

COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL STEAM HUMIDIFIERS



J-Series Humidifiers

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

- LED Indicators and an LCD True Touchscreen Display Unit Activity, and Built-in Menu Guides Assist in Tailoring the Unit's Functionality to Meet Your Needs
- 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

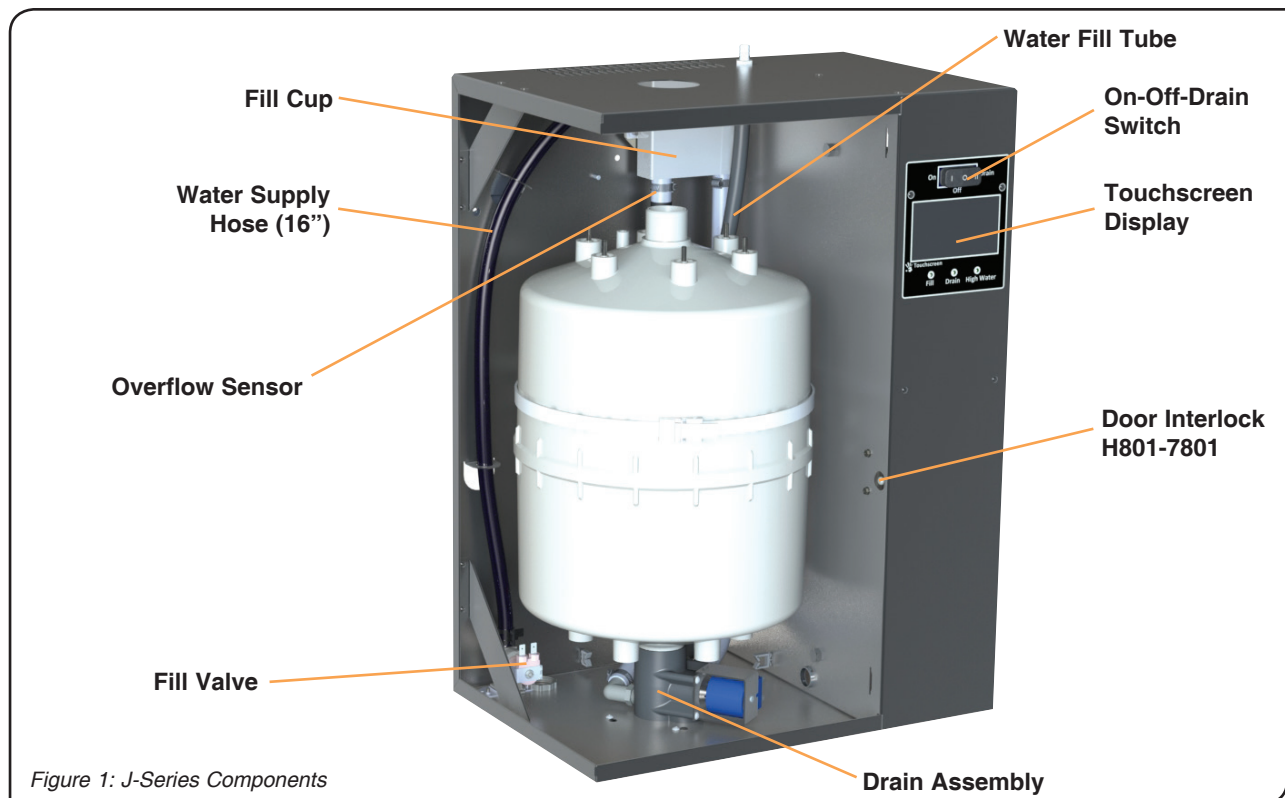


Figure 1: J-Series Components

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 and 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.

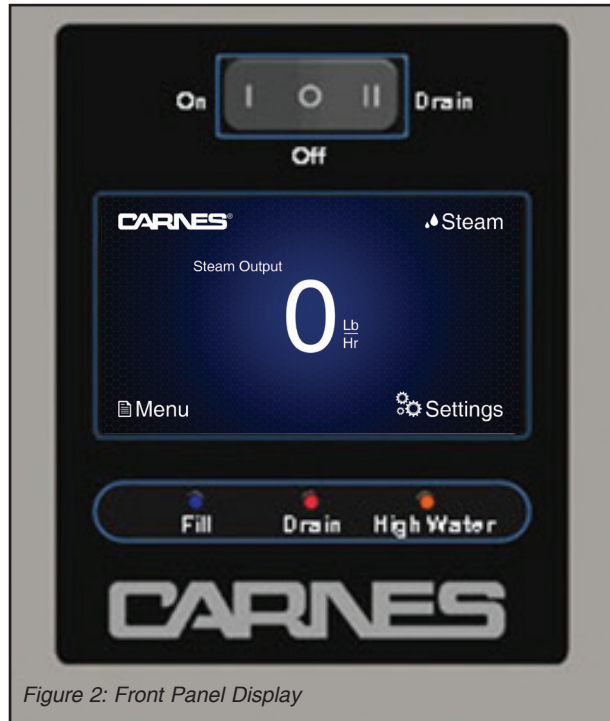


Figure 2: Front Panel Display

On-Off-Drain Switch

When the humidifier toggle switch is placed in the “On” position, the humidifier will generate steam if all internal and external control requirements are met. 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.

Important Note: When the toggle switch is in the “Drain” position, the fill valve and drain valve will both be active. The fill valve opens to mix cold water into the cylinder for a short cycle before the drain valve opens. This reduces the water’s temperature to ensure it is no longer boiling. Water exiting the drain port should never exceed 140°F.

Fill LED

The LED which indicates that the cylinder is filling is blue and turns on as the fill-valve activates. An activated fill valve allows water to flow from the source into the primary feed lines. An analogous indicator, and a description of its operation can be accessed through the Unit Activity Page (See LCD True Touchscreen Display Section (Unit Activity Page)).

Drain LED

The LED indication which indicates that the cylinder is drained is red and illuminates when the drain valve is active. An activated drain valve allows water to exit the

humidifier cylinder and dump into the drain line. An analogous indicator, and a description of its operation can be accessed through the Unit Activity Page (See LCD True Touchscreen Display Section (Unit Activity Page)).

High Water LED

The LED labeled “High Water” is an orange light that illuminates when the high water sensor is triggered. A tripped high water sensor indicates that the water has risen to the maximum allowable level in the cylinder. This can be a normal situation, particularly for cylinders filled with mostly unconditioned water. Frequent tripping of the high water sensor may also indicate that the cylinder is close to end-of-life and needs replacing. An analogous indicator, and a description of its operation can be accessed through the Unit Activity Page. More information on troubleshooting high water situations can also be found in the Help pages (See LCD True Touchscreen Display Section (Help Page)).

LCD True Touchscreen Display

This LCD True Touchscreen display offers an intuitive interface to control and monitor many variables of the humidifier. The screen uses pressure-sensitive technology, and can be activated by touching emulated buttons with any stylus or even just a finger. Various buttons and labels allow the user to navigate through menus, adjust and password-protect various settings, and visualize internal operations.

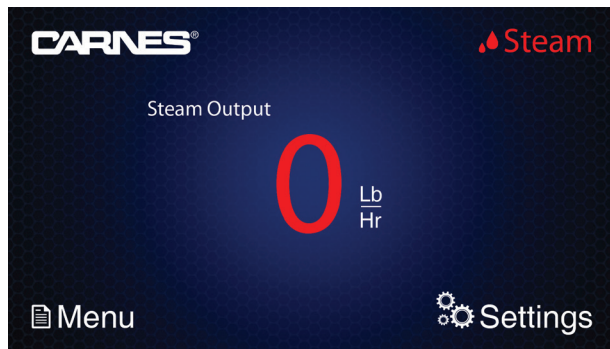
Home Page

The home page is the main page through which most other device menus can be accessed. The home page primarily serves as a display for the current steam output, but also shows indications of factors. The home page features multiple navigation buttons; four of these are always active, while others appear on the home page when different services or issues are active.

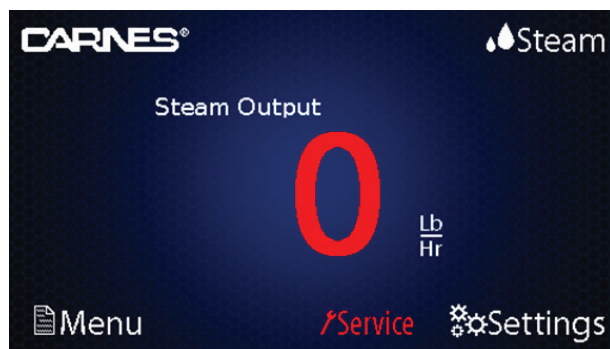


- **Carnes Icon:** Tapping the Carnes logo on the home page opens a window which displays Carnes Company contact information (address, phone number, and company website). This feature is for the purpose of contacting the factory for any startup questions, troubleshooting, or service issues that may arise.
- **Menu Icon:** Tapping the menu icon will take you to the main menu page. This can be used to access most of the unit’s specific function menus.

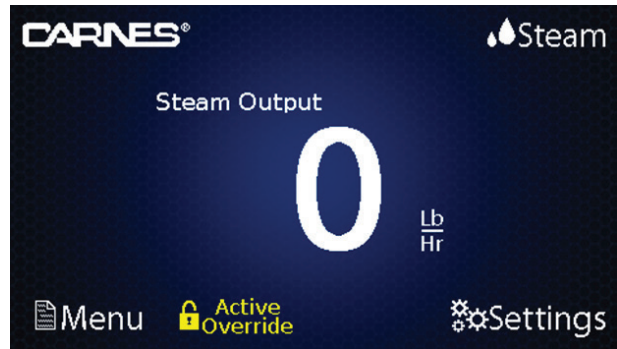
- **Settings Icon:** After powering the unit on, the first time the settings icon is pressed, the unit will display the settings password screen. The unit is shipped with the settings password enabled and a default password of "1212". The settings password can be enabled, disabled, and updated through the settings password page.
- **Steam Icon:** The steam icon is displayed in white when all of the external control signal requirements are met, and red if any of the controls are missing or faulted. Pressing the steam icon will take the user to the steam menu page.
- **Steam Output:** The steam output value is displayed as white text when the unit is switched on and able to generate steam (ready no-fault condition). If the unit is switched on and cannot generate steam due to missing external controls or fault signals, then the steam output text will be red.



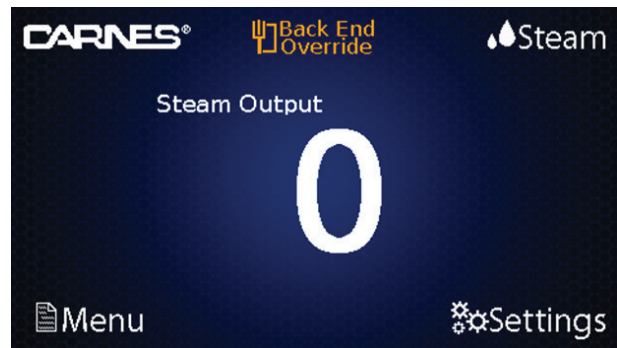
- **Service Required Icon:** The service required icon will appear at the bottom of the screen if the unit detects a fault that requires maintenance. Pressing the service required icon will take the user to the service required page, where fault details can be found.



- **Control Override Icon:** The control override icon will appear at the bottom of the screen if a manual override of a control signal or limit is currently active. Pressing the control override icon will take the user to the control override page.



- **Backend Override Icon:** The backend override icon will appear if an external communication protocol is active and the external device has commanded the unit on or off. Pressing the backend override icon will take the user to the backend override page.

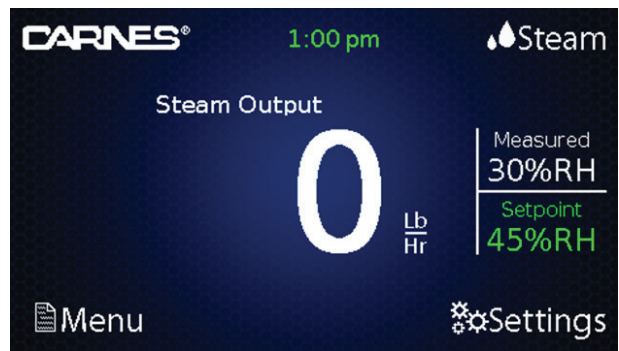
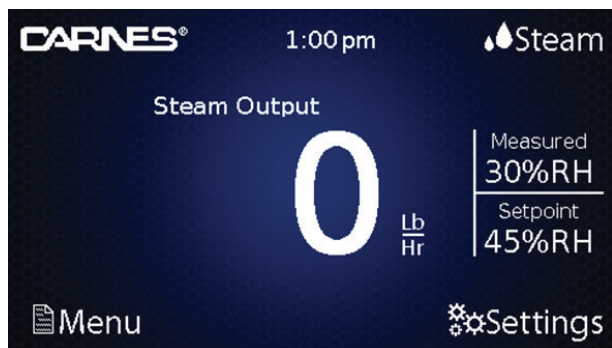
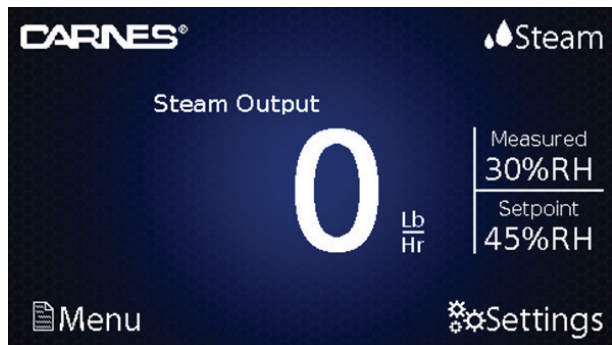


- **Time Icon:** The time icon will appear if the schedule function of the humidifier unit is enabled. If the schedule function is active but the time setting does not fall between a scheduled "on" time, the time icon will be white, signifying that the schedule function is not currently commanding the humidifier. If the time falls between a scheduled "on" time, the time icon will appear green, signifying that the unit is following the demand of the schedule.



