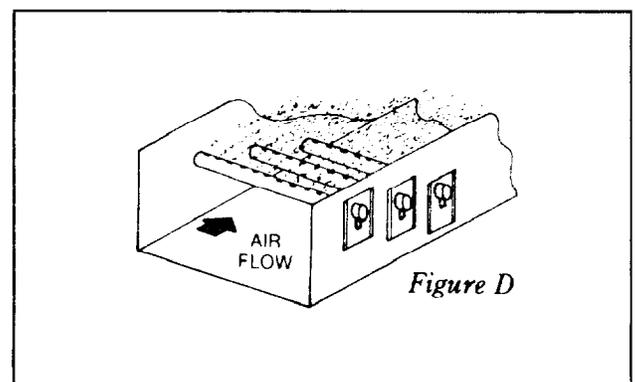
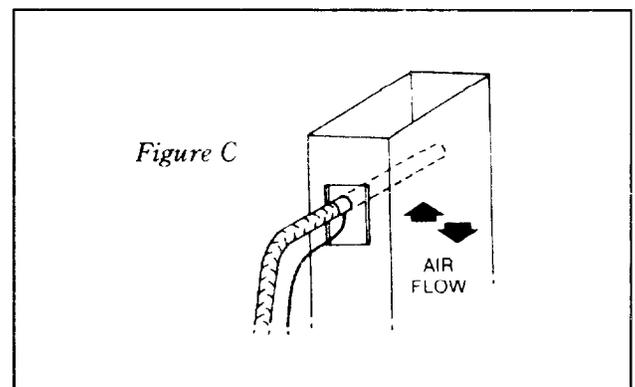
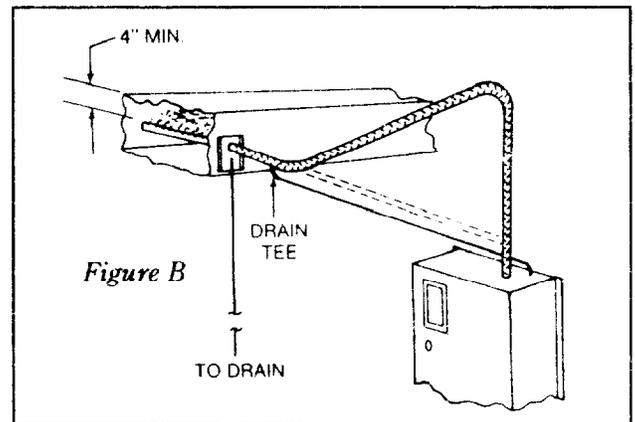
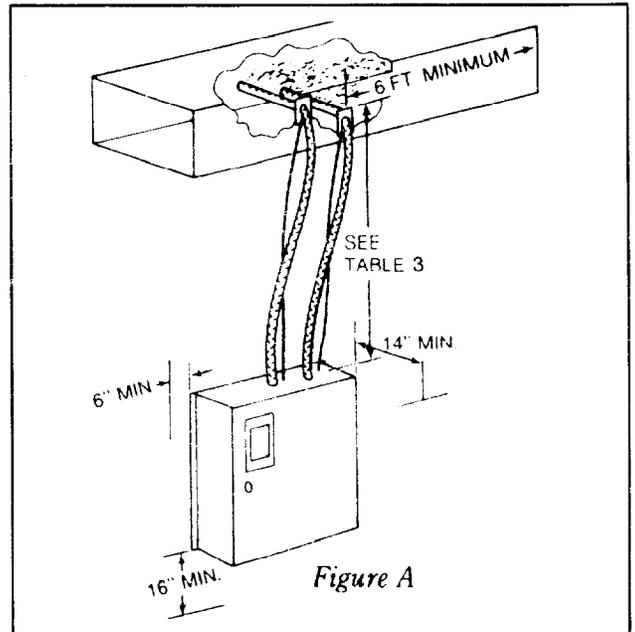
Steam distributor pipes should be mounted in the duct to insure even distribution of steam across the center portion of the duct. The condensate return line must always be kept on the bottom. A minimum clearance of 4" must be maintained between top of the duct and distributor pipe.

