

READ AND SAVE THESE INSTRUCTIONS

CARNES®

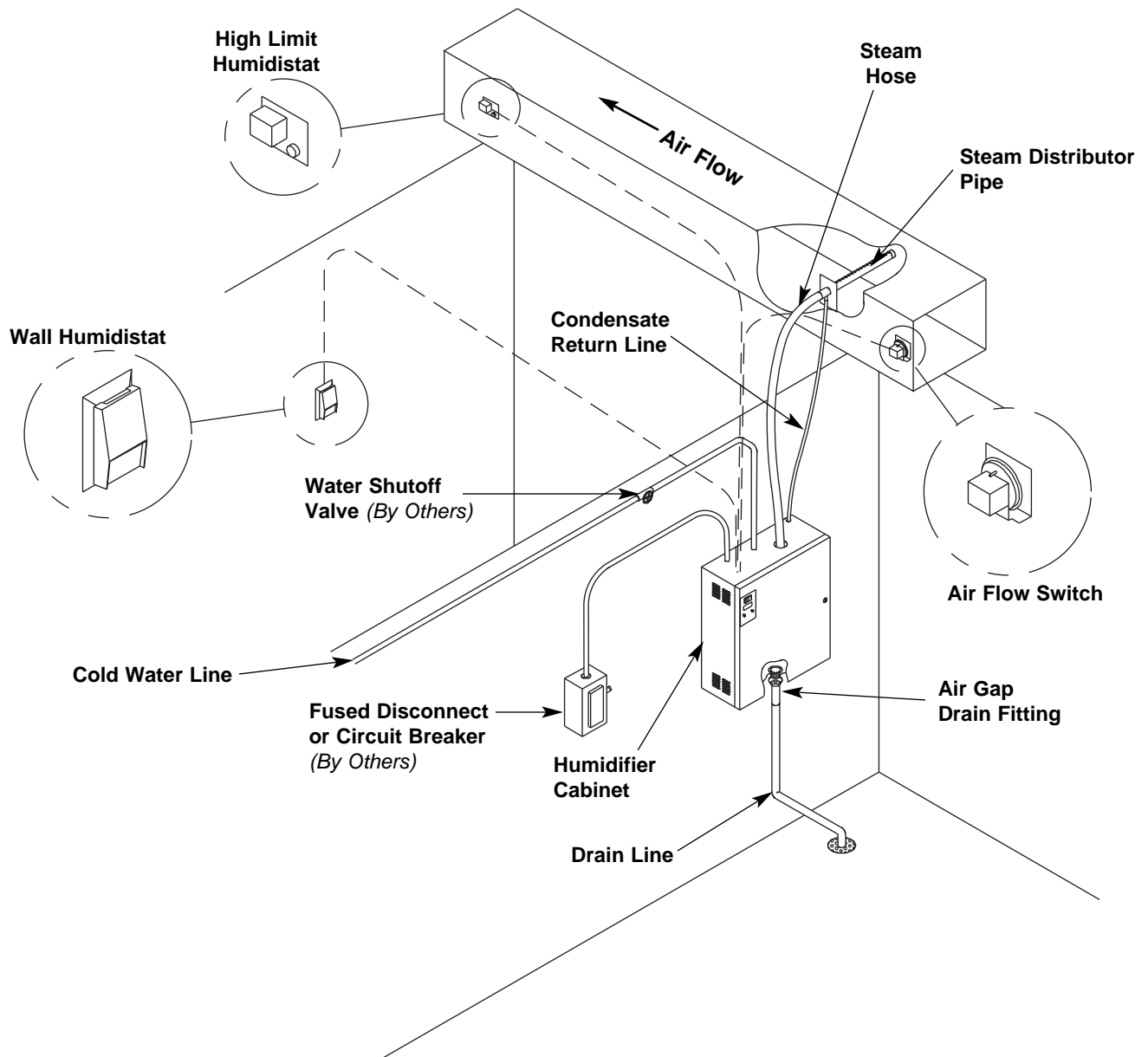
MODEL HRAA TECHNICAL MANUAL

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

CARNES COMPANY, 448 S. Main St., P. O. Box 930040, Verona, WI 53593-0040 - Phone: 608/845-6411 - Fax: 608/845-6470 carnes@carnes.com www.carnes.com

TYPICAL INSTALLATION

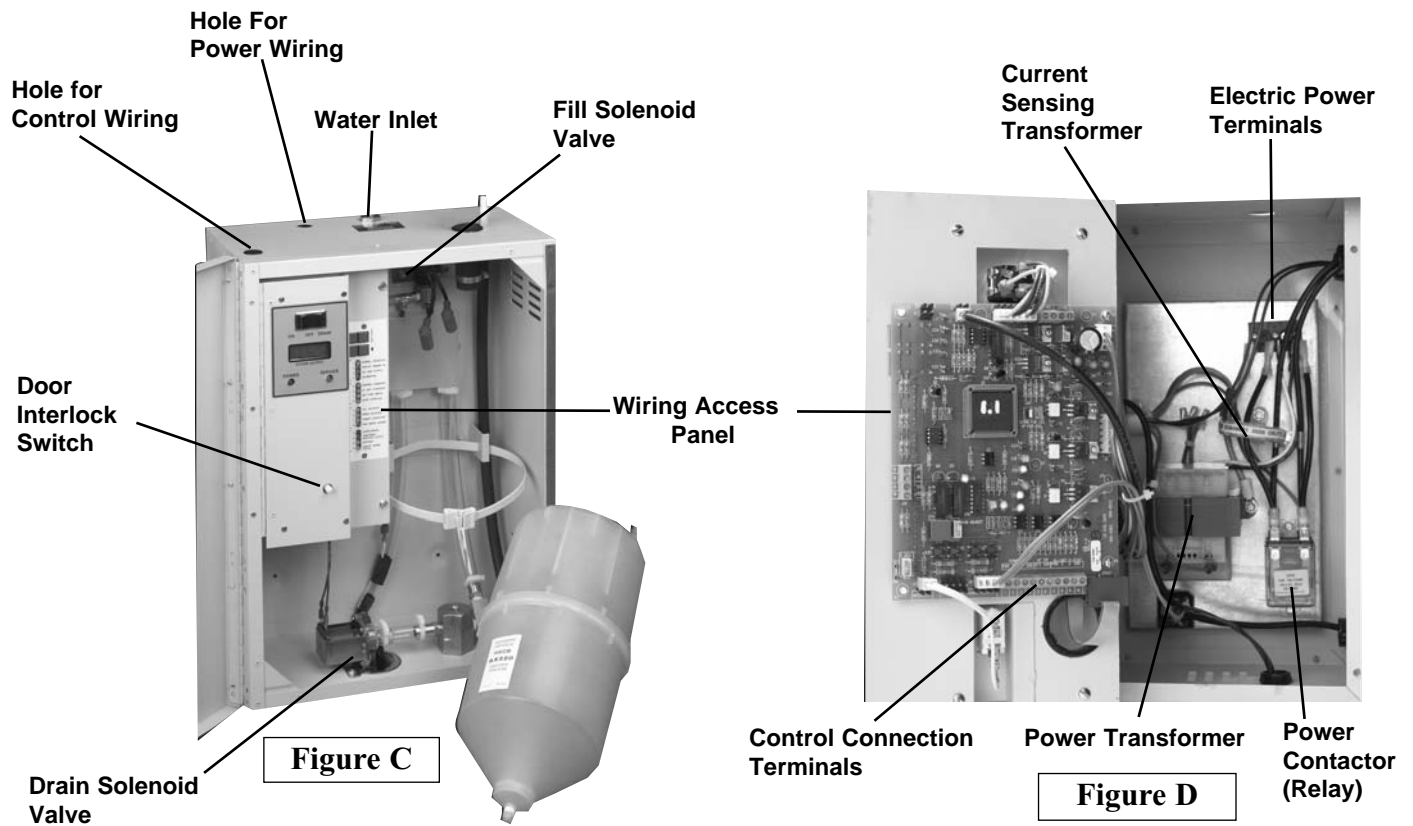
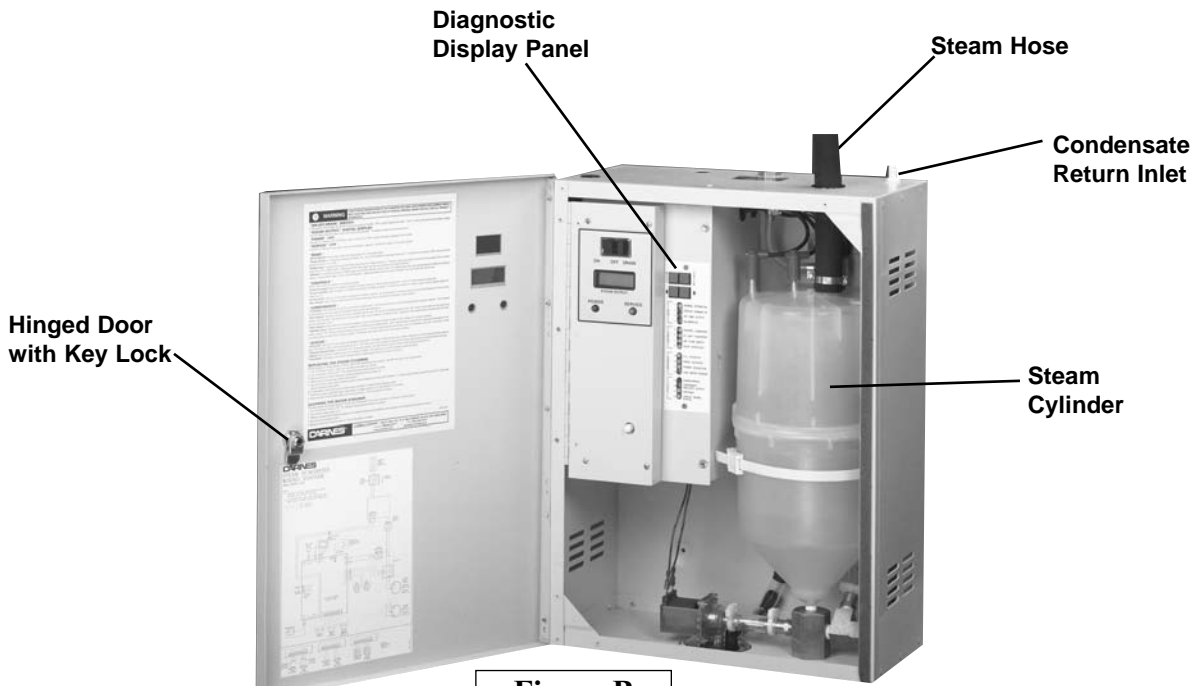
Figure A