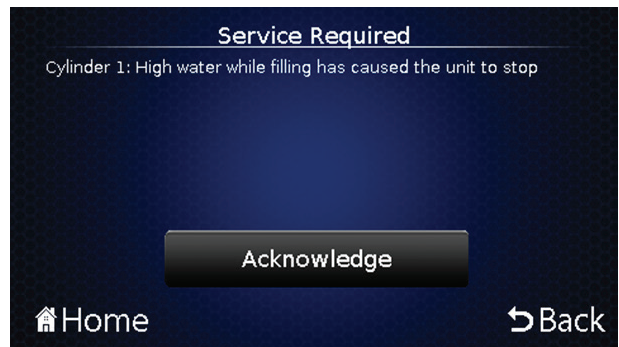


- Humidity Sensor Display:** The humidity sensor display will appear on the home screen if the selected method of external humidity control is by use of a humidity sensor. The humidity sensor display shows the current measurement of the humidity sensor and the internal humidity setpoint of the humidifier. When the schedule function is active and the time falls between a schedule "on" time, the humidity sensor setpoint will display in green, signifying that the schedule is currently controlling the humidity sensor setpoint. Pressing the humidity sensor display will take the user to the humidity control method page.



Service Required Page

The service required page displays any faults or issues with the humidifier unit that require attention. If no service is required, there should be no access to the service required page. If service is required, a detailed description will appear on the page with the ability to acknowledge the issue and force the unit to try and operate normally again.



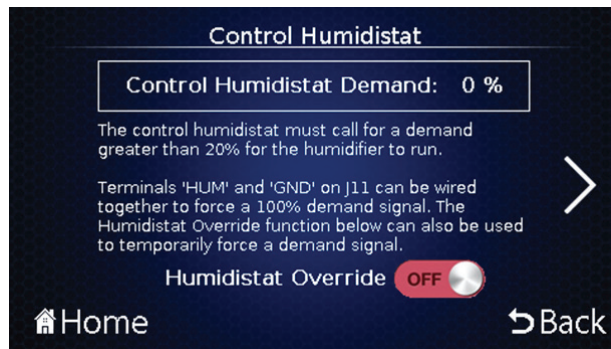
Steam Menu Page

The steam menu page displays to the user the status of the external control signals. The external control signals shown on this page are the humidistat, high limit humidistat, air flow switch, and door interlock switch. If a control signal is satisfied, a green check mark will appear on the corresponding icon. If the condition is not satisfied, a red "x" will appear on the icon. If the control signal has been overridden for troubleshooting, the button will appear with a yellow "i".



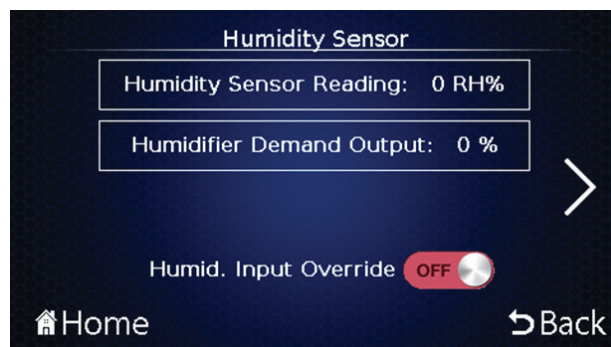
Control Humidistat Page

If the humidifier is configured to use a common humidistat with an output demand signal, the control humidistat icon will be shown on the steam menu page instead of the humidity sensor icon. The control humidistat page explains the device status, shows the current demand signal of the control humidistat, and has a toggle switch to allow for a temporary override of the control humidistat signal. The control humidistat must issue a demand signal greater than 20% for the humidifier to run. The humidistat override toggle button can set the humidistat demand to 100% for up to 30 minutes, at which time it will revert back to normal operation mode. The override is intended to only be used for troubleshooting purposes.

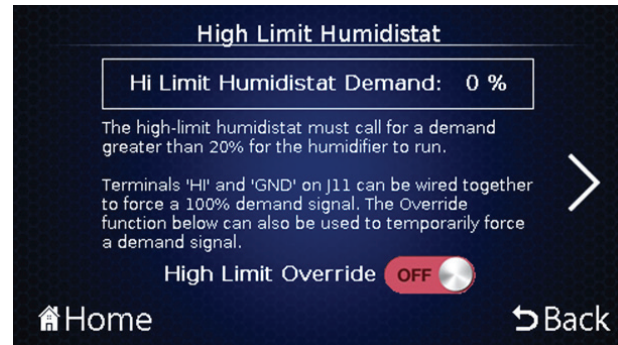


- Humidity Sensor Page**

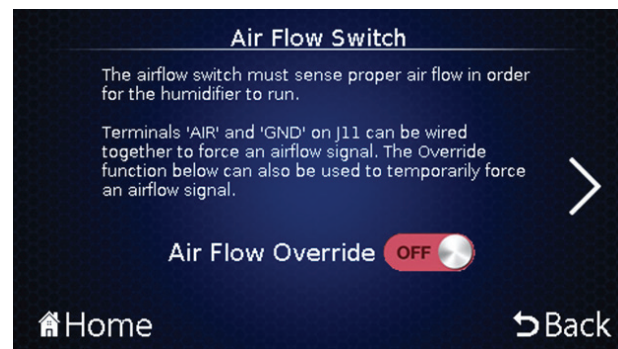
If the humidifier control settings are set to use a humidity sensor with measured humidity as the output signal, the humidity sensor icon will be shown on the steam menu page instead of the control humidistat icon. The humidity sensor page explains the status, shows the measured humidity and humidifier demand, and has a toggle switch to allow for a temporary override of the humidity sensor signal. The calculated demand must be greater than 20% for the humidifier to run. If pressed, the humidity sensor override toggle will set the calculated demand to 100% for up to 30 minutes, which time it will revert back to normal operation mode. The override is intended to only be used for troubleshooting purposes.

**High Limit Humidistat Page**

The high limit humidistat page explains the status, shows the current demand of the high limit humidistat, and has a toggle switch to allow for a temporarily override of the control humidistat signal. The high limit humidistat must call for a demand greater than 20% for the humidifier to run. The high limit humidistat override toggle will set the high limit humidistat demand to 100% for up to 30 minutes, at which time it will revert back to normal operation mode. The override is intended to only be used for troubleshooting purposes.

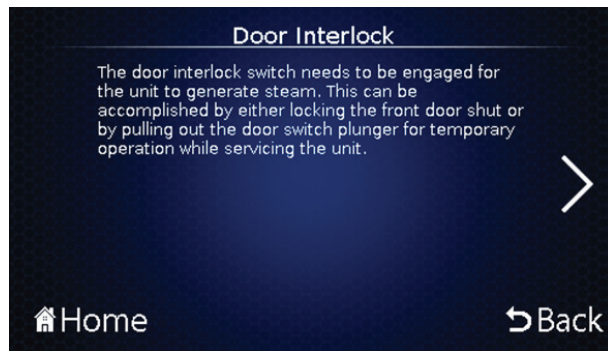
**Air Flow Switch Page**

The air flow switch page explains the status of the air flow switch and has a toggle switch to allow for a temporary override of the signal. The air flow switch must send an active signal for the humidifier to run. The air flow override command will set the air flow switch signal to active for up to 30 minutes, at which time it will revert back to normal operation mode. The override is intended to only be used for troubleshooting purposes.

**Door Interlock Page**

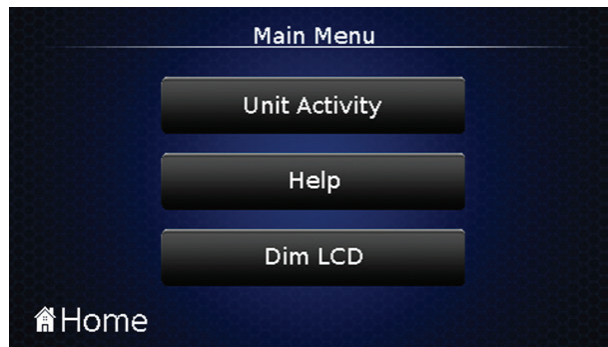
The door interlock switch page explains the status of the door interlock switch. The door interlock switch needs to be engaged for the unit to generate steam. This can be accomplished by either locking the front door shut or by pulling out the door switch plunger for temporary operation while servicing the unit.

Important Note: Operating the unit with the door off and lock plunger pulled out will allow high voltage and current to pass through the cylinder chamber. Additional precautions must be taken to prevent burns and electric shock.



Menu Page

The menu page is accessed through the bottom left corner of the home screen. There are no settings adjustments directly available from the menu page and it is used solely to access information about the unit.



Unit Activity Page

The unit activity page displays information for troubleshooting potential unit issues. This page was set up to show the internal functions of the unit, the program state of the unit, and all of the relevant settings currently being utilized. Pressing the individual icons on the screen will bring up more information about that segment. Active segments are shown on screen with a green or yellow outline, and relevant data is always displayed as white text.

- **Max Setpoint**

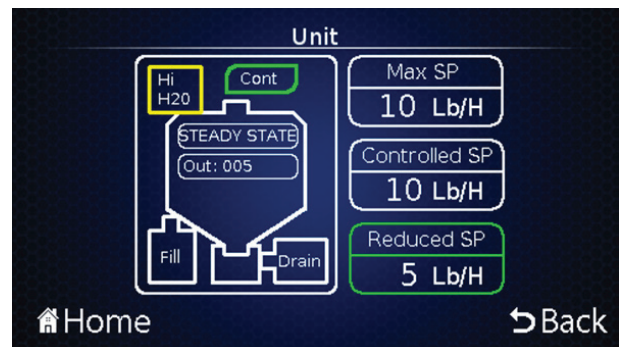
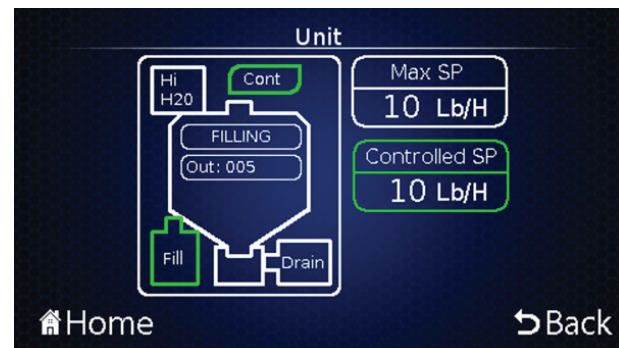
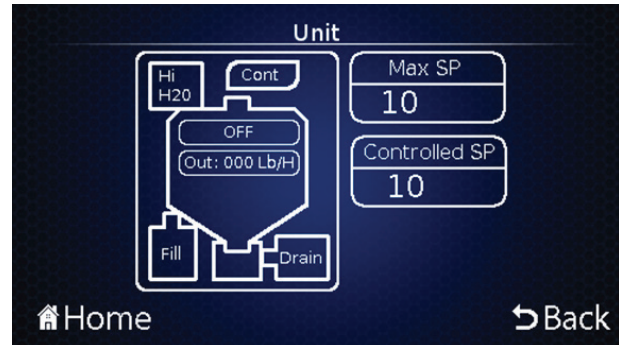
The maximum setpoint is the maximum output limit set by the user in the settings menu. The default maximum setpoint is the maximum rated output for that unit and is set at the factory. This value is used to determine the maximum steam output the system can produce when ramping up to meet the requested humidity.

- **Controlled Setpoint**

The controlled setpoint is the demand output signal specified by the user or an external device, and reduces the unit's output from the maximum to stabilize humidity during steady state operations.

- **Reduced Setpoint**

The reduced setpoint is the output value limit that is calculated when the maximum or controlled setpoints cannot be reached following repeated high water sensor activations. Setpoints may be reduced if the cylinder becomes clogged, or the electrodes are damaged. Check the home screen to see if service is required.

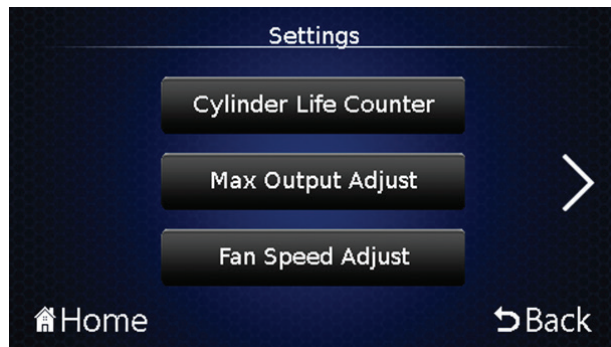


Help Pages

The Help pages display information pertinent to understanding how the unit functions. The multiple help pages were set up to act as a simplified digital manual for the unit, to help the user understand certain functionality and issues that may have arisen.

Settings Pages

The settings pages are where operational parameters of the humidifier can be adjusted. Each unit is shipped with a password protected settings page, and the default password is "1212". Everything from maximum output to the settings password itself can be adjusted through sub-menus of the settings page. Most of the settings available on this page can also be adjusted via communications with a Building Management System.



Cylinder Life Counter

The cylinder life span counter is used to help the user monitor cylinder life by recording how long the unit has been actively generating steam. When a used cylinder has reached its end of life, the user should record the cylinder life span and reset the counter before operating the unit with a new cylinder. The cylinder life counter information can help diagnose potential problems with cylinders burning out too quickly.