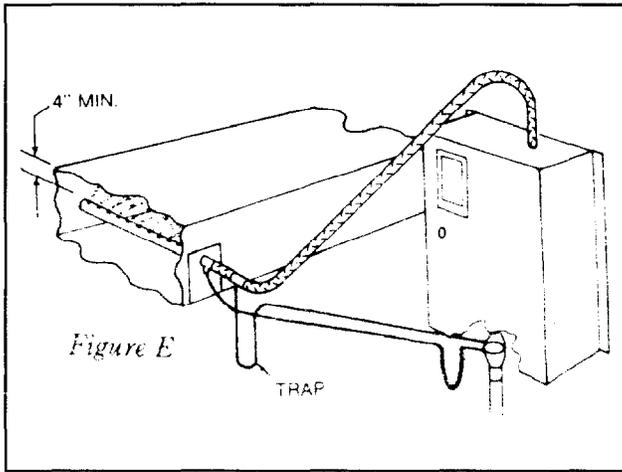
The steam distributor pipes are normally located in the supply air stream, downstream of the fan. When installed in packaged units (central station air handlers, multizone units, make-up air units, etc.) the distributor pipe should be mounted just downstream of the fan discharge in the primary air stream.

In multizone applications it is preferable to have a separate humidifier serving each zone. However, steam can be introduced into the hot deck upstream of the zone dampers. In this case, good distribution of steam across the entire of the hot deck is very important.

*Table 3* — MAXIMUM STEAM HOSE LENGTHS

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





### Steam Distribution Pipe Location (Continued)

The steam distributor pipe may be located below the humidifier if the installation is made in accordance with Figure E. A trap must be installed as shown to prevent steam from flowing back through the condensate return line.

It is preferable to locate the steam distributor pipe downstream from any obstructions in the ductwork so that air can absorb moisture before it impinges on a surface and accumulates. There must be a minimum of six feet between the steam distributor pipes and any fans, coils, filters, zone dampers, elbows or outlets which may be installed downstream of the distributor pipe. However, in all cases, the steam distributor pipes should be located as far upstream from any such obstruction as possible.

It is very important that the steam hose is installed so that sags in the hose are prevented. Because the steam is at very low pressure (less than .78 psi) it cannot overcome resistance caused by water standing in the steam hose. The steam hose is flexible so it must be supported adequately to prevent any low point from occurring. The steam hose and condensate return line must have a continuous pitch so that standing water will not develop.

If it is difficult to install the steam hose to prevent sags, it is recommended that copper tube be used as a substitute. If copper tube is used, a minimum of one inch of insulation must be applied to prevent excessive condensation. A short length of steam hose should be used to connect to the cylinder on the humidifier and another short length to connect to the steam distributor pipe. Size 3/4" copper tube can be used with steam cylinders having output rates of up to 30 pounds of steam per hour. Size 1 1/2" copper tube should be used with 60 pound per hour steam cylinders. The condensate return line which connects the outlet on the steam distributor pipe to the inlet on the top of the humidifier also must be supported to prevent sags that would restrict the flow of water.

## 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.
2. Insert distributor pipe into duct and secure tightly 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 accessory fan distribution unit is to be used, follow the instructions included with the unit.

## CONNECTING 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 or pockets.
2. Any turns should have a minimum radius of 8" to prevent the hose from kinking.
3. Fasten the steam hose to the distributor pipe with one of the hose clamps provided.
4. 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, or over the copper fitting in 2 or 3 cylinder models. Fasten with the hose clamp provided.

