

COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL STEAM HUMIDIFIERS



HSHH Shown

CARNES MICROPROCESSOR CONTROLLED STEAM HUMIDIFIERS use ordinary untreated tap water and convert it to mineral free steam for humidity control in commercial, industrial, institutional and residential applications.

ECONOMICAL

- Disposable Cylinders Eliminate Periodic Maintenance for Reduced Maintenance Costs
- Fast and Easy Installation
- Reliable Electronic Components for Long Life

EFFICIENT

- Circuit Board Utilizes Microprocessor to Maximize Energy Conservation
- Exclusive Circuit Board Design with Attached True Touchscreen Control Display

VERSATILE

- Digital Output on a True Touchscreen Control Display Providing Status and Help Buttons For Operational Details and Troubleshooting
- Capacities up to 200 Pounds of Steam Per Hour Per Single Unit
- Utilize any On-Off Humidistat, Carnes Proportional Humidistat or External Signal from DDC Controls



The simplicity and unique advantages of humidity from directly boiling water in disposable cylinders has been well known since Carnes pioneered the concept in North America in 1969. Pan type humidifiers require messy, time consuming cleaning that may require the use of acids. Electric heating elements in pan type units may also require replacement. Easily changeable steam cylinders containing electrodes can be replaced in less than five minutes.

Cut-away used steam cylinder showing mineral deposits.



FRONT PANEL DISPLAYS & CONTROLS

The display on the front panel of the humidifier cabinet contains the “On-Off-Drain” switch, the LCD True Touchscreen display and the “Fill”, “Drain”, and “High Water” LED’s.



“ON-OFF-DRAIN” SWITCH

In the “On” position the humidifier will operate if all controls are calling for humidity. The “Off” position is used for seasonal shut down if desired. The “Drain” position is used to drain water from the steam cylinder for maintenance. The fill solenoid valve will be on whenever the drain is activated to reduce the drain water temperature.

LCD TRUE TOUCHSCREEN DISPLAY

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

HOME SCREEN

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

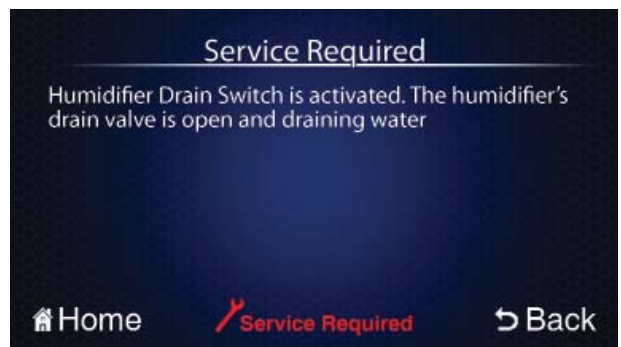


“SERVICE REQUIRED” PAGE

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



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



“FILL” LED

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

“DRAIN” LED

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

“HIGH WATER” LED

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

“CARNES®” LOGO

The Carnes logo on the “Home Screen” will take you to a page that displays the Carnes Company contact information (address, phone number and company website). This feature is for the purpose of contacting the factory for any startup questions, troubleshooting, or service issues that may arise.

“STEAM” MENU

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

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

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



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



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

The Control Humidistat, which provides the Control Demand, is normally the humidistat located in the room being humidified. It is either installed in the room itself or the return air duct. The High Limit Humidistat, which provides the High Limit Demand, is a safe-guard humidistat, is usually set to a high level (80-90%), and will shut down the humidifier if the humidity gets too high in the supply duct. Without a High Limit Humidistat properly installed the supply

duct could reach a humidity level where any steam entering the duct would readily condense. Both Control Humidistats and High Limit Humidistats are wired in the same way, only Control Humidistats are wired to port J16 of the circuit board and High Limit Humidistats are wired to port J17. Both ports have the same number of pins and connection layout.

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

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

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

MENU



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



"SETPOINTS"

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

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

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

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

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

“COMPONENT ACTIVITY”

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

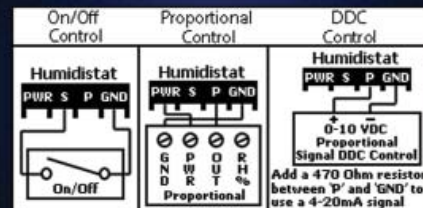
The other component in the “Component Activity” page is the Board Communication (Comm.) button. The Board Communication button represents whether the touchscreen controller on the circuit board is properly communicating with the microcontroller and that the microcontroller is properly communicating with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

**“HELP” MENU****How Do I Install My Control Humidistat?**

The humidifier control circuit should include a control humidistat for a user to designate the desired humidity level. Control humidistats come in both on/off and proportional varieties. The control humidistat can also be replaced with a DDC control signal of either 0-10 volts or 4-20 milliamps. Wiring configurations are featured on the next page.

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How Do I Install My Control Humidistat?

Home

Back

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

“SETTINGS” MENU



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

Max Output Adjust



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

Cylinder Life Counter



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

cylinder life is about 1150 hours, but this can vary greatly depending on individual water conditions.

Fan Speed Adjust



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

Setpoint Timeout



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

High Water Timeout



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

Boil Down Timer



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

Settings Password



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

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

Corrective Drain Length



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

CarnesLink Communication Protocol Setup



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

ON/OFF Setting Buttons



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

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

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

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

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

▼ APPLICATIONS

COMFORT

Temperature and relative humidity affect the comfort and well being of all living things. High temperatures require low humidity to maintain comfort conditions, while low temperatures can more easily be tolerated at high relative humidity. Humidification occurs when air is moisturized by a humidification unit or when hygroscopic materials (materials containing moisture) lose moisture to drier air. Proper humidification is widely accepted as healthy, minimizing employee illness and lost work time.

MATERIALS STORAGE

Paper, fabrics, wood, plastic, chemicals and most other materials are hygroscopic. Their water content depends on the humidity of the air around them. If air is too dry, these substances lose moisture until an equilibrium is reached between hygroscopic materials and the air.

PROCESS

Process operations, such as data processing areas, are affected by two major humidity factors: **hygroscopic material** and generation of **static electricity**.

Hygroscopic material used in the process influences **material weights, dimensions and workability**.

Static Electricity can totally disrupt high speed process operations as found in a data processing center, paper or film handling business. Created by friction between two substances, static electricity can be prevented by proper humidification of the process environment.

RECOMMENDED TEMPERATURE AND HUMIDITY RANGE - Table 1

APPLICATION	TEMP F°	RH %
Computer Rooms	72±2	50±5
Office Buildings	70-74	20-30
Libraries & Museums	68-72	40-55
Archival Libraries & Museums	55-65	35
Art Storage	60-72	50±2
Stuffed Animals	40-50	50
Bowling Centers	70-74	20-30
Health Facilities		
Full Term Nursery	75	30min.-60max.
Special Care Nursery	75-80	30min.-60max.
Patient Rooms	75	30
Intensive Care	75-80	30min.-60max.
Operating Rooms	68-76	50min.-60max.
Recovery Rooms	75	50min.-60max.
Lasik Eye Centers		
Electrical Instrument Mfg.	70	50-55
Fur Storage	40-50	55-65
Photo Film Darkroom	70-72	45-55
Photo Print Darkroom	70-72	45-55
Photo Drying Room	90-100	35-45
Photo Finishing Room	72-75	40-55
Cellophane Wrapping	75-80	45-65
Animal Laboratories		
Mouse, Rat	64-79	40-70
Cat	65-85	30-70
Dog	65-85	30-70
Primate	65-84	30-70
Clean Rooms	67-77	40-55
Printing Plants		
Lithography	76-80	43-47±2
Rotogravure		45-50±2
Collotype	80±2	85±2
Platemaking	75-80±2	45±2
Telephone Terminal Rooms	72-78	30-40
Radio and TV Studios	74-78	30-40

± = plus or minus

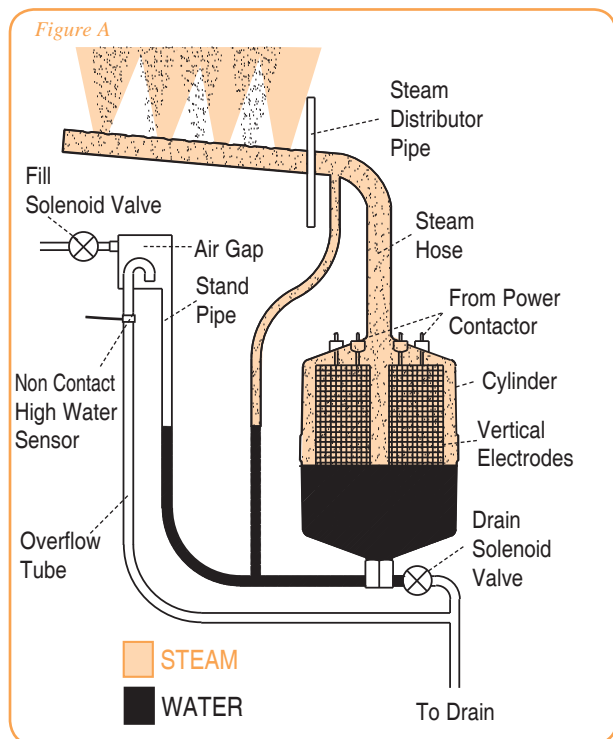
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▼ OPERATION