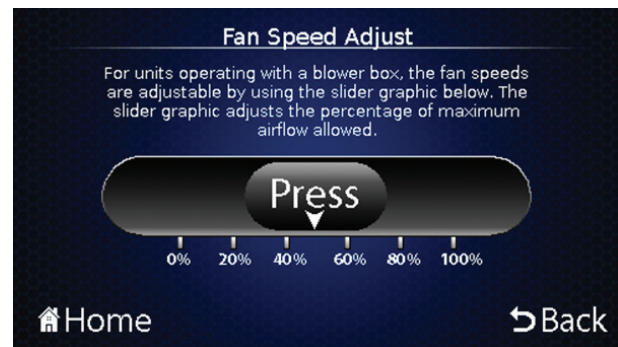
Max Steam Output Adjustment

The maximum steam output of the humidifier can be adjusted through this page. Each Carnes humidifier is shipped with a default maximum steam output that matches the maximum safe output capacity determined for that unit. Lowering the maximum steam output can help with various control issues, such as large humidity fluctuations in the controlled space or nonoptimal air flow in the duct. The maximum steam output cannot exceed the nominal output of the unit, which is listed on the label of the humidifier. Maximum output also cannot be set lower than 20% of the nominal output of the unit. One issue with setting the maximum steam output to its lowest value is that the unit can no longer function in a modulating manner, utilizing the full control of a proportional controller. When using a proportional controller, the unit functions by modulating its maximum steam output, so if this is set at its lowest possible value, there is no modulation of maximum steam output.



Fan Speed Adjustment

Fan speed adjustment only affects units that utilize a Carnes blower pack. The fan speed can be adjusted between 20-100% using the slider selection on the page. Each unit is shipped with a default of 100% fan speed. **Note:** Even with the slider set to 0%, the fans will operate at a minimum of 20% speed to prevent steam from entering a stagnant blower box.



Boil Down Timer

The boil down timer is a value, in seconds, that determines how fast consecutive fill cycles can occur before a periodic drain is required to reduce the conductivity of the water inside the cylinder.

If the unit is on and active, it will begin to fill. Once the desired output has been reached the unit will stop filling and switch into a steady state cycle, where it is only boiling the water and not filling or draining. As steam leaves the cylinder, the water level will drop, causing the unit to eventually begin to fill again, in an attempt to get back to the desired steam output. The boil down time is the length of time that the unit was in the steady state mode in between consecutive fill cycles. Higher conductivity water causes faster steady state cycles, so it is important to monitor this time and periodically reduce the conductivity of the water by draining some of the high conductivity water out and allow new, less conductive water to flow in. If the boil down timer does not elapse before a fill cycle starts again, the unit will drain to the corrective drain length setting.

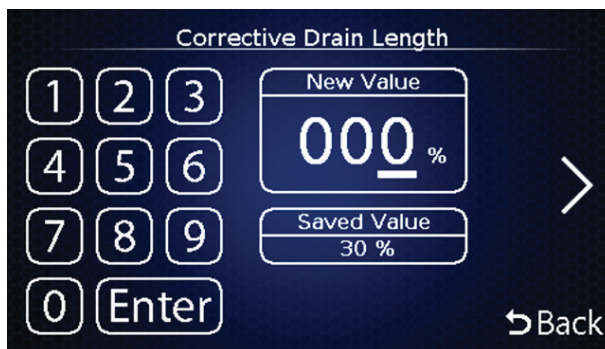
The boil down timer is a user adjustable variable with a valid range of 10-255 seconds and the unit is shipped with a factory default of 25 seconds. A larger time value will result in an overall higher cylinder water level and increased water usage. A lower time value will operate the humidifier at a lower water level and use less water, but will decrease the total lifespan of the cylinder.



Corrective Drain Length

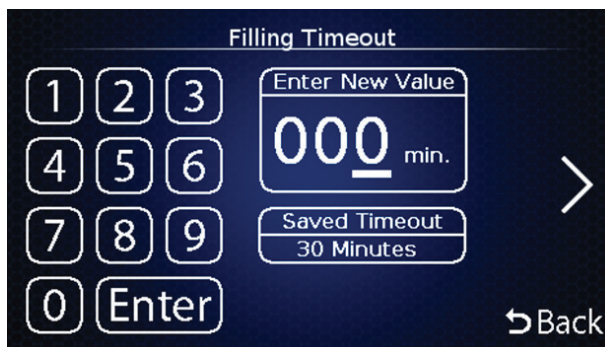
The corrective drain length is the percentage of water to be drained from the cylinder during a corrective drain cycle, that occurs when the unit boil down time period has not been met. The corrective drain length and boil down timer are directly connected as the corrective drain will never occur if a boil down time issue did not occur. As the humidifier boils water, minerals increase in the cylinder causing the water to become more conductive.

The corrective drain length setting is a user-adjustable percentage with a valid range of 20-100%, and is shipped with a default value of 30%. Increasing the percentage of the corrective drain flushes more conductive material from the humidifier, decreasing water conductivity, but increasing water usage. Decreasing the percentage of the corrective drain flushes less conductive material from the humidifier with the impacts of only slightly decreasing the water conductivity, reducing water usage, and reducing the cylinder lifespan. Back to back corrective drains can also cause the humidifier to trigger a service required alarm for water conductivity issues.



Filling Timeout Page

The filling timeout is a user adjustable timer that has a valid range of 30-255 minutes, with a default setting of 30 minutes. The filling timeout is the maximum amount of time allowed for a unit to reach a setpoint during a fill sequence. If the time expires during a fill sequence, the humidifier assumes the drain is stuck open and pulses the drain valve. After the pulsing routine, the humidifier will attempt to reach setpoint for second and third time. After the third attempt without reaching setpoint, the humidifier will shut down with a service required indication.



Reduced Setpoint Timeout Page

The reduced setpoint timeout is a user adjustable timer that has a valid range of 0-168 hours, with a default setting of 24 hours. The reduced setpoint timeout is the maximum amount of time, in hours, that a unit can run at a reduced setpoint. If the unit cannot return to full setpoint capacity within the amount of time set by the reduced setpoint timeout value, the unit will shut down with a service required indication.



Humidity Control Method

The humidity control method selection is where the user can set the humidifier to either be controlled by a common humidistat with a demand signal or a humidity sensor with a relative humidity measurement. All Carnes humidifiers are shipped with demand signal control as the default input control signal, because a demand signal is the industry standard for humidifier control. It is important to completely understand the differences in control between a demand signal and a humidity sensor signal before deciding to change from the default. These two control methods are discussed further in the External Controls section of this document.



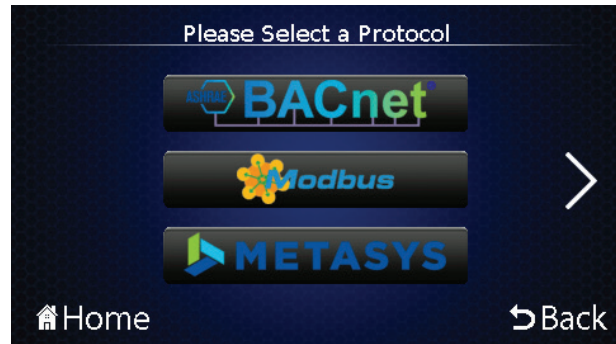
Communication Setup Pages

If the humidifier unit is equipped with the CarnesLink module, the communication setup pages can be fully utilized. All parameters of the selected communication protocol can be adjusted from the communication setup pages.



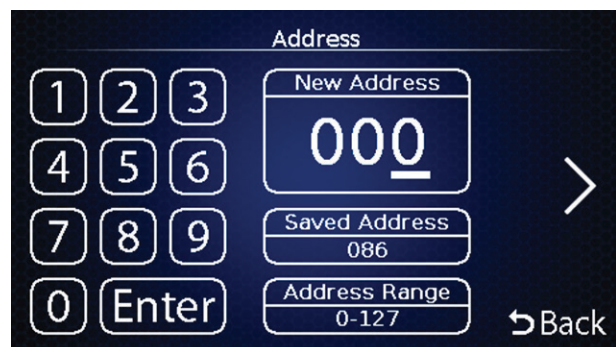
Protocol Selection

The selected protocol is displayed on the first button on the communication setup page. To change the selected protocol, press the button and select the desired protocol. There are five options in the protocol selection page, those being BACnet®, Modbus®, Metasys®, Siemens®, and no protocol. If no communication is being utilized for a time, make sure to select the no protocol option so the unit does not continuously update the communication database with no main controller protocol feedback.



Address Selection

The address of the unit can be updated by entering into the address page. Each address value range is protocol specific and each unit address should be completely unique to the Building Management System. Repeat addresses on the same network can cause issues with network communication because the network uses unit-specific addresses to communicate to individual units.



Baud Rate Selection Page

The baud rate of the unit can be updated by entering into the baud rate selection page. Each unit on the network must have a baud rate that matches the main controller or the units will not be able to communicate with the network properly. It is possible that one unit with a mismatched baud rate can take down the whole network by sending information at an unrecognized rate. Metasys® utilizes a single baud rate of 9600 for all systems, and therefore does not need to ever be changed.

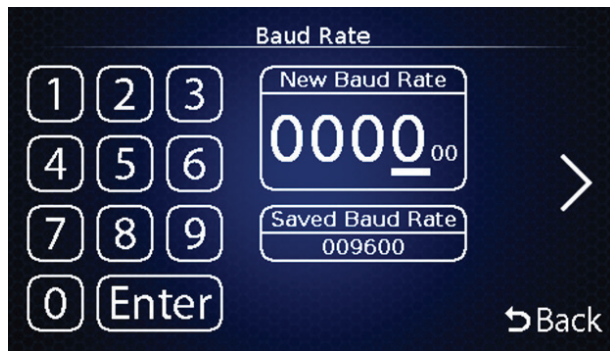


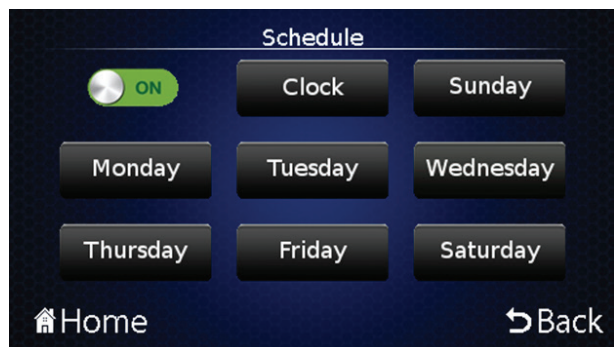
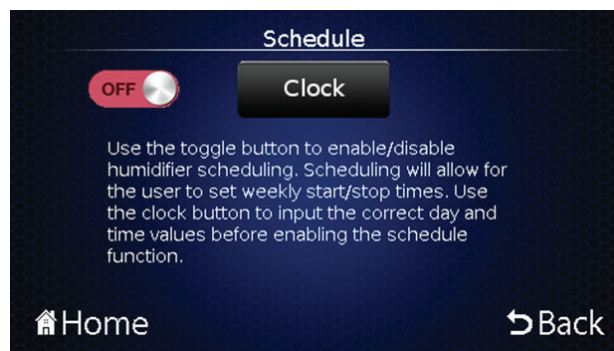
Table 1 - Network Device Parameters

Protocol	Address Range	Baud Rate Range	Polarity	Device Instance
BACnet® MS/TP	1 - 127	9600 - 115200	Fixed at: 0 = No Parity, 1 Stop Bit	0 - 9999
Modbus® RTU	1 - 247	2400 - 115200	0 = No Parity, 1 Stop Bit 1 = Odd Parity, 1 Stop Bit 2 = Even Parity, 1 Stop Bit 3 = No Parity, 2 Stop Bits	NA
Metasys® N2	1 - 255	Fixed at 9600	Fixed at: 0 = No Parity, 1 Stop Bit	NA
Siemens® FLN	1 - 98	2400 - 115200	Fixed at: 0 = No Parity, 1 Stop Bit	NA

Schedule Page

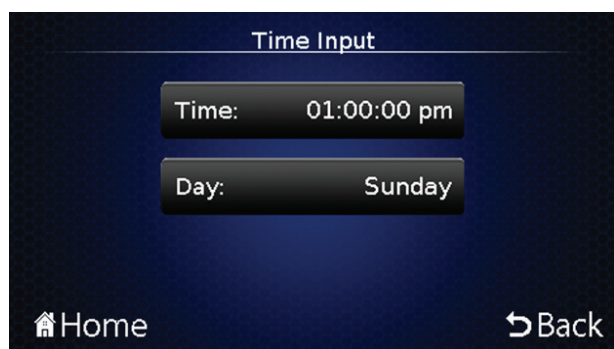
Important Note: The schedule function cannot run simultaneously with a BMS backend override; enabling one will automatically disable the other. That is not to say that the BMS communication cannot be active while the schedule function is active, just that the backend override functions cannot be active when the schedule function is active. This means that the BMS cannot control the unit on, off, or drain without disabling the schedule function also. This works both ways also, as in the schedule function activating will disable any backend override control that is currently active.

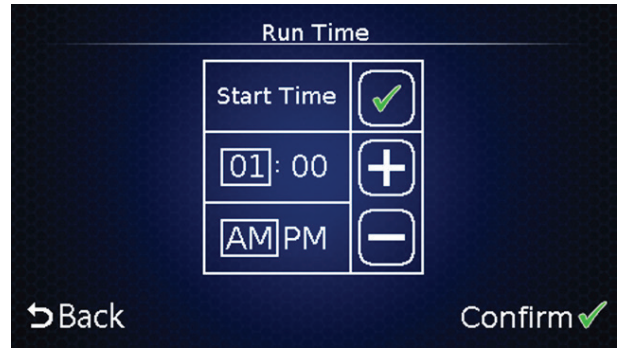
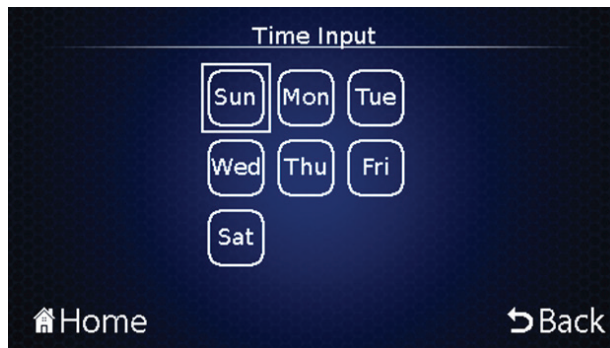
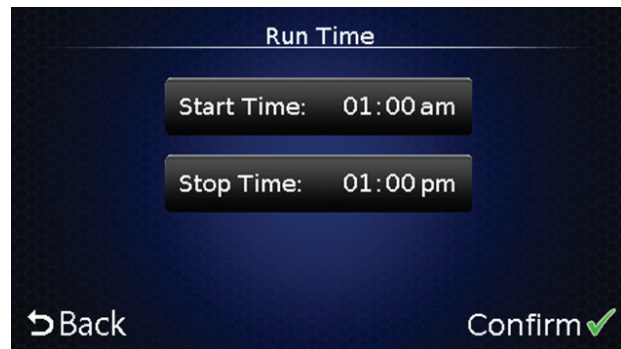
The schedule function gives the user the ability to control the humidifier based on an internal schedule. When the schedule function is enabled, the user is prompted to enter in a time value for the unit to track. The time is shown in the top center of the home screen when the schedule function is enabled. Each day contains 5 active timeslots for the user to program. If the humidity control selection is common humidistat the unit will either be on or off depending on the timeslot selection. If the humidity control selection is humidity sensor, the unit can control to different %RH setpoints in each timeslot and control to the default %RH setpoint when no timeslots are active.