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



WARNING: INSTALLING AND SERVICING THIS EQUIPMENT CAN BE HAZARDOUS DUE TO ELECTRICAL COMPONENTS AND HOT SURFACES. ONLY TRAINED AND QUALIFIED PERSONNEL SHOULD INSTALL, REPAIR OR SERVICE THIS EQUIPMENT. INSTALLATION MUST BE MADE IN ACCORDANCE WITH ALL APPLICABLE CODES AND STANDARDS.



INSTALLATION

UNPACKING AND INSPECTION

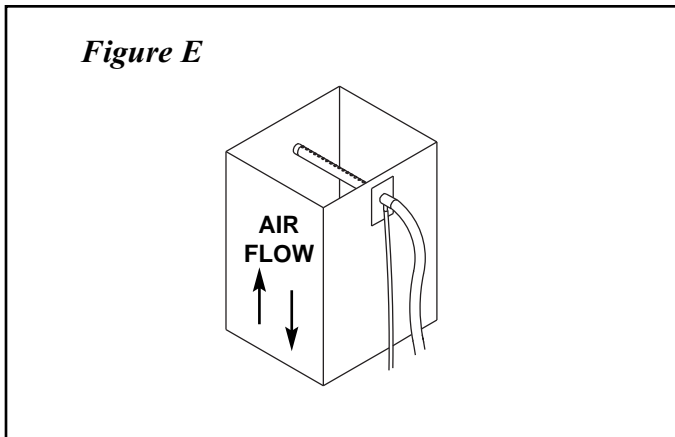
1. An envelope shipped with the cabinet contains the cabinet keys and Installation, Operation and Maintenance Instructions.
2. The following optional components are packed in a separate shipping carton for connection when installing the humidifier.
 - A. Steam Distributor Pipe.
 - B. Steam Hose.
 - C. Condensate Return Line.
 - D. Humidistats and Air Flow Switches.
 - E. Steam Hose Clamps.
 - F. Condensate Return Clamps.
 - G. Air Gap Drain Fitting.

STEAM DISTRIBUTOR PIPE LOCATION

In a typical installation the humidifier is located below a duct as shown in Figure A. The distance between the humidifier cabinet and the steam distributor pipe should be the shortest possible.

The maximum length of steam hose that may be installed is 10 feet.

In a vertical duct with either upward or downward air flow the distributor pipe should be installed horizontally.

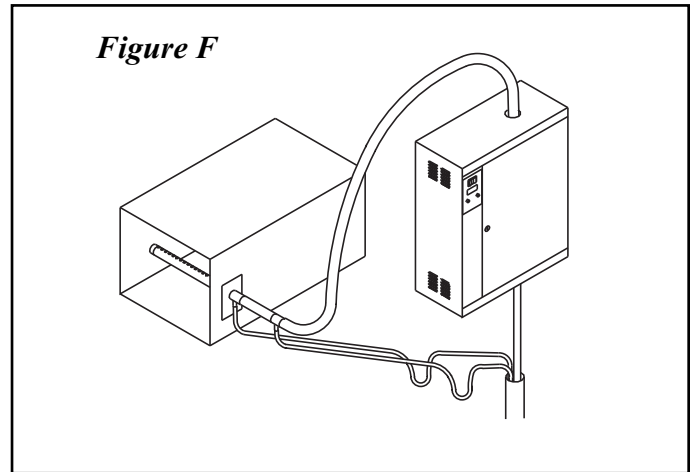


The distributor pipe should be located to insure best distribution of steam into the airstream. A minimum clearance of 4" must be maintained between the top of the duct and the distributor pipe.

The steam distributor pipe is usually located in the supply duct downstream of the fan. It is important to locate the distributor as far upstream as possible from any obstructions in the ductwork so that air can absorb the steam before it impinges on a surface and condenses. There must be minimum of three feet between the distributor and any fans, coils, filters, dampers, elbows or outlets downstream to reduce the possibility of condensation.

Duct air temperatures below 60°F may require a condensate drain pan, supplied by others, below the steam distributor pipe.

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



INSTALL STEAM DISTRIBUTOR PIPE

The steam distributor pipe must be mounted on a plumb surface so that it is inclined upward. This is required so the condensate, which forms in the distributor pipe, will drain into the return line.