## 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.

# ELECTRICAL CONNECTIONS

POWER MUST BE OFF BEFORE MAKING ANY ELECTRICAL CONNECTIONS

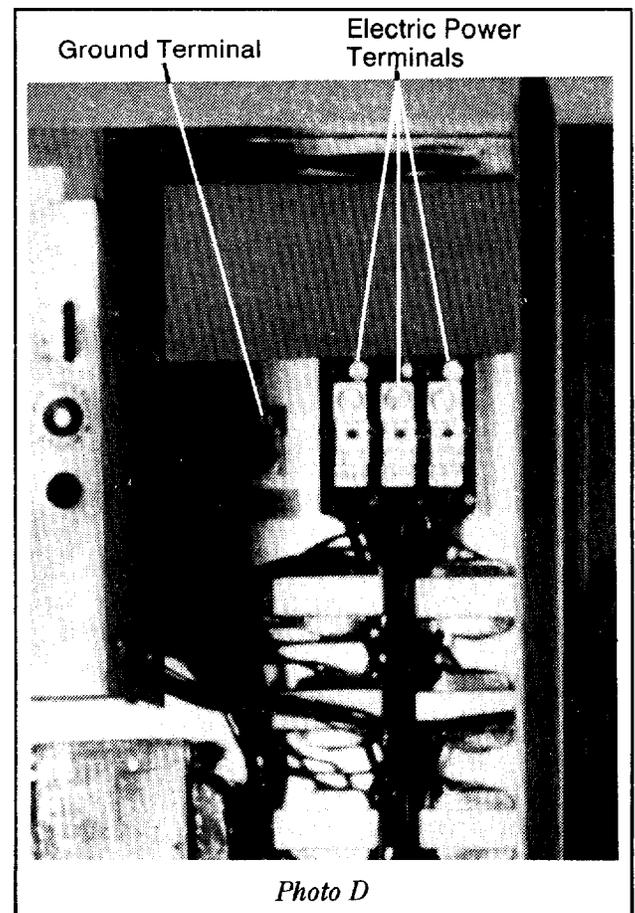
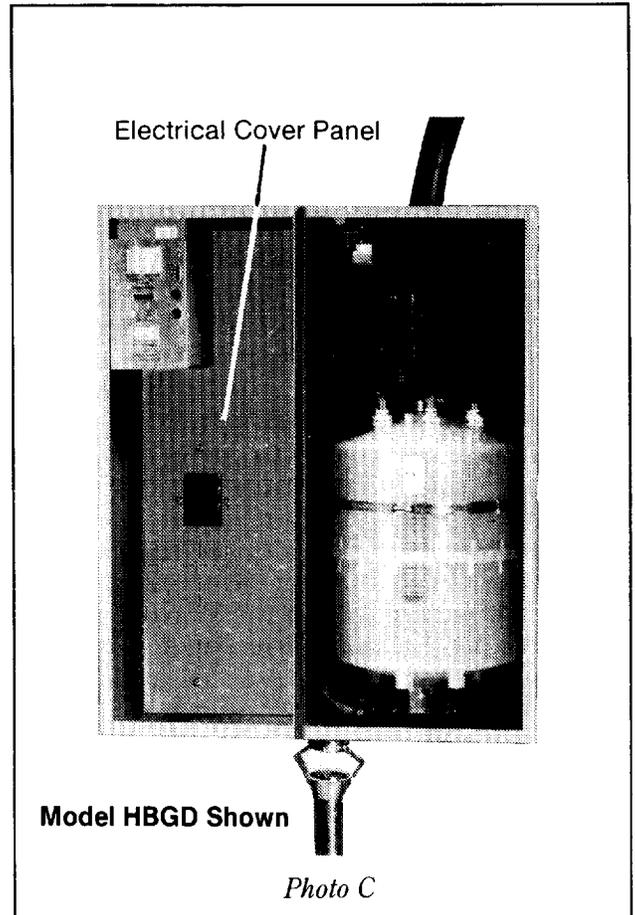
Check unit electrical characteristics on label on outside of cabinet. It must agree with the power provided to the unit. If it does not, contact your Carnes representative.

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

*Table 4* — RECOMMENDED CIRCUIT RATINGS

MODEL	OUTPUT RATING	P H A S E	VOLTAGE (Amperes)					
			120	208	230	277	460	575
HBAC/D	5	1	20	15	15	15	15	15
HCAC/D	10	1	40	25	20	20	15	15
HBDC/D	20	1	—	45	40	35	20	15
HCDC/D	20	3	—	30	25	—	15	15
	30	3	—	40	35	—	20	15
HBGC/D	30	1	—	70	60	50	30	25
	40	3	—	60	50	—	25	20
HCGC/D	50	3	—	70	60	—	30	25
	60	3	—	80	70	—	35	30
HBHC/D	80	3	—	110	100	—	50	40
HCHC/D	100	3	—	125	125	—	60	50
	120	3	—	150	150	—	70	60
HBJC/D	150	3	—	—	—	—	90	80
HCJC/D	180	3	—	—	—	—	110	90

1. Remove screws securing electrical cover panel for access to wiring (*Photo C*).
2. An opening is provided on the top of the electrical section. Bring electric power wires through this opening and connect to electric power terminals (*Photo D*).
3. Connect cabinet ground terminal to an independent ground (*Photo D*). **DO NOT** use the neutral of a four-wire power supply.
4. Replace electrical cover panel.