Time Input Page

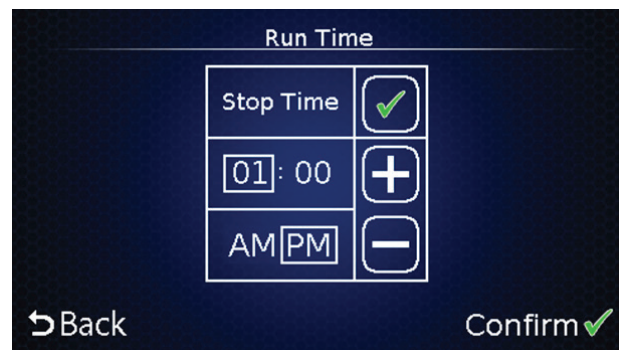
The time input page gives the user the ability to input the current day and time. The time input is required for the unit to function properly with the schedule function enabled. The time input does not sync with any outside parameters, so it is important that the user verify that the time and day are setup correctly. The time input does not allow for dates to be entered because the humidifier controls the schedule on a weekly basis, meaning that each week will control to the same timeslots saved for the previous week.





- **Day Pages**

Each day page gives the user the ability to enter in times (and %RH depending on the humidity control method) for when they would like their humidifier to be active during that specific day. Each day can hold up to 5 unique timeslots and each timeslot is saved into internal memory when entered, so the only way to stop a timeslot from running is to delete it from the queue on that specific day.



Pressing the minus button from the day page will allow the user to delete timeslots. Once the minus button is pressed the outline of the timeslots will appear red with a red "X" at the end of each. Pressing the timeslot or the red "X" when they are outlined in red will delete that timeslot.

Pressing the plus button will take the user to a page where a start and stop time can be input. From here, pressing the start or stop buttons will allow the user to enter in a time. Once the correct times are entered, the timeslot can be saved by pressing the confirm button on the run time page. If the stop time and start time do not arrange chronologically you will not be allowed to save the timeslot.



Pressing on an individual timeslot when they are outlined in white (not red, for when the delete selection is active) will give the user the ability to edit the selected timeslot. This action will take the user to the run time page where start and stop times can then be edited and saved if they are valid.

- **Schedule Function Control of %RH When Using a Humidity Sensor**

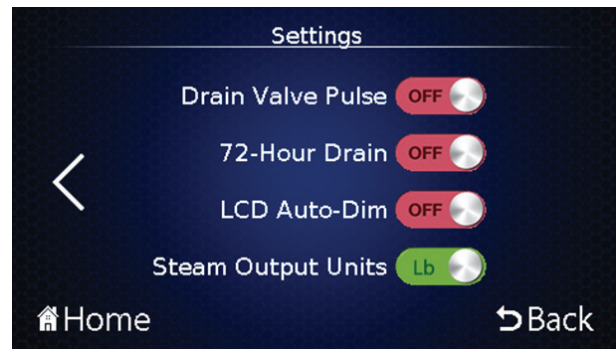
The schedule function has the ability to control the %RH setpoint individually in each timeslot if the humidity control method utilizes a humidity sensor over a humidistat. When the humidity sensor control mode is enabled there is an extra setting added to the run time page for adding the desired %RH setpoint for that specific timeslot. When a timeslot is not active and the humidity control method is humidity sensor, the unit will stay active with the common default %RH setpoint, unlike if the humidistat is the humidity control method selected, where the unit will turn off in between active timeslots.



Settings Toggle Page

The settings toggle page is located at the end of the settings pages when pressing the right arrow. The settings on the settings toggle page are described as follows.

- **Drain Valve Pulse:** The default is disabled, and enabling this setting will cause the drain valve to pulse whenever draining. This is especially helpful when it is common for the drain valve to get sediment stuck in the plunger system, and occurs when cylinders have significant scale and sediment buildup inside.
- **72-Hour Drain:** The default is enabled and this function will drain the unit if there is no activity for 72-hours. It is not recommended to disable this option as standing water in a cylinder can cause various conductivity and sanitary issues. Dirty water and rust can build up in a cylinder that is not periodically drained during times of inactivity.
- **LCD Auto-Dim:** The default is enabled and this function will allow the LCD screen to dim after a period of no user input. It is recommended to leave this function enabled as it will reduce risk of LCD backlight issues.
- **Steam Output Units:** The default is Lb/Hr and can be switched between Lb/Hr and Kg/Hr.



Start-Up Procedure:

1. Connect supply water, drain, steam hose, electrical power, and control wiring to the unit.
2. Verify the power and steam output on the unit sticker match the supplied power.
3. Verify that the steam cylinder is properly installed in the drain valve assembly, and that all wires and wire connectors are in the proper position and secure on the top of the cylinder.
4. Open valve allowing water to flow to the humidifier and check for leaks inside the humidifier cabinet.
5. Reattach the front and side panels.
6. Turn on main power to the unit.
7. Adjust the desired humidity setpoint on the humidistat or thermostat.
8. Press the on/off button on the front panel to turn the humidifier on.
9. The humidifier will run if the unit is turned on, the air flow is active, and the humidistat is measuring a humidity level that is lower than the user entered setpoint.
10. Press the drain button on the front display to verify the drain function is operating properly. The fill valve and drain valve will open in sync to lower the water temperature from the unit to the drain.
11. Press the drain button again to enter back into the normal operation of the humidifier.

▼ 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 2

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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▼ PRINCIPALS OF OPERATION

The Carnes J-Series commercial steam humidifiers add conditioned moisture to an otherwise dry space through the use of the existing ductwork or blower fan. Carnes humidifiers use electrode technology to generate pure, sanitary steam from water fed to the unit. The amount of steam generated by the system is controlled through the use of external interlocks and digital controls by modulating the volume of water in contact with the electrodes. The humidifier unit internally verifies that safety and control protocols have been satisfied before filling with water and beginning operation (e.g. the control humidistat is calling for steam, the humidifier door is shut, and the air handling system is active). The fill valve then opens and allows water to flow into the fill cup, where it drops into the standpipe, feeding directly to the steam cylinder. The standpipe directs a column of water into the cylinder using gravity, and the air gap above the fill cup prevents the cylinder from pressurizing against the water supply stream, as shown in Figure 3. The steam cylinder normally operates at a pressure of approximately 0 to 1/2 psi above ambient. When the power contactor is activated, current is allowed to flow between the electrodes that are sealed within the steam cylinder. Current passes directly through the water between the electrodes. Accounting for the differences in conductivity due to minerals present in the water, the system uses the resistance of the water to generate the heat needed to turn it into steam (this is the most efficient method to generate steam from tap or softened water). The steam exits the top of the cylinder, passes through the flexible steam hose, and makes its way out of the steam distributor pipe mounted inside the ductwork of the air handling system. The steam distribution pipe delivers steam over a wide area in the duct and directs any condensed moisture back into the steam cylinder.

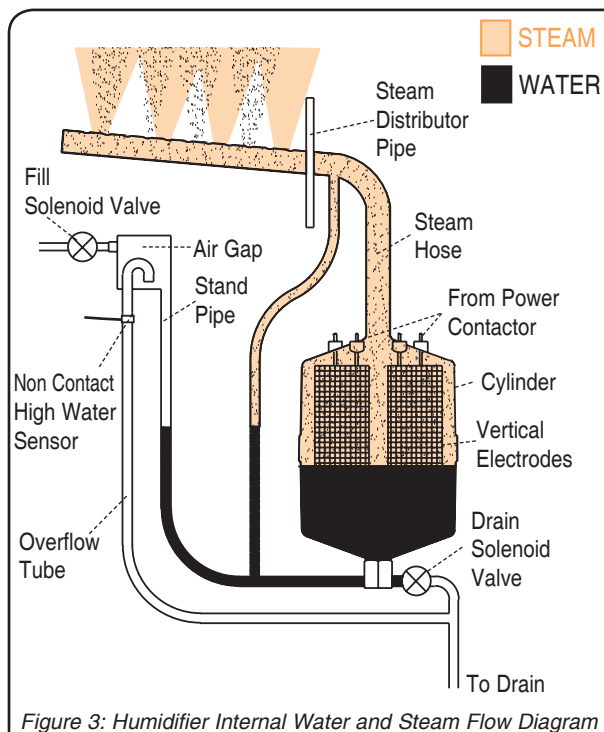


Figure 3: Humidifier Internal Water and Steam Flow Diagram

A digital control-board calculates when to open and close the water supply valve to maintain constant steam production. In combination with the drain valve, the system automatically responds to conditional changes and periodically drains the required quantity of water to provide stable operation, flush dirty electrolyte, and prolong cylinder life. As mineral deposits build up within the cylinder, the water level will slowly rise to utilize fresh electrode surface-area in an attempt to maintain the desired steam output rate. If mineral deposits encrust too much of the electrode surface or the electrode itself degrades, current flow will be reduced to a level where the desired steam output cannot be reached. At such a point, the "Service Required" indication on the monitor will alert the user to perform maintenance or insert a new cylinder. Cylinders can be easily replaced in a span of minutes (not including cool down time).

Important Note: Many variables affect the operation of humidifiers (water conductivity, water hardness, etc.). Systems may require up to 24 hours of steam generation before a humidifier is truly operating in the nominal range, and the water in the steam chamber is properly conditioned. "Conditioned," in this case, refers to when the amount of electrolyte dissolved in the water is at a steady state. Conditioned water is typically more conductive than fresh water at the fill valve. Conditioned cylinders may have a film of insoluble precipitate lining the inner walls of the chamber.

▼ MOUNTING THE HUMIDIFIER

Fasten the mounting bracket to a solid surface using 1/4" lag screws with at least 1" of length, (refer to Table 3 below for required counts). Verify that the mounting surface can handle the maximum operating weight of the unit, (unit weights shown in Table 3 below). Once the humidifier mounting bracket is placed and secured to the wall, the humidifier unit can attach to the bracket rail. A sheet metal screw should be installed through the back of the humidifier cabinet to secure the humidifier to the mounting bracket.

Important Note: Fasteners are not provided by Carnes, and must be sourced from other vendors.

Table 3: Humidifier Mounting Information

Cabinet Style	Dry Wgt.	Max. Wgt.	# of Fasteners Required (1/4" Lag Screw, 1" Length)
H_AJ	48 lbs.	61 lbs.	4
H_AJ w/Blower Package			4
H_BJ	59 lbs.	72 lbs.	4
H_BJ w/Blower Package			4
H_CJ	65 lbs.	110 lbs.	4
H_CJ w/Blower Package			4
H_HJ	113 lbs.	230 lbs.	6

▼ MOUNTING THE STEAM DISTRIBUTION PIPE(S)

The perforated steam distribution pipe must be mounted perpendicular to the flow of air such that the holes of the pipe face upwards. The distribution end itself should be roughly horizontal, pitched back slightly towards the delivery pipe. This is required so that any condensation in the distribution pipe will drain to the return line. Once the distribution pipe is in place, it should be secured with 4 sheet metal screws (not included with unit). Multiple distribution pipes may be required to achieve a shorter steam absorption length and if so, each distribution pipe should be mounted following the instructions described above.

Important Notes:

- Special distribution systems are shipped with specific instructions on how to mount them properly.
- If a blower pack is utilized for the system, a standalone steam distribution pipe is not required.
- Fasteners required to affix the distribution apparatus are not provided by Carnes, and must be sourced from other vendors.

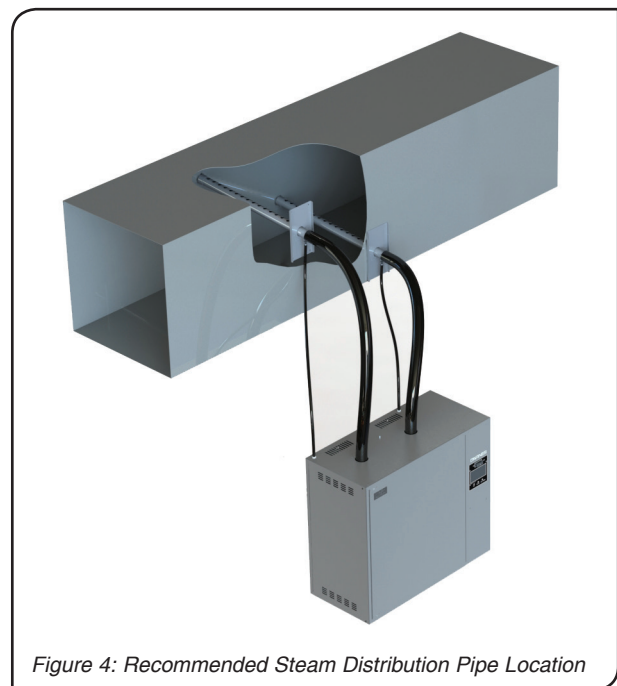


Figure 4: Recommended Steam Distribution Pipe Location

Important Notes:

- The distance between the humidifier and steam hose/pipe should be the minimum length possible. The maximum approved length of steam hose/pipe for a system has been determined to impact duct static pressure and steam capacity.
- Copper or brass tubing is the only acceptable substitute for steam or condensate flexible hose.
- Both steam delivery and condensate return lines should be installed so there are no sags, low points, dips or horizontal runs between the outlet or dispersal fittings.

