



Elite XL[®]

Volume Water Heaters

Installation

Start-Up

Maintenance

Parts

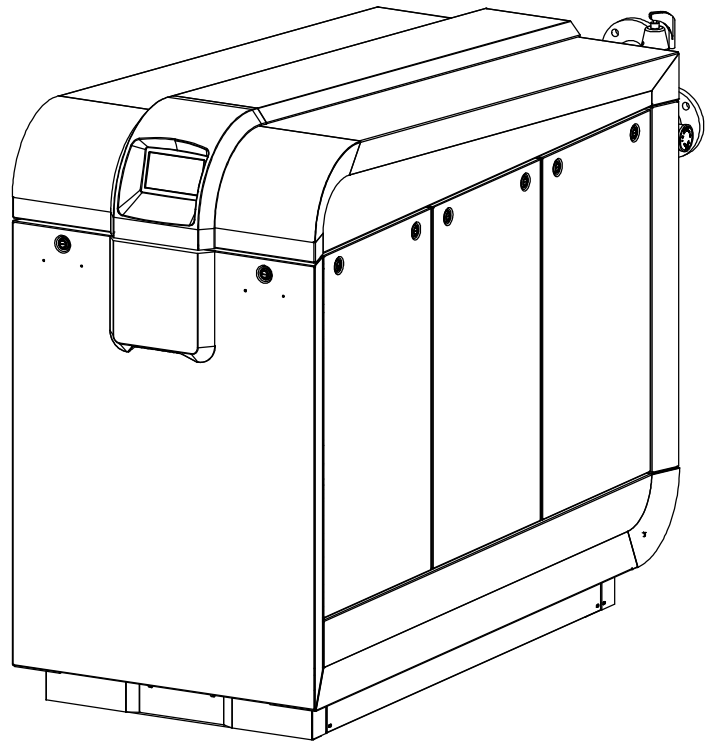
Warranty

ELX-400 / 500 / 650 / 800 / 1000 / 1500 / 2000

Models*

*"VWH" Denotes Volume Water Heater Models,
"N" Denotes Natural Gas, "LP" Denotes Propane,
and "F" Denotes Floor Mount Models

Example Model: ELX-1000FVWHN



Heat Exchanger Bears the ASME "H"
Stamp



DANGER

This manual must only be used by a qualified installer / service technician. Read all instructions in this manual before installing. Perform steps in the given order. Failure to do so could result in substantial property damage, severe personal injury, or death.



WARNING

Improper installation, adjustment, alteration, service, or maintenance could void product warranty and cause property damage, severe personal injury, or death.

California Proposition 65 Warning: This product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

NOTICE

HTP reserves the right to make product changes or updates without notice and will not be held liable for typographical errors in literature.

NOTE TO CONSUMER: PLEASE KEEP ALL INSTRUCTIONS FOR FUTURE REFERENCE.

! WARNING

WARNING: If the information in these instructions is not followed exactly, a fire or explosion may result causing property damage, personal injury or death.

- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.
- Installation and service must be provided by a qualified installer, service agency or the gas supplier.

Improper installation, adjustment, alteration, service, or maintenance can cause injury, property damage, or death. Refer to this manual. Installation and service must be performed by a qualified installer, service agency, or gas supplier.

FOR YOUR SAFETY READ BEFORE OPERATING

WARNING: If you do not follow these instructions exactly, a fire or explosion may result, causing property damage, personal injury or loss of life.

- | | |
|--|--|
| <p>A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do <u>not</u> try to light the burner by hand.</p> <p>B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.</p> | <ul style="list-style-type: none"> If you cannot reach your gas supplier, call the fire department. <p>C. Use only your hand to turn the gas control knob. Never use tools. If the handle will not turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.</p> |
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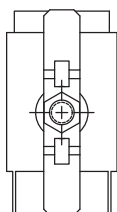
WHAT TO DO IF YOU SMELL GAS

- | | |
|---|---|
| <ul style="list-style-type: none"> Do not try to light any appliance Do not touch any electric switch; do not use any phone in your building Immediately call your gas supplier from a neighbor's phone. Follow the gas suppliers' instructions. | <p>D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.</p> |
|---|---|

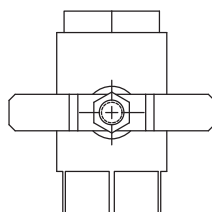
OPERATING INSTRUCTIONS

- | | |
|--|--|
| <ol style="list-style-type: none"> STOP! Read the safety information above. Set the thermostat to lowest setting. Turn off all electric power to the appliance. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand. | <ol style="list-style-type: none"> Remove front cover. Turn gas shutoff valve to "off". Handle will be across the piping, do not force. Wait five (5) minutes to clear out any gas. If you then smell gas, STOP! Follow "B" in the safety information above on this label. If you don't smell gas, go to next step. Turn gas shutoff valve to "on". Handle will be in line with piping. Install Front Cover. Turn on all electric power to appliance. Set thermostat to desired setting. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier. |
|--|--|

**GAS VALVE
ON**



**GAS VALVE
OFF**



TO TURN OFF GAS TO APPLIANCE

- | | |
|---|--|
| <ol style="list-style-type: none"> Set the thermostat to lowest setting. Turn off all electric power to the appliance if service is to be performed. Remove Front Cover. | <ol style="list-style-type: none"> Turn gas shutoff valve to "off". Handle will be across the piping. Do not force. Install Front Cover. |
|---|--|

SPECIAL ATTENTION BOXES

The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels or to important product information.



DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in serious personal injury or death.



WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in personal injury or death.



CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in moderate or minor personal injury.

CAUTION

CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

NOTICE

NOTICE is used to address practices not related to personal injury.

Foreword

This manual is intended to be used in conjunction with other literature provided with the volume water heater (VWH). This includes all related control information. It is important that this manual, all other documents included in this system, and additional publications including the *National Fuel Gas Code - ANSI Z223.1* (latest versions), be reviewed in their entirety before beginning any work.

Installation should be made in accordance with the regulations of the Authority Having Jurisdiction, local code authorities, and utility companies which pertain to this type of water heating equipment.

Authority Having Jurisdiction (AHJ) – The AHJ may be a federal, state, local government, or individual such as a fire chief, fire marshal, chief of a fire prevention bureau, labor department or health department, building official or electrical inspector, or others having statutory authority. In some circumstances, the property owner or his/her agent assumes the role, and at government installations, the commanding officer or departmental official may be the AHJ.

NOTE: HTP reserves the right to modify product technical specifications and components without prior notice.

For the Installer

This VWH must be installed by qualified and licensed personnel. The installer should be guided by the instructions furnished with the VWH, and by local codes and utility company requirements. In the absence of local codes, preference should be given to the *National Fuel Gas Code - ANSI Z223.1* in the United States and the *Natural Gas and Propane Installation Code - B149.1* in Canada (latest versions).

Installations Must Comply With:

Local, state, provincial, and national codes, laws, regulations, and ordinances.

In the United States - The latest version of the *National Fuel Gas Code, ANSI Z223.1*, from American Gas Association Laboratories, 8501 East Pleasant Valley Road, Cleveland, OH 44131.

The latest version of the *National Electrical Code, NFPA No. 70*.

In Canada - The latest versions of the *Natural Gas and Propane Installation Code, CSA B149.1*, and the *Canadian Electrical Code, C22.1*, from CSA Group, 178 Rexdale Blvd, Toronto, Ontario, Canada M9W 1R3.

NOTE: The gas manifold and controls met safe lighting and other performance criteria when undergoing tests specified in *ANSI Z21.13* - latest edition.

DANGER

Flammable Vapors

⚠ Vapors from flammable liquids will explode and catch fire causing death or severe burns.
Do not use or store flammable products such as gasoline, solvents or adhesives in the same room or area near the water heater.
Keep flammable products:

1. far away from heater,
2. in approved containers,
3. tightly closed and
4. out of children's reach.

Water heater has a main burner and pilot flame.
The pilot flame:

1. which can come on at any time and
2. will ignite flammable vapors.

Vapors:

1. cannot be seen,
2. are heavier than air,
3. go a long way on the floor and
4. can be carried from other rooms to the pilot flame by air currents.

Installation:
Do not install water heater where flammable products will be stored or used unless the main burner and pilot flames

are at least 18" above the floor. This will reduce, but not eliminate, the risk of vapors being ignited by the main burner or pilot flame.

Read and follow water heater warnings and instructions. If owners manual is missing, contact the retailer or manufacturer.

DANGER

Water temperature over 125°F can cause severe burns instantly or death from scalds.
Children, disabled and elderly are at highest risk of being scalded.
See instruction manual before setting temperature at water heater.
Feel water before bathing or showering.
Temperature limiting valves are available, see manual.

NOTICE

The CSD-1 ASME Code, Section CW-400 requires that hot water heating and supply boilers have a) a UL 353 temperature control device, b) at least one (1) temperature-actuated control to shut off the fuel supply when system water reaches a preset operating temperature, c) a high temperature limit control that prevents the water temperature from exceeding the maximum allowable temperature by causing a safety shutdown and lockout, and d) its own sensing element and operating switch.

The temperature control system integrated into the 928 control provided with this heating appliance complies with the requirements of CSD-1 Section CW-400 as a temperature operation control. The control monitors the temperature difference between the inlet and the outlet sensor, which is affected by VWH water flow. If this temperature difference exceeds 55°F (typically because of low water flow or very low heat load), the control will reduce the maximum fan speed. If the temperature difference exceeds 60°F, the control will effectively sense there is little or no water flow or heat load and shut the VWH down. The controller will restart automatically once the temperature difference has dropped below 55°F and the minimum off time (anti-cycle time) has expired. In addition, if the control senses that the outlet water temperature has reached 210°F, the VWH is put into a hard lockout and requires manual reset to restart.

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Part 1 - General Safety Information

This VWH is approved for indoor or outdoor installations and is not intended for use as a pool heater. Clearance to combustible materials: 0" top, bottom, sides, and back. The VWH must have room for service: 24" front, 24" right side, and 18" left side are minimum recommended service clearances. (A combustible door or removable panel is acceptable front clearance.) 400 - 1000 Models have been approved for installation on combustible flooring. Do not install on carpeting. 1500 - 2000 MODELS ARE NOT APPROVED FOR INSTALLATION ON COMBUSTIBLE FLOORING. Install the VWH in a location where temperature and pressure relief valve discharge or a leak will not result in damage to the surrounding area. If such a location is not available, install an auxiliary catch pan.

This appliance is rated Category IV (pressurized vent, likely to form condensate in the vent) and requires a special vent system designed for pressurized venting. **Use only Category IV vent systems.**

WARNING

Installer - Read all instructions in this manual before installing. Perform steps in the given order.

User - This manual is for use only by a qualified heating installer / service technician. Have this VWH serviced / inspected annually by a qualified service technician.

FAILURE TO ADHERE TO THE GUIDELINES ON THIS PAGE CAN RESULT IN SUBSTANTIAL PROPERTY DAMAGE, SEVERE PERSONAL INJURY, OR DEATH.

NOTE: Obey all local codes. Obtain all applicable permits before installing the VWH.

NOTE: Install all system components and piping in such a manner that does not reduce the performance of any fire rated assembly.

A. Operation and Installation Warnings

To avoid serious injury or death, read, understand, and follow all of the precautions listed here.

DANGER

Vapors from flammable liquids will explode and cause a fire, resulting in personal injury or death. The VWH has a burner that can come on at any time and ignite vapors. DO NOT use or store flammable liquids around the VWH.

DANGER

Improper venting can cause a build-up of carbon monoxide. Breathing carbon monoxide can result in brain damage or death. DO NOT operate the VWH unless it is properly vented to the outside and has an adequate fresh air supply for safe operation. Inspect the exterior exhaust gas outlet port and fresh air inlet port on a regular basis to ensure they are functioning properly.

A concentration of carbon monoxide as small as .04% (400 parts per million) in the air can be fatal. When making high fire or low fire adjustments, CO levels must be monitored using a calibrated combustion analyzer such that a CO level of no more than 150 ppm is exceeded at any time during operation.

Adjusting the "low fire offset" or the "main flow restrictor" in small increments can result in a significant increase in CO concentration. To avoid serious injury or death, DO NOT make any adjustments to the gas valve without monitoring the exhaust gases with a fully functional and calibrated combustion analyzer.

Failure to follow these instructions will result in property damage, severe personal injury, or death.

WARNING

This VWH must be installed by a qualified service technician. Improper installation and/or operation can cause a potentially hazardous situation, which if not avoided will void the warranty and could result in serious injury or death.