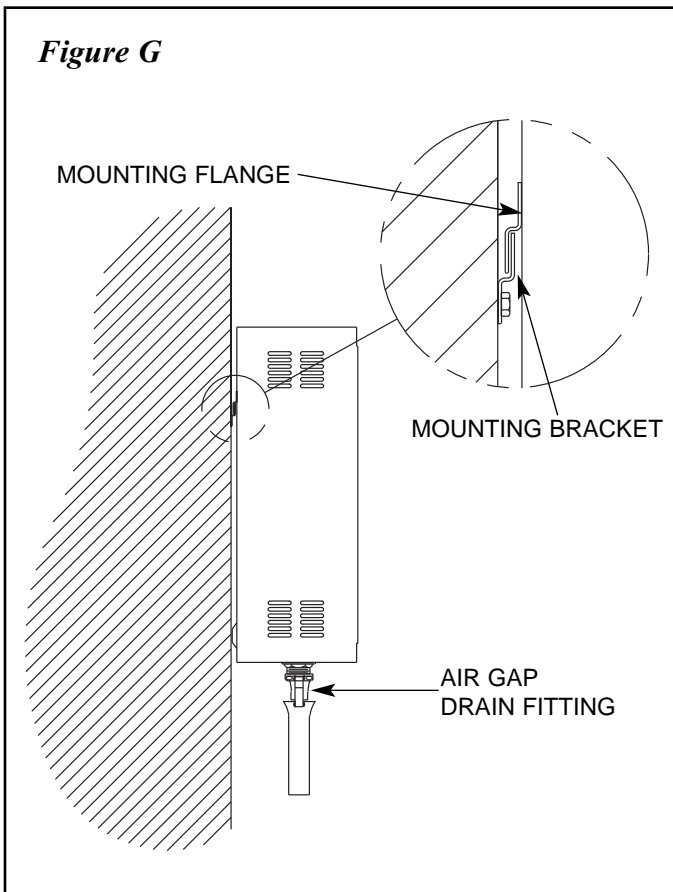
Insert the distributor pipe into duct and secure with four sheet metal screws, not provided.

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 sides for ventilation and 16" from the bottom to the floor to allow for drain connections. Allow at least 16" in front of cabinet for door opening. Consult local and national codes prior to installation and comply with any provisions they require.

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

Maximum operating weight is 70 pounds. Fasten the mounting bracket to wood studs or solid wood. Recommended fasteners: Four 1/4" x 1" long lag screws. Fasteners are not provided.



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.

WATER SUPPLY CONNECTION

DO NOT use hot water, deionized water, or water that has been treated by a water softener without consulting the factory.

Use ordinary tap water (20 to 120 psi). A 1/4" FPT fitting is provided at the top of the humidifier. A shutoff valve, not provided, must be installed 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. The nut and gasket may be used with standard type drain fitting if an air gap fitting is not required by local codes.
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 or run piping to a floor drain. Use plumbing material capable of handling hot water, such as copper or CPVC.

CONNECT THE STEAM HOSE & CONDENSATE RETURN LINE

COPPER TUBE IS THE ONLY ACCEPTABLE SUBSTITUTE FOR STEAM HOSE OR CONDENSATE RETURN LINE.

1. The steam hose should be installed so there is a continuous rise from the humidifier to the distributor pipe. The rise should be 2" in 12" to allow proper condensate drainage.

Support the steam hose at intermediate points to prevent dips or pockets. It is very important that both the steam hose and condensate return line be installed so that sags are prevented. The steam is at very low pressure and it cannot overcome resistance caused by water standing in the steam hose. Water accumulating in sags in the return line will restrict the flow and may cause water to enter the duct from the distributor pipe.

If it is difficult to install the steam hose to prevent sags, it is recommended that copper tube be used as a substitute. Size 3/4" copper tube can be used. Any 90° elbows are approximately equivalent to three feet of steam hose.

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 cylinder in the humidifier to the copper tube. Another short length should be used to connect the copper tube to the distributor pipe. Any turns in the hose should have a minimum radius of 8" to prevent kinking.

2. 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 with the hose clamp provided.
4. Fasten the condensate return line to the distributor pipe with the hose clamp provided. Connect the return line to the condensate return inlet with the hose clamp provided.

If it is impossible to maintain a drop to the top of the cabinet, it will be necessary to run the condensate return line directly to the air gap drain fitting or some other drain. A trap (usually 8" is sufficient) may be necessary to prevent loss of steam through the return line. Do **not** install a trap if condensate is returned to the top of the cabinet.

ELECTRICAL DATA


Model	Maximum Lb./Hr.	kW	Voltage	Phase	Line Amp Rating	Recommended Disconnect Size (Amps)	Steam Cylinder	Digital Display Code
HRAAA U 005	5	1.7	120	1	14.4	20	HXCBAX220	0005
HRAAD U 005	5	1.7	230	1	7.5	15	HXCBAX380	3005
HRAAD U 010	10	3.4	230	1	15.0	20	HXCBAX380	3010

U = UL

C = cUL



ELECTRICAL CONNECTIONS



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

Check unit electrical characteristics on label outside of cabinet. They must agree with power provided to the unit.

A fused disconnect or circuit breaker, not provided, must be installed per local and national codes.

1. Remove screws securing hinged panel for access to wiring.
2. An opening is provided on the top of the electrical section. Bring electrical power lines through this opening and connect to the electric power terminals as shown on wiring diagram.
3. Replace electrical cover panel.

CONTROLS

CONTROL HUMIDISTAT

Either a wall-mounted 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 adjusted to accommodate changing requirements or to lower the level of relative humidity in the space to prevent condensation on windows during extremely cold weather. Room humidity is usually set in range of 30-40% RH. Other settings may be necessary for certain conditions.

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.

If a 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 humidistat. Proportional control provides less on-off cycling of the humidifier.

AIR FLOW DETECTION

The humidifier control circuit should include some method to confirm air flow. If the steam distributor pipe were "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 using a pressure differential switch that detects air flow by sensing static pressure in the duct.

CONDENSATION PROTECTION

An additional device may be used to provide condensation protection in the duct system. A high limit humidistat may be installed 10 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. Once the humidity level returns below the set-point, humidifier operation will resume following a delay of several minutes after reclosure of the circuit. Use of this device is recommended particularly when the humidifier is used in applications where cooling air is being humidified.

Either an on-off or proportional high limit humidistat may be used. 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. One may be located in the area to be humidified or its 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.