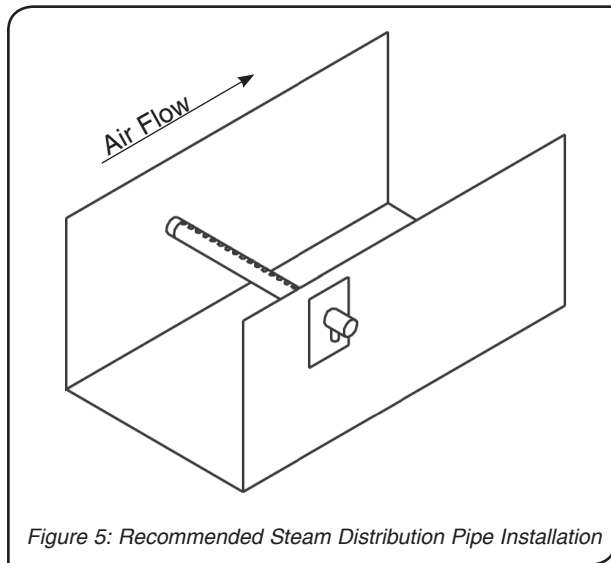


Figure 5: Recommended Steam Distribution Pipe Installation

Hose/Pipe Lengths Less than 12'

For any hose less than or equal to 12 feet in length, it is highly recommended that the hose be routed with a continuous vertical rise from the cabinet with no sags, low points, dips, or horizontal runs (shown in *Figure 6*). The delivery pipe should be sloped 10° up from the horizontal position, or 2" of vertical for every 12" of horizontal, to allow for proper condensate drainage shown in *Figure 7*. Supports at intermediate points may be necessary to help eliminate any issues due to sagging or low points. Any turns should have a minimum radius of 8" to prevent the hose from kinking. Push the steam hose through the top of the humidifier cabinet and slip it over the outlet stub on the top of the cylinder. The steam hose should be fastened to the humidifier and distribution pipe with hose clamps provided.

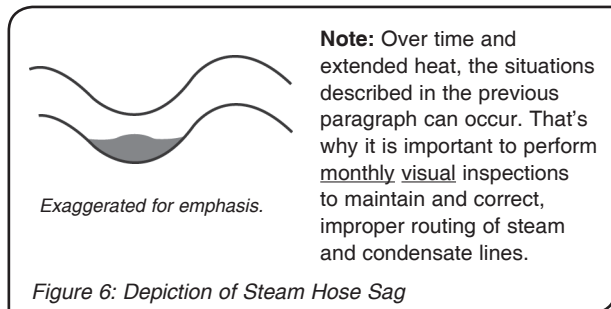


Figure 6: Depiction of Steam Hose Sag

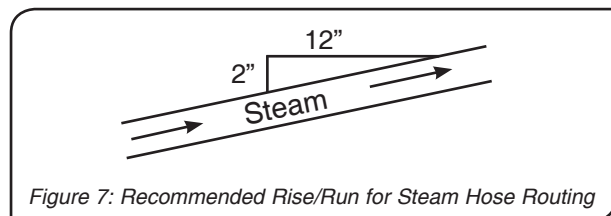
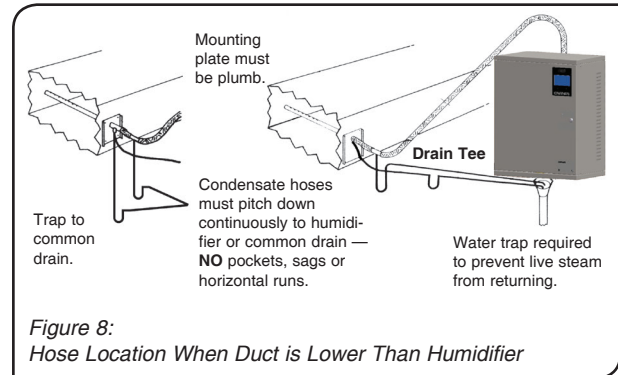


Figure 7: Recommended Rise/Run for Steam Hose Routing

Hose/Pipe Lengths Exceeding 12'

For hose lengths exceeding 12 feet, an alternative installation can be utilized, if the previously described requirements cannot be met. The steam hose can be routed out vertically from the humidifier and pitched downward

toward the distribution pipe drain 'T', as shown in *Figure 8*. A drain 'T' fitting might be required to remove condensate that occurs when using a steam hose with a length exceeding 12 feet. It is possible to lose significant volumes of steam output due to improper hose routing.

Figure 8:
Hose Location When Duct is Lower Than Humidifier**Table 4: Maximum Steam Hose Length**

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

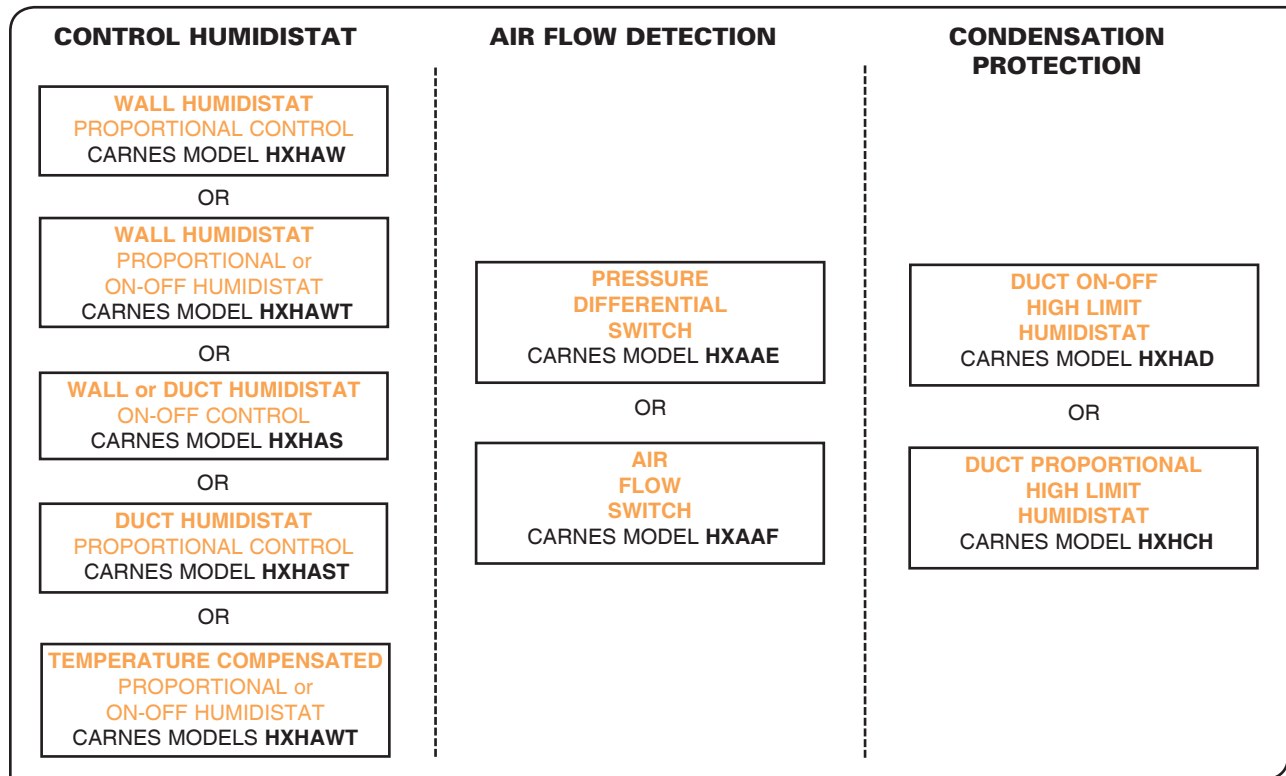
Supply Water Guidelines**Important Notes:**

- Carnes recommends that supply lines be installed by a licensed plumbing professional.
- Verify the water supply satisfies the guidelines listed in the Water Quality Section of this document.
- Carnes does not supply optional plumbing such as shutoff valves with humidifier units, and these will need to be sourced from another vendor if desired.
- Connect a supply hose to the 3/8" FPT fitting that is provided, located at the bottom of the humidifier for connection to tap water. It is recommended that the installer adds a shutoff valve ahead of this fitting in order to disable the water source before servicing the system.

Table 5: Acceptable Conductivity Ranges (Micromhos)

Voltage		H_AJ	H_DJ	H_GJ	H_HJ
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 9



▼ 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 for 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.

▼ 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 must be installed a minimum of 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

External controls for the humidifier are connected through use of screw-terminal connector J11 located on the bottom of the humidifier main control board. The terminals are labeled on the board and the connection diagrams. 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 pin 1 and pin 2 of J11.

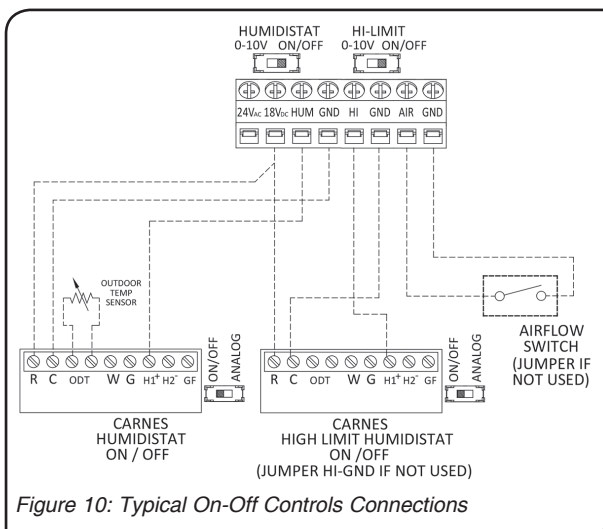


Figure 10: Typical On-Off Controls Connections

EXTERNAL DDC CONTROL SIGNALS

Carnes humidifiers can also accept a 0-10 volt DC signal to modulate the output of the humidifier. Polarity must be observed. Input impedance is 20K ohms. If a 4-20 mA input signal is provided to the humidifier a 470 ohm 1/4 watt resistor must be installed as shown below (Figure 11).

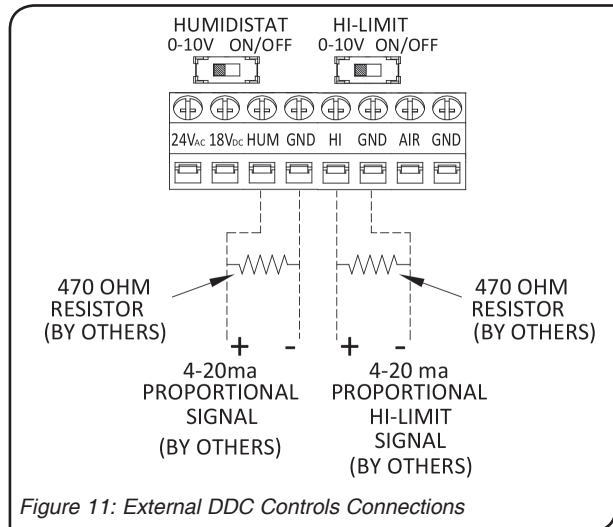


Figure 11: External DDC Controls Connections

EXTERNAL MONITORING

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 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.)

If the unit was selected with CarnesLink the control board will come with an external mounted BMS card located on pin J8 on the control board, shown in Figure 12. See Form 16865 for module functions and wiring diagram.