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

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

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



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

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

▼ MOUNTING THE HUMIDIFIER

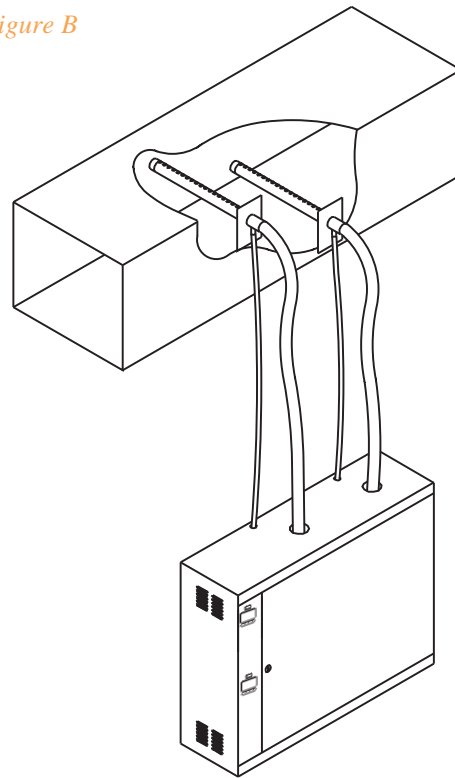
Locate the humidifier cabinet level and plumb, using the level screws on a surface as close to the steam distributor as possible at a convenient height for servicing. Allow 12" or more on each side for panel access and 16" from the bottom of the unit to the floor to allow for drain connections. If there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

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

▼ STEAM DISTRIBUTOR PIPE LOCATION

It is critical to provide proper routing of flexible hose and hard tubing to maximize efficiency and effectiveness. See Figure B-E. Not following the instructions in this Installation, Operation, and Maintenance Manual could void all warranties, unless you have consulted with the factory and have prior written approval. Each steam cylinder requires a separate distributor pipe, steam hose, and condensate return line. A cylinder may supply more than one distributor pipe by using an accessory "T" fitting but the output cannot be controlled separately. In a typical installation the humidifier is located below the duct as shown in Figure B. **The distance between the humidifier cabinet and the steam distributor should be the minimum distance possible.** Refer to Table 2 for maximum length that may be installed based on duct static pressure and pound output. Under less than perfect conditions, (installation issues, routing problems for steam and condensate return hose, and extreme steam hose lengths) it is possible to lose significant amounts of output. **The use of 90° elbows add approximately three feet of equivalent length when hard tubing is used, thus negatively affecting capacity, efficiency, and can cause back pressure issues and cylinder arching.**

Figure B

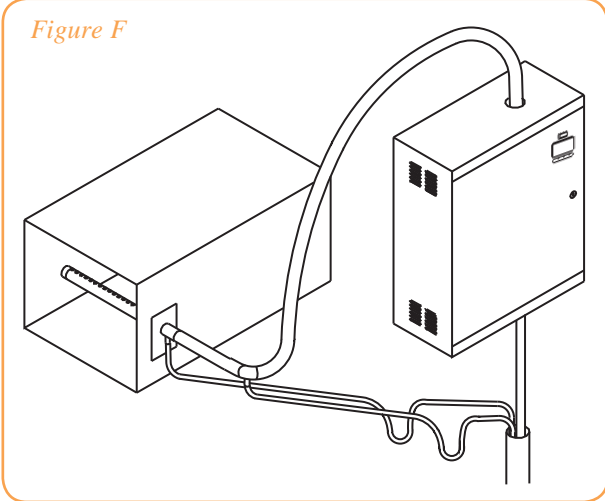
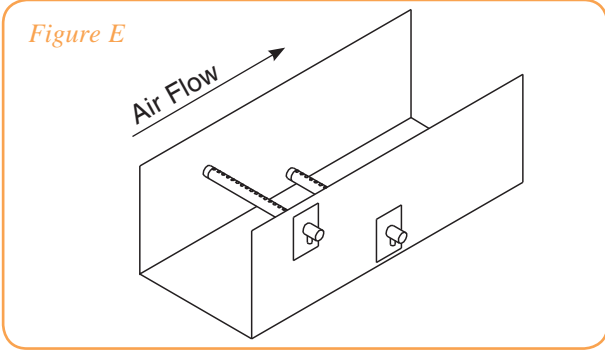
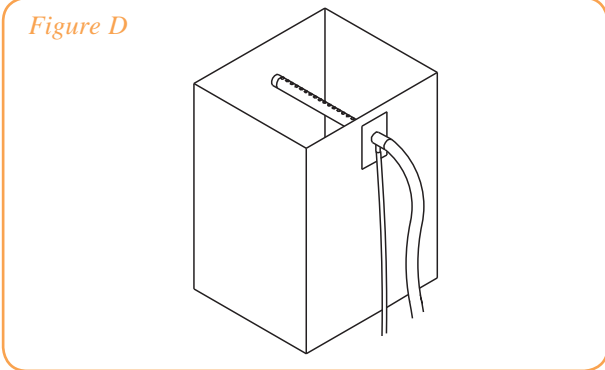
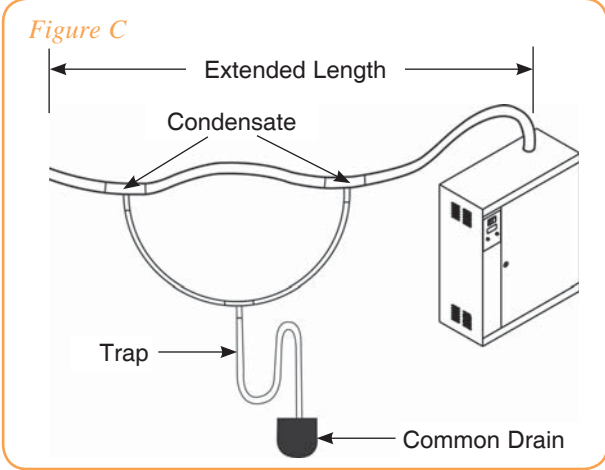


MAXIMUM STEAM HOSE LENGTH

Table 2

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

The maximum length of steam hose that may be installed as shown in Figure B is 12 feet. For steam hose lengths over 12 feet refer to Figure C. 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 proper condensate drainage and steam flow. Carnes electrode steam humidifiers are non-pressurized, maximum of 1/2 psi. Every application is different. Hose lengths for small capacity units will be considerably shorter than larger units. All variables must be taken into consideration.



▼ WATER SUPPLY REQUIREMENT

Carnes humidifiers will operate at water supply pressure from 20 to 120 psi and maximum water temperatures of 140°F. Water piping must be sized to allow the minimum flow rate shown in Table 3. This table does **NOT** indicate water consumption, only minimum flow rates. Actual consumption is determined by steam generated and water drained during the automatic or manual drain cycle.

Table 3

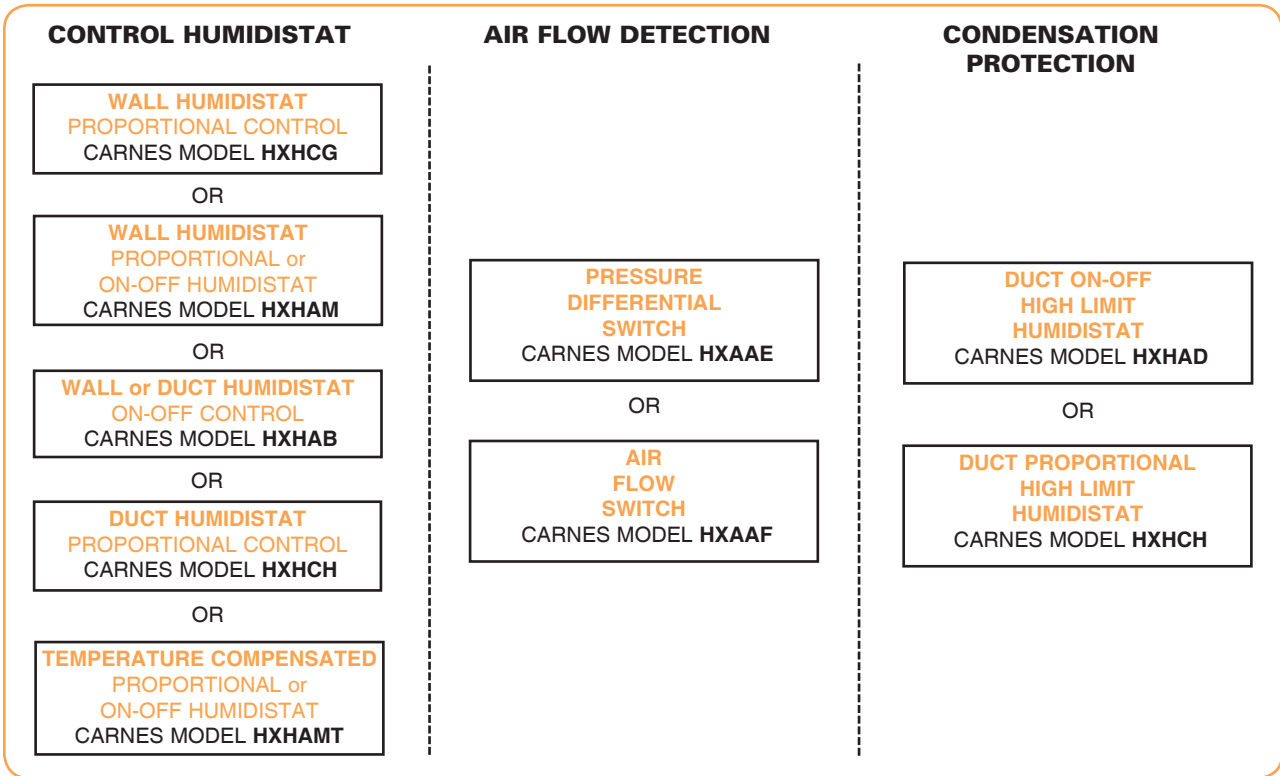
Model	Minimum Flow Rate	GPM
H_AH	18	.3-.5 gpm
H_DH	18	.3-.5 gpm
H_GH	24	.4-.7 gpm
H_HH	48	.8-1.0 gpm

In certain areas with extreme water conditions it may not be possible to operate the humidifier at all voltages. Table 4 shows acceptable water conductivity, measured in micromhos, in relation to the primary supply voltage. Water conductivity may be determined by contacting the local water utility or sending a six ounce sample to Carnes for a free analysis. Deionized water or water treated by a reverse osmosis process may have conductivity too low to operate. It may be possible to use a water softener to treat the water but contact the factory before installing the equipment.