The manufacturer cannot anticipate every circumstance that might involve a potential hazard. Each installation has its own specialized characteristics, requirements, and possible hazards. Therefore, all possible incidents are not included in these warnings. Proper and safe installation, operation, and service are the responsibility of the qualified service technician.

Proper care of the VWH is the user's responsibility. Ensure the user carefully reads and understands the User's Information Manual before operating the VWH.

Make sure the user knows the location of the gas shut-off valve and how to operate it. Immediately close the gas shut-off valve if the appliance is subjected to fire, overheating, flood, physical damage, or any other damaging condition that might affect the operation of the unit. Have the appliance checked by a qualified service technician before resuming operation.

Do not power up the unit unless the gas and water supply valves are fully opened. Make sure the fresh air intake port and exhaust gas port are open and functional.

No one but a qualified service technician should attempt to install, service, or repair this VWH. There are no serviceable parts which can be changed by the user / owner.

User / Owner: Contact the original qualified service technician if the VWH needs repair / maintenance. If the original technician is unavailable, ask your gas supplier for a list of qualified service providers.

DO NOT store or place newspapers, laundry, or other combustible items near the appliance or the exterior exhaust gas outlet and/or fresh air inlet port.

The owner should inspect the system monthly for damage, water stains, signs of rust, corrosion, and exhaust vent and air intake blockage. If inspection of the unit shows signs of damage, the VWH should be shut off until the problem is repaired by a qualified technician.

After installation, all appliance safety devices should be tested.

DO NOT allow children to operate this VWH. DO NOT use this VWH if it does not appear to be operating correctly. A qualified service technician should service and inspect the VWH annually.

WARNING

NOTE: If the VWH is exposed to fire or water (or is any way damaged), do not operate. Immediately call a qualified service technician. Failure to follow this information could result in property damage, severe personal injury, or death.

The VWH is certified for indoor installations only. The VWH consists of gas ignition system components which must be protected from water (dripping, spraying, etc.) during operation and service. Carefully consider installation location and the placement of critical components (circulators, condensate neutralizers, etc.) before installing the VWH.

DO NOT USE THIS VWH IF ANY PART HAS BEEN SUBMERGED IN WATER. Immediately call a qualified service technician. The VWH MUST BE replaced if it has been submerged. Attempting to operate a VWH that has been submerged could create numerous harmful conditions, such as a potential gas leakage causing a fire and/or explosion, or the release of mold, bacteria, or other harmful particulates into the air. Operating a previously submerged VWH could result in property damage, severe personal injury, or death.

NOTE: VWH damage due to flood or submersion is considered an Act of God, and IS NOT covered under product warranty.

DO NOT alter or modify the appliance or appliance controls. Altering any HTP VWH with parts not manufactured by HTP WILL INSTANTLY VOID the VWH warranty and could result in property damage, personal injury, or death.

This VWH has been designed to heat potable water ONLY. Using the VWH to heat non-potable fluid WILL VOID product warranty, and could result in property damage, personal injury, or death.

CAUTION

Due to low water content of the VWH, improperly sizing the VWH in regard to heating load will result in excessive VWH cycling and accelerated component failure. HTP DOES NOT warrant failures caused by improperly sized VWH applications. DO NOT oversize the VWH to the system. Modular VWH installations greatly reduce the likelihood of VWH oversizing.

High heat sources (sources generating heat 100°F / 37°C or greater, such as stove pipes, space heaters, etc.) may damage plastic components of the VWH as well as plastic vent pipe materials. Such damages ARE NOT covered by warranty. It is recommended to keep a minimum clearance of 8" from high heat sources. Observe heat source manufacturer instructions, as well as local, state, provincial, and national codes, laws, regulations and ordinances when installing this VWH and related components near high heat sources.

Do not use this VWH for anything other than its intended purpose (as described in this manual). Doing so could result in property damage and WILL VOID product warranty.

NOTICE

This VWH provides an overheat shutdown limit. In the event the VWH water temperature exceeds the setpoint of the control limit, the cutoff will trip and the appliance will shut down. Certain local codes require additional temperature limits. In addition, certain types of systems may operate at temperatures below the minimum setpoint of the limit provided with the appliance. Contact the manufacturer for additional overheat controls.

B. Improper Combustion

WARNING

Do not obstruct the flow of combustion and ventilating air. Adequate air is necessary for safe operation. Failure to keep the exhaust vent and combustion air intake clear of ice, snow, or other debris could result in property damage, serious personal injury, or death.

C. Gas

Should overheating or gas supply fail to shut off, turn off the manual gas control valve to the VWH.

D. When Servicing the VWH

WARNING

Be sure to disconnect electrical power before opening VWH cabinet or performing service. Label all wires while performing service to ensure proper re-wiring of the appliance. Wiring errors can cause improper or dangerous operation. Failure to do so could result in electrical shock, improper VWH or system operation, property damage, serious personal injury, or death.

- To avoid electric shock, disconnect electrical supply before performing maintenance.
- To avoid severe burns, allow VWH and associated equipment to cool before servicing.
- Always verify proper operation after servicing the VWH.

NOTE: When inquiring about service or troubleshooting, reference the model and serial numbers from the VWH rating label.

E. VWH Water

- Do not use petroleum-based cleaning or sealing compounds in VWH system. Gaskets and seals in the system may be damaged, possibly resulting in substantial property damage.
- Do not use "homemade cures" or "boiler patent medicines". Substantial property damage, damage to the VWH, and/or serious personal injury may result.

F. Water Chemistry Requirements*

CAUTION

Chemical imbalance of the water supply may affect efficiency and cause severe damage to the appliance and associated equipment. It is important that the water chemistry on both the domestic hot water and central heating sides are checked before installing the appliance. Water quality must be professionally analyzed to determine whether it is necessary to treat the water. Various solutions are available to adjust water quality. Adverse water quality will affect the reliability of the system. In addition, operating temperatures above 135°F will accelerate the build-up of lime scale and possibly shorten appliance service life. Failure of an appliance due to lime scale build-up, low pH, or other chemical imbalance IS NOT covered by the warranty.

The water must be potable, free of corrosive chemicals, sand, dirt, and other contaminants. It is up to the installer to ensure the water does not contain corrosive chemicals or elements that can damage the heat exchanger. Potable water is defined as drinkable water supplied from utility or well water in compliance with EPA secondary maximum contaminant levels (40 CFR Part 143.3) as shown in the table below. If the water contains contaminants higher than outlined by the EPA, water treatment is recommended and additional, more frequent maintenance may be required.

If you suspect that your water is contaminated in any way, discontinue use of the appliance and contact an authorized technician or licensed professional.

Contaminant	Maximum Allowable Level	Contaminant	Maximum Allowable Level
Total Hardness (Commercial Use - 140°F and above water temperature)	120 mg/l (7 grains/gallon)	pH	6.5-8.5
		Sulfate	205 mg/l
		Total Dissolved Solids (TDS)	500 mg/l
Aluminum	0.05 to 0.2 mg/l	Zinc	5 mg/l
Chloride	100 mg/l		
Copper	1 mg/l	Dissolved Carbon Dioxide (CO ₂)	15 mg/l or PPM
Iron	0.3 mg/l		
Manganese	0.05 mg/l		

Table 1 - Water Quality Specifications

***NOTE:** It is recommended to clean heat exchanger at least once a year to prevent lime scale buildup. Follow the maintenance procedure in the Maintenance Section of this manual to clean the heat exchanger.

Closed loop water must be free of corrosive chemicals, sand, dirt, and other contaminants. It is up to the installer to ensure the water does not contain corrosive chemicals or elements that can damage the heat exchanger.

If you suspect that your water is contaminated in any way, discontinue use of the appliance and contact an authorized technician or licensed professional.

- **Water pH between 6.5 and 8.5**
 - pH levels below 6.5 can cause an increase in the rate of corrosion. pH of 8.5 or higher can potentially cause lime scale build-up.
 - Maintain water pH between 6.5 and 8.5. Check with litmus paper or have it chemically analyzed by a local water treatment company.
 - If the pH is not between 6.5 and 8.5, consult a local water treatment company for solutions.
- **Hardness between 5 and 7 grains (71.3 and 120 mg/L)***
 - Hardness levels above the required amounts can lead to lime scale build-up throughout the system. Water below 5 grains/gallon (71.3 mg/L) may be over softened.
 - Consult local water treatment companies for unusually hard water areas (above the required amounts) or for other treatment solutions if water is being over softened (below 5 grains/gallon [71.3 mg/L]).
- **Chloride concentration less than 100 ppm (mg/L)**
 - Do not fill appliance or operate with water containing chlorides in excess of 100 ppm (mg/L).
 - Using chlorinated fresh water should be acceptable as levels are typically less than 5 ppm (mg/L).
 - Do not connect the appliance to directly heat swimming pool or spa water.
- **Total Dissolved Solids (TDS) between 100 and 450 ppm (mg/L)***
 - Total dissolved solids are minerals, salts, metals, and charged particles that are dissolved in water.
 - The greater the amounts of TDS present, the higher the corrosion potential due to increased conductivity in the water.

- If using softened water to fill the appliance, it is still possible to have high TDS. This water can be corrosive. Consult local water treatment companies for other treatment solutions to reduce this affect.

***NOTE:** The amount of Hardness ppm (mg/L) + TDS ppm (mg/L) must be less than 450 ppm (mg/L) total. For Example:

NOTE: Regularly monitoring pH, chlorides, TDS, and hardness levels can prolong the life of the appliance by reducing mineral scale buildup, corrosion, and erosion. Mineral buildup in the heat exchanger reduces heat transfer, overheats the stainless steel heat exchanger, and causes failure.

G. Freeze Protection

CAUTION

Consider piping and installation when determining VWH location. Damages resulting from incorrect installation or from use of products not approved by the manufacturer ARE NOT covered by warranty. Failure of the VWH due to freeze related damage IS NOT covered by product warranty.



WARNING

NEVER use any toxic chemical, including automotive, standard glycol antifreeze, or ethylene glycol made for hydronic (non-potable) systems. These chemicals can attack gaskets and seals in water systems, are poisonous if consumed, and can cause personal injury or death.

NOTE: HTP DOES NOT WARRANT THE VWH AGAINST FREEZE-RELATED DAMAGE.

The boiler control is equipped with freeze protection that activates based on internal water temperature.

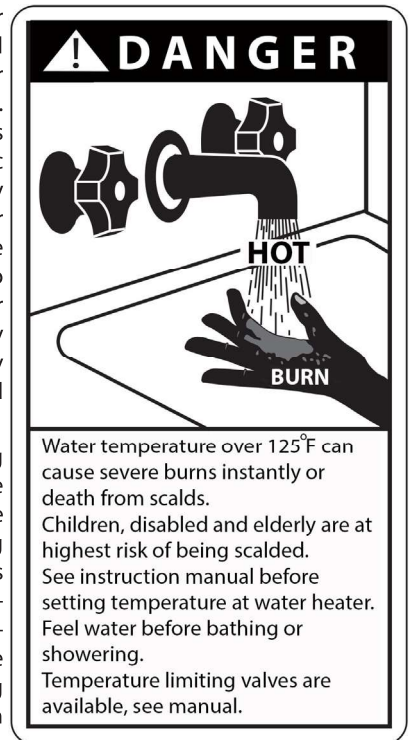
NOTE: Freeze protection will not be active if the boiler loses power.

H. Water Temperature Adjustment and Scalding

The VWH can deliver scalding water. Be careful whenever using hot water to avoid scalding injury. Certain appliances such as dishwashers and automatic clothes washers may require increased water temperatures. By setting the thermostat on this VWH to obtain the increased water temperature required by these appliances you may create the potential for scald injury.

If the VWH system is going to have a set temperature above 120°F, you must use an ASSE 1017 rated mixing valve to avoid severe burns or death from scalding temperatures. This valve will reduce point of use discharge temperatures by mixing cold and hot water in branch supply lines. Such valves are available from your local plumbing supplier.

Table 2 details the relationship of water temperature and time with regard to scald injury and may be used as a guide in determining the safest water temperature for your applications.



⚠ WARNING

Households with small children, disabled, or elderly persons may require a 120°F or lower temperature setting to prevent severe personal injury or death due to scalding.