EXTERNAL MONITORING

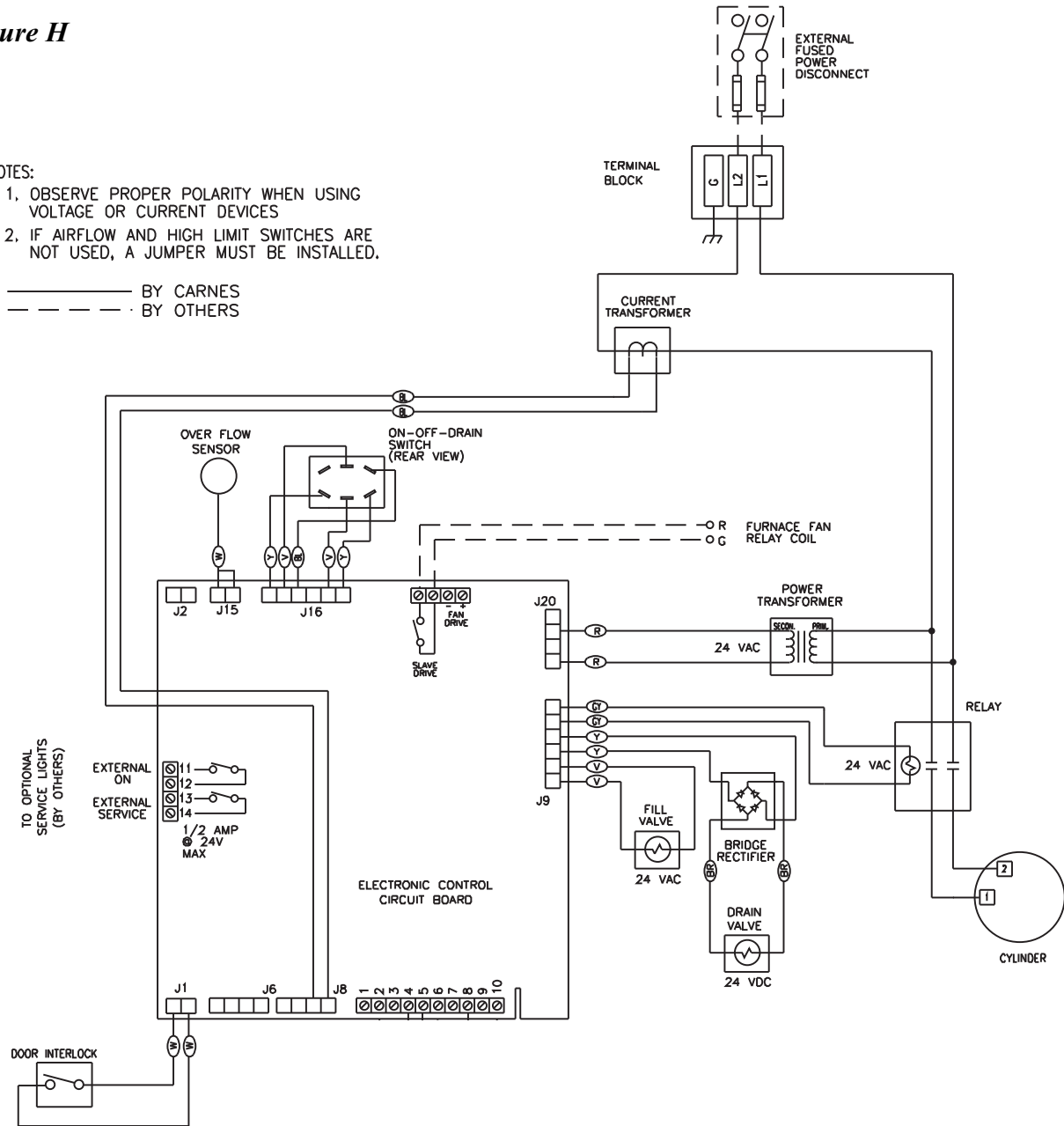
Terminals 11 and 12, shown in Figure H are provided for remote monitoring of the status of the humidifier if desired. When the unit is on terminals 11 and 12 are closed. When the output of the humidifier is less than 50% of set-point terminals 13 and 14 are closed indicating a need for service. Each set of terminals is capable of switching 1/2 amp at 24 volt maximum.

Figure H

NOTES:

1. OBSERVE PROPER POLARITY WHEN USING VOLTAGE OR CURRENT DEVICES
2. IF AIRFLOW AND HIGH LIMIT SWITCHES ARE NOT USED, A JUMPER MUST BE INSTALLED.

————— BY CARNES
 - - - - - BY OTHERS



CONTROL CONNECTIONS

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

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

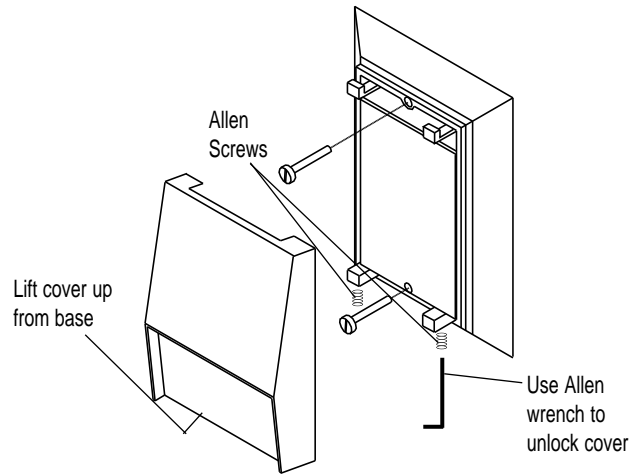
Controls should be connected to the terminals on the electronic circuit board as shown Figure H using #18 AWG wire. Avoid running control wiring near high voltage wires.

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

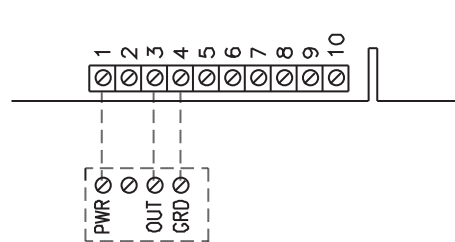
NOTE: A built-in transformer provides power for the control circuit. No outside power supply is required for the control circuit.

OPTIONAL ACCESSORY CONTROLS

WALL HUMIDISTAT, PROPORTIONAL CONTROL



The wall mounted HXHCG humidistat uses a special sensor and electronic circuitry to modulate the output of the humidifier. The humidistat automatically adjusts the humidifier output to match the humidity requirements. This humidistat has a concealed set-point adjustment with a locking cover. Set-point range is from 10-90% RH.



WALL HUMIDISTAT, ON-OFF CONTROL



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

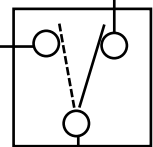
Mount with Number 6 screws provided for switch box mounting. Different screws are required for wall mounting.

RED MAKES TO ORANGE
on a R. H. Rise.

BROWN (N. O.) (To Terminal 2 or 4)

BROWN MAKES TO ORANGE
on a R. H. Drop.

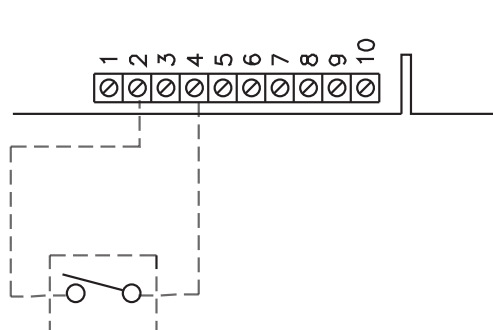
RED (N. C.)



ORANGE (COMMON)
(To Terminal 2 or 4)

NOTE: The HXHAA has 6" (152mm) leads and a green grounding wire for use with non-conducting conduit.

Mount this humidistat four or five feet above the floor in freely circulating air of the temperature and humidity about average for the entire space to be controlled. Avoid locations near hot or cold air ducts and discharge air from the humidifier. Scale range is from 10-90% RH. Differential is 5% non-adjustable.