ACCEPTABLE CONDUCTIVITY RANGES (Micromhos) Table 4

VOLTAGE		H_AH	H_DH	H_GH	H_HH
120	Min.	50	-	-	-
	Max.	1300	-	-	-
208	Min.	50	50	50	50
	Max.	1300	1300	1300	1300
230	Min.	50	50	50	50
	Max.	1300	1300	1300	1300
277	Min.	50	50	50	-
	Max.	1300	1300	1300	-
380	Min.	50	50	50	50
	Max.	1300	1100	1600	1600
415	Min.	50	50	50	50
	Max.	1300	1100	1600	1600
460	Min.	50	50	50	50
	Max.	1300	1100	1600	1600
575	Min.	50	50	50	50
	Max.	1100	900	1250	1250

CONTROL OPTIONS - Figure G



▼ CONTROL HUMIDISTAT

If an on-off humidistat is used, the humidifier will generate steam at the max output rate and cycle on or off as necessary to satisfy the conditioned area requirements. All humidifiers are preset at the factory for the maximum rating of the unit. The maximum output may be easily reset to a lower limit in the range of 20-100% in the settings menu of the touchscreen.

If Carnes proportional humidistat is used the humidifier will automatically vary the steam output rate in the range of 20-100% of the humidifiers maximum output (set by the user) in response to the 0-10V signal from the humidistat. However, the output of the humidifier will not drop below 20% of the preset nominal output of the humidifier set at the factory. Proportional control provides less cycling of the humidifier.

A wall humidistat or duct mounted humidistat in the return air may be used. The wall mounted humidistat is the most common as it allows the setting to be easily changed to accommodate changing requirements or to lower the level of relative humidity in the space to prevent condensation on windows during extremely cold weather. In applications where it may be desirable to prevent the occupants of a space from changing the setting, a duct mounted humidistat in the return may be used. This is normally mounted in the equipment room or in the duct where it is accessible only to maintenance personnel.

▼ AIR FLOW DETECTION

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

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

▼ CONDENSATION PROTECTION

A third device may be desirable to provide condensation protection in the duct system. A high limit humidistat may be installed ten feet downstream from the steam distributor pipe. This humidistat is normally set to 90-95% RH and opens the circuit if the humidity level in the duct exceeds the setpoint. Use of this device is recommended particularly when the humidifier is used in applications where cooling air is being humidified or where a VAV system may throttle back to a point where air flow is insufficient to absorb the steam being introduced.

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

▼ CONTROL CONNECTIONS

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

Figure H



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

▼ EXTERNAL DDC CONTROL SIGNALS

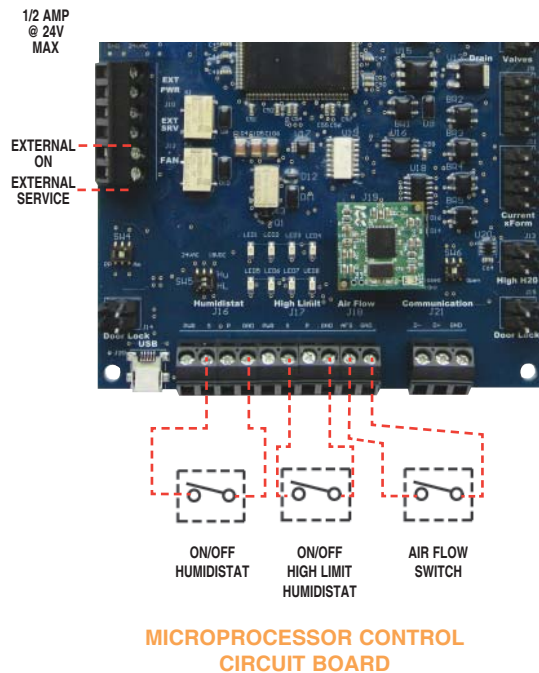
Carnes humidifiers can also accept a 0-10 volt DC signal to modulate the output of the humidifier. Polarity must be observed. Input impedance is 20K ohms. If a 4-20 mA input signal is provided to the humidifier a 470 ohm 1/4 watt resistor must be installed.

▼ EXTERNAL MONITORING

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

CarnesLink is an option to have full external monitoring and control of your Carnes humidifier(s) by allowing the humidifier(s) to link to a Building Management System (BMS) using one of the following communication protocols: BACnet® (MS/TP), Modbus® (RTU), Metasys® (N2) and Siemens® (FLN). The user friendly interface on the True Touchscreen makes setting up CarnesLink easy and convenient. (See the CarnesLink Communication Protocol Installation, Operation, and Maintenance Manual for further info.)

Figure I



MODELS AVAILABLE AND ELECTRICAL DATA - Table 5

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

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

MODELS AVAILABLE AND ELECTRICAL DATA - Table 5

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

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

NOTES: Identifying and explaining the electrical data and unit detail in Table 8 on the previous page

“**Model**” and “**Optional Circuit Breaker**” columns designates the quantity and amp rating of optional factory installed circuit breakers. Circuit breakers are available in models with an ‘HT’ prefix. All models over 48 amps have internal circuit breakers factory installed.

“**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 20% of maximum capacity.

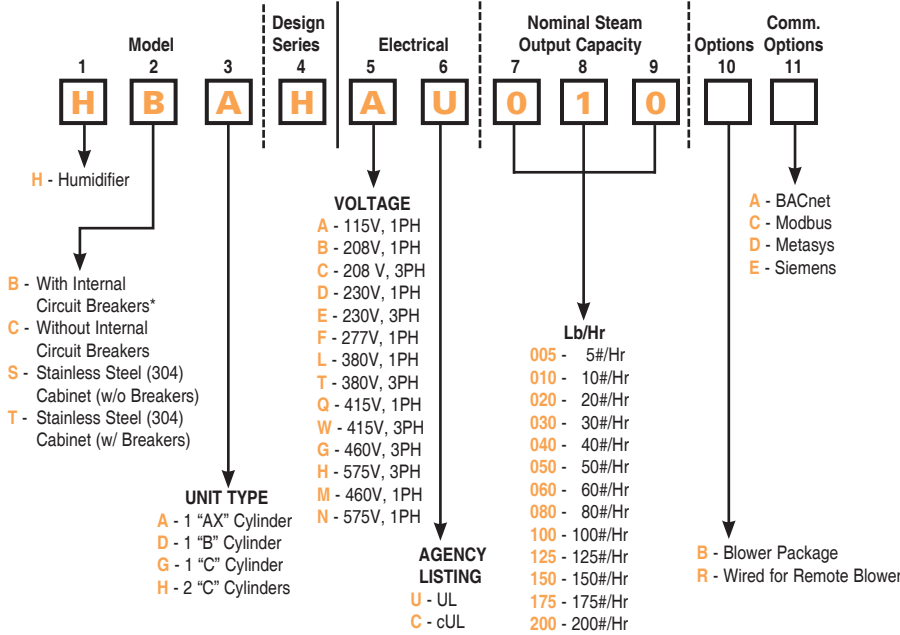
“**Voltage**” and “**Phase**” designates available phase and nominal voltages. Single phase units may be operated from two legs of a three phase supply but the load will be unbalanced.

“**kW**” is the power rating of the maximum output rate of the humidifier. If a unit’s max output is adjusted lower, the kW is reduced proportionally.

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

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

“**Cylinder Wire Current**” is the current a single cylinder wire should be carrying for a given unit at max output. This does not include ‘dummy’ electrode wires that never carry any current, i.e. humidifiers with C65 cylinders and single phase humidifiers not using AX cylinders.



***NOTE:** AN EXTERNAL FUSED DISCONNECT SWITCH, OR OTHER SIMILAR PROTECTION, AS REQUIRED BY LOCAL, AND NATIONAL ELECTRICAL CODES MUST BE SUPPLIED AND INSTALLED BY OTHERS. An optional circuit breaker (except for select models over 48 amps) is available in the unit to reduce the risk of costly damage in the event of internal failure. It is not meant to be the primary protection as may be required by local and national electrical codes. All units include electronic overload protection as a standard feature.

UNIT VOLTAGE CHARACTERISTICS

Humidifiers may be ordered with the voltage nameplate ratings shown below. The units may be operated at nominal system voltage shown in Table 6.

Table 6

Unit Nameplate Voltage	Suitable Nominal System Voltages
120	115, 120
208	208
230	220, 230, 240
277	277
380	380
415	400, 415
460	440, 460, 480
575	550, 575, 600

CYLINDER LIFE

Cylinders have an average life of 1150 hours when operating at maximum output with a water supply hardness of 150 ppm. Approximate cylinder life for other water hardness may be determined by multiplying 1150 by the correction factor shown in Table 7.

Table 7

Water Hardness (ppm)	Correction Factor
50	3.00
100	1.50
150	1.00
200	0.75
250	0.60
300	0.50

Cylinder life will be extended if operated at less than maximum output. Multiply the cylinder life calculated in Table 7 by the correction factory shown in Table 8.