Approximate Time / Temperature Relationships in Scalds

120°F	More than 5 minutes
125°F	1 1/2 to 2 minutes
130°F	About 30 seconds
135°F	About 10 seconds
140°F	Less than 5 seconds
145°F	Less than 3 seconds
150°F	About 1 1/2 seconds
155°F	About 1 second

Table 2 - Approximate Time / Temperature Relationships in Scalds

I. High Elevation Installations

This VWH is designed to operate at its maximum listed capacity in installations located at 0 - 2000 ft above Sea Level. Since the density of air decreases as elevation increases, maximum specified capacity should be de-rated for elevations above 2000 ft (610 m) in accordance with the table below.

Elevations	2001 ft (610 m)	3000 ft (914 m)	4000 ft (1219 m)	4500 ft (1372 m)	5000 ft (1524 m)
In Canada ¹ , de-rate by:	10%	10%	10%	10%	may vary
In USA ² , de-rate by:	-	12%	16%	18%	20%

NOTES:

¹Canada: Elevations between 2000 - 4500 ft (610 - 1372 m), de-rate by 10%. Consult local authorities for de-rating for elevations above 4500 ft (1372 m).

²USA: If elevation is above 2000 ft (610 m), de-rate capacity by 4% for every 1000 ft (305 m).

Table 3 - De-Rate % for High Elevations

⚠ WARNING

Combustion - At elevations above 2000 ft, the combustion of the VWH must be checked with a calibrated combustion analyzer to ensure safe and reliable operation. **It is the Installer's responsibility to check and adjust the combustion in accordance with this manual.** Failure to follow these instructions may result in property damage, serious personal injury, or death.

Part 2 - Before You Start

NOTICE

UNCRATING THE VWH - Any claims for damage or shortage in shipment must be filed immediately against the transportation company by the consignee.

Remove the boiler and accessories from the packaging. Take care to place the boiler and accessories in a safe location prior to installation to prevent damage to the mechanical connections.

The boiler is also equipped with leveling feet that can be used to level the boiler properly on an uneven location surface. If surface flooring is rough, take care when moving the boiler into position, as catching the leveling feet could damage the boiler.

A. What's in the Box

Components included with the VWH:

- Intake / Exhaust Screens (400 - 500 Models [7550P-995], 650 - 1000 Models [7550P-996], 1500 - 2000 Models [7550P-997])
- Installation Manual and Warranty
- User's Information Manual
- Tear Down Instructions
- CSD-1 Form
- H-3 Data Sheet

B. How the VWH Operates

Condensing technology intelligently delivers highly efficient hydronic heating while maximizing efficiency by measuring data from the heating system. The following are features of the system and how they operate.

Stainless Steel / Steel Heat Exchanger

The highly efficient heat exchanger is designed to use the cold water return from the system and extract the last bit of heat before it is exhausted.

Modulating Combustion System

The combustion system modulates the output of the burner during operation to match system demand and achieve the control set point while in operation. The set point can change by internal or external signals to enhance the overall performance of the system.

Control

The integrated control system monitors the system and regulates fan speed to control VWH output. This allows the VWH to deliver only the amount of heat energy required and nothing more.

The control can regulate the output of multiple VWHs through its cascade system function. The cascade system is capable of connecting up to eight VWHs together in such a way that they function as one VWH system. This allows for greater turn down ratios and provides systematic control of the multiple VWHs in an installation to minimize downtime and maximize efficiency.

The master VWH requires a sensor to provide feedback on set point temperature in order to adjust heating input from the connected VWHs. Each cascaded VWH will have its own pump to provide maximum flow and control heat exchanger flow rate.

Electronic Touchscreen Display with Status Indicators

Digital controls with full color resistive touchscreen technology. The display allows the user to change system parameters and monitor system operation.

Gas Valve

The gas valve senses suction from the blower, allowing gas to flow only if powered and combustion air is flowing.

Integrated Venturi

Controls air and gas flow into the burner.

Burner

The high grade stainless steel burner uses premixed air and gas to provide a wide range of firing rates.

Spark Ignition

The burner is ignited by applying high voltage through the system spark electrode. The spark from the electrode ignites mixed gas off of the burner.

Dual Supply Water Temperature Sensor / High Limit Water ECO

This dual sensor monitors the VWH outlet water temperature (System Supply). The control adjusts VWH firing rate so the supply temperature will match the VWH set point. The dual sensor in combination with the 928 control meets all requirements of a UL 353 water limiting control, eliminating the mechanical ECO and increasing safety and reliability.

Return Water Temperature Sensor

This sensor monitors VWH return water temperature (System Return).

Temperature and Pressure Gauge

Allows the user to monitor system temperature and pressure.

Electrical field connections with terminal strips

The electrical cover allows easy access to the clearly marked line voltage and low voltage terminal strips to facilitate wiring the VWH.

Supplied Condensate Collection System with Clean Out

This VWH is a high efficiency appliance and will produce condensate. The condensate collection system has a float switch which monitors condensate level and prevents condensate from backing up into the combustion system. Inside the collection system is a built in trap which seals the combustion system from the connected drain. This condensate should be neutralized to avoid damage to the drainage system or piping.

Flow Protection

The flow switch is designed to protect the VWH during low flow conditions. The VWH control also monitors flow through the heat exchanger by monitoring the return and supply sensors and will shut down the burner before overheating occurs. The flow switch activates at 4 GPM for 400 - 1000 Models; 9 GPM for 1500 - 2000 Models.

0-10 Volt Input

Allows the installer to connect a BMS (Building Management System) to control the VWH.

0-10 Volt Output A (Configured through Control System)

0-10 Volt Output A is configured through the VWH control system. 0-10 Volt Output A is related to one of the following values: VWH power, cascade power, fan speed, alarm status, temperature setting based on outdoor reset curve, flame, or pump.

0-10 Volt Output B (Configured through Control System)

0-10 Volt Output B is configured through the VWH control system, and is related to one of the following values: VWH power, cascade power, fan speed, alarm status, temperature setting based on outdoor reset curve, or flame.

UL 353 Internal Low Water Cutoff (LWCO)

The supplied internal Low Water Cutoff in conjunction with the 928 control meets UL 353 requirements to function as a safety, locking out the VWH when water level is inadequate for safe operation. See Service Mode, this manual, to test LWCO function.

Flue Temperature Modulation

As an additional safety feature, if the flue temperature exceeds 200°F, the control will modulate the VWH down based on the vent temperature, rather than the supply temperature. If the flue temperature exceeds 210°F the control will lock out the VWH.

HTP Link

HTP Link allows the installer to connect the VWH to WiFi, providing the user / installer with tools to remotely monitor the system, optimize efficiency, and aid in troubleshooting.

System Sensor (Optional)

This sensor is designed to be used in a cascade system. The system pipe sensor measures the temperature of return water and communicates with the control system to modulate the firing rate of the connected VWHs.

NOTE: When using a system sensor, pipe insulation must be wrapped around it to improve temperature measurement accuracy and increase overall system efficiency.

C. Optional Equipment

Optional equipment available from HTP (and Part #):

- System Sensor (7250P-324)
- Indirect Tank Sensor (7250P-325)
- High and Low Gas Pressure Switch Kit with Manual Reset (500 - 2000 Models [7550P-988])
- 4" Stainless Steel Vent Termination Kit (V2000)
- 6" Stainless Steel Outside Termination Vent Kit (V3000)
- 8" Stainless Steel Elbow (7550P-067)
- 8" Stainless Steel to PVC / CPVC Vent Pipe Adapter (7550P-064)
- Mechanical Manual Reset High Temperature Limit (6300P-998)
- Alarm System Kit (to monitor any failure) (7350P-602)
- 928 PC Connection Kit (7450P-330)
- Condensate Neutralizer (7350P-611)
- Condensate Removal Pump (554200)
- Outdoor Installation Kit (400 - 1000 Models [7550P-987], 1500 - 2000 Models [7550P-982])
- Stack Rack Kit (400 - 500 Models [7550P-983], 650 - 1000 Models [7550P-984])
- Flush Kit (7550P-606)
- Fuel Conversion Kits (See Table Below)
- Glass-Lined Storage Tanks (GL-80, GL-119, GL-175)
- Stainless Steel Storage Tank (SSU-80CB, SSU-119CB)

NOTE: When using an optional system sensor, pipe insulation must be wrapped around it to improve temperature measurement accuracy and increase overall system efficiency.

Model	Description	Kit Number
ELX-400	LP to NG Conversion Kit	7550P-200
ELX-400	NG to LP Conversion Kit	7550P-201
ELX-500	LP to NG Conversion Kit	7550P-202
ELX-500	NG to LP Conversion Kit	7550P-203
ELX-650	LP to NG Conversion Kit	7550P-204
ELX-650	NG to LP Conversion Kit	7550P-205
ELX-800	LP to NG Conversion Kit	7550P-206
ELX-800	NG to LP Conversion Kit	4255007
ELX-1000	LP to NG Conversion Kit	7550P-314
ELX-1000	NG to LP Conversion Kit	7550P-208
ELX-1500	LP to NG Conversion Kit	7550P-309
ELX-1500	NG to LP Conversion Kit	7550P-310

Contact HTP for Available Storage Tanks

ΔT (Delta T) (°F)	400VWH			
	Continuous Draw Gallons Per Hour (GPH)*	Storage Tank Gallon Size and First Hour Rating		
		80	119	175
40°	1176	1236	1266	1308
50°	941	1001	1030	1072
60°	784	844	873	915
70°	672	732	761	803
80°	588	648	677	719
90°	523	583	612	654
100°	471	531	560	602
110°	428	488	517	559
120°	392	452	481	523
130°	362	422	451	493
140°	336	396	425	467

CAUTION

These VWH units must be connected to a storage tank. You must not have a direct connection of the potable water system into the heat exchanger. This could cause flow issues, short cycling, and an increase of mineral build-up in the unit. This system is designed to have incoming potable water flow through the storage tank first, then through the heat exchanger. Failure to connect the VWH to a storage tank will result in property damage and/or premature VWH failure. Damages resulting from incorrect installation or from use of products not approved by HTP ARE NOT covered by warranty.

ΔT (Delta T) (°F)	500VWH				650VWH				800VWH			
	Continuous Draw Gallons Per Hour (GPH)*	Storage Tank Gallon Size and First Hour Rating			Continuous Draw Gallons Per Hour (GPH)*	Storage Tank Gallon Size and First Hour Rating			Continuous Draw Gallons Per Hour (GPH)*	Storage Tank Gallon Size and First Hour Rating		
		119	175	200		119	175	200		175	200	300
40°	1474	1563	1605	1624	1916	2006	2048	2066	2359	2490	2509	2584
50°	1179	1269	1311	1329	1533	1622	1664	1683	1887	2018	2037	2112
60°	983	1072	1114	1133	1278	1367	1409	1428	1572	1704	1722	1797
70°	842	932	974	992	1095	1184	1226	1245	1348	1479	1498	1573
80°	737	826	868	887	958	1047	1089	1108	1179	1311	1329	1404
90°	655	744	786	805	852	941	983	1002	1048	1180	1198	1273
100°	590	679	721	740	767	856	898	917	943	1075	1093	1168
110°	536	625	667	686	697	786	828	847	858	989	1008	1083
120°	491	581	623	641	639	728	770	789	786	917	936	1011
130°	454	543	585	604	590	679	721	740	726	857	876	951
140°	421	510	552	571	548	637	679	698	674	805	824	899

ΔT (Delta T) (°F)	1000VWH				1500VWH				2000VWH			
	Continuous Draw Gallons Per Hour (GPH)*	Storage Tank Gallon Size and First Hour Rating			Continuous Draw Gallons Per Hour (GPH)*	Storage Tank Gallon Size and First Hour Rating			Continuous Draw Gallons Per Hour (GPH)*	Storage Tank Gallon Size and First Hour Rating		
		200	350	500		350	500	750		350	500	750
40°	2948	3098	3211	3323	4422	4647	4797	4985	5897	6159	6272	6459
50°	2359	2509	2621	2734	3538	3763	3913	4100	4717	4980	5092	5280
60°	1966	2116	2228	2341	2948	3173	3323	3511	3931	4194	4306	4494
70°	1685	1835	1947	2060	2527	2752	2902	3090	3369	3632	3744	3932
80°	1474	1624	1737	1849	2211	2436	2586	2774	2948	3211	3323	3511
90°	1310	1460	1573	1685	1966	2191	2341	2528	2621	2883	2996	3183
100°	1179	1329	1442	1554	1769	1994	2144	2331	2359	2621	2734	2921
110°	1072	1222	1335	1447	1608	1833	1983	2171	2144	2407	2519	2707
120°	983	1133	1245	1358	1474	1699	1849	2037	1966	2228	2341	2528
130°	907	1057	1170	1282	1361	1586	1736	1923	1814	2077	2189	2377
140°	842	992	1105	1217	1264	1489	1639	1826	1685	1947	2060	2247