# CONTROLS

If an on-off electric type humidistat is used the humidifier will generate steam at the preset output rate and cycle on or off as necessary to satisfy the conditioned areas requirements. All humidifiers are preset at the factory for the maximum rating of the unit.

If Carnes proportional humidistat is used (may be used with "D" Design Series Only) the humidifier will automatically vary the steam output rate in response to the signal from the humidistat. 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 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 duct is used. This is normally mounted in the equipment room or in the duct where it is accessible only to maintenance personnel.

The humidifier control circuit should include some method to verify 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 preferred device as it is less susceptible to erratic operation caused by improper positioning in the duct system. Paddle type switches require careful positioning in the duct to insure sufficient air flow to activate the switch. A combination return air duct humidistat and sail switch is available but care must be taken during installation to insure proper operation.

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 for 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.

# CONTROL CONNECTIONS

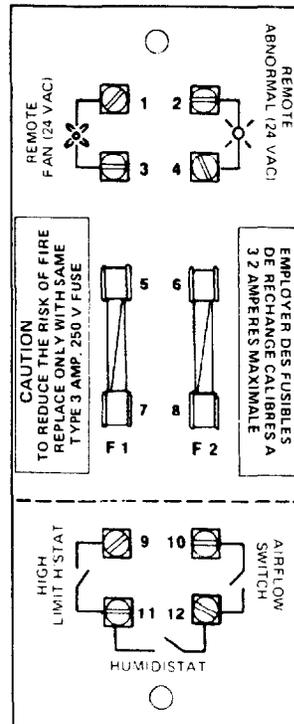
**IMPORTANT:** TURN OFF POWER AT EXTERNAL DISCONNECT BEFORE MAKING ANY CONNECTIONS TO PREVENT POSSIBLE DAMAGE TO ELECTRONIC CIRCUIT BOARD.

1. A 1/2" opening is provided on the top of the cabinet. The control wiring should pass through the opening to the terminal strip (Figures F or G).

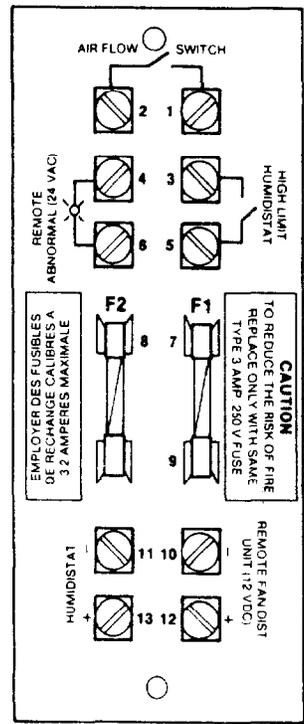
**Note:** A built-in transformer provides power for the control circuit. No outside power supply is required for the control circuit.

2. The design series of the humidifier is shown as the fourth letter of the Model Number. For example a HBGC is a "C" design unit and a HBGD is a "D" design unit. Refer to Figure F (Below) for "C" design units and Figure G for "D" design units.
3. If an air flow switch or high limit humidistat is not used, jumpers must be installed before the humidifier will operate.

Field Wiring Terminal Board—"C" Design Series  
Figure F



Field Wiring Terminal Board—"D" Design Series  
Figure G



## START UP

While the external disconnect switch is off, be sure terminal connectors are firmly secured to the top of the cylinder.