Table 8

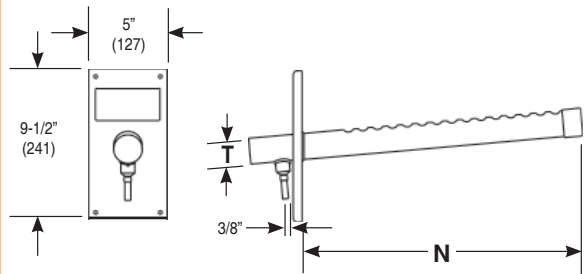
% of Maximum Output	Correction Factor
100	1.00
75	1.33
50	2.00



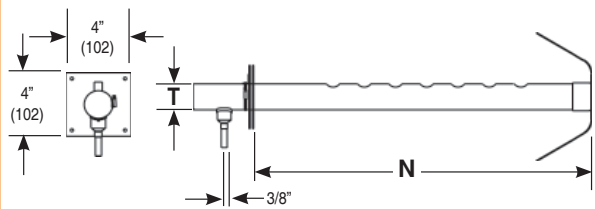
STEAM DISTRIBUTOR PIPES



Lengths 012-036



Lengths 048-120



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

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

Distributor Pipes for Models: H_GH, H_HH

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

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

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

****NOTE A**

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

MATERIAL

Standard distributor pipes are fabricated from stainless steel.

**See Note A

▼ FAN DISTRIBUTION UNITS

REMOTE MOUNTED



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

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

HUMIDIFIER MOUNTED



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

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

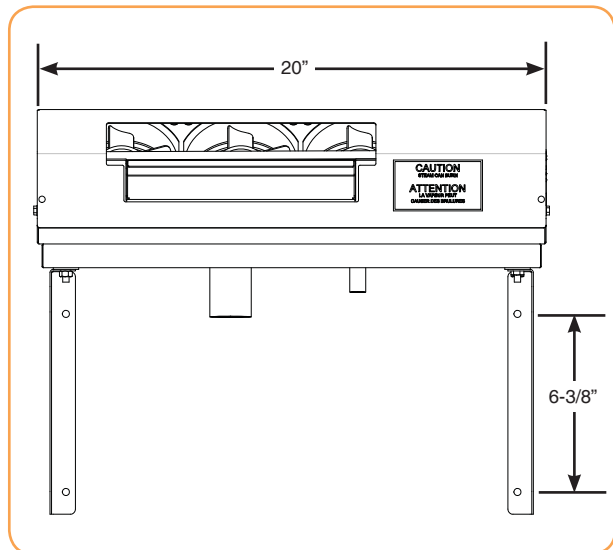
▼ OPTIONS

STANDARD MOUNTING: Factory attached to humidifier.

OPTION: Mounted remote from humidifier.

FAN VOLTAGE: 3 fans attached, 12 volt from humidifier

***NOTE:** Selected control humidifiers (HXHAA-ON/OFF, HXHCG/Proportional, or HXHAM), whether mounted or remote units, will be mounted external to fan distribution boxes for more consistent and accurate operation. Field wiring, by others, will need to be done for both mounted and remote units. (Note wiring diagram on door of fan distribution unit.)



**WALL HUMIDISTAT,
PROPORTIONAL CONTROL**



Model HXHAM/HXHAMT

The Model HXHAM is a wall-mounted, microprocessor-controlled humidistat solution for humidity control. The HXHAM employs a backlit LCD module, which displays both the ambient temperature and humidity of the surrounding air. The embedded software allows user navigation between temperature/humidity viewing mode, setpoint adjustment mode, and also outdoor temperature and humidity viewing mode, and outdoor temperature/humidity viewing mode. An optional outdoor temperature compensation sensor can be added (HXHAMT).

**WALL HUMIDISTAT,
PROPORTIONAL CONTROL**



Model HXHCG

The wall mounted HXHCG humidistat uses a monolithic sensor and electronic circuitry to provide accurate and reliable humidity sensing. Setpoint range is 0 to 100%. The HXHCG has a concealed setpoint adjustment with a locking cover to prevent tampering. Ambient operating conditions are from 0° to 85°C. Case dimensions are 2-13/16" x 4-1/2" x 1-1/4".

WALL/DUCT HUMIDISTAT, ON-OFF CONTROL



Model HXHAB

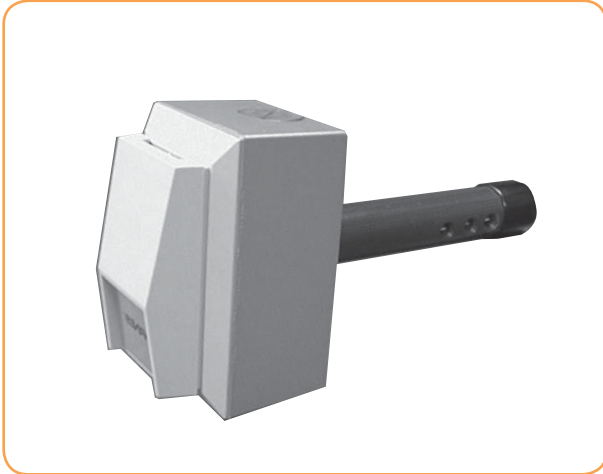
The Model HXHAB can be mounted to a wall or duct to provide automatic low voltage control for humidifiers in central heating and air condition systems. The inherent flexibility of this unit's size and installation make this the perfect fit for any number of rooms. They have a snap-acting and dust-proof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

DUCT HIGH LIMIT HUMIDISTAT, ON-OFF CONTROL



Model HXHAD

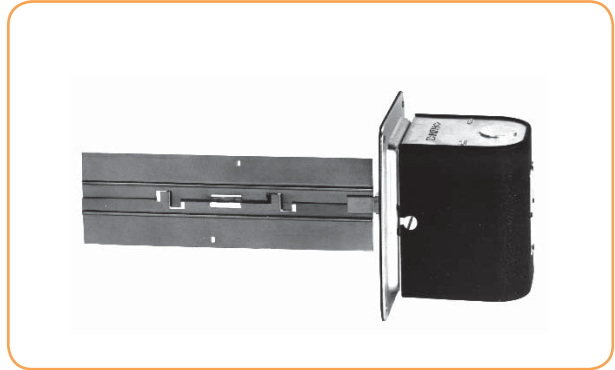
The Model HXHAD humidistat is available for use as a safety precaution to prevent air in the duct from exceeding a preset level. Do not use the humidistat in air that is over 125°F or in locations where the unit could become wet. The control must be mounted a minimum of 10 feet downstream of the distributor pipe. Scale range is from 15%-95% RH. Differential is 5% non-adjustable. Mounting plate dimensions are 6-1/2" wide, 4-3/4" high. Humidistat extends 1-1/4" into duct and projects 2-1/4" outside the duct.

**DUCT HUMIDISTAT OR HIGH LIMIT,
PROPORTIONAL CONTROL****Model HXHCH**

The Model HXHCH is designed to be mounted in a duct to provide a means of sensing relative humidity. Setpoint range is from 0 to 100% RH. Ambient operating conditions are from 0° to 85°C. The humidistat may be mounted in a return duct to provide a mean of sensing and controlling relative humidity. The humidistat may be mounted in a supply duct a minimum of 10 feet downstream from the distributor pipe when used as a high limit humidistat. Case dimensions are 2-13/16" x 4-1/2" x 2-1/4". The probe extends 5-3/4" into the duct.

**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 and ambient when air is moving in the duct closes a micro switch allowing the humidifier to operate. Air pressure differential as low as .07 w.g. and as high as 12.0 w.g. may be sensed with one model. The switch may be mounted with tubing connecting to the duct. Switch is **UL** listed.

AIR FLOW SWITCH, VELOCITY TYPE**Model HXAAF**

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

STEAM HOSE



Carnes steam hose is made from EPDM compound to withstand the low pressure steam without deterioration. Model HXSAB steam hose has an I. D. of 7/8" for use with units that use "AX" or "B" steam cylinders. Model HXSAC has an I. D. of 1-5/8" for use with units that use "C" cylinders. The hose may be easily cut to the exact length at time of installation.

STEAM HOSE DRAIN "T" FITTINGS



Steam hose drain "T" are available for use when the duct is located below the top of the humidifier or where the length of steam hose is in excess of 12 feet.

Humidifier Model	Drain "T" Model	Dimensions
HBA, HCA, HSA, HTA HBD, HCD, HSD, HTD	HXTABB	7/8"x7/8"x3/8"
HBG, HCG, HSG, HTG HBH, HCH, HSH, HTH	HXTACB	1-5/8"x1-5/8"x3/8"

CONDENSATE RETURN LINE



Two models of condensate return line are available. Model HXRA has an I. D. of 3/8" and is used whenever steam distributor pipes are used with the humidifier. Model HXLA has an I. D. of 5/8" and is used with optional fan distribution units.

"T" FITTINGS



In some applications it may be desirable to have the steam generator cylinder feed two steam distributor pipes. "T" fittings can be installed in the steam hose and condensate return line.