Table 4 - VWH Ratings with Storage Tanks - *NOTE: Continuous Draw Does Not Take a Storage Tank into Account

NOTE: First Hour Rating can be increased by using an external mixing valve and increasing tank setpoint temperature.
Example: If installation requires 120°F from mixing valve, set the tank at 140°F to increase First Hour Rating.

$$\text{First Hour Rating (FHR)} = \frac{\text{Total Input Rate} \times \text{Thermal Efficiency}}{(\text{VWH Outlet Temp} - \text{Inlet Temp}) \times 8.31} + .75 \times \text{Total Storage}$$

Example:

2 500VWHs = Total Output = 1,000,000 BTU
Thermal Efficiency = 98% Efficiency
VWH Outlet Temp = 140°F - Inlet Temp = 40°F
2 Storage Tanks (119 Gallons Each) = 238 Gallons Total Storage

$$\text{FHR} = \frac{1,000,000 \times .98}{(140 - 40) \times 8.31} + .75 \times 238$$

$$\text{FHR} = \frac{980,000}{831} + 179$$

$$\text{FHR} = 1,179 + 179$$

$$\text{FHR} = 1,358 \text{ Gallons}$$

Peak Hour Demand / First Hour Rating*			
Use	Average Gallons of Hot Water Per Usage	Times Used During One Hour	Gallons Used in One Hour
Shower	20	1	20
Bath	20	1	20
Shavings	2	1	2
Hands and Face Washing	4	1	4
Hair Shampoo	4	1	4
Hand Dishwashing	4	1	4
Automatic Dishwasher	14	1	14
Food Preparation	5	1	5
Wringer Clothes Washer	26	1	26
Automatic Clothes Washer	32	1	32
Total Peak Hour Demand (FHR)			131

Table 5 - Peak Hour Demand / First Hour Rating - NOTE: The above table assumes no water conservation measures. - *For Reference Use ONLY.

Part 3 - Prepare the VWH

The VWH is heavy. At least two individuals and special equipment (pallet jack, forklift, etc.) are needed to properly handle the VWH. If surface flooring is rough, take care not to damage the VWH when moving it into position.

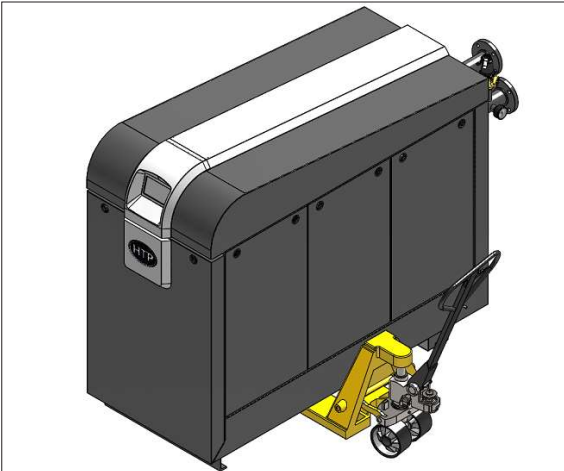


Figure 1 - Moving the ELX - 1500 - 2000 Models Shown

CAUTION

COLD WEATHER HANDLING - If the VWH has been stored in a very cold location (BELOW 0°F) before installation, handle with care until the components come to room temperature. Failure to do so could result in damage to the VWH.

CAUTION

Carefully consider installation when determining VWH location. Please read the entire manual before attempting installation. Failure to properly take factors such as VWH venting, piping, condensate removal, and wiring into account before installation could result in wasted time, money, and possible property damage and personal injury.

A. Locating the VWH



WARNING

DO NOT INSTALL the Elite XL OUTDOORS without an optional Outdoor Installation Kit. Follow the instructions included with the optional Outdoor Installation Kit when installing the VWH outdoors. Installing the VWH outdoors without an optional Outdoor Installation Kit WILL VOID the warranty, and could result in property damage, severe personal injury, or death.

Incorrect ambient conditions can lead to damage to the heating system and put safe operation at risk. Ensure that the installation location adheres to the information included in this manual. Failure to do so could result in property damage, serious personal injury, or death. Failure of the VWH or components due to incorrect operating conditions IS NOT covered by product warranty.

This VWH must be installed upright in the vertical position as described in this manual. DO NOT attempt to install this VWH in any other orientation. Doing so will result in improper VWH operation and property damage, and could result in serious personal injury or death.

1. Installation Area (Mechanical Room) Operating Conditions

- Ensure ambient temperatures are higher than 32°F / 0°C
- Prevent the air from becoming contaminated by the products, places, and conditions listed in this manual
- Avoid continuously high levels of humidity
- Never close existing ventilation openings
- Ensure a minimum 1" clearance around hot water and exhaust vent pipes
- NOTE: To prevent condensing in the fan, it is recommended to avoid prolonged exposure to temperatures below 45°F

WARNING

This VWH has a condensate disposal system that may freeze if exposed to sustained temperatures below 32°F. Precautions should be taken to protect the condensate trap and drain lines from sustained freezing conditions. Failure to take precautions could result in property damage, severe personal injury, or death.

2. Check for nearby connections to:

- System water piping
- Venting connections
- Gas supply piping
- Electrical power
- Condensate drain

3. Check area around the VWH. Remove any combustible materials, gasoline, and other flammable liquids.

WARNING

Failure to keep the VWH area clear and free of combustible materials, liquids, and vapors can result in substantial property damage, severe personal injury, or death.

CAUTION

High heat sources (generating heat 100°F / 37°C or greater, such as VWH flue pipes, space heaters, etc.) may damage plastic components of the VWH as well as plastic vent pipe materials. Such damages ARE NOT covered by warranty. It is recommended to keep a minimum clearance of 8" from high heat sources. Observe heat source manufacturer instructions, as well as local, state, provincial, and national codes, laws, regulations, and ordinances when installing this VWH and related components near high heat sources.

The service life of the VWH's exposed metallic surfaces, such as the casing, as well as internal surfaces, such as the heat exchanger, are directly influenced by proximity to damp and salty marine environments. In such areas higher concentration levels of chlorides from sea spray coupled with relative humidity can lead to degradation of VWH components. In these environments, VWHs must not be installed using direct vent systems which draw outdoor air for combustion. Such VWHs must be installed using room air for combustion. Indoor air will have a much lower relative humidity, and hence potential corrosion will be minimized.

Failure of the VWH or components due to incorrect operating conditions IS NOT covered by product warranty.

4. Gas control system components must be protected from dripping water during operation and service.

5. If the VWH is to replace an existing VWH, check for and correct any existing system problems, such as:

- System leaks
- Location that could cause the system and VWH to freeze and leak
- Incorrectly sized expansion tank

CAUTION

Always take future maintenance into consideration when locating the boiler. If the boiler is located in an installation location with limited clearances, it may be necessary to remove the boiler from the space to perform maintenance. Failure to consider maintenance when determining installation location could result in property damage.

6. Clean and flush system when reinstalling a VWH.

WARNING

Do not introduce toxic chemicals, such as antifreeze or appliance treatments, into any piping meant for potable water purposes.

Do not connect DHW connections to any heating systems or components that have been previously used for nonpotable applications.

Ensure that all piping and components connected to the appliance are suitable for potable water applications.

Failure to follow these instructions could result in serious personal injury or death.

NOTE: When installing in a minimum clearance location, it may not be possible to read or view some product labeling. It is recommended to make note of the VWH model and serial number.

NOTE: A combustible door or removable panel is acceptable front clearance.

WARNING

Use extreme care not to drop the VWH or cause bodily injury while lifting the VWH. Failure to follow these instructions could result in property damage, severe personal injury, or death.

B. Flooring

WARNING

400 - 1000 Models ONLY are approved for installation on combustible flooring, but must never be installed on carpeting. 1500 - 2000 MODELS ARE NOT APPROVED FOR INSTALLATION ON COMBUSTIBLE FLOORING. Failure to follow these instructions could result in fire, property damage, severe personal injury, or death.

Ensure that the floor and structure of the installation location are sufficient to support the full installed weight of the VWH, including water content of the heat exchanger and related piping. Failure to ensure the floor and structure of the installation location are structurally sound before installation of the VWH can result in structural failure, substantial property damage, severe personal injury, or death.

C. Leveling

CAUTION

In order for the condensate to properly flow out of the collection system, the area where you locate the VWH must be level. Location must also fully support the weight of the filled VWH. See Figures 2 - 4.

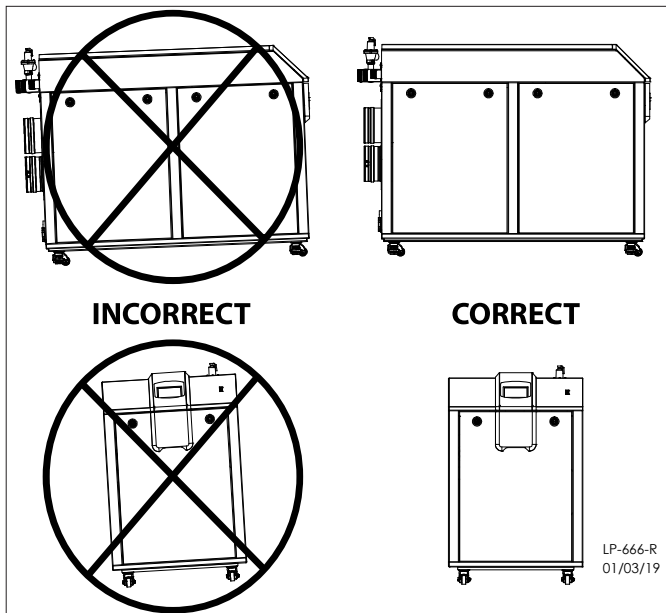


Figure 2 - Leveling - 400 - 1000 Models

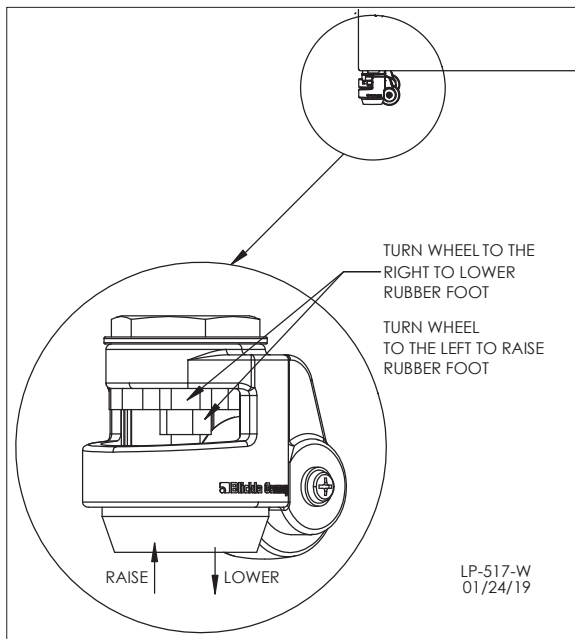


Figure 3 - Caster Wheel Adjustment - 400 - 1000 Models ONLY

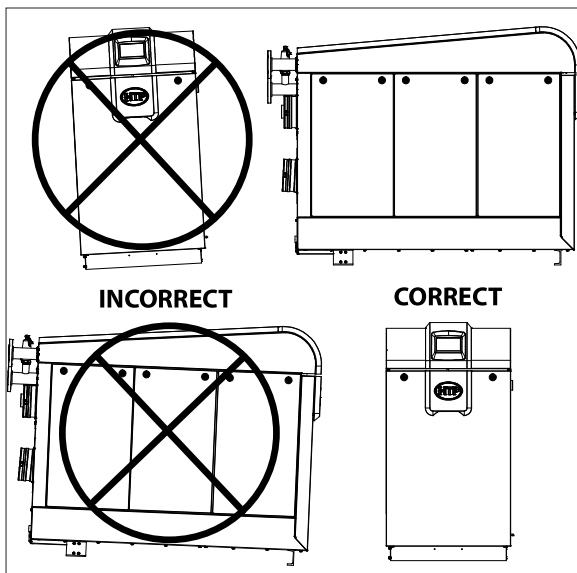


Figure 4 - Leveling - 1500 - 2000 Models

1500 - 2000 Models ONLY - After the VWH has been installed level in the final location the decorative skirts may be installed. These can be found in the VWH cabinet. Use the included bolts to install the front skirt (1) before proceeding to the side skirts (2). See Figure 5.