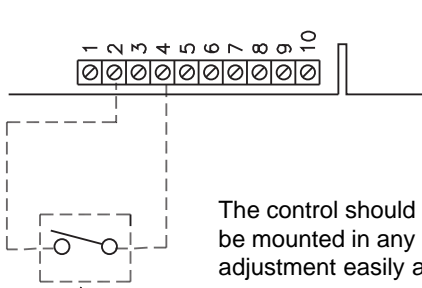


DUCT HUMIDISTAT, ON-OFF CONTROL

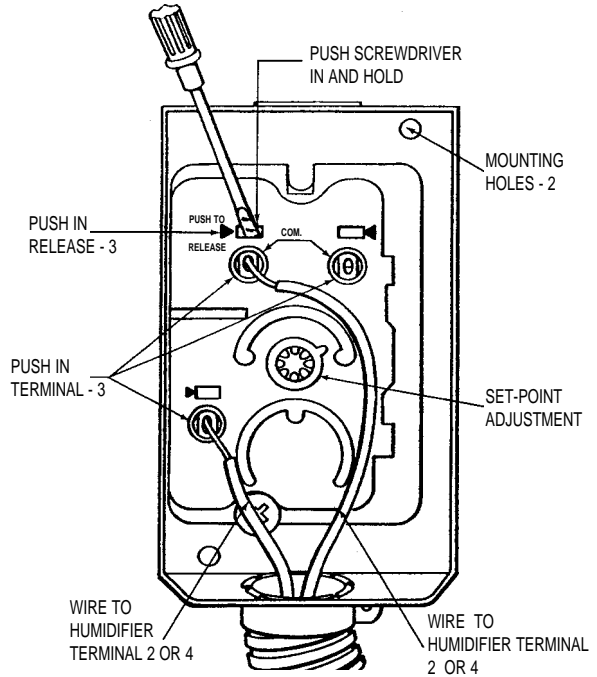
Model HXHAB



This duct mounted humidistat is installed in the return air duct to sense the humidity level in the area being served. Scale range is 15-50% RH. Differential is 4-6% non-adjustable.

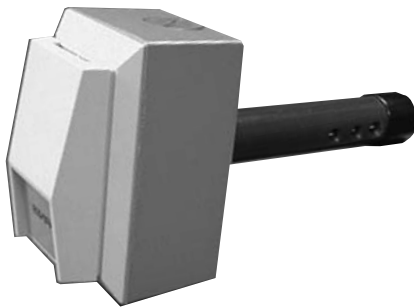


The control should be located in the duct where it will be affected by normal air flow. The control can be mounted in any position, but where possible locate it on the side of the duct to make the set-point adjustment easily accessible.

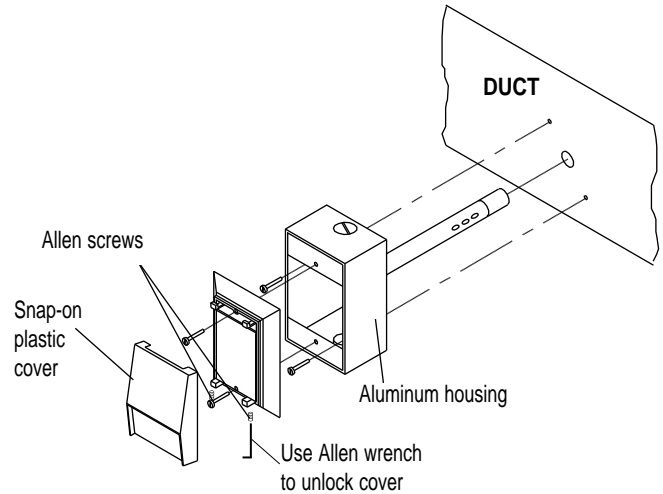


DUCT HUMIDISTAT, PROPORTIONAL CONTROL

Model HXHCH



The model HXHCH can be mounted in either the return air duct when used to sense the humidity in the area being served or in the supply duct a minimum of 10 feet downstream of the steam distributor pipe when used as a high limit control. Set-point range is 10-90% RH.

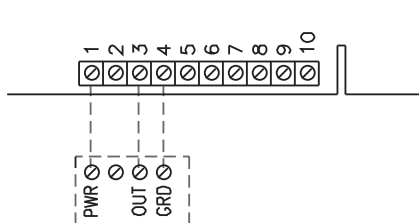


Remove any excess insulation from the duct that would prevent the probe from extending a minimum of 4" (106mm) into the air stream.

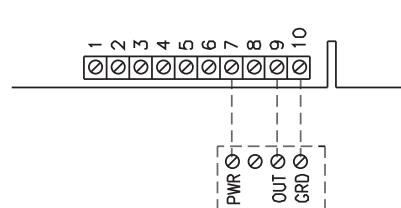
Make a 1-1/2" (38mm) hole in the duct for inserting the probe.

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

WHEN USED TO CONTROL ROOM RELATIVE HUMIDITY



WHEN USED AS HIGH LIMIT HUMIDISTAT



AIR FLOW SWITCH, PRESSURE DIFFERENTIAL TYPE

Model HXAEE



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

Environment:

Ambient Temperature Limits,

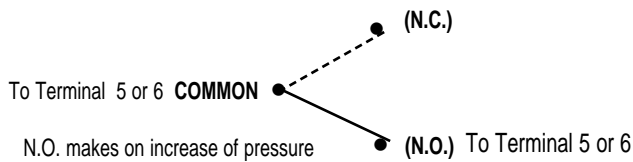
Shipping -40 to 140°F (-40 to 60°C).

Operating 35 to 140°F (0 to 60°C).

Humidity, 5 to 95% R.H., non-condensing.

Locations, NEMA Type 1 indoor only.

Mounting: In vertical position on any surface free of vibration



On an increase of air pressure to above set-point, common contact of switch is made to normally open contact. On a decrease of air pressure to below set-point, common contact of switch is made to normally closed contact. Avoid locations where excessive moisture, corrosive fumes or vibrations are present.

Set-point:

Factory Set, 0.07" (1.8mm) W.C.

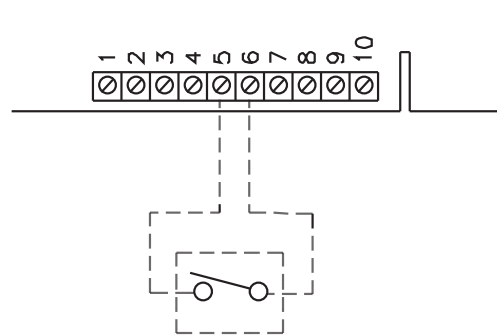
Field Adjustable, 0.07 to 1" (1.8 to 25.4mm) W.C.

Sensing Element: Neoprene diaphragm.

Adjustment

Note: Units are shipped at minimum set-point.

To increase set-point, turn adjustment screw clockwise. Adjustable 0.05 ±0.02" to 1.0" (1.25mm ±0.5mm to 25mm) W.C. To decrease set-point, turn adjustment screw counterclockwise.



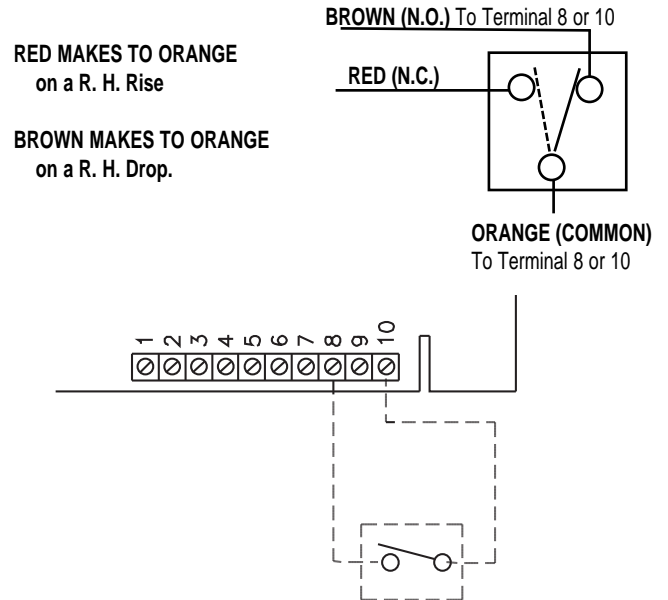
HIGH LIMIT HUMIDISTAT

Model HXHAD



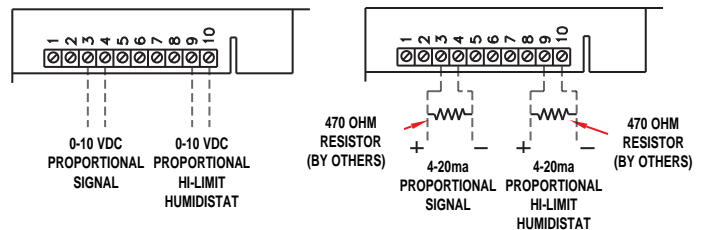
The Model HXHAD is available to reduce the potential of condensation occurring in the supply duct. The control must be mounted a minimum of 10 feet downstream of the steam distributor pipe. Set-point range is 15-95% RH. Differential is 5% non-adjustable.