STEAM HOSE "T" FITTINGS

Humidifier Model	Drain "T" Model	Dimensions
HBA, HCA, HSA, HTA HBD, HCD, HSD, HTD	HXTABA	7/8"x7/8"x7/8"
HBG, HCG, HSG, HTG HBH, HCH, HSH, HTH	HXTACA	1-5/8"x1-5/8"x1-5/8"

CONDENSATE HOSE "T" FITTINGS

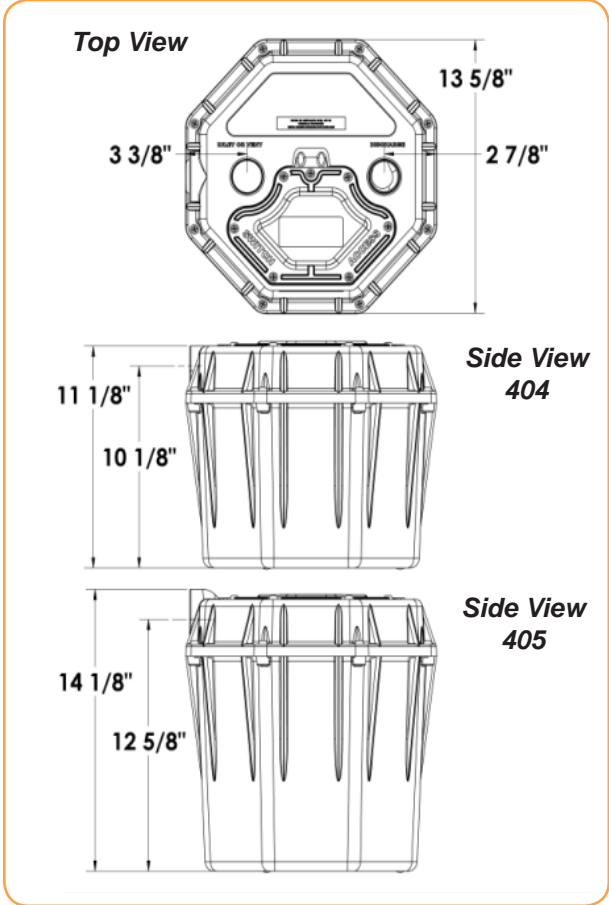
Humidifier Model	Drain "T" Model	Dimensions
ALL	HXTAD	3/8"x3/8"x3/8"

DRAIN WATER PUMP



Model HXWA

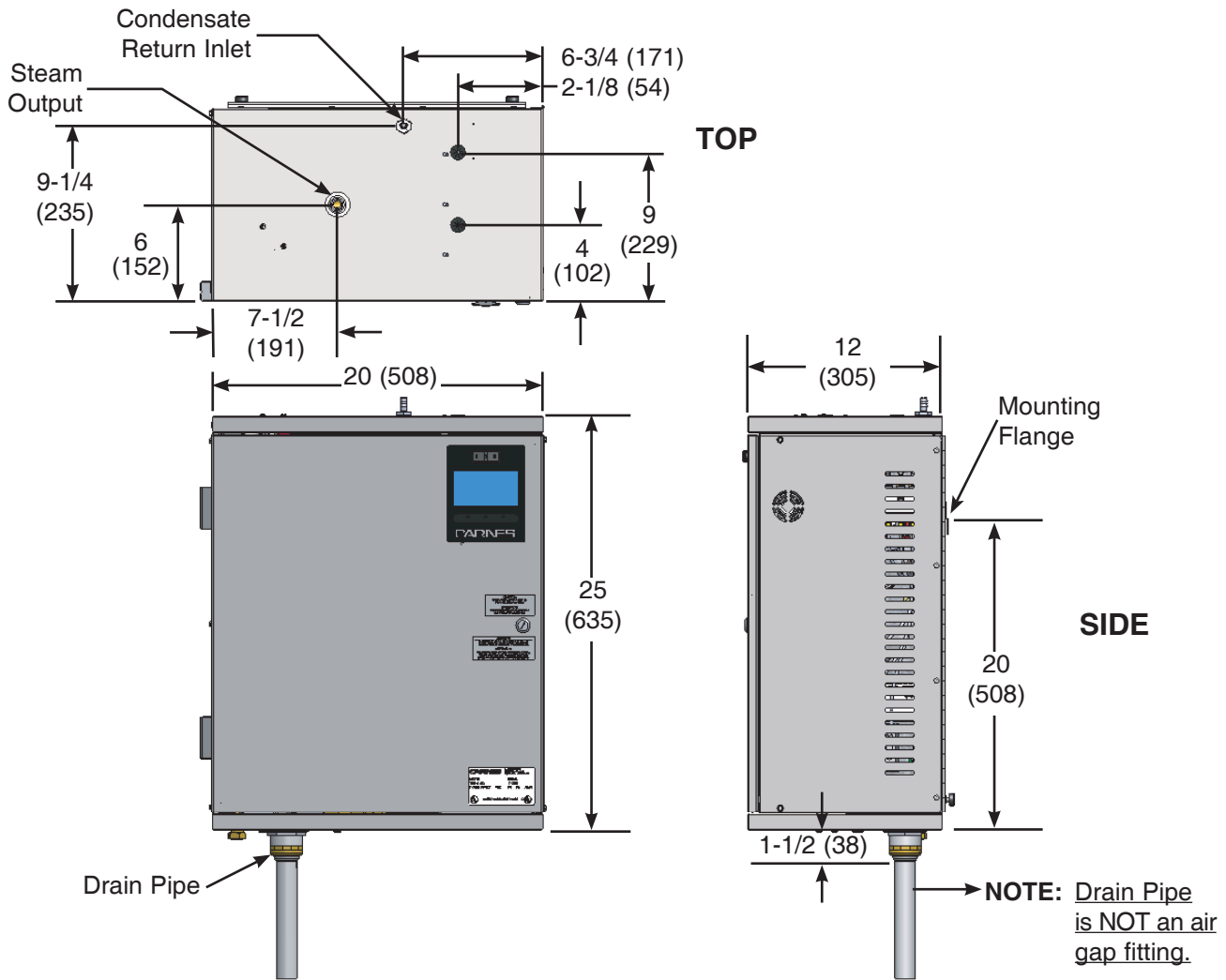
The HXWA is a drain water pump for mounting directly under the humidifier cabinet. This pump is ideal for an application where the building drain is remotely located or is at a higher elevation than the humidifier drain connection. This unit operates on a float principle which automatically starts the pump when the reservoir is 3/4 full of water.



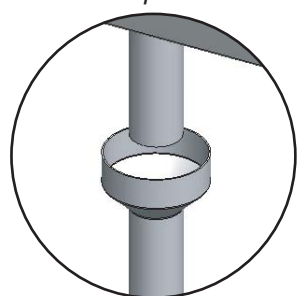
Models Available

HXCBA145	HXCBB380	HXCBC6F
HXCBA220	HXCBB500	HXCBC6X
HXCBA380	HXCBB600	HXCBC61
HXCBA500	HXCBB700	HXCBC62
HXCBA600		HXCBC63
HXCBA700		HXCBC64
		HXCBC65
		HXCBC12

MODELS: H_AH
H_DH
H_GH

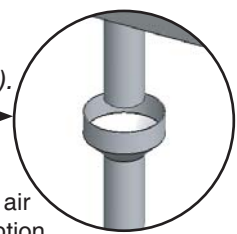
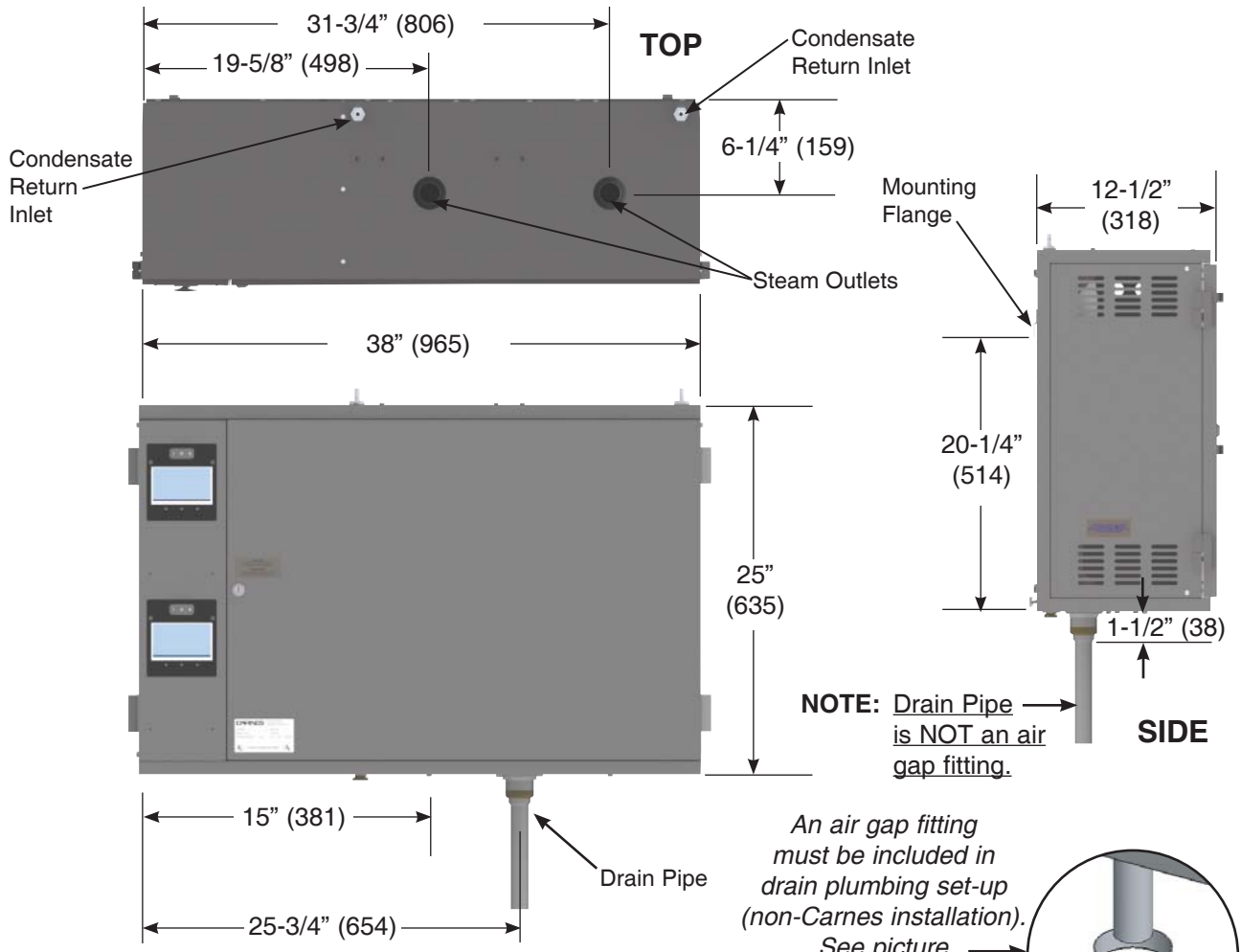


An air gap fitting must be included in drain plumbing set-up (non-Carnes installation). See picture:

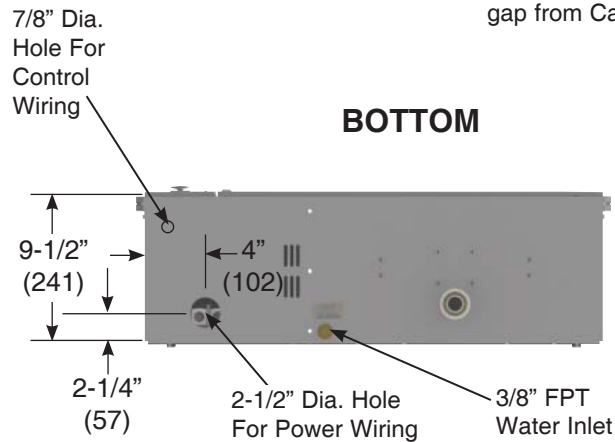


If you wish to purchase an air gap from Carnes it is an option.