1. Open all water supply valves external to unit.
2. Turn external disconnect switch to "On" position.
3. In units with optional circuit breakers, turn circuit breaker(s) to "On" position.
4. For safety, door interlock disconnects power to cylinder(s) when door is open. Humidifier may be operated for service purposes when door is open by pulling out white button located above the meter. **CAUTION: HIGH VOLTAGES ARE PRESENT.**
5. Turn "On-Off-Drain" switch to "On" position. Green "On" light should now be on.
6. Unit will now be in operation if humidistat is calling for humidity. If humidistat is not calling for humidity, adjust humidistat control upward to check operation.
7. When humidistat is calling for humidity water will slowly flow into cylinder. Steam output meter will slowly rise as water enters cylinder.
8. The "Abnormal" light will remain on until sufficient water has entered cylinder to provide 50% of set output.

**Note:** Unit has been preset at factory for maximum output as shown on label on bottom left side of humidifier.

9. When high level or full output is reached, the fill solenoid valve will close.

**Note:** When starting unit with new cylinder the "Abnormal" light may come on and the drain solenoid valve and contactor may open for brief periods until water has come to full boil.

## LOW CONDUCTIVITY OPERATION

In areas where water conductivity is low full output may not be reached until humidifier has conditioned water.

1. If water comes in contact with the high level probe at the top of the cylinder (red wire) the fill valve will automatically close.
2. Water will boil and slowly drop below high level probe.
3. When water drops below probe, fill valve will reopen until probe is activated again.
4. Process will continue to occur until sufficient minerals have accumulated to allow full output.

## AUTOMATIC DRAIN CYCLE

The electronic circuit board controls the drain solenoid valve to drain a portion of the water from the steam cylinder.

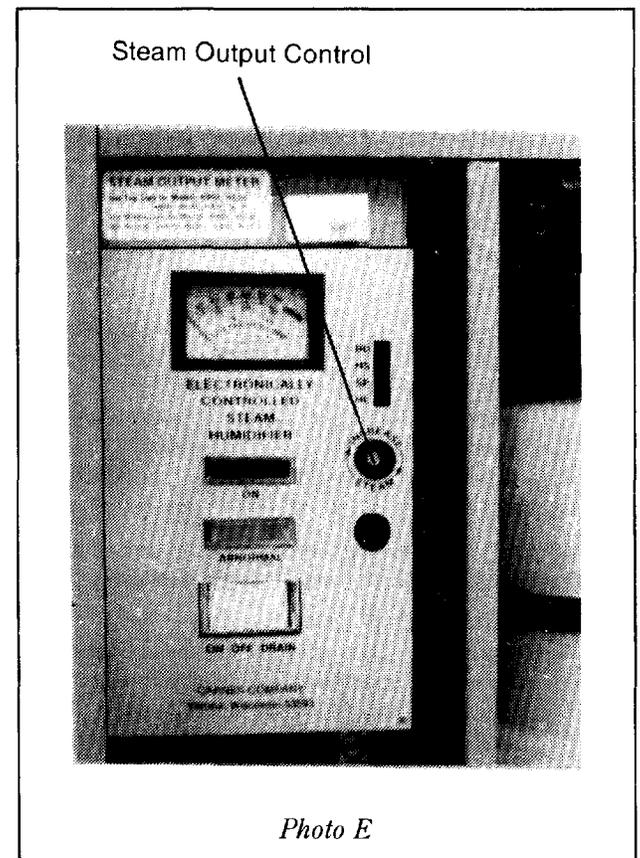
1. As water boils away in the cylinder a timer (indicated by "BD" light) is activated as current falls to 95% of setpoint.
2. The timer runs for a predetermined time until 90% of setpoint is reached.
3. If rate of change of current occurs too rapidly the drain solenoid will open to drain mineral rich water from the cylinder.
4. Fill valve will automatically reopen to refill cylinder to proper current level.

## ADJUSTING STEAM OUTPUT RATE

Steam output is regulated by adjusting steam output control (*Photo E*).

To change steam output:

1. Drain water from cylinder by turning "On-Off-Drain" switch to "Drain" position.
2. Turn steam output rate control fully clockwise.
3. Turn "On-Off-Drain" switch to "On" position. Steam output rate will gradually increase as shown on steam output rate meter. When desired output is reached, slowly turn counter clockwise until inlet water valve closes and stops incoming water.



*Photo E*

# MAINTENANCE

**NOTE:** It is advisable to inspect the humidifier visually at approximately two week intervals.

## UNIT MAINTENANCE

1. For safety, door interlock disconnects power to cylinder(s) when door is open. Humidifier may be operated when door is open by pulling out white button located above the steam output meter.