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



EXTERNAL DDC CONTROL SIGNALS

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



OPERATION

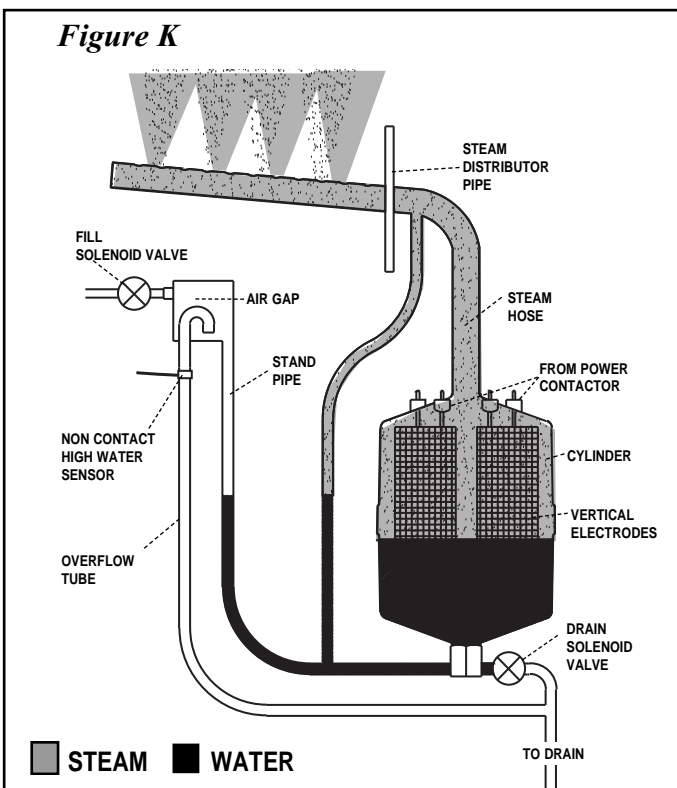
Upon a signal from external controls the circuit board opens a fill solenoid valve, allowing water to flow across an air gap into a standpipe. See Figure K. The standpipe provides a column of water to be fed into the cylinder using gravity. The air gap prevents back flow into the water supply and prevents the cylinder from becoming a pressure vessel. The steam cylinder operates at a pressure of less than 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 monitors current flow between the electrodes and automatically opens the fill solenoid valve when more water is required to maintain the desired output rate, and closes when the desired rate is reached.

The operation of the drain solenoid valve is automatically controlled by the circuit board, which responds to any changes in water conditions and drains the required quantity of water to provide stable operation and long cylinder life.

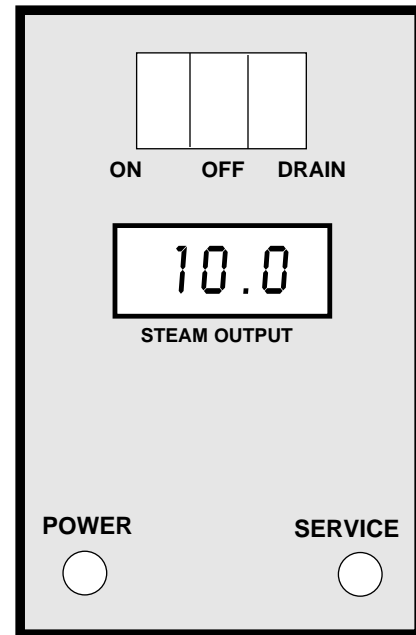
As mineral deposits build up within the cylinder the water level will slowly rise to uncovered electrode surfaces to maintain the desired steam output rate. When mineral deposits have covered all available electrode areas, current flow will be reduced to a level when the desired steam output cannot be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



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 L



"ON-OFF-DRAIN"

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 opens 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.

"SERVICE" LED

This LED 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" for additional information.

DIAGNOSTIC DISPLAY PANEL

PUSH BUTTONS

"Mode" button selects "Normal Operation", "Display Demand %", "Set Max Output" and "Calibration". "Enter" button is used with "Mode" button to reset maximum steam output.

"MODE"

"Normal Operation" shows steam output rate in pounds per hour on the digital display.

“Display Demand %” is selected by pressing the “Mode” button once. The digital display will then show the % demand from the humidistat. If an on-off type humidistat is used the display will read approximately “100”. If an proportional humidistat is used the display will show the percent demand from 0 to 100%. For example if the input voltage between terminals 3 and 4 is 8 volts DC the display would indicate “80”.

“Set Max Output” is selected by pressing the “Mode” button once from “Display Demand %”. The steam output may be set to a new maximum 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” 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 if necessary to prevent condensation in the duct.

“Calibration” is selected by pressing the “Mode” button once from “Set Max Output”. The digital display then shows a four-digit code indicating the voltage and maximum capacity of the humidifier. See Electrical Data Table for code numbers. Pressing “Mode” again returns to “Normal Operation”. The humidifier will automatically return to “Normal Operation” 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.

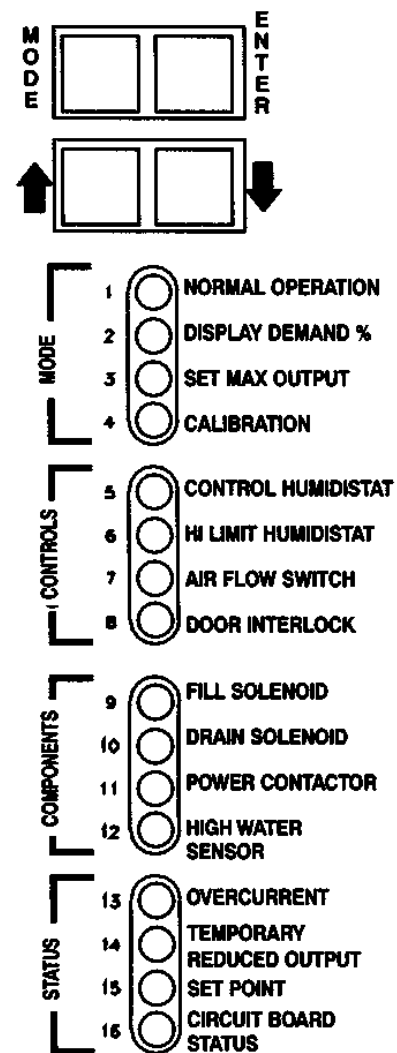
“Control Humidistat” LED lights if an on-off humidistat connected to terminals 2 and 4 is calling for humidity. It will also be on if a voltage from a proportional humidistat is connected to terminals 3 and 4 and the signal is above 3 volts DC. A 10-volt DC signal will call for maximum output and modulate proportionally down to 2 volts DC. The humidifier will be off below 2 volts DC.

“High 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 an voltage from a proportional high limit humidistat 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 for temporary manual operation or closing the door.