MODELS: H_HH



If you wish to purchase an air gap from Carnes it is an option.



1. Provide self-contained microprocessor controlled steam generating humidifiers of the size(s) shown on plans as manufactured by Carnes Company, Verona, WI.
2. Carnes Humidifiers shall have the capacity to operate at 115, 208, 230, 277, 380, 415, 460 and 575 volt (or nominal value), 60 or 50 hz (cycle), single or 3 phase power. Specific combination of maximum output, voltage and phase for order application determined by electrical data chart.
3. The humidifier(s) shall be UL and cUL listed.
4. The humidifier(s) shall have a total Color "True Touchscreen" user interface. Features:
 - a. True Touchscreen navigation for all aspects of operation and information access.
 - b. Cylinder life counter for hours of operation. Found by accessing the "Settings" button.
 - c. With Fan Distribution Unit, there is a fan speed Slide Bar control with CFM indication. Found by accessing Settings button.
 - d. "Help" screen button.
 - e. "Service Required" button and indicator and corresponding screen explaining service issues and possible troubleshooting tips.
 - f. "Dim LCD" feature button.
 - g. "Settings" button - where all operational values can be set.
 - h. "Setpoints" button - target steam output of the humidifier.
5. Steam shall be generated from tap water or softened water (see factory representative) in a factory sealed cylinder containing electrodes. Cylinders shall not require setting of electrode spacing, cleaning or maintenance and shall be of the disposable type.
6. The humidifier(s) shall include an automatic drain cycle controlled electronically to maximize energy efficiency. Drain cycle shall adapt to variations in water conditions (high/low conductivity and high/low hardness) and not require manual setting. There is also a default setting for a pulsing drain action to assist in keeping drain lines open.
7. In the event of over-current, the humidifier shall signal that a fault condition exists by message on touchscreen.

Option: Humidifier(s) shall also include secondary magnetic overload switches (circuit breakers) that shall be manually resettable and shall be of the type that positively disconnects power to the steam cylinder.
8. Humidifier(s) shall include a door interlock safety switch to disconnect power to steam cylinder(s) when cabinet door is opened.
9. The system shall include one steam distributor pipe for each steam generating cylinder mounting in the duct as shown on the plans. Steam distributing pipe(s) shall be of corrosion resistant design (stainless steel) and be designed to provide uniform distribution over the entire length of the pipe.

Option: Supply and install remote (or humidifier mounted) fan distribution units to discharge steam

directly into the conditioned space.

Provide the following components:

- a. Three 12VDC fans operated by circuit board.
- b. Integral steam manifold trap.
- b. Remote mounted on/off, proportional control humidistat.

Option: When plans call for a specific short absorption distance from dispersion system, a multi-tube Short Absorption Manifold is available sized specifically to duct dimensions, with horizontal stainless steel cross tubes and vertical headers.

10. The system shall include flexible hose to connect the steam cylinder(s) to the steam distributor pipe(s). A separate condensate return line shall return condensate to the humidifier for reuse to minimize consumption. If due to specific routing issues or application of unit, condensate line cannot run back to unit, the line can go directly to the common drain, and the addition of a "circle" or "U" trap will be required (see IOM). Long distances from unit to common drain can be accommodated with accessory option Water Pump (HXWA). Hard tubing can be used for Steam Hose and Condensate Return to prevent sags, restrictions or obstructions (see IOM), but it is recommended a minimum of 12 inches of flexible hose be used from unit and before distributor pipe. We recommend a maximum distance of 10 feet from unit to distributor pipe(s) or short absorption manifold and proper routing and inclination of hoses and hard tubing be adhered to for proper, overall consistent and dependable operation.
11. The humidifier(s) shall incorporate a 1" air gap on the fill water line to prevent backflow. It is recommended that a drain air gap fitting be installed by a non-Carnes contractor to prevent backflow of water. Carnes offers an air gap fitting as a purchased option.
12. The humidifier cabinet(s) shall be constructed of 304 B 20 gauge stainless steel and shipped with protective film. The cabinet door shall be hinged and provided with a lock and key. The main door is also provided with a quick release pin for removal to provide easy access to internals. The True Touchscreen Home Page will show a digital LCD steam output meter calibrated in pounds of steam per hour (kg of steam per hour selection is included as a built in option), fill cycle, drain cycle and high water indicator lights will be visible with the cabinet door closed.
13. The humidifier(s) shall be controlled by a humidistat which operates through the circuit board. Humidifier(s) shall incorporate terminals for connection of humidistat, air flow switch and high limit control humidistat.

Option: Provide the following accessory controls:

 - a. Wall mounted humidistat, on/off control.
 - b. Wall mounted humidistat, w/ LCD combo.
 - c. Duct mounted humidistat, on/off control.
 - d. Duct mounted humidistat, proportional control.

- e. Duct mounted humidistat w/digital humidity and temperature, combo.
 - f. High limit duct mounted humidistat, on/off control.
 - g. High limit duct mounted humidistat, proportional control.
 - h. Pressure differential type air flow switch.
 - i. Paddle type air flow switch.
 - j. Wall or duct mounted temperature compensated, on/off or proportional control, digital display humidistat.
14. External Control Signals - All Carnes humidifiers will accept external DDC control signals of 0-10 volt DC. Signal to modulate the output of humidifier. Polarity must be observed and input impedance is 20 kilo-ohms. If 4-20 mA signal is provided a 470 ohm, 1/4 watt resistor must be installed. Humidifiers will also accept internal (BMS) building management system or (BAS) building automation system signal.
- Option:** CarnesLink offers the ability to monitor and control all Carnes humidifier(s) ("H" Series and newer) by allowing the humidifier(s) to link to your Building Management System (BMS) using communication protocols; BACnet® (MS/TP), Modbus® (RTU), Metasys® (N2) and Siemens® (FLN). CarnesLink uses a communication chip that is factory installed on our electronic circuit board, mounted internally inside the humidifier(s) cabinet. This electronic circuit control board has a translucent protective conformal coating that protects the electronic components on the board. Features include: Oxidation Resistant, Ozone Resistant, Thermal Resistant, UV Resistant, Water Resistant, high temperature stable, low temperature stable and temperature range -45°C to 200°C.
15. The fill water line shall include a strainer to remove sediment from incoming water and a flow regulating control to automatically compensate for water pressures from 20-120 psi.
16. Humidifier(s) shall include a "Service Required" button (illuminated in RED) on the total "True Touchscreen" home page which shall explain service issues and possible troubleshooting tips. The light shall be visible with the cabinet door closed and terminals shall be provided for remote signal. Terminals are also provided to indicate normal operation to a remote location.
17. Dedicated buttons with indicator lights on the steam page of the total "True Touchscreen" shall indicate status of the control humidistat, high limit humidistat, air flow switch and door interlock switch. Operation of fill solenoid, drain solenoid, power contactor and high water sensor shall be shown after accessing the "Component Activity" button on the home page of the total "True Touchscreen".
18. The humidifier(s) electronic circuit board shall include automatic controls to compensate for varying water conditions without changing cylinders or electrode spacing. The control shall activate the fill and drain solenoid valves to automatically maximize efficiency. Unit will perform system self-correction procedures to assist in preventing unit shut-down due to any fault in operational sequence. A drain pulsing feature is included to assist in expelling any blockage that may occur during a self-correcting drain cycle. If self-correction procedures are unable to correct problems after specific cycles, unit will automatically shutdown.
19. The humidifier(s) shall include a non-water contact capacitance proximity high water sensor to prevent overflowing and loss of water.
20. The fill solenoid valve shall open whenever the drain solenoid is activated, whether in automatic or manual operation, to prevent discharge of boiling water into drainage system. Drain light shall indicate the switch is in drain position.
21. Humidifiers, dependent upon capacity, will have one (1) or two (2) cylinders for operation. If a capacity is desired of 125, 150, 175 or 200 lb./hr., the units will be equipped with two (2) cylinders, each independently and separately controlled by their own control signal.
22. Automatic Drain of cylinder water will take place when there is a demand signal loss for 72-hours. Unit will remain in stand-by in the event that a quick startup is required.

LIGHT COMMERCIAL & PREMIER HOME OR CONDOMINIUM STEAM HUMIDIFIERS



Status display visible with door closed and locked.



Hinged door provides full access for service.



Steam cylinder easily removed for replacement.

Two Sizes Available

Size 005 satisfies areas up through 1400 square feet. Size 010 will humidify areas up through 2800 square feet under normal conditions. If multiple furnaces are used a separate humidifier should be used for each.

Pure, Clean Steam vs. Evaporative

Because of their purity steam humidifiers have been used in critical applications such as hospital operating rooms, computer rooms, and electronic manufacturing for years. Evaporative humidifiers do not boil water and provide a place for organisms to accumulate and grow.