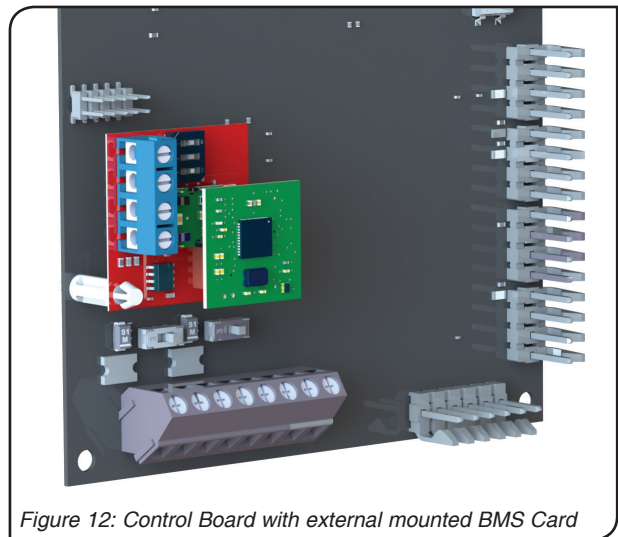


Figure 12: Control Board with external mounted BMS Card

Table 6: Electrical Data and Unit Detail Sheet

	Model	Max Lb/Hr	Voltage	Phase	kW	Line Amp	Disc. Size	Optional Circuit Breaker*	Steam Cylinder	Cyl Wire Current
HSAJ HTAJ	H_AJAU	5	120	1	1.725	14.4	25	1-20 Amp	AX220	14.4
	H_AJBU	5	208	1	1.725	8.3	15	1-15 Amp	AX380	8.3
	H_AJDU	5	230	1	1.725	7.5	15	1-20 Amp	AX380	7.5
	H_AJFU	5	277	1	1.725	6.2	15	1-15 Amp	AX380	6.2
	H_AJLU	5	380	1	1.725	4.5	15	1-15 Amp	AX600	4.5
	H_AJQU	5	415	1	1.725	4.2	15	1-15 Amp	AX600	4.2
	H_AJMU	5	460	1	1.725	3.7	15	1-15 Amp	AX700	3.7
	H_AJNU	5	575	1	1.725	3.0	15	1-15 Amp	AX700	3
	H_AJAU	10	120	1	3.45	28.7	45	1-40 Amp	AX220	28.7
	H_AJBU	10	208	1	3.45	16.6	25	1-25 Amp	AX380	16.6
	H_AJDU	10	230	1	3.45	15.0	25	1-25 Amp	AX380	15
	H_AJFU	10	277	1	3.45	12.4	20	1-20 Amp	AX380	12.4
	H_AJLU	10	380	1	3.45	9.1	15	1-15 Amp	AX600	9.1
	H_AJQU	10	415	1	3.45	8.3	15	1-15 Amp	AX600	8.3
	H_AJMU	10	460	1	3.45	7.5	15	1-15 Amp	AX700	7.5
	H_AJNU	10	575	1	3.45	6.0	15	1-15 Amp	AX700	6
HSDJ HTDJ	H_DJBU	20	208	1	6.9	33.1	50	1-45 Amp	B381	33.1
	H_DJDU	20	230	1	6.9	29.9	45	1-40 Amp	B381	30
	H_DJFU	20	277	1	6.9	24.9	40	1-35 Amp	B381	24.9
	H_DJLU	20	380	1	6.9	18.1	30	1-30 Amp	B600	18.1
	H_DJQU	20	415	1	6.9	16.6	25	1-25 Amp	B600	16.6
	H_DJMU	20	460	1	6.9	15.0	25	1-25 Amp	B700	15
	H_DJNU	20	575	1	6.9	12.0	20	1-15 Amp	B700	12
	H_DJCU	20	208	3	6.9	19.1	30	1-25 Amp	B500	19.1
	H_DJEU	20	230	3	6.9	17.3	30	1-25 Amp	B500	17.3
	H_DJTU	20	380	3	6.9	10.4	20	1-20 Amp	B600	10.4
	H_DJWU	20	415	3	6.9	9.6	20	1-20 Amp	B600	9.6
	H_DJGU	20	460	3	6.9	8.6	15	1-15 Amp	B700	8.6
	H_DJHU	20	575	3	6.9	6.9	15	1-15 Amp	B700	6.9
	H_DJCU	30	208	3	10.3	28.7	45	1-40 Amp	B500	28.7
	H_DJEU	30	230	3	10.3	25.9	40	1-35 Amp	B500	25.9
	H_DJTU	30	380	3	10.3	15.6	25	1-25 Amp	B600	15.6
	H_DJWU	30	415	3	10.3	14.4	25	1-25 Amp	B600	14.4
	H_DJGU	30	460	3	10.3	13.0	20	1-20 Amp	B700	13
	H_DJHU	30	575	3	10.3	10.4	20	1-15 Amp	B700	10.4
HSGJ HTGJ	H_GJBU*	30	208	1	10.3	49.7*	80	2-35 Amp*	C62	24.8
	H_GJDU	30	230	1	10.3	44.9	70	1-60 Amp	C62	22.4
	H_GJFU	30	277	1	10.3	37.3	60	1-50 Amp	C62	18.6
	H_GJLU	30	380	1	10.3	27.2	45	1-40 Amp	C62	13.6
	H_GJQU	30	415	1	10.3	24.9	40	1-40 Amp	C62	12.5
	H_GJMU	30	460	1	10.3	22.5	35	1-30 Amp	C62	11.3
	H_GJNU	30	575	1	10.3	17.9	30	1-25 Amp	C62	9.0
	H_GJCU	40	208	3	13.8	38.3	60	1-60 Amp	C62	19.1
	H_GJEU	40	230	3	13.8	34.6	60	1-50 Amp	C62	17.2
	H_GJTU	40	380	3	13.8	20.9	35	1-35 Amp	C65	20.9
	H_GJWU	40	415	3	13.8	19.2	30	1-30 Amp	C65	19.2
	H_GJGU	40	460	3	13.8	17.3	30	1-25 Amp	C65	17.3
	H_GJHU	40	575	3	13.8	13.8	25	1-20 Amp	C65	13.8

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

Table 6: *Electrical Data and Unit Detail Sheet (Continued)*

	Model	Max Lb/Hr	Voltage	Phase	kW	Line Amp	Disc. Size	Optional Circuit Breaker*	Steam Cylinder	Cyl Wire Current
HSGJ HTGJ	H_GJCU	50	208	3	17.2	47.8	80	2-35 Amp	C62	23.9
	H_GJEU	50	230	3	17.2	43.2	70	1-60 Amp	C62	21.6
	H_GJTU	50	380	3	17.2	26.2	40	1-40 Amp	C65	26.2
	H_GJWU	50	415	3	17.2	24.0	40	1-40 Amp	C65	24
	H_GJGU	50	460	3	17.2	21.6	35	1-30 Amp	C65	21.6
	H_GJHU	50	575	3	17.2	17.3	30	1-25 Amp	C65	17.3
	H_GJCU*	60	208	3	20.7	57.4*	90	2-40 Amp*	C62	28.7
	H_GJEU*	60	230	3	20.7	51.9*	80	2-40 Amp*	C62	26
	H_GJTU	60	380	3	20.7	31.4	50	1-50 Amp	C65	31.4
	H_GJWU	60	415	3	20.7	28.8	45	1-45 Amp	C65	28.8
	H_GJGU	60	460	3	20.7	26.0	40	1-40 Amp	C65	26
	H_GJHU	60	575	3	20.7	20.8	35	1-30 Amp	C65	20.8
	H_GJCU*	80	208	3	27.5	76.5*	125	2-60 Amp*	C62	38.2
	H_GJEU*	80	230	3	27.5	69.2*	110	2-50 Amp*	C62	34.6
	H_GJTU	80	380	3	27.5	41.9	70	1-60 Amp	C12	21
	H_GJWU	80	415	3	27.5	38.4	60	1-60 Amp	C12	19.2
	H_GJGU	80	460	3	27.5	34.6	60	1-50 Amp	C12	17.3
	H_GJHU	80	575	3	27.5	27.7	45	1-40 Amp	C12	13.9
	H_GJCU*	100	208	3	34.4	95.6*	150	2-60 Amp*	C62	47.8
	H_GJEU*	100	230	3	34.4	86.4*	150	2-60 Amp*	C62	43.2
	H_GJTU*	100	380	3	34.4	52.3*	110	2-50 Amp*	C12	34.2
	H_GJWU	100	415	3	34.4	47.9	80	2-40 Amp	C12	24
	H_GJGU	100	460	3	34.4	43.3	70	1-60 Amp	C12	21.7
	H_GJHU	100	575	3	34.4	34.6	60	1-50 Amp	C12	17.3
HSHJ HTHJ	H_HJCU*	125	208	3	43	119.5*	200	4-40 Amp*	C62 (2)	29.8
	H_HJEU*	125	230	3	43	108*	175	4-40 Amp*	C62 (2)	27
	H_HJTU*	125	380	3	43	65.3*	100	2-50 Amp*	C12 (2)	16.3
	H_HJWU*	125	415	3	43	59.8*	90	2-45 Amp*	C12 (2)	15
	H_HJGU*	125	460	3	43	54.0*	90	2-40 Amp*	C12 (2)	13.5
	H_HJHU	125	575	3	43	43.2	70	2-30 Amp	C12 (2)	10.8
	H_HJCU*	150	208	3	51.7	143.5*	225	4-50 Amp*	C62 (2)	35.8
	H_HJEU*	150	230	3	51.7	129.7*	200	4-50 Amp*	C62 (2)	32.4
	H_HJTU*	150	380	3	51.7	78.6*	125	2-60 Amp*	C12 (2)	19.7
	H_HJWU*	150	415	3	51.7	71.9*	110	2-60 Amp*	C12 (2)	18
	H_HJGU*	150	460	3	51.7	64.8*	100	2-50 Amp*	C12 (2)	16.2
	H_HJHU*	150	575	3	51.7	51.9*	80	2-35 Amp*	C12 (2)	13
	H_HJCU*	175	208	3	60.3	167.3*	300	4-60 Amp*	C62 (2)	41.8
	H_HJEU*	175	230	3	60.3	151.3*	250	4-60 Amp*	C62 (2)	37.8
	H_HJTU*	175	380	3	60.3	91.6*	150	4-35 Amp*	C12 (2)	22.9
	H_HJWU*	175	415	3	60.3	83.9*	150	2-60 Amp*	C12 (2)	21
	H_HJGU*	175	460	3	60.3	75.6*	125	2-60 Amp*	C12 (2)	18.9
	H_HJHU*	175	575	3	60.3	60.5*	100	2-50 Amp*	C12 (2)	15.1
	H_HJCU*	200	208	3	68.9	191.2*	300	4-60 Amp*	C62 (2)	47.8
	H_HJEU*	200	230	3	68.9	172.9*	300	4-60 Amp*	C62 (2)	43.2
	H_HJTU*	200	380	3	68.9	104.7*	175	4-40 Amp*	C12 (2)	26.2
	H_HJWU*	200	415	3	68.9	95.9*	150	4-35 Amp*	C12 (2)	23.9
	H_HJGU*	200	460	3	68.9	86.4*	150	2-60 Amp*	C12 (2)	21.6
	H_HJHU*	200	575	3	68.9	69.2*	110	2-50 Amp*	C12 (2)	17.2

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

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.

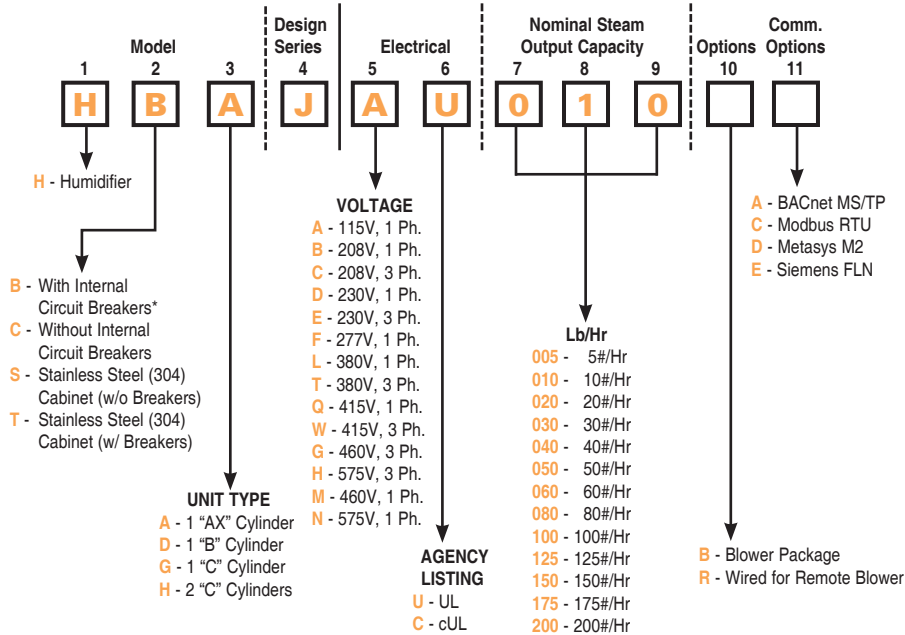
“Voltage” and **“Phase”** designates available phase and nominal voltages. Single phase units may be operated from two legs of a three phase supply but the load will be unbalanced.

“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 7

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 8

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 9

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

STEAM DISTRIBUTOR PIPES

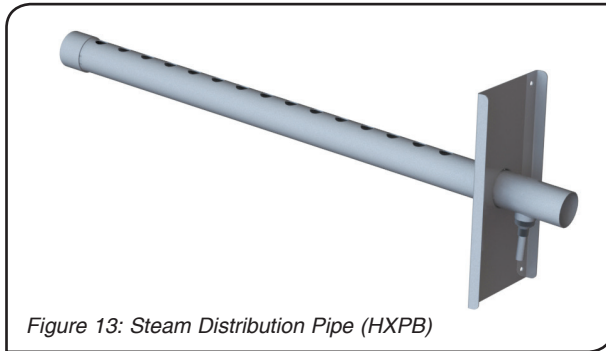


Figure 13: Steam Distribution Pipe (HXPB)

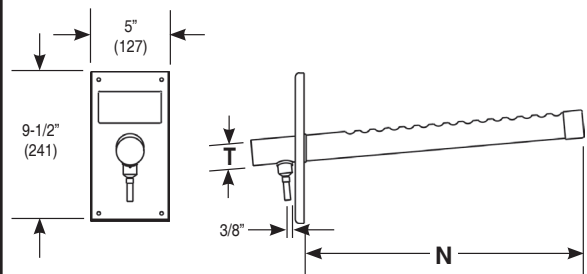
Distributor Pipes for Models: HTA, HSA, HTD, HSD

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

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

**See Note A

Lengths 012-036



Lengths 048-120

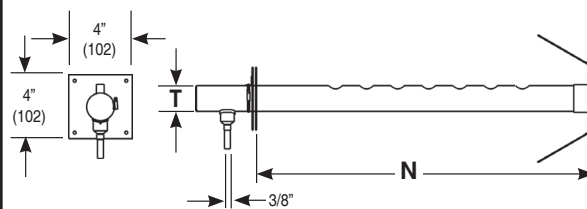


Figure 14

Distributor Pipes for Models: H_GJ, H_HJ

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**	Maximum**	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.

Fan Distribution Units

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

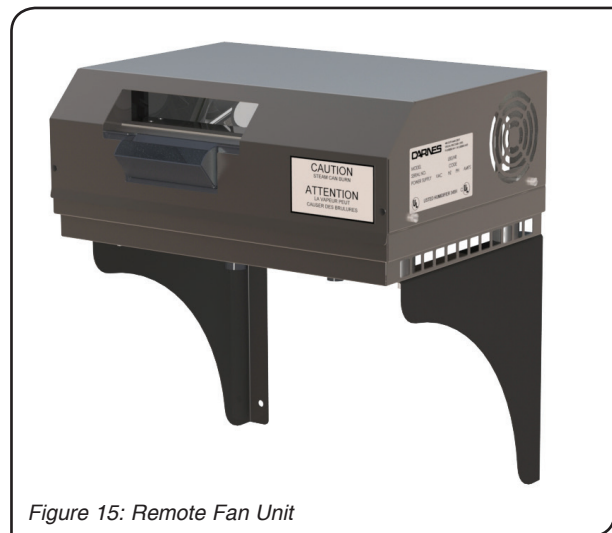


Figure 15: Remote Fan Unit

Table 10: Blower Package Match List

Humidifier Model	Nominal Steam Output Rate	Remote Mounted Fan Unit Model
H_AJ	005, 010	HXBJB (1 Req'd)
H_DJ	020, 030	HXBJB (1 Req'd)
H_GJ	030, 040, 050, 060, 080, 100	HXBJC (1 Req'd)

***NOTE:** Blower Package not available on dual cylinder units (units over 100 lbs.)



Figure 16: Mounted Fan Unit

Fan distribution units must be mounted securely on a level and plumb surface at least 3 feet below the ceiling for a Model HXBJB and at least 4 feet below the ceiling for a Model HXBJC to prevent steam condensing on the ceiling surface. Allow 20 feet in front of the HXBJB and 30 feet in front of the HXBJC for the steam to be absorbed into the air. Do not mount the units above any items that would be damaged if a water leak were to develop.