**CAUTION: HIGH VOLTAGES ARE PRESENT.**

2. Green "On" light should be on whenever power is supplied to the humidifier, and "On-Off-Drain" switch is in "On" or "Drain" position. If green light is **NOT** on, check the following items:

- a. If unit has optional internal circuit breakers they must be in "On" position.
- b. Check each incoming power wire for proper voltage as shown on humidifier rating plate.

**CAUTION: HIGH VOLTAGES ARE PRESENT.**

- c. Check green "On" light bulb (24 volt) using voltmeter.
3. When amber "Abnormal" light is *continually* on check the following items: **NOTE: Abnormal light will occasionally be on for short periods of time during operation such as initial startup, during a drain cycle and whenever the switch is in "Drain" position.)**
    - a. Clean water strainer.
    - b. All valves in water supply must be open and water pressure above 20 psi.
    - c. Check drain to be sure water is not constantly draining. Disassemble and clean drain valve if necessary.
    - d. Replace cylinder if desired output cannot be reached.
    - e. Check incoming power wire for proper voltage as shown on humidifier rating plate. **CAUTION: HIGH VOLTAGES ARE PRESENT.**
    - f. Check voltage at fill solenoid valve. Replace if 24 volts are present but valve is not open.
    - g. Check steam hose for any restriction.
  4. When amber "Abnormal" light is flashing it indicates that excessive current has occurred.

- a. Turn "On-Off-Drain" switch to the "Drain" position. If water does not drain from cylinder disassemble and clean drain valve.
- b. If water drains from cylinder, turn switch back to "On" position and allow unit to operate.
- c. Mineral build-up in the cylinder, may have caused a short. If this has occurred, replace cylinder.

5. Lights on electronic control module above the "Increase Steam" control are labeled as follows:

"BD" Used for factory calibration only.

"HS" If the green light is on it indicates that the humidistat and other external controls are closed and are calling for humidification.

"SP" Used for factory calibration only.

"HL" Red light indicates water is touching probe at the top of the cylinder. May be on during initial startup. May also be on when cylinder is full of minerals and needs replacement.

## CLEANING WATER STRAINER

1. Turn "On-Off-Drain" switch to "Off".
2. Turn circuit breakers to "Off". (Optional circuit breaker units only)
3. Shut off water supply valve ahead of unit.
4. Remove brass nut by turning counter-clockwise. (A small amount of water will drain when nut is removed. Use small container to catch this water).
5. Rinse strainer screen to remove deposits.
6. Reinstall screen, nut, and gasket in strainer housing.
7. Return unit to service.

## CHANGING STEAM CYLINDERS

**NOTE:** On two and three cylinder models, all cylinders must be replaced at the same time.

1. Turn "On-Off-Drain" switch to "Drain". Completely drain cylinder.
2. Turn circuit breakers to "Off" (Optional circuit breaker units only).
3. Slip off cylinder terminal connectors.
4. Remove steam hose.
5. Loosen cylinder retaining band.
6. Remove cylinder by turning counter-clockwise on cylinders with threaded connection. Lift cylinders up on cylinders with unthreaded connection.
7. Replace cylinder using teflon tape or pipe dope on cylinders with threaded connection. Make sure the new "O" ring is installed on the cylinder base and insert cylinders into holder with enough pressure to seat the "O" ring on cylinders with unthreaded connections.
8. Tighten cylinder retaining band.
9. Reconnect steam hose and tighten clamp.
10. Reconnect terminal connectors. **NOTE: Match numbers on terminal connectors with numbers on cylinders.**
11. Reconnect red high level probe wire.
12. Turn circuit breakers to "On." (Optional circuit breaker units only)
13. Turn "On-Off-Drain" switch to "On."
14. "Abnormal" light will remain on until water fills cylinder.

*After replacing humidifier cylinder, order a replacement immediately. This will insure having a spare cylinder on hand when the next change is required. Order model number shown on cylinder label.*

## MISCELLANEOUS

If humidification is not going to be required for a long period of time, e.g. during summer cooling cycle in a comfort application, it is recommended the steam cylinders be completely drained before switching off power and closing water supply valve.