Figure M



“COMPONENTS”

“Fill Solenoid” LED lights whenever the circuit board is sending 24 volts 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 to the drain solenoid valve. The valve is opened to drain some of the high mineral content water from the cylinder and replace it with fresh water. This is not a preset repetitive cycle but is automatically determined by the circuit board and only occurs when necessary to maintain proper mineral content 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 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 without making physical contact with the water. When overflow is detected, the fill solenoid valve is temporarily prevented from opening. 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. This cycle may be repeated several times if the incoming water is very low in mineral content. As minerals build up in the water in the cylinder increasing its conductivity the set-point will gradually increase until the full output 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.

“STATUS”

“Overcurrent” LED lights if the circuit board has detected over-current in the steam cylinder and has been unable to reduce the current by operating the drain solenoid valve. The humidifier is placed in 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 is reached. This light will be on and off during the normal operating cycle of the humidifier as water fills the steam cylinder and is boiled away and filled again.

“Circuit Board” LED pulsing is normal and indicates that the microprocessor on the 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. For safety, the door interlock disconnects power to cylinder when the door is opened. Humidifier may be temporarily operated for service purposes by pulling out white button.



CAUTION: HIGH VOLTAGES AND HOT SURFACES ARE PRESENT.

4. Turn “On-Off-Drain” switch to “On” position. Green “On” LED should now be on.
5. Unit will now begin to operate if external controls are calling for humidity. See “Controls” for details.
6. As water slowly fills into cylinder the digital display will begin to increase when water contacts electrodes.
7. The “Service” LED may come on until sufficient water has entered cylinder to provide 50% of set-point.
8. 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” for details.
9. 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 complete boil.
10. 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 the 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. The circuit board opens the fill solenoid valve to refill the cylinder to proper levels.

REDUCING OVERCURRENT

1. If current to 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 is open.
5. 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.

ADJUSTING STEAM OUTPUT RATE

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.

ROUTINE MAINTENANCE

REPLACING THE STEAM CYLINDER:



WARNING: THE ABILITY TO SAFELY PERFORM MAINTENANCE ON THIS EQUIPMENT REQUIRES TRAINING, MECHANICAL SKILLS AND TOOLS. IF YOU DO NOT POSSESS THESE, DO NOT ATTEMPT TO PERFORM MAINTENANCE ON THIS EQUIPMENT. FAILURE TO FOLLOW THIS WARNING COULD RESULT IN DAMAGE TO THIS EQUIPMENT, SERIOUS PERSONNEL INJURY, OR DEATH.



CAUTION: HIGH VOLTAGES AND HOT SURFACES ARE PRESENT. ALLOW CYLINDER TO COOL BEFORE HANDLING.

Normal indication to replace cylinder is "Service" light on after extended period of operation (500-2000 hours).

1. Turn "On-Off-Drain" switch to "Drain" and completely drain water from cylinder.
2. Turn "On-Off-Drain" switch to "Off". Turn power disconnect switch ahead of humidifier off.
3. Remove terminal connectors from top of cylinder by twisting and pulling straight up.
4. Remove steam hose and open cylinder retaining band.
5. Remove cylinder by turning counter-clockwise.
6. It is advisable to check drain lines and solenoid valve and clean if necessary before replacing cylinder.
7. Install new cylinder by using Teflon tape or pipe dope.
8. Reconnect hose, retaining band and terminal connectors. Turn on all power to humidifier.

CLEANING THE WATER STRAINER:

The water strainer may require cleaning if "Service" and "Fill Solenoid" LED's are on and water is not flowing or is flowing slowly.

1. Turn "On-Off-Drain" switch to "Off". Turn off power disconnect switch ahead of humidifier.
2. Shut off water valve ahead of the unit. Disconnect flexible tube, brass fitting, and electrical connections from fill valve. Remove fill valve by loosening two mounting nuts.
3. Strainer is located inside threaded connection on fill solenoid valve.
4. Rise strainer screen. Do not attempt to remove screen from valve body.
5. Replace valve and reconnect brass fitting, flexible tube, and electrical connections. Turn on all power to humidifier.



WARNING: THE ABILITY TO SAFELY PERFORM MAINTENANCE ON THIS EQUIPMENT REQUIRES TRAINING, MECHANICAL SKILLS AND TOOLS. IF YOU DO NOT POSSESS THESE, DO NOT ATTEMPT TO PERFORM MAINTENANCE ON THIS EQUIPMENT. FAILURE TO FOLLOW THIS WARNING COULD RESULT IN DAMAGE TO THIS EQUIPMENT, SERIOUS PERSONNEL INJURY, OR DEATH.

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. Verify that 24 V 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.
3. If 24 V AC is not present reset the overload located on the transformer and recheck.
4. If 24 V 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 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.

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 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, and standpipe but not into the steam cylinder check to determine if drain solenoid valve is partially open. See "Drains Continuously" section on next page.
4. If water is not flowing check "High Water Sensor" LED. If LED is on, wait a minimum of one minute. Every 60 seconds the high water sensor resets and rechecks for water flow through the overflow tube. The sensor is touch and proximity sensitive so touching the wire or sensor will cause it to activate.
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" info.
3. If all four LED's are on check LED labeled "Fill Solenoid". If LED is on, check 24 V AC at coil of fill solenoid valve. If 24 V AC is present water should be flowing. Be sure all shut off valves ahead of the unit are open.
4. If water is available check strainer on solenoid valve for sediment. Clean if necessary.
5. If 24 V 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" for details.

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 out.
2. The "Drain Solenoid" LED indicates if the electronic circuit board is sending 24 V DC to the valve. If the LED is off but 24 V 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 volume.
2. Make sure that the condensate return line is not restricted. Areas where the hose bends or where it is tied using cable ties are often the problem.
3. The distributor pipe must be installed so that far end of the distributor pipe is higher than the incoming end where the condensate return connection is located. The mounting plate on distributor pipes should be mounted on a plumb surface to provide proper pitch.
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 to the drain below the unit rather than connecting at the top of the cabinet.

5. If the condensate return line is connected to 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.

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 3 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" 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 occur 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 an 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. 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 24 V 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 even with the fill solenoid open.
4. Insufficient flow of incoming 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, 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 cause low water levels and arcing.
7. Frequent cleaning of the steam cylinder by removing and flushing or by striking the side of the cylinder potentially dislodges flakes that can build up a "dam" in the drain lines. It is not recommended that the cylinder be removed except for replacement.
8. Chemicals should not be used to attempt to prevent mineral build up in the cylinder or to dissolve minerals that accumulate. Chemical treatment may affect conductivity. Only untreated tap water is recommended for use in the humidifier.