Sealed Cylinder vs. Pad

The sealed disposable plastic cylinder captures the hard mineral deposits that are left behind by boiling water. Only pure steam vapor leaves the steam cylinder and the mineral residue is completely harmless. Since the water is sterilized each time the cylinder operates there is no possibility of slimy residue that is objectionable to handle.

Maintenance

Typical maintenance consists of changing the plastic steam cylinder after 500 to 2000 hours of operation. A "Service" light on the humidifier conveniently indicates the need for service. Changing the plastic cylinder usually takes ten minutes. Typical evaporative humidifiers do not have any indication of their need for service and no warning is given until humidity drops below the desired levels.

Modulating Control vs. On-Off

A highly desirable feature of Carnes humidifiers is the ability to modulate the output to meet humidity requirements. This option allows the humidifier to automatically adjust its output to match the amount of humidity required. Evaporative humidifiers are either on or off, allowing humidity levels to fluctuate which can provide spikes of low and high humidity.

CARNES STEAM HUMIDIFIERS use a microprocessor, digital display, and LED's to provide superior operating and diagnostic functions to simplify troubleshooting and reduce maintenance costs.

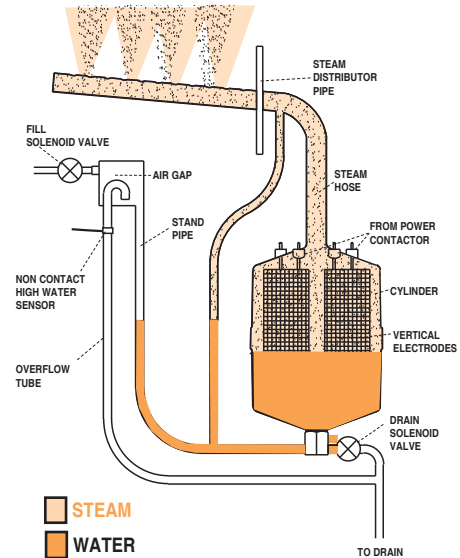
OPERATION

Upon a signal from a humidistat the circuit board opens a **fill solenoid valve**, allowing water to flow across a 1" **air gap** into a **standpipe**. The air gap prevents back flow to the water supply and prevents the cylinder from becoming a pressure vessel.

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**.

The circuit board automatically opens the fill solenoid valve when more water is required to maintain the desired output rate. The operation of the **drain solenoid valve** is also controlled by the circuit board, to provide stable operation and long cylinder life.

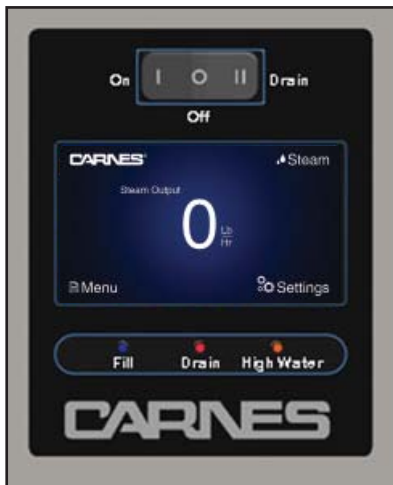
As mineral deposits build up in the cylinder the water level will slowly rise to cover more electrode surface to maintain the desired steam output rate. When mineral deposits have covered all available electrode surface areas, current flow will be reduced so that the desired steam output cannot be reached. The service light will signal the need for maintenance.



DISPLAY AND DIAGNOSTIC INFORMATION

FRONT PANEL DISPLAYS & CONTROLS

The display on the front panel of the humidifier cabinet contains the "On-Off-Drain" switch, the LCD True Touchscreen display and the "Fill", "Drain", and "High Water" LED's.



"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 shutdown if desired. The "Drain" position is used to drain water from the steam cylinder for maintenance. The fill solenoid valve will be on whenever the drain is activated to reduce the drain water temperature.

LCD TRUE TOUCHSCREEN DISPLAY

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

HOME SCREEN

The "Home Screen" page is the main screen through which most other pages can be accessed. The "Home Screen" displays the current steam output in Lb./Hr. (or Kg/Hr., selected in "Settings"). The main "Home Screen" features four navigation buttons, Carnes logo (providing contact information to the factory

and the company website), Steam Menu, Menu and Settings. The "Home Screen" will also display a "Service Required" indicator when a current service issue is indicated. The "Service Required" and Steam Output number will illuminate in red. Tap on "Service Required" to access the service required page which indicates what service issue is being detected.

"FILL" LED:

The FILL LED is a blue light illuminated when the Fill Valve is activated. An activated Fill Valve allows water to flow into the cylinder of the humidifier.

"DRAIN" LED

The DRAIN LED is a red light illuminated when the Drain Valve is activated. An activated Drain Valve allows water to drain from the humidifier.

"HIGH WATER" LED

The HIGH WATER LED is an orange light illuminated when the High Water Sensor is activated. An activated High Water Sensor indicates that the water has risen to the maximum allowable level in the cylinder.

ELECTRICAL DATA

Max. Sq. Ft. Humidified Area*	Carnes Model	Maximum Lb./Hr.	kW	Voltage	Phase	Line Amp Rating	Recommended Disconnect Size (Amps)	Cylinder
1400	HRABA U 005	5	1.7	120	1	14.4	20	HXCBA220
1400	HRABD U 005	5	1.7	230	1	7.5	15	HXCBA380
2800	HRABD U 010	10	3.4	230	1	15.0	20	HXCBA380

U = UL

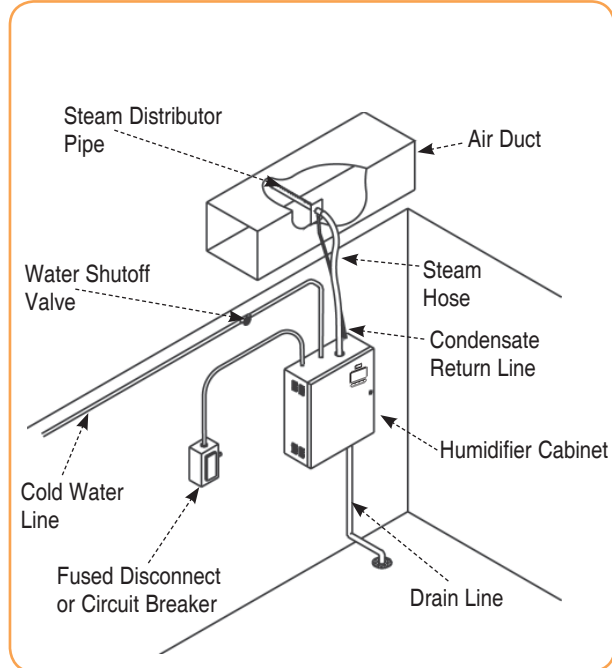
C = cUL

*Based on average conditions. For complete load calculation, use our humidifier selection program.



CARNES STEAM HUMIDIFIERS are designed for quiet, efficient operation and are easy to install.

TYPICAL INSTALLATION



The **humidifier cabinet** with key locked door is usually located in an area where other mechanical equipment such as a furnace or water heater is installed.

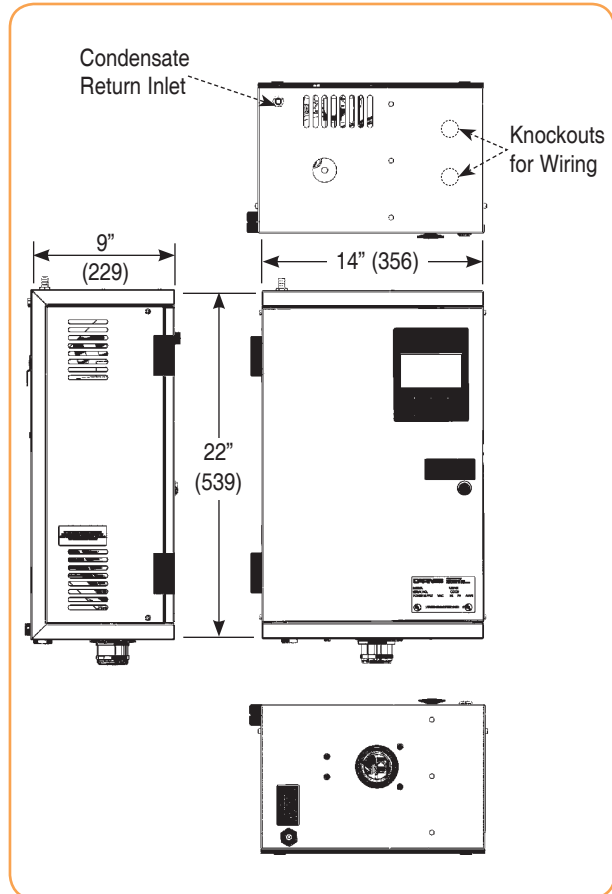
The unit must be connected through a **water shutoff valve** to a **cold water line** that is not treated by a water softener. Connections must be made to a 120 or 230 volt **fused disconnect** or **circuit breaker**. A **drain line** must be installed from the bottom of the humidifier to a convenient floor drain.

Steam is generated in the disposable plastic steam cylinder and transferred to the **steam distributor pipe** which must be located within 10 feet of the humidifier cabinet. Special **steam hose** is used to make the connection.

The steam is injected into the **air duct** to be distributed throughout the desired area. Any water that condenses within the distributor pipe is returned by a **condensate return line**.

The humidifier is controlled by a humidistat that can be located either in the humidified space or the return air duct. An air flow switch should be used to turn the humidifier off if there is no air moving in the duct where the steam is injected. A high limit humidistat may be used to prevent air in the duct from becoming too moist.