▼ OPTIONS

STANDARD MOUNTING: 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.)

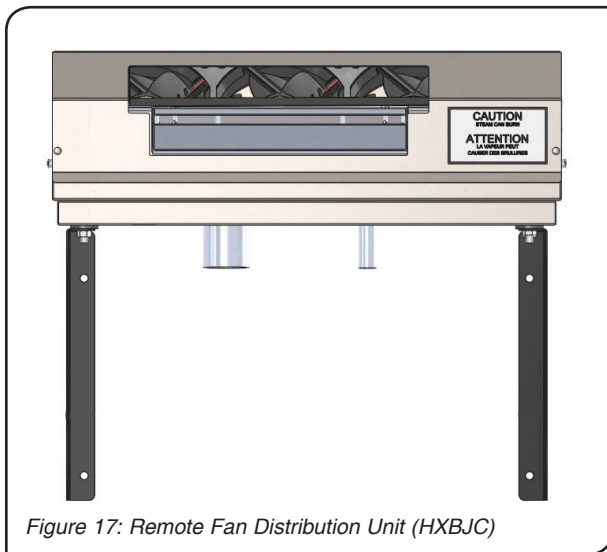


Figure 17: Remote Fan Distribution Unit (HXBJC)

Wall Humidistat, Proportional Control

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 outdoor temperature/humidity viewing mode. An optional outdoor temperature compensation sensor can be added (HXHAMT).

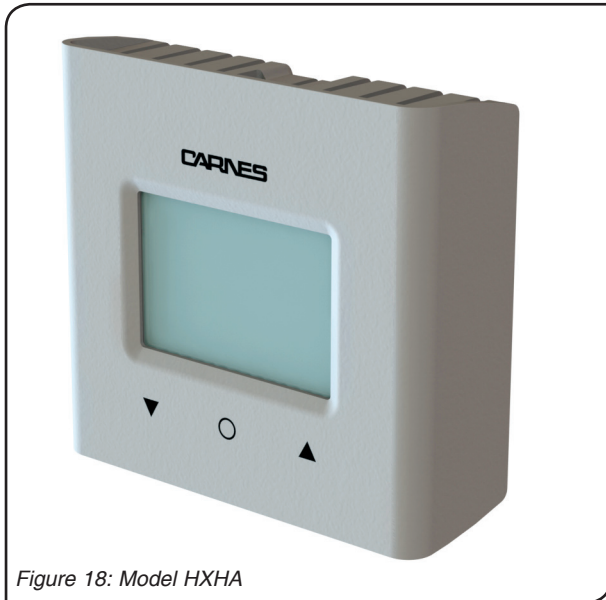


Figure 18: Model HXHA

Humidistat (Carnes Model HXHAW, HXHAWT, HXHAS, HXHAST)

- **Humidistat:** A humidistat is the industry standard humidity controller. It functions by sending an analog (0-10VDC, 4-20mA) or an on/off demand signal directly to the input of a humidifier. A humidistat calculates the demand output by measuring the difference between actual relative humidity and the desired humidity setpoint selected by the user.
- If on-off mode 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 between 20-100% in the settings menu of the touchscreen.
- If proportional mode is used the humidifier will automatically vary the steam output rate in the range of 20-100% of the humidifier's 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 needs to be used. The wall mounted humidistat is the most common as it allows the

setting to be easily changed to accommodate for 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.

- **Humidity Sensor:** A humidity sensor is a device which only measures relative humidity, and does not allow a user to control the desired conditions. Carnes commercial humidifiers have the ability to operate using a standalone humidity sensor, so long as it can send a 0-10VDC or 4-20mA signal corresponding to 0-100% relative humidity. The humidifier unit needs to be reconfigured before operating in this mode, as each Carnes humidifier is shipped with a standard humidistat as the default control method to serve the industry standard. Humidifiers which use standalone sensors must have their relative humidity setpoint programmed into the unit itself, and the controller calculates a demand internally. The main advantage of this style of control is the ability to use extra features inside the humidifier. Additional features include password protected settings, graphical status indicators, and scheduling functions of the humidifier. The scheduling function allows the user to choose certain desired humidity levels for a given timeslot. Another feature of this style of control is that the humidifier can then communicate the measured humidity level over external communication to a Building Management System.

- **Control Humidistat / Temperature Compensated:** The HXHAWT or HXHAST can be used if your application has a requirement for an outdoor temperature compensation feature. Both controls will provide monitoring of RH percentage and outdoor temperature, along with automatically adjusting the RH setpoint as outdoor temperatures change. The HXHAWT or HXHAST provides a 0-10V signal in either a proportional or on-off configuration. See Figure 18.

High Limit Humidistat (Model HXHAD)

The high limit humidistat functions similarly to the standard control humidistat. However, it is always mounted in a duct and has a higher setpoint than the primary controller. The high limit humidistat is used as an interlock to prevent excess condensation building up in the duct or conditioned space. The duct mounted sensor must be a minimum of 10 feet downstream of the steam distribution pipe. The high limit humidistat is installed 10 feet downstream from the distribution pipe and is normally set to 90-95% RH. The high limit humidistat 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.

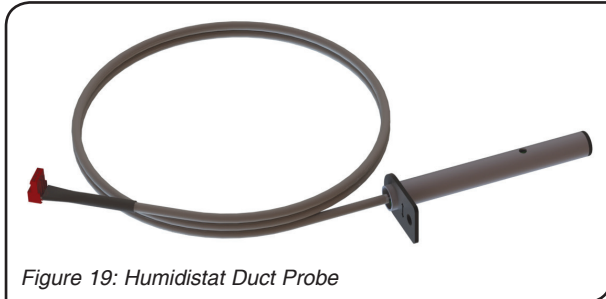


Figure 19: Humidistat Duct Probe

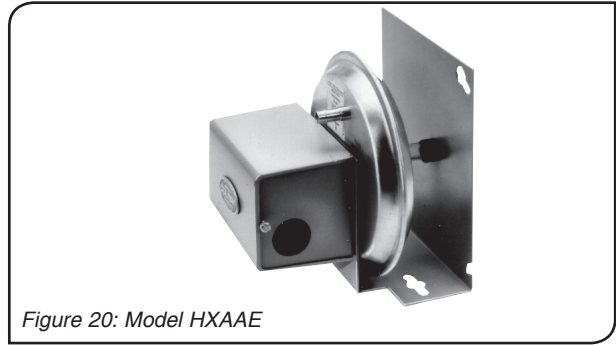


Figure 20: Model HXAEE

Air Flow Switch, Pressure Differential Type

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% RH, non-condensing.

Locations, NEMA Type 1 indoor only.

Mounting: In vertical position on any surface free of vibration

STEAM HOSE

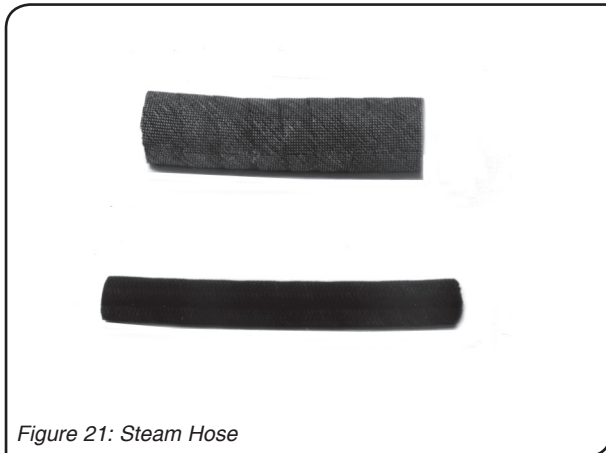


Figure 21: Steam Hose

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

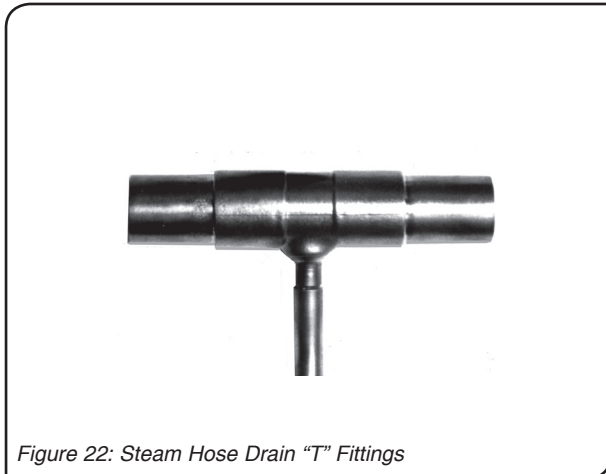


Figure 22: Steam Hose Drain "T" Fittings

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



Figure 23: 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

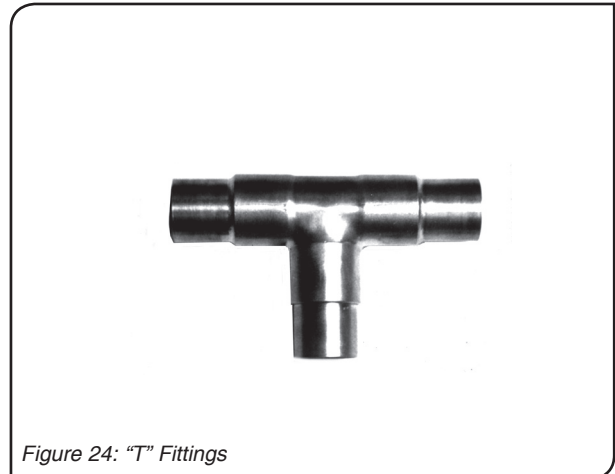


Figure 24: "T" Fittings

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"

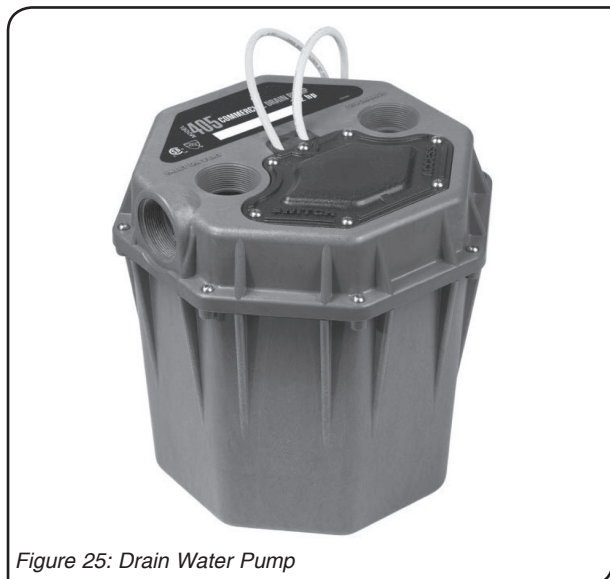
DRAIN WATER PUMP

Figure 25: 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.

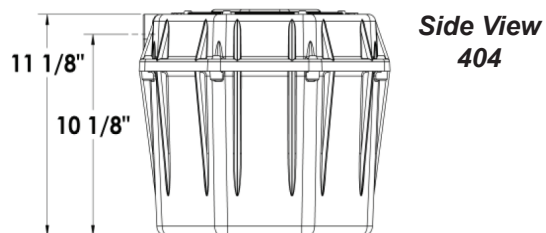
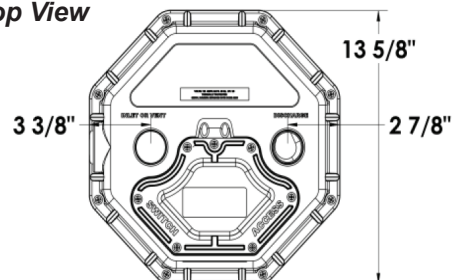
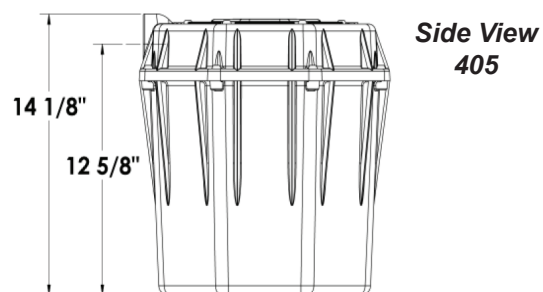
Top View**Side View
404****Side View
405**