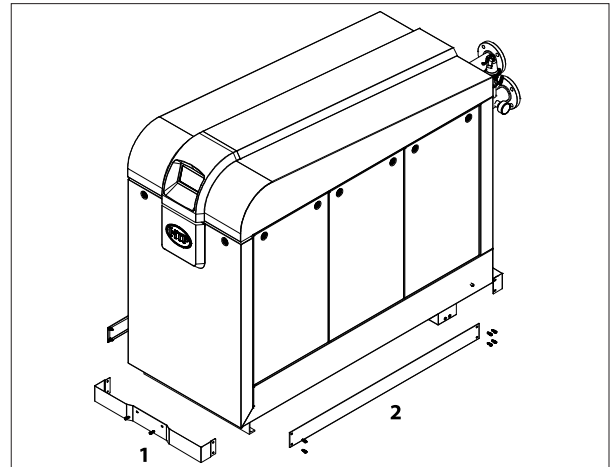


Figure 5 - 1500 - 2000 Models - Installing Decorative Skirts

D. Clearances for Service Access

⚠ WARNING

The space must be provided with combustion / ventilation air openings correctly sized for all other appliances located in the same space as the VWH. The VWH cover must be securely fastened to prevent the VWH from drawing air from the VWH room. This is particularly important if the VWH is in a room with other appliances. Failure to comply with the above warnings could result in substantial property damage, severe personal injury, or death.

NOTE: If you do not provide the minimum clearances shown in Figure 6 it might not be possible to service the VWH without removing it from the space.

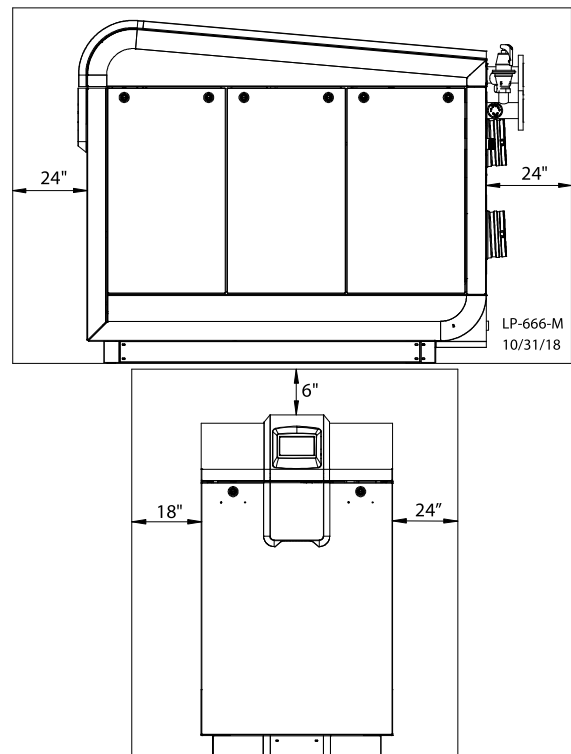


Figure 6 - Recommended Service Clearances

CAUTION

All VWHs eventually leak. Locate the VWH where any leakage from the relief valve, related piping, tank, or connections will not result in damage to surrounding areas or lower floors of the building. Any VWH should be installed in such a manner that if it should leak the resulting flow of water will not cause damage to the area in which it is installed. If the VWH is installed in a location where a leak could cause damage, it is required to provide containment measures. Such measures include but are not limited to: a properly sized drain pan installed beneath the VWH and piped to an open drain line, or installing the VWH on a concrete floor pitched to a free flowing drain. Failure to provide containment measures is the sole responsibility of the owner and/or installer. Leakage damages ARE NOT covered by warranty.

In addition, water leak detection devices and automatic water shutoff valves are readily available at plumbing supply houses. IT IS HIGHLY RECOMMENDED BY THE MANUFACTURER TO INSTALL WATER LEAK DETECTION DEVICES AND AUTOMATIC SHUTOFF VALVES IN ANY VWH INSTALLATION WHERE A LEAKAGE OF WATER COULD RESULT IN PROPERTY DAMAGES.

NOTE: In multiple VWH installations, ensure an 18" minimum clearance is maintained between VWHs.

NOTE: For closet installations, a combustible door or removable panel is acceptable front clearance. A 3" minimum clearance must be provided from the appliance front cover to the removable panel or combustible door.

Minimum Clearances from Combustible Materials

- Hot water pipes - at least 1" from combustible materials
- Exhaust vent pipe - at least 1" from combustible materials

Boiler Area Ventilation Air Openings - Closet Installations

If the boiler is installed in a closet or alcove the boiler area/room must be ventilated.

EXCEPTION: If the boiler area/room has a volume of 150 ft³ or greater, ventilation of the boiler area/room is not required.

Each ventilation air opening must meet the minimum requirements of 1 in² per 1000 BTU/hr., but not less than 100 in². The lower ventilation opening must be located within 6 in. of the floor, while the upper opening must be located 6 in. from the top of the space.

WARNING

If the boiler area has a volume less than 150 ft³, it is considered a Closet or Alcove. In the US/Canada, PVC vent pipe and fittings SHALL NOT BE USED within the closet or alcove. Only approved CPVC, Polypropylene, or Stainless Steel vent pipe and fittings may be used. See Table 14 for a list of approved materials. Under all circumstances proper ventilation must be provided.

The space must be provided with correctly sized combustion/ventilation air openings for all other appliances located in the space with the boiler. For power venting installations using room air for combustion, refer to the boiler venting section, this manual, for descriptions of confined and unconfined spaces. Do not install the boiler in an attic. The boiler cover must be securely fastened to prevent the boiler from drawing air from the boiler room. This is particularly important if the boiler is in a room with other appliances. Failure to comply with the above warnings could result in substantial property damage, severe personal injury, or death.

Alcove Installations

Alcove installations have the same minimum dimensions as closet installations, except the installation must be completely open to the room at a distance no greater than 18 in. (457 mm) from the front of the boiler and the room must be at least three (3) times the size of the alcove. Provided these conditions are met, the boiler requires no extra

ventilation air openings to the space. If these conditions are not met, follow the requirements for Closet Installations.

E. Residential Garage and Closet Installations

CAUTION

Check with your local Authority Having Jurisdiction for requirements when installing the VWH in a garage or closet. Please read the entire manual before attempting installation. Failure to properly take factors such as venting, piping, condensate removal, and wiring into account before installation could result in wasted time, money, and possible property damage and personal injury.

Precautions

If the VWH is located in a residential garage, per ANSI Z223.1:

- Install the VWH burner and ignition devices a minimum of 18" above the floor of the garage. This will ensure the burner and ignition devices are well off the floor.
- When raising the VWH ensure the entire bottom and fully filled weight of the VWH are fully supported.
- Locate or protect the VWH so it cannot be damaged by a moving vehicle.

F. Exhaust Vent and Intake Pipe

The VWH is rated ANSI Z21.13 Category IV (pressurized vent, likely to form condensate in the vent) and requires a special vent system designed for pressurized venting.

NOTE: The venting options described here (and further detailed in the Venting section, this manual) are the lone venting options approved for this VWH. Failure to vent the VWH in accordance with the provided venting instructions will void the warranty.

! DANGER

Failure to vent the VWH properly will result in serious personal injury or death.

! WARNING

Do not attempt to vent this VWH by any means other than those described in this manual. Doing so will void the warranty and may result in severe personal injury or death.

The exhaust discharged by this VWH may be very hot. Avoid touching or other direct contact with the exhaust gases of the vent termination assembly. Doing so could result in severe personal injury or death.

Vents must be properly supported. VWH exhaust and intake connections are not designed to carry heavy weight. Vent support brackets must be within 1' of the VWH and the balance at 4' intervals. VWH must be readily accessible for visual inspection for first 3' from the VWH. Failure to properly support vents could result in property damage, severe personal injury, or death.

1. Direct Vent of Exhaust and Intake

If installing a direct vent option, combustion air must be drawn from the outdoors directly into the VWH intake and exhaust must terminate outdoors. There are three basic direct vent options detailed in this manual: 1. Side Wall Venting, 2. Roof Venting, and 3. Unbalanced Venting.

Be sure to locate the VWH such that the exhaust vent and intake piping can be routed through the building and properly terminated. Different vent terminals can be used to simplify and eliminate multiple penetrations in the building structure (see Optional Equipment in Venting Section). The exhaust vent and intake piping lengths, routing, and termination methods must all comply with the methods and limits given in the Venting Section, this manual.

When installing a combustion air intake from outdoors, care must be taken to utilize uncontaminated combustion air. **To prevent combustion air contamination, see Table 6.**

2. Power Venting, Indoor Combustion Air in Confined or Unconfined Space

This VWH requires fresh, uncontaminated air for safe operation and must be installed in a mechanical room where there is adequate combustion and ventilating air. **NOTE: To prevent combustion air contamination, see Table 6.**

Combustion air from the indoor space can be used if the space has adequate area or when air is provided through a duct or louver to supply sufficient combustion air based on the VWH input. Never obstruct the supply of combustion air to the VWH. If the VWH is installed in areas where indoor air is contaminated (see Table 6) it is imperative that the VWH be installed as direct vent so that all combustion air is taken directly from the outdoors into the VWH intake connection.

Unconfined space is space with volume greater than 50 cubic feet per 1,000 BTU/hr (4.8 cubic meters per kW) of the total input rating of all fuel-burning appliances installed in that space. Rooms connected directly to this space through openings not furnished with doors are considered part of the space. See Venting Section for details.

Confined space is space with volume less than 50 cubic feet per 1,000 BTU/hr (4.8 cubic meters per kW) of the total input rating of all fuel-burning appliances installed in that space. Rooms connected directly to this space through openings not furnished with doors are considered part of the space.

When drawing combustion air from inside a conventionally constructed building to a confined space, such space should be provided with two permanent openings: one located 6" (15 cm) below the space ceiling, the other 6" (15cm) above the space floor. Each opening should have a free area of one square inch per 1,000 BTU/hr (22cm²/kW) of the total input of all appliances in the space, but not less than 100 square inches (645cm²).

If the confined space is within a building of tight construction, air for combustion must be obtained from the outdoors as outlined in the Venting section of this manual.

CAUTION

When drawing combustion air from the outside into the mechanical room, care must be taken to provide adequate freeze protection.



WARNING

Failure to provide an adequate supply of fresh combustion air can cause poisonous flue gases to enter the living space, resulting in severe personal injury or death. To prevent combustion air contamination, see Table 6.

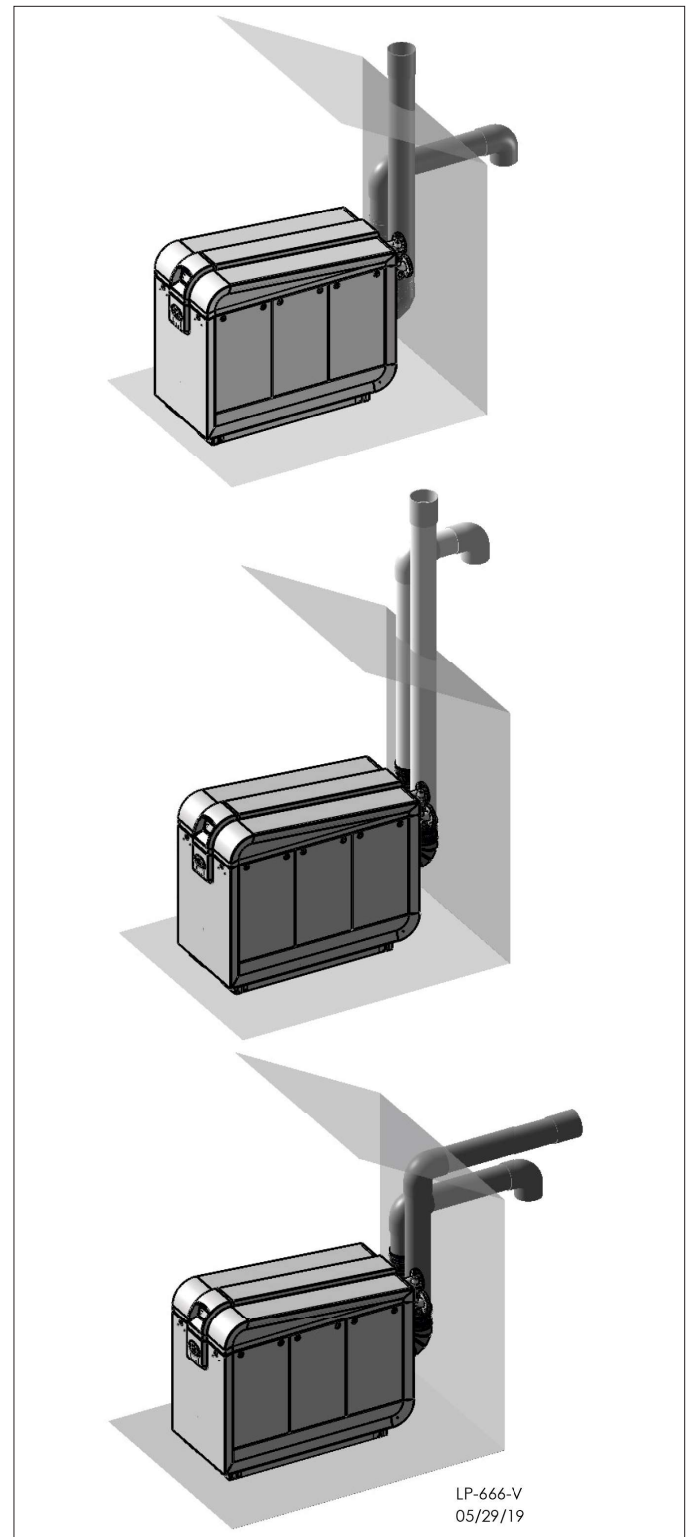


Figure 7 - Direct Vent Examples

G. Carbon Monoxide Detectors

In the Commonwealth of Massachusetts and As Required by State and Local Codes:

Installation of Carbon Monoxide Detectors: At the time of installation or replacement of the vented gas fueled appliance, the installing plumber or gas fitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on the floor level where the gas appliance is installed, unless the appliance is located in a detached, uninhabitable structure separate from the dwelling, building, or structure used in whole or in part for residential purposes.

In addition, the installing plumber or gas fitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on each additional level of the dwelling, building, or structure served by the vented gas appliance. It shall be the responsibility of the property owner to secure the service of qualified licensed professionals for the installation of hard wired carbon monoxide detectors.

a. In the event that the vented gas fueled appliance is installed in a crawl space or attic, the hard wired carbon monoxide detector with alarm and battery back-up shall be installed on the next adjacent floor level.

b. In the event that these requirements cannot be met at the time of completion of installation, the owner shall have a period of thirty (30) days to comply with the above requirements; provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed.

! WARNING

Do not attempt to vent this appliance by any means other than those described in this manual. Doing so will void the warranty and may result in severe personal injury or death.

Approved Carbon Monoxide Detectors: Each carbon monoxide detector as required in accordance with the above provisions shall comply with NFPA 70 and be ANSI/UL 2034 listed and IAS certified.

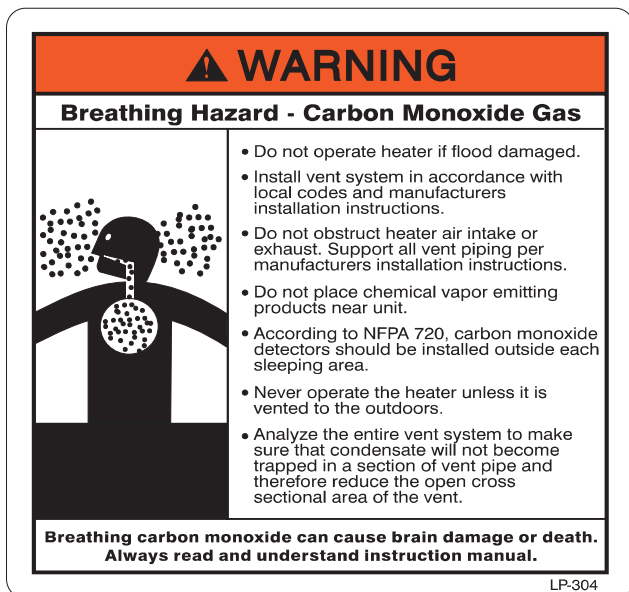


Figure 8 - CO Warning Label

H. Prevent Combustion Air Contamination

Install intake air piping for the VWH as described in the Venting Section, this manual. Do not terminate exhaust in locations that can allow contamination of intake air.

! WARNING

Ensure that the intake air will not contain any of the contaminants in Table 6. Contaminated air will damage the VWH, resulting in possible substantial property damage, severe personal injury, or death. For example, do not pipe intake air near a swimming pool or laundry facilities. These areas always contain contaminants.

Products to Avoid	Areas Likely to Have Contaminants
Spray cans containing fluorocarbons	Dry cleaning / laundry areas and establishments
Permanent wave solutions	Swimming pools
Chlorinated waxes / cleaners	Metal fabrication plants
Chlorine-based swimming pool chemicals	Beauty shops
Calcium chloride used for thawing	Refrigeration repair shops
Sodium chloride used for water softening	Photo processing plants
Refrigerant leaks	Auto body shops
Paint or varnish removers	Plastic manufacturing plants
Hydrochloric or Muriatic acid	Furniture refinishing areas and establishments
Cements and glues	New building construction
Antistatic fabric softeners used in clothes dryers	Remodeling areas
Chlorine-type bleaches, laundry detergents, and cleaning solvents	Garages and workshops
Adhesives used to fasten building products	

Table 6 - Products and Areas Likely to Have Contaminants

NOTE: DAMAGE TO THE VWH CAUSED BY EXPOSURE TO CORROSIVE VAPORS IS NOT COVERED BY WARRANTY. (Refer to the limited warranty for complete terms and conditions.)

I. Removing an Appliance from a Common Vent System

! DANGER

Do not install the VWH into a common vent with any other appliance. This will cause flue gas spillage or appliance malfunction, resulting in possible substantial property damage, severe personal injury, or death.

! WARNING


Failure to follow all instructions can result in flue gas spillage and carbon monoxide emissions, causing severe personal injury or death.

When removing an existing appliance, follow the steps below.

1. Seal any unused openings in the common venting system.
2. Visually inspect the venting system for proper size and horizontal pitch to determine if there is blockage, leakage, corrosion, or other deficiencies that could cause an unsafe condition.
3. If practical, close all building doors, windows, and doors between the space in which the appliance remains connected to the common venting system and other spaces in the building. Turn on clothes dryers and any appliances not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, at maximum speed. Do not operate a summer exhaust fan. Close all fireplace dampers.

4. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust the thermostat so the appliance will operate continuously.
5. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle or smoke from a cigarette.
6. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined, return doors, windows, exhaust fans, fireplace dampers, and any other gas burning appliances to their previous condition of use.
7. Any improper operation of the common venting system should be corrected to conform to the National Fuel Gas Code, ANSI Z223.1. When resizing any portion of the common venting system, the system should approach the minimum size as determined using the appropriate tables in Appendix G of ANSI Z223.1.

K. Outdoor Installations

 WARNING
<p>DO NOT INSTALL the Elite XL OUTDOORS without an optional Outdoor Installation Kit. Follow the instructions included with the optional Outdoor Installation Kit when installing the VWH outdoors. Installing the VWH outdoors without an optional Outdoor Installation Kit WILL VOID the warranty, and could result in property damage, severe personal injury, or death.</p>
<p>Elite XL outdoor models are intended for warm weather applications. DO NOT install the Elite XL outdoors in areas prone to freezing (below 32°F / 0°C). Incorrect ambient conditions can lead to damage to the heating system and put safe operation at risk. Ensure that the installation location adheres to the information included in this manual. Failure to do so could result in property damage, serious personal injury, or death. Failure of Elite XL or components due to incorrect operating conditions IS NOT covered by product warranty.</p>
<p>Exhaust vent adaptors are not designed as load-bearing devices, and must not be used to support exhaust vent piping. All vent pipes must be properly connected, supported, and the exhaust vent must be pitched a minimum of 1/4" per foot back to the Elite XL to allow drainage of condensate. Failure to properly support vent piping and follow the information in this statement could result in product damage, severe personal injury, or death.</p>

General Outdoor Installation Guidelines

1. The Elite XL must not be installed outdoors in freezing climates. Elite XLs installed outdoors must be vented with listed UV-resistant vent materials per the following instructions and installed with the optional factory-supplied Outdoor Installation Kit.
2. Keep venting areas free of obstructions, and combustible and flammable materials. Keep the air intake and exhaust vent terminations free of obstructions.
3. Do not install directly on the ground. Install on a concrete, brick, block, or other non-combustible pad.
4. Install unit in a location that avoids opportunities for exhaust gas recirculation.
5. Clearances around outdoor installations may change over time. Make sure the growth or trees, shrubs, landscaping, etc. is properly maintained.
6. Do not install in locations where building runoff will spill onto the unit.
7. Multiple unit installations require at least a 4' (48 in.) clearance between exhaust vents.
8. Locate unit at least 3' (36 in.) away from any overhang.
9. Follow the outdoor kit instructions when locating / venting the unit.