HUMIDIFIER DIMENSIONS

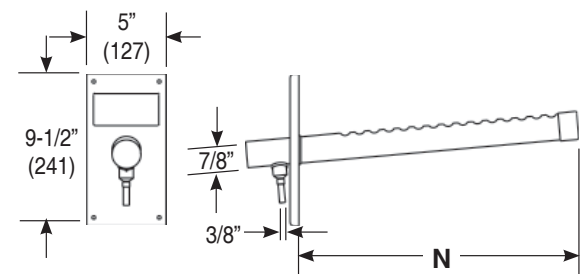


DISTRIBUTOR PIPE & HOSE DIMENSIONS

Carnes steam distributor pipes are fabricated from stainless steel.

Select the longest pipe that will fit into the duct.

DISTRIBUTOR PIPE MODEL	"N" DIMENSION
HXPBB012S	11-13/16" (300mm)
HXPBB018S	17-13/16" (452mm)
HXPBB024S	23-13/16" (605mm)



Carnes steam hose and condensate return line are available in either 5 or 10 foot lengths and may be field cut to the exact length needed. Both hoses are made from EPDM compound.

HOSE TYPE	MODEL	ID (Inches)	OD (Inches)
Steam	HXSAB	7/8"	1-3/16"
Condensate	HXRA	3/8"	5/8"

CARNES STEAM HUMIDIFIERS are available with a complete selection of accessories to provide accurate humidity control.

WALL HUMIDISTAT, PROPORTIONAL CONTROL

Model HXHAM/HXHAMT



The Model HXHAM is a wall-mounted, microprocessor-controlled humidistat solution for cutting edge humidity control. The HXHAM employs a backlit LCD module, which displays both the ambient temperature and humidity of the surrounding air. The embedded software allows user navigation between temperature/humidity viewing mode, setpoint adjustment mode, and also outdoor temperature and humidity viewing mode. Setpoint range is 0 to 100%. An optional outdoor temperature compensation sensor can be added (HXHAMT).

WALL HUMIDISTAT, PROPORTIONAL CONTROL

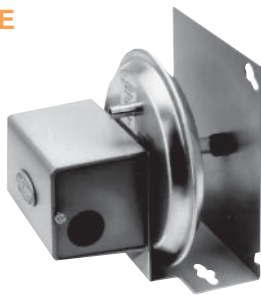
Model HXHCG



The wall mounted HXHCG humidistat uses a monolithic sensor and electronic circuitry to provide accurate and reliable humidity sensing. Setpoint range is 0 to 100%. The HXHCG has a concealed setpoint adjustment with a locking cover to prevent tampering. Ambient operating conditions are from 0° to 85°C. Case dimensions are 2-13/16" x 4-1/2" x 1-1/4".

AIR FLOW SWITCH, PRESSURE DIFFERENTIAL TYPE

Model HXAAE



Air flow in the duct may be sensed by using this differential pressure switch. The differential in pressure between the interior of the duct and ambient when air is moving in the duct closes a micro switch allowing the humidifier to operate. Air pressure differential as low as .07 w.g. and as high as 12.0 w.g. may be sensed with one model. The switch may be mounted with tubing connecting to the duct. Switch is UL listed.

WALL/DUCT HUMIDISTAT, ON-OFF CONTROL

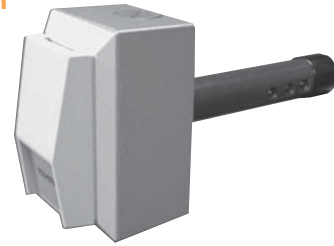
Model HXHAB



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

DUCT HUMIDISTAT OR HIGH LIMIT, PROPORTIONAL CONTROL

Model HXHCH



The Model HXHCH is designed to be mounted in a duct to provide a means of sensing relative humidity. Setpoint range is from 0 to 100% RH. Ambient operating conditions are from 0° to 85°C. The humidistat may be mounted in a return duct to provide a mean of sensing and controlling relative humidity. The humidistat may be mounted in a supply duct a minimum of 10 feet downstream from the distributor pipe when used as a high limit humidistat. Case dimensions are 2-13/16" x 4-1/2" x 2-1/4". The probe extends 5-3/4" into the duct.

HIGH LIMIT HUMIDISTAT

Model HXHAD



The Model HXHAD humidistat is available for use as a safety precaution to prevent air in the duct from exceeding a preset level. Do not use the humidistat in air that is over 125°F or in locations where the unit could become wet. The control must be mounted a minimum of 10 feet downstream of the distributor pipe. Scale range is from 15%-95% RH. Differential is 5% non-adjustable. Mounting plate dimensions are 6-1/2" wide, 4-3/4" high. Humidistat extends 1-1/4" into duct and projects 2-1/4" outside the duct.

SHORT ABSORPTION MANIFOLDS FOR STEAM HUMIDIFIERS



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**

CARNES STEAM MANIFOLDS are available in standard sizes from 18" x 12" through 72" x 48" in two inch increments. Additional special sizes are available.

Table 1
Air Pressure Loss, "w.g."

500 fpm	.02
750 fpm	.07

Table 2 Model Numbering System

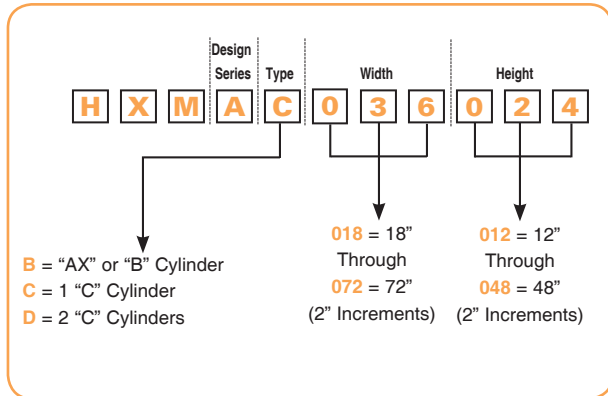
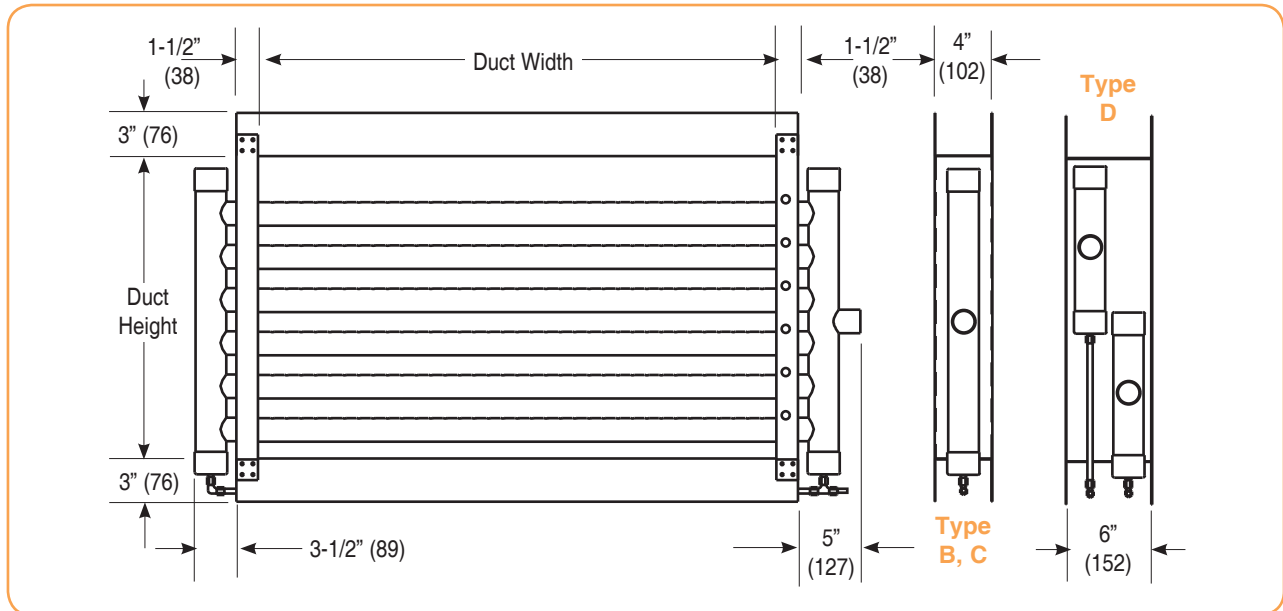


Table 3

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

Dimensions



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.

Table 8 - Maximum Steam Hose Length

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

Figure A

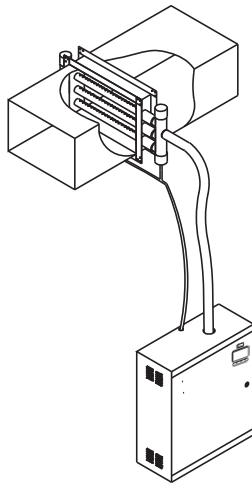


Figure B

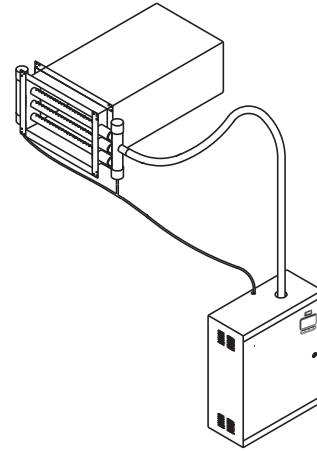


Figure C

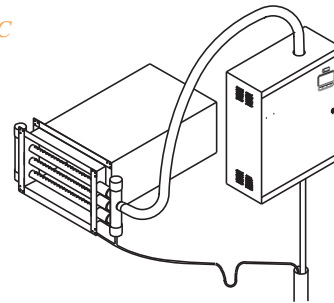


Figure D