Figure 26: Drain Water Pump Dimensions

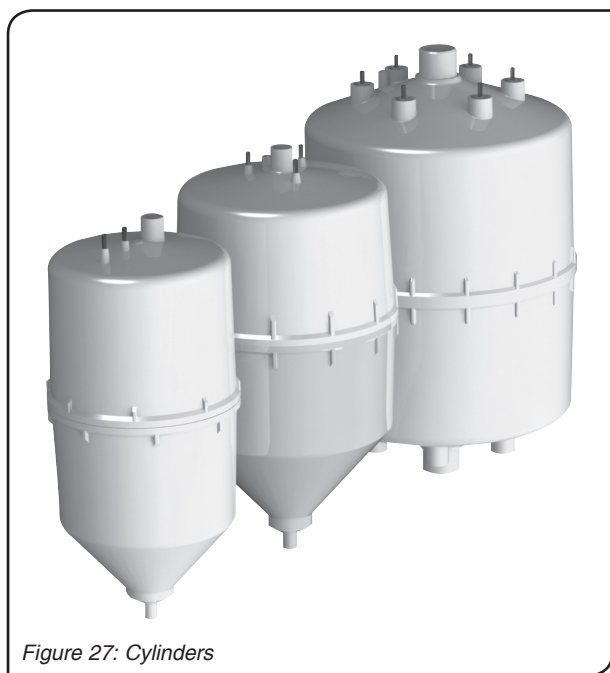
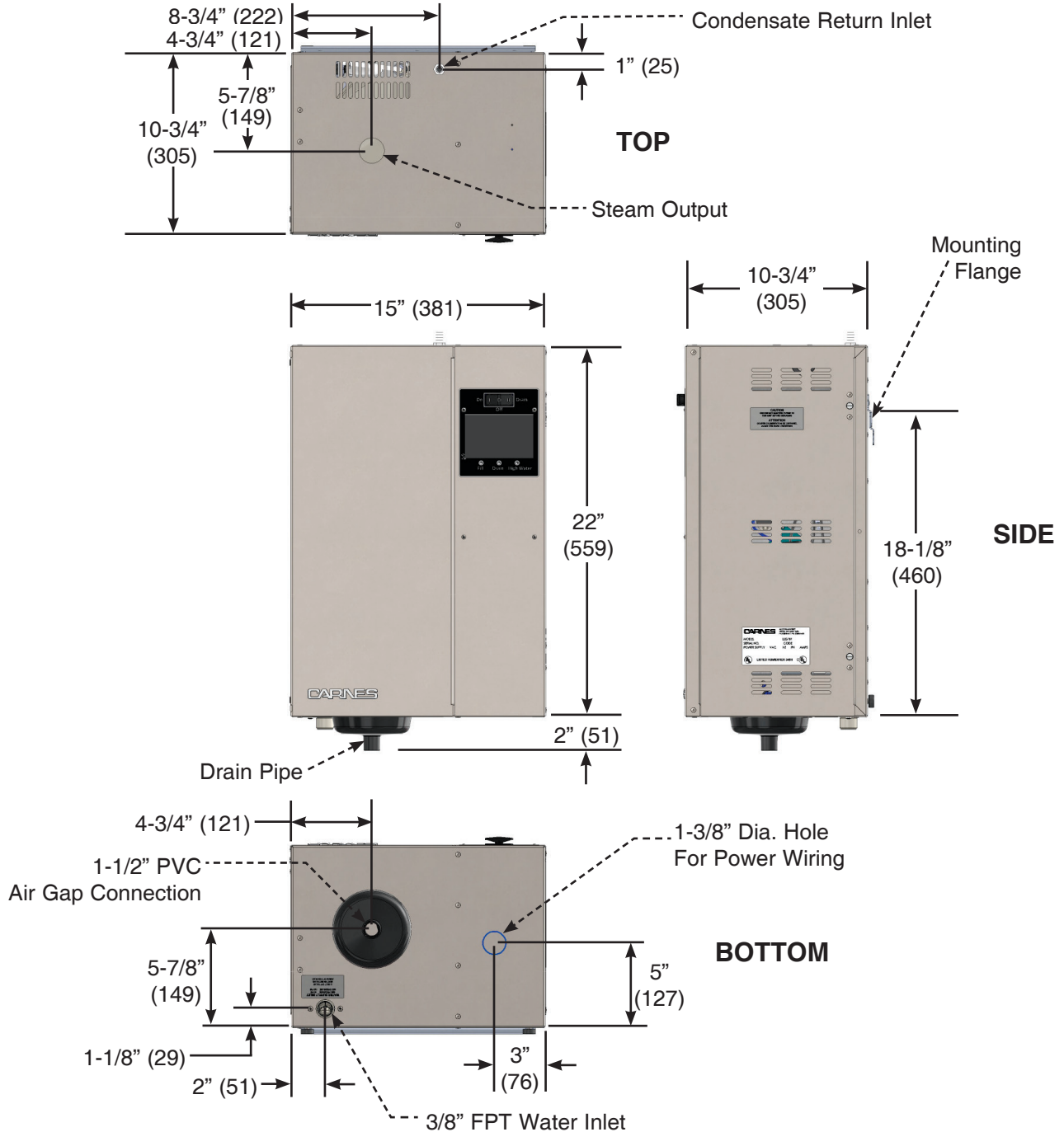


Figure 27: Cylinders

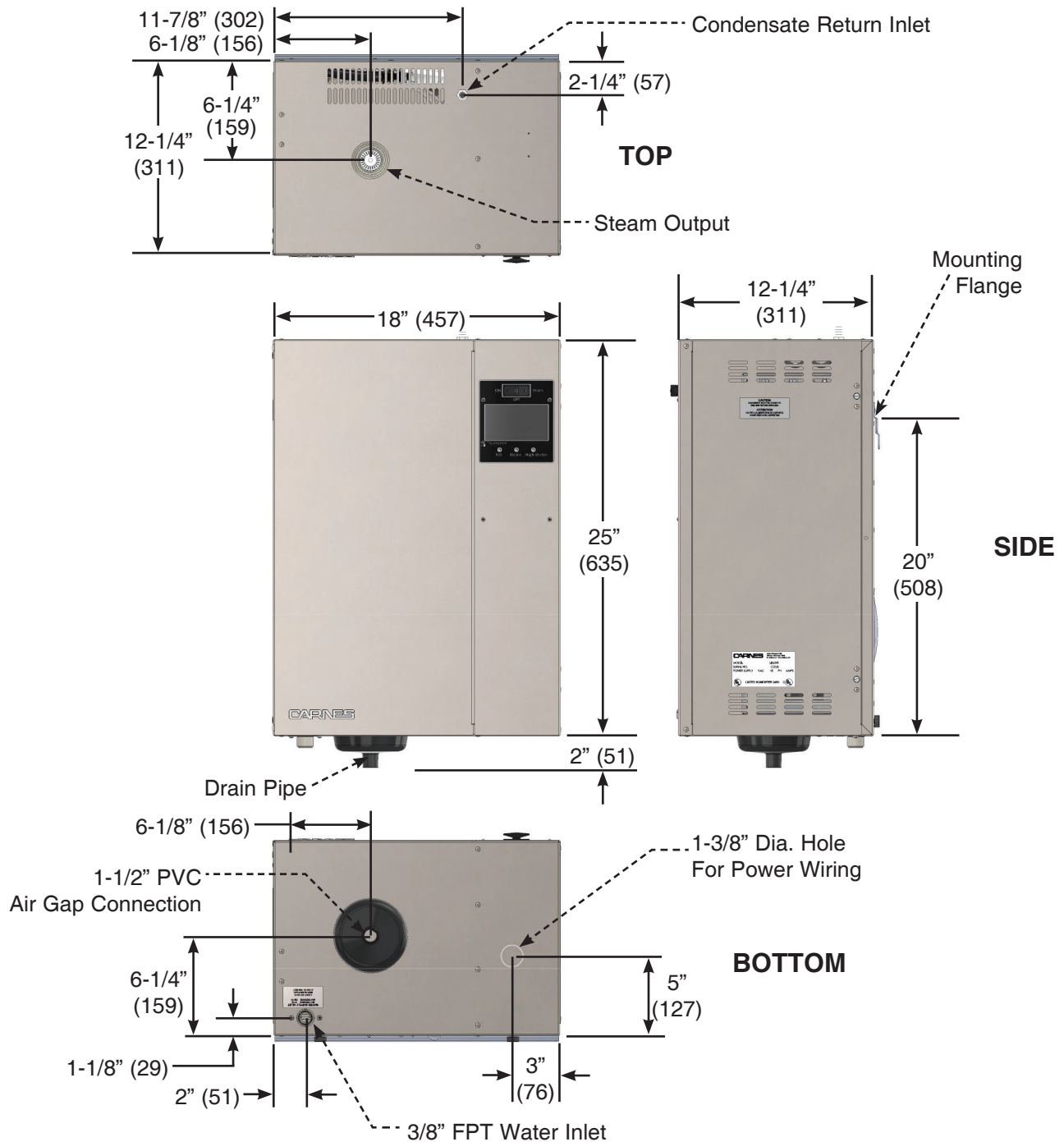
Models Available

HXCBAX145	HXCBB381	HXCBC6F
HXCBAX220	HXCBB500	HXCBC6X
HXCBAX380	HXCBB600	HXCBC61
HXCBAX500	HXCBB700	HXCCC62
HXCBAX600		HXCBC63
HXCBAX700		HXCBC64
		HXCBC65
		HXCBC12

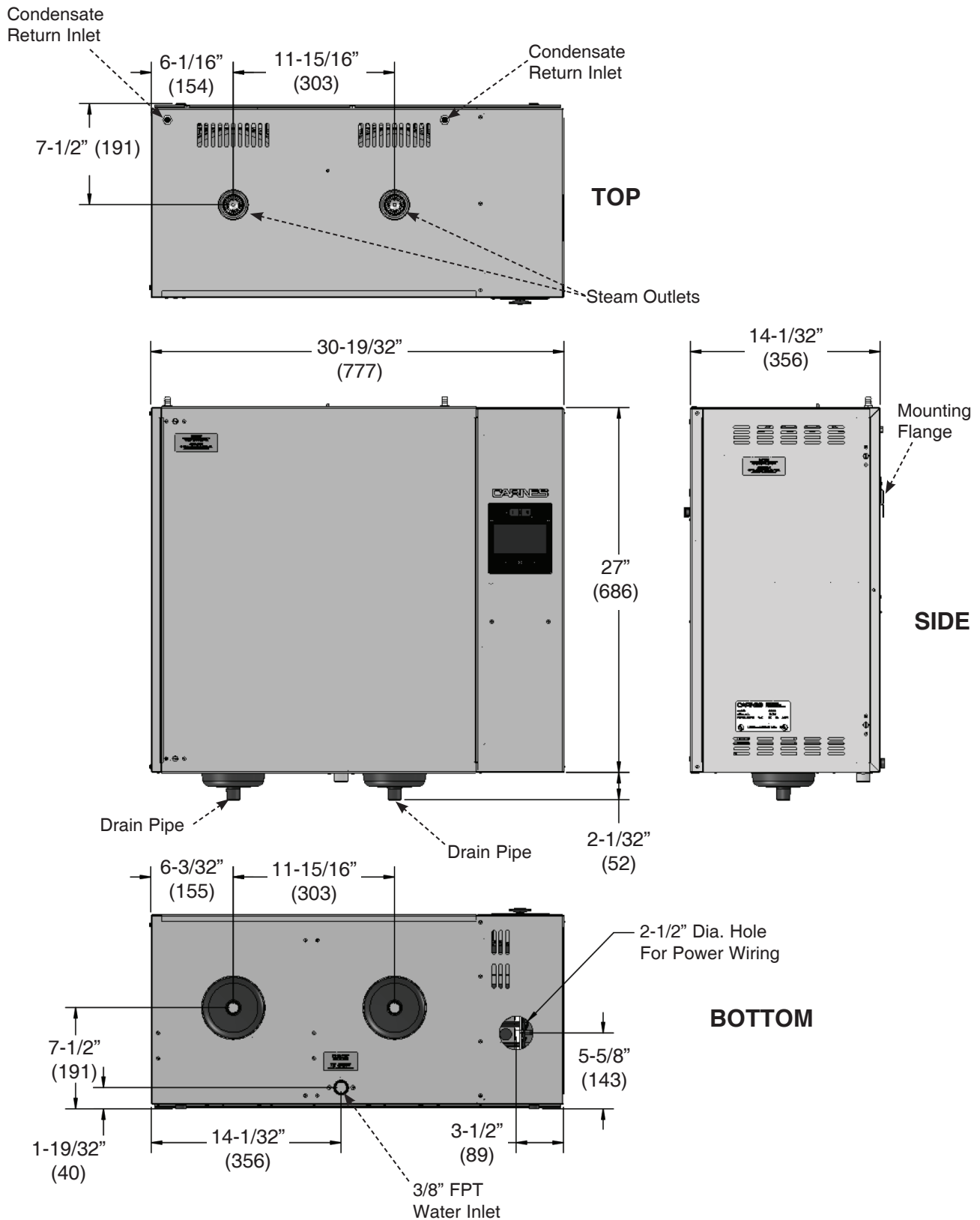
MODELS: HSAJ
HTAJ
HSDJ
HTDJ



MODELS: HSGJ
HTGJ



MODELS: HSHJ
HTHJ



1. Provide self-contained electronically controlled steam generating humidifiers of the size(s) shown on plans as manufactured by Carnes Company, Verona, WI.
2. Carnes Humidifiers shall have the capacity to operate at 115, 208, 230, 277, 380, 415, 460 and 575 volt (or nominal value), 60 or 50 hz (cycle), single or 3 phase power. Specific combination of maximum output, voltage and phase for order application determined by electrical data chart.
3. The humidifier(s) shall be UL and cUL listed.
4. The humidifier(s) shall have a total Color "True Touchscreen" user interface. Features:
 - a. True Touchscreen navigation for all aspects of operation and information access.
 - b. Cylinder life counter 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 and water usage 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 a message on the 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 the 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 a 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 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 Siemen® (FLN). CarnesLink uses a communication chip that is factory installed on our electronic circuit board, mounted internally inside the humidifier(s) cabinet. The 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 operational 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 control 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 shut-down.
 19. The humidifier(s) shall include a non-water contact capacitance proximity high water sensor to prevent overfilling and loss of water.
 20. The fill solenoid valve shall open whenever the drain solenoid is activated, whether in automatic or manual operation, to prevent discharge of boiling water into drainage system. Drain light shall indicate the switch is in drain position.
 21. Humidifiers, dependent upon capacity, will have one (1) or two (2) cylinders for operation. If a capacity is desired of 125, 150, 175 or 200 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-hour drain setting is turned on. Unit will remain in stand-by in the event that a quick startup is required.