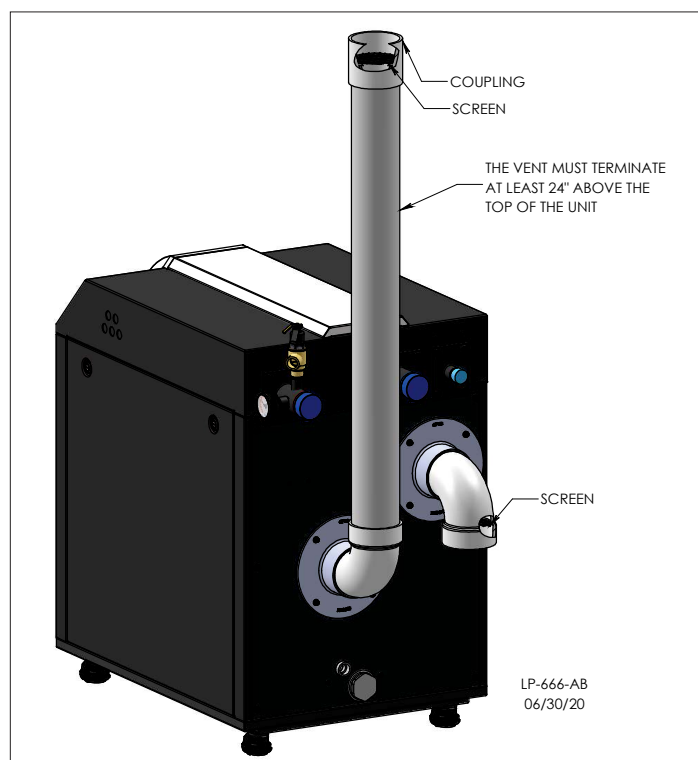
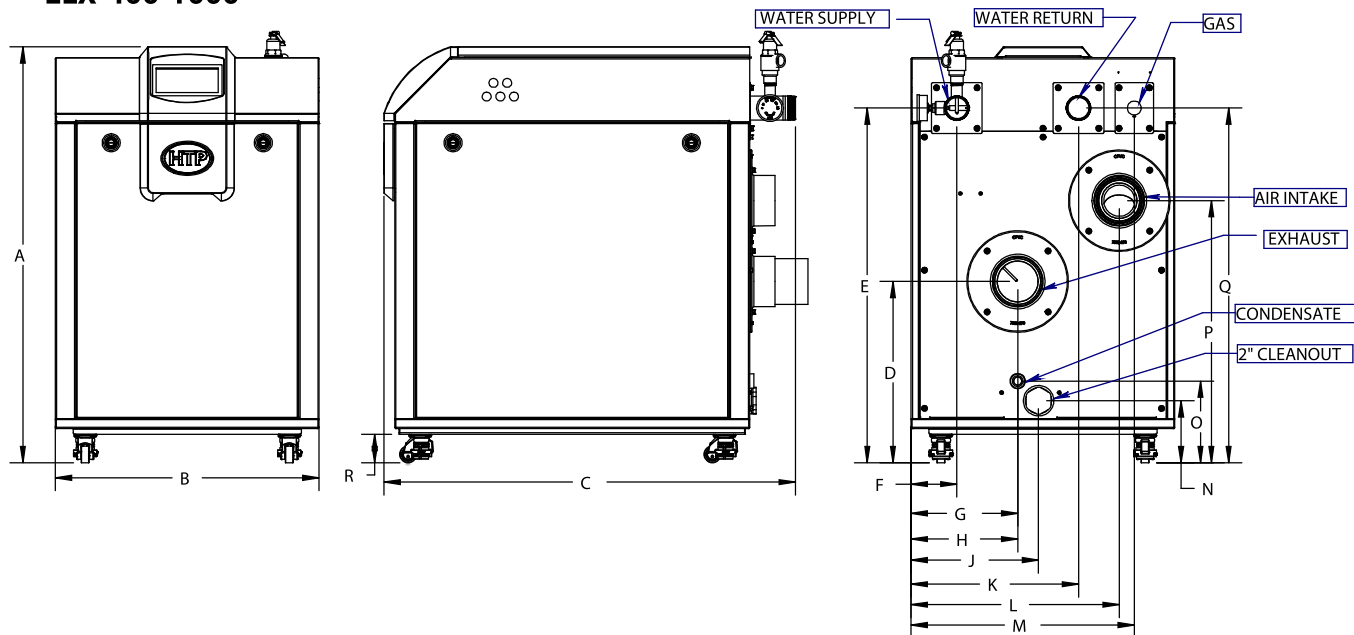
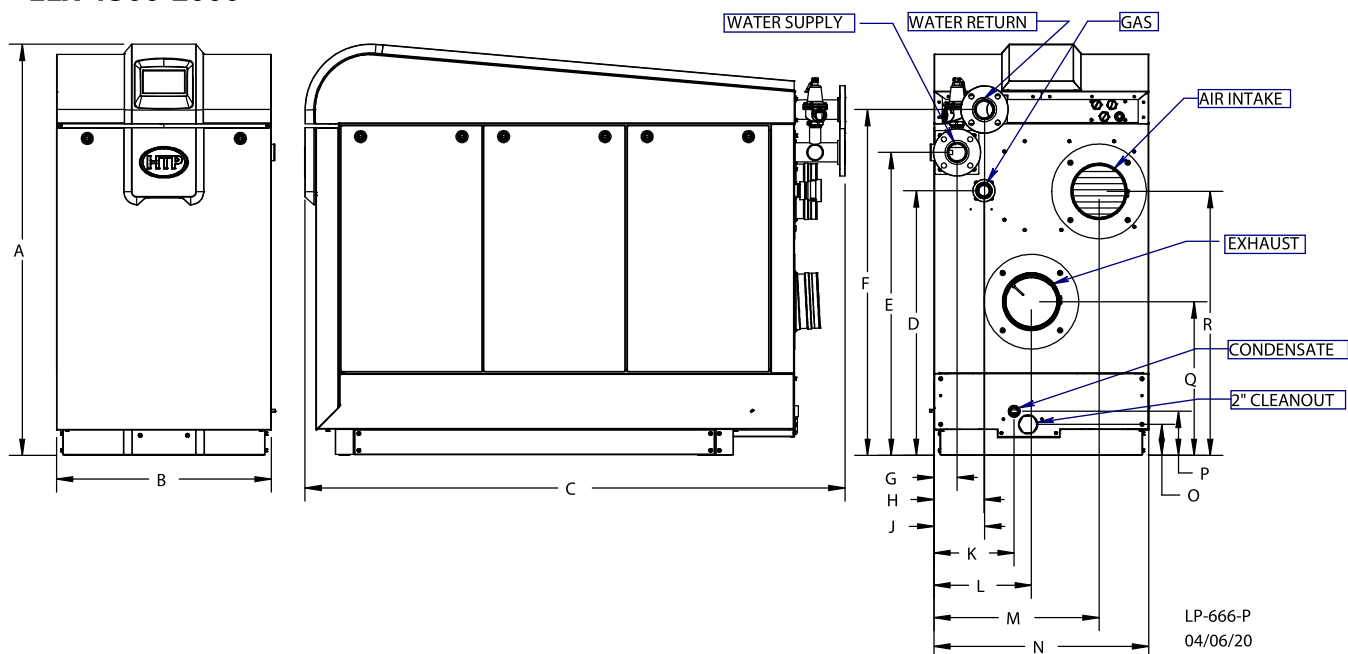


Figure 9 - Outdoor Venting Installation

ELX-400-1000**ELX-1500-2000**

MODEL #	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R
ELX-400-500	41.0	26.0	40.7	17.9	35.0	4.1	10.1	10.5	12.6	16.1	20.5	22.0	6.1	8.1	25.8	35.0	2.8*
ELX-650-1000			56.5														
ELX-1500	60.8	31.8	67.5	39.2	44.8	51.2	3.4	7.4	7.5	11.9	14.4	24.4	31.8	4.6	6.5	22.7	39.1
ELX-2000			80.0														

Figure 10 - ELX VWH Specifications and Dimensions - NOTE: All Dimensions Are Approximate

Model	Water Connection	Vent Size	Air Intake	Gas Connection	Condensate
400	2" NPT	4"	4"	1"	3/4" PVC
500				1"	
650		6"	6"	1-1/4"	
800				1-1/4"	
1000	2 1/2" Flange	8"	8"	1-1/2"	1" PVC
1500				1-1/2"	
2000				2"	

Table 7 - ELX VWH Adapter Dimensions and Specifications

L. Technical Specifications

Model		400	500	650	800	1000	1500	2000	
Installation		Indoor or Outdoor (with Optional Kit), Floor Standing, Fully Condensing							
Minimum / Maximum Input (Btu/Hr)		39,900 / 399,000	50,000 / 500,000	65,000 / 650,000	80,000 / 800,000	100,000 / 1,000,000	150,000 / 1,500,000	200,000 / 2,000,000	
Heating Capacity (MBH)		391	490	637	784	980	1,470	1,960	
Flue System		Category IV, Sealed Combustion Direct Vent, Power Vent							
Minimum Combined Vent Run		10 feet						15 feet	
Maximum Combined Vent Run		4" (125 feet)		6" (125 feet)			8" (150 feet)		
Approved Exhaust Vent Materials		PVC, CPVC, PP, Stainless Steel							
Packaging Dimensions (in Inches)	W	32.25					43.25		
	H	49.625					64.25		
	D	48		64			76	86	
Shipping Weight (lbs)		538	545	680	700	745	1400	1750	
Gas Supply Pressure		3.5" to 14"WC (NG or LP)							3.5" to 10.5" WC (NG ONLY)
Manifold Pressure	Min / Max	-0.08"WC (NG or LP)							-0.07"WC (NG ONLY)
Power Supply		120V 60 Hz, 20A							208/3PH WYE, 60Hz, 15A/Leg
Customer Connection Board Fuse Amperage Ratings		2 Amps							5 Amps
General Operating Conditions		Minimum Ambient Temperature: Greater than 32°F (0°C) Product Approvals and Requirements: ANSI Z21.13 / CSA 4.9, CSD-1 ASME Code							
Ignition System		Direct Electronic Spark Ignition / Flame Rectification							
Burner System		Premixed Fuel Modulation / Stainless Steel Burner							
Gas Valve System		Pneumatic Gas Valve							
Dimensions (in Inches)	W	26					31.8		
	H	41					60.8		
	D	40.7		56.5			66.5	79	
VWH Water Content (Gallons)		3.8	4.3	5.6	6.6	8.1	12.9	16.25	
Minimum Flow Rate @ 20°F ΔT at Low Fire (GPM)		4	5	6.5	8	10	15	20	
Flow Switch Activation (GPM)		4					9		
DHW Indirect Setpoint Temperature Range		70 – 185°F							
Water Pressure (PSI)	Heat Exchanger MAWP	160							
	Relief Valve	Temperature: 210F / Pressure: 150							
Control Panel		7" Full Color Touch Screen							
Main Controller		928 SIT Control							
Connection Sizes	Supply / Return	2" NPT					2 1/2" Flange		
	Gas Inlet	1" NPT			1 1/4" NPT		1 1/2" NPT	2" NPT	
Materials	Cabinet	Powder Coated Galvaneal Steel							
	Heat Exchanger	316L Stainless Steel Water Tube							
Safety Devices		Flame Rectifier Probe, Dual Water Supply Temperature Sensor / High Limit (210°F), Freeze Protection, Condensate Trap with Float, Dual Flue Sensor (210°F), Blocked Vent Pressure Switch, Internal UL 353 Approved Low Water Cut-Off (LWCO), High Resolution Flow Switch							

Table 8 - Technical Specifications

Part 4 - Piping

WARNING

Failure to follow the instructions in this section WILL VOID the warranty and may result in property damage, severe personal injury, or death.

CAUTION

Dielectric unions or galvanized steel fittings must not be used in a system with this VWH. Doing so WILL VOID the warranty. Use only copper, brass, or stainless steel fittings. Teflon thread sealant must be used on all connections.

DO NOT pipe this VWH with black iron, galvanized steel, steel, or lead pipe. Doing so will result in premature product failure and property damage, and WILL VOID the warranty.

Plumbing of this product should only be done by a qualified, licensed plumber in accordance with all local plumbing codes. The VWH is designed to be connected to a storage tank to supply domestic hot water. HTP offers 60/80/119/175 gallon storage tanks in either stainless steel or glass-lined construction. These storage tanks will be directly connected to the VWH supply and return connections.

A. General Plumbing Information

CAUTION

The building piping system must meet or exceed the piping requirements in this manual.

The control module uses temperature sensors to provide both high limit protection and modulating temperature control. The control module also provides low water protection by sensing the water level in the heat exchanger. Some codes/jurisdictions may require additional external controls.

Use two wrenches when tightening water piping at the VWH. Use one wrench to prevent the VWH return or supply line from turning. Failure to prevent piping connections from turning could cause damage to VWH components.

The water connections must be installed in accordance with all local and national plumbing codes, or any applicable standard which prevails.

- Pipe material must be suitable to meet local codes and industry standards.
- The pipe must be cleaned and without blemish before any connections are made.
- Isolation (shut-off valves) should be used to ease future servicing.
- All piping should be insulated.

It is recommended to install a shut-off valve and a union in the return and supply piping to ease future servicing. If there is a back flow preventer or any type of no return valve in the system you must install an additional tee for a suitable potable hot water expansion tank.

NOTE: The addition of a high temperature limiting device is important if the VWH is to be connected to a domestic hot water system.

Connect the cold water supply to both the storage tank bottom port and the supply side of the VWH (shown in Applications, this manual). It is important that you install a flow check on the supply line of the VWH BEFORE connecting the feed line to the storage tank. This allows the cold feed to flow through the storage tank first. Connect the storage tank return line to the return connection located on the VWH (shown in Applications, this manual). Then connect the storage tank hot water outlet to the hot water plumbing lines.

B. Backflow Preventer

Use a backflow preventer specifically designed for hot water heater installations. This valve should be installed on the cold water fill supply line per local codes.

C. Expansion Tank

Expansion Tank and Make-Up Water

1. Ensure that the expansion tank is sized to correctly handle VWH and system water volume and temperature.

WARNING

Expansion tanks must be sized according to total system volume. This includes all length of pipe, all fixtures, VWHs, etc. Failure to properly size for system expansion could result in wasted time, money, possible property damage, serious injury, or death.

CAUTION

Undersized expansion tanks cause system water to be lost from the relief valve, causing make-up water to be added. Eventual VWH failure can result due to excessive make-up water addition.

SUCH FAILURE IS NOT COVERED BY WARRANTY.

DO NOT install automatic air vents on closed type expansion tank systems. Air must remain in the system and return to the tank to provide an air cushion. An automatic air vent would cause air to leave the system, resulting in improper operation of the expansion tank.

The expansion tank must be suitable for potable water systems.

Model	Heat Exchanger Volume (Gallons)
400	3.8
500	4.3
650	5.6
800	6.6
1000	8.1
1500	12.9
2000	16.25

Table 9 - Heat Exchanger Volume - Add Required Storage Tank Gallon Size to Heat Exchanger Volume

2. The expansion tank must be located as shown in Applications, this manual, or following recognized design methods. See expansion tank manufacturer's instructions for details.

D. Circulators

Every VWH system requires special attention to circulator size to overcome pressure drop through the VWH and its related piping. All circulators installed on the VWH system must be designed for potable water installations. VWH pressure drop is detailed in this manual.

CAUTION

Water temperature above 140°F requires the circulator to run continuously. Water hardness must be between 5 and 7 grains. Hardness above 7 grains will damage the heat exchanger and shorten the service life of the VWH.

DO NOT use the VWH circulator in any location other than the ones shown in this manual. The VWH circulator location is selected to ensure adequate flow through the VWH. Failure to comply with this caution could result in unreliable performance and nuisance shutdowns from insufficient flow.