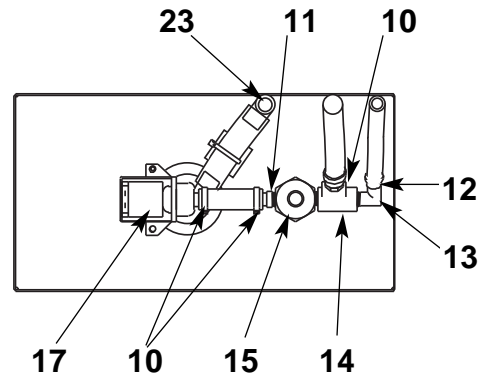
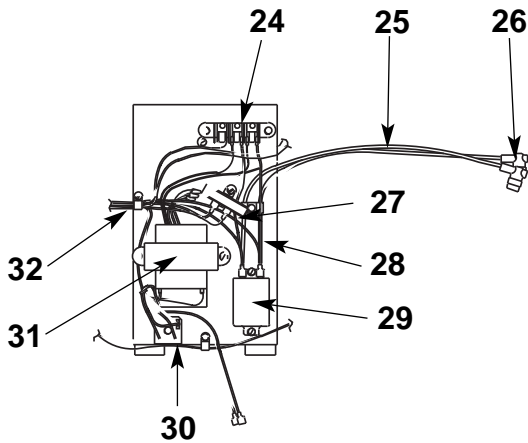
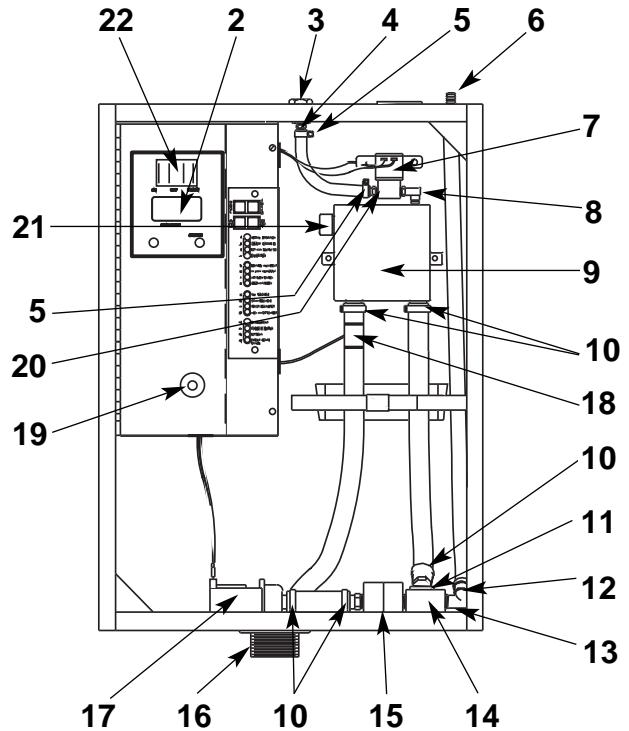
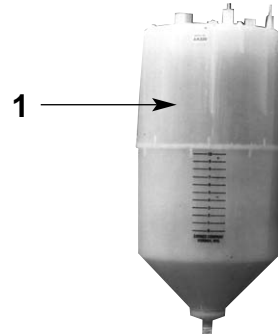
WARNING:

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.

Model HRAA - Replacement Parts

Item Number	Description	Part Number
1	Steam Cylinder (120V)	HXCBAX220
1	Steam Cylinder (230V)	HXCBAX380
2	Circuit Board with LCD Display	H-690-0080
3	Water Inlet Fitting, 1/4" NPT	H-999-4055
4	Barbed Connector, 1/4" NPT (Straight)	H-999-4057
5	Metal Hose Clamp	H-999-7166
6	Plastic Fitting	H-999-4062
7	Fill Solenoid Valve	H-999-7447
8	Barbed Connector, 1/8" NPT (Elbow)	H-999-4059
9	Molded Fill Cup	H-690-4139
10	Plastic Hose Clamp	H-999-7161
11	Barbed Connector, 3/8" NPT (Straight)	H-999-4058
12	Plastic Hose Clamp	H-999-7162
13	Barbed Connector, 3/8" NPT (Elbow)	H-999-4060
14	Brass Tee, 3/8" NPT	H-999-4061
15	"AX" Cylinder Connector	H-998-5703
16	Sink Fitting	H-999-8676
17	Drain Solenoid Valve	H-999-7448
18	High Level Sensor Including Overflow Tube	H-690-1352
19	Door Interlock Switch	H-801-7801
20	Barbed Connector, 1/8" NPT (Straight)	H-999-4056
21	Plastic Cap	H-999-8310
22	On-Off-Drain Switch	H-999-7330
23	Plastic Elbow	H-999-9690
24	Terminal Block	H-999-7992
25	Power Wire with Cylinder Terminal Connector	H-690-2991
26	Terminal Connector - Red	H-998-1256
27	Current Sensing Transformer	H-999-9429
28	Power Wire	H-690-2990
29	Power Contactor (Relay)	H-999-6126
30	Bridge Rectifier	H-999-6127
31	Power Transformer	H-998-9537
32	Low Voltage Wiring Harness	H-998-7008
*	Air Gap Drain Fitting	H-690-0176
*	Door Lock with Key	H-999-9141
*	Key for Door Lock	H-999-5106

* Not Shown



**ADDENDUM (1) TO FORM #'S - 16799, 16828, 16789, 16831
INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS**

CARNES COMPANY 448 S. Main St., P. O. Box 930040, Verona, WI 53593-0040 Phone: (608)845-6411 Fax: (608)845-6470 www.carnes.com

In an attempt to improve quality and ease of maintenance, certain performance enhancements have been added to the Microprocessor chip, located on the back side of Circuit Board H-690-0080. The new version installed as of the week of May 19, 2008 is 1.5. This version will replace all previous versions of the "G" model design series. It is also available as a replacement part (H-998-5928).

"SET-POINT" LED: (Current 1.5 Version Microprocessor)

Flashing LED indicating an error condition where the drain valve is stuck open, typically due to large flakes or chunks of solid mineral deposits broken free from the cylinder and lodged within the valve body. This program will attempt corrective action and, if unsuccessful, will shutdown the unit and signal user.

CORRECTIVE ACTION TO TAKE: Clean or replace solenoid valve.

"OVER-CURRENT" LED: (Current 1.5 Version Microprocessor)

Steady LED indicating an inoperative drain system, due to plugging with mineral deposits or inoperative drain valve mechanics. Flashing LED will no longer be included in fault indications.

CORRECTIVE ACTION TO TAKE: Clean or replace drain solenoid valve and/or clean out drain plumbing.

"HIGH WATER" LED: (Current 1.5 Version Microprocessor)

Flashing LED distinguishes between overflows caused by abnormal operating conditions (excessive back-pressure, drain valve stuck closed, aged cylinder) versus overflows caused by normal, allowable conditions (start-up with low conductivity water).

CORRECTIVE ACTION TO TAKE: If cylinder has been in use for a period of time, replace cylinder. Check and clean or replace as necessary the drain solenoid valve. Check and clean as necessary the drain plumbing.

If cylinder is new, check the following and take corrective action as shown. Back-pressure can be fixed by removing any elbows or sags in hoses, or reduce the length of hose between humidifier and distribution pipe by moving them closer together.

OTHER PROGRAM CHANGES: (Version 1.5)

The fill delay at each overflow detection for past and current microprocessor version is as follows: 1.1 Version is 1 minute, 1.2 Version is 10 minutes & 1.3 Version is 5 minutes. 1.5 Version is 5 minutes like 1.3 & 1.4 and will now be the current version of all "G" model design series. It can also replace any previous versions as necessary.

DISPLAY DEMAND % FOR CONTROL HUMIDISTAT & HIGH LIMIT HUMIDISTAT: (Version 1.5)

To display demand from High Limit Humidistat, in addition to control humidistat, which previous version did not provide. When user selects Display Demand % mode, the following will be displayed as XX.YY: XX = Demand from control humidistat in %, YY = Demand from high limit humidistat in %. (the highest value that the control humidistat or high limit humidistat will show is 99. 99 will be defined as 100% value. 2 is the maximum characters available for each control value on the digital LCD).

New program feature available with 1.5 version microprocessor chip. In the event of humidifiers being used in areas where the potable tap water supply is questionable, based on bad water, high hardness, high mineral content, etc, the 1.5 version offers the following. With the input of a specific digital operating code in the software of the circuit board, a pulsing drain cycle can be activated whenever a self correcting cycle is initiated on the low side of operating cycle during boil down. Contact technical rep for details.