E. Relief Valve

Connect discharge piping to a safe disposal location by following these guidelines.

WARNING

Do not thread a cap or plug into the relief valve or relief valve line under any circumstances! Explosion and property damage, serious injury, or death may result.

RE-INSPECTION OF RELIEF VALVES: Valves should be inspected AT LEAST ONCE EVERY THREE YEARS, and replaced if necessary, by a licensed plumbing contractor or qualified service technician to ensure that the product has not been affected by corrosive water conditions and to ensure that the valve and discharge line have not been altered or tampered with illegally. Certain naturally occurring conditions may corrode the valve and its components over time, rendering the valve inoperative. Such conditions can only be detected if the valve and its components are physically removed and inspected. **Do not attempt to conduct an inspection on your own.** Contact your plumbing contractor for a re-inspection to assure continued safety.

FAILURE TO RE-INSPECT THE RELIEF VALVE AS DIRECTED COULD RESULT IN UNSAFE TEMPERATURE AND/OR PRESSURE BUILD-UP WHICH CAN RESULT IN PROPERTY DAMAGE, SERIOUS PERSONAL INJURY, OR DEATH.

To avoid water damage or scalding due to relief valve operation:

- Discharge line must be connected to relief valve outlet and run to a safe place of disposal. Terminate the discharge line in a manner that will prevent possibility of severe burns or property damage should the relief valve discharge.
- Discharge line must be as short as possible and the same size as the valve discharge connection throughout its entire length.
- Discharge line must pitch downward from the valve and terminate at least 6" above the floor drain, making discharge clearly visible.
- The discharge line shall terminate plain, not threaded, with a material serviceable for temperatures of 375°F or greater.
- Do not pipe discharge to any location where freezing could occur.
- No valve may be installed between the relief valve and VWH or in the discharge line. Do not plug or place any obstruction in the discharge line.
- Test the operation of the relief valve after filling and pressurizing the system by lifting the lever. Make sure the valve discharges freely. If the valve fails to operate correctly, immediately replace with a new properly rated relief valve.
- Test relief valve at least once annually to ensure the waterway is clear. If valve does not operate, turn the VWH "off" and call a plumber immediately.
- Take care whenever operating relief valve to avoid scalding injury or property damage.

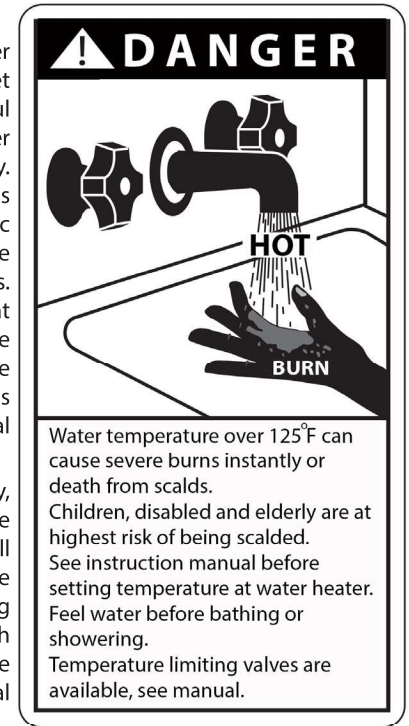
FAILURE TO COMPLY WITH THE ABOVE GUIDELINES COULD RESULT IN FAILURE OF RELIEF VALVE OPERATION, RESULTING IN POSSIBILITY OF SUBSTANTIAL PROPERTY DAMAGE, SEVERE PERSONAL INJURY, OR DEATH.

F. Scalding

This VWH can deliver scalding water at any faucet in the system. Be careful whenever using hot water to avoid scalding injury. Certain appliances such as dishwashers and automatic clothes washers may require increased water temperatures. By setting the thermostat on this VWH to obtain the increased water temperature required by these appliances you may create the potential for scald injury.

To protect against injury, install a mixing valve in the water system. This valve will reduce point of use discharge temperatures by mixing cold and hot water in branch supply lines. Such valves are available from your local plumbing supplier.

Table 10 details the relationship of water temperature and time with regard to scald injury and may be used as a guide in determining the safest water temperature for your applications.



WARNING

The risk of scalding increases when raising tank temperature. Use a water tempering or mixing valve when raising tank temperature to lessen the chance of scalds. Consult codes for conformance. Failure to install a temperature limiting or mixing valve and follow these instructions could result in property damage, severe personal injury, or death due to scalds.

Approximate Time / Temperature Relationships in Scalds

120°F	More than 5 minutes
125°F	1 1/2 to 2 minutes
130°F	About 30 seconds
135°F	About 10 seconds
140°F	Less than 5 seconds
145°F	Less than 3 seconds
150°F	About 1 1/2 seconds
155°F	About 1 second

Table 10 - Approximate Time / Temperature Relationships in Scalds

G. High Velocity Circulator Pump

Every VWH system requires special attention to pump size in order to overcome pressure drop through the VWH and its related piping. All circulators installed on the VWH system must be designed for a potable water system.

In addition, the heat exchanger has a minimum flow rate that must be taken into account when sizing the circulator. Minimum flow rates are listed in Table 11.

Model	20°F		30°F		40°F	
	GPM	Ft / Hd	GPM	Ft / Hd	GPM	Ft / Hd
400	39	12.0	26	7.2	19	4.0
500	48	11.4	32	5.4	24	3.2
650	63	11.5	42	6.2	31	4.0
800	77	12	52	6	39	3
1000	96	14.0	64	7	48	4.7
1500	146	16	97	7.6	73	4.7
2000	200	21	133	11.5	100	6.7

Table 11 - Pressure Drop at Various Temperature Rises

The VWH heat exchanger does have a pressure drop which must be considered in system design.

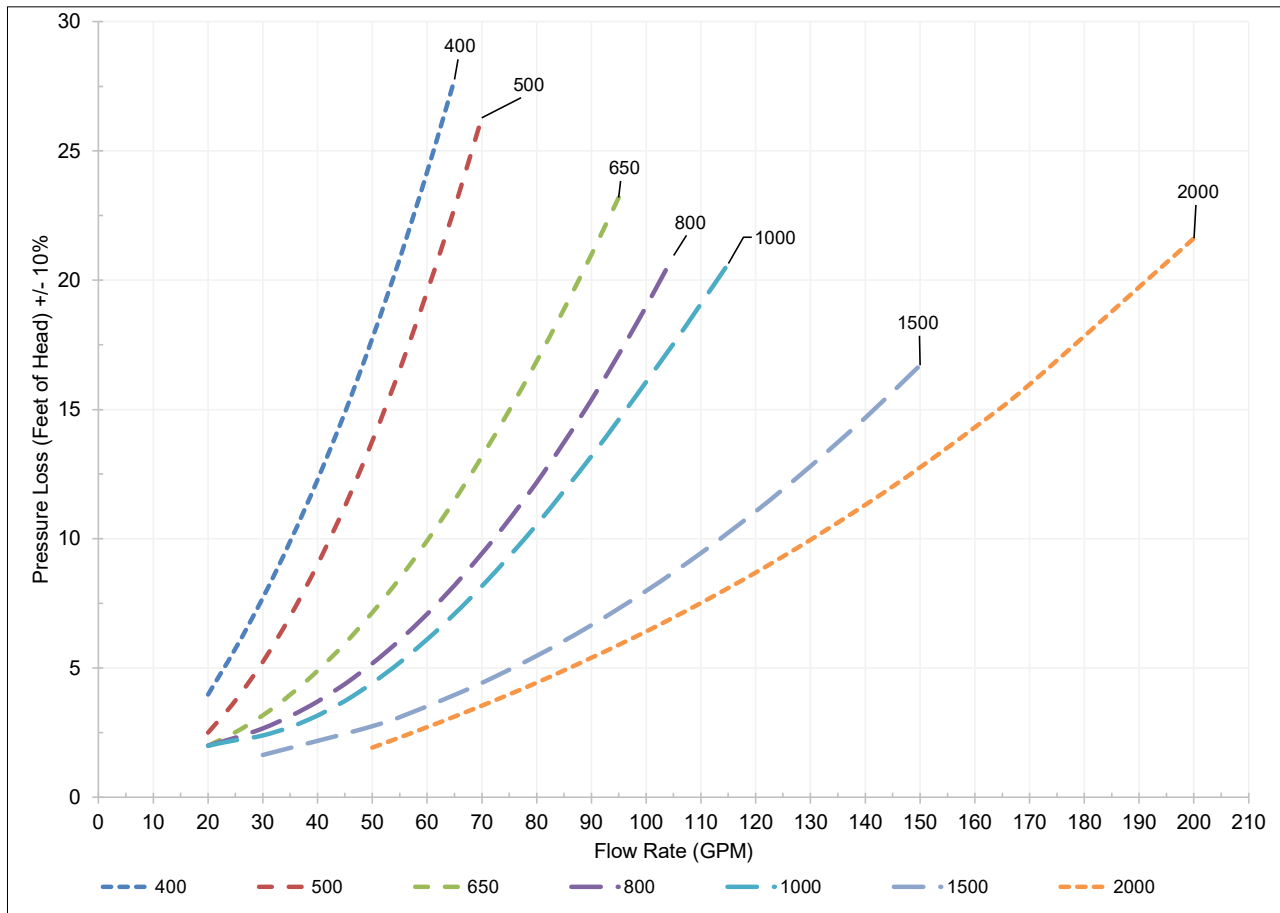


Figure 11 - Pressure Drop through the VWH

The chart below represents the combined flow rates and pipe sizes when using multiple VWHs to design the manifold system for the primary circuit. To size, simply add up the number of VWHs and the required flow rates for the system design temperature.

Example: (5) 1000 VWHs with a design of 30°F temperature rise with each VWH having an individual flow rate of 64 GPM. To correctly size the manifold feeding these VWHs, you would need a pipe size of 6".

Model	Number of Units and Recommended Common Header Pipe Sizes in Inches						
	2	3	4	5	6	7	8
400	3	3	4	4	5	5	5
500	3	4	4	5	5	5	6
650	4	4	5	5	6	6	6
800	4	5	5	6	6	8	8
1000	4	5	6	6	8	8	8
1500	5	6	8	8	8	10	10
2000	6	6	8	8	10	10	12

Table 12 - Multiple VWH Manifold Piping - NOTE: Table based on water velocity less than Five (5) feet per second.

H. Check / Control Water Chemistry

CAUTION

Chemical imbalance of the water supply may affect efficiency and cause severe damage to the appliance and associated equipment. Water quality must be professionally analyzed to determine whether it is necessary to treat the water. Various solutions are available to adjust water quality. Adverse water quality will affect the reliability of the system. In addition, operating temperatures above 135°F will accelerate the build-up of lime scale and possibly shorten appliance service life. Failure of an appliance due to lime scale build-up, low pH, or other chemical imbalance IS NOT covered by the warranty.

The water must be potable, free of corrosive chemicals, sand, dirt, and other contaminants. It is up to the installer to ensure the water does not contain corrosive chemicals or elements that can damage the heat exchanger. Potable water is defined as drinkable water supplied from utility or well water in compliance with EPA secondary maximum contaminant levels (40 CFR Part 143.3) as shown in the table below. If the water contains contaminants higher than outlined by the EPA, water treatment is recommended and additional, more frequent maintenance may be required.

If you suspect that your water is contaminated in any way, discontinue use of the appliance and contact an authorized technician or licensed professional.

Contaminant	Maximum Allowable Level	Contaminant	Maximum Allowable Level
Total Hardness (Commercial Use - 140°F and above water temperature)	120 mg/l (7 grains/gallon)	pH	6.5-8.5
		Sulfate	205 mg/l
		Total Dissolved Solids (TDS)	500 mg/l
Aluminum	0.05 to 0.2 mg/l	Zinc	5 mg/l
Chloride	100 mg/l		
Copper	1 mg/l	Dissolved Carbon Dioxide (CO ₂)	15 mg/l or PPM
Iron	0.3 mg/l		
Manganese	0.05 mg/l		

***NOTE:** It is recommended to clean heat exchanger at least once a year to prevent lime scale buildup. Follow the maintenance procedure in the Maintenance Section of this manual to clean the heat exchanger.

I. Piping the VWH

Piping Components

System Piping

System piping MUST meet the technical pipe requirements listed in Table 13. Reducing pipe size can restrict flow rate through the VWH, causing inadvertent short cycling and poor system performance.

Minimum Water Pipe Size	
Model	Size
400 - 1000	2" NPT
1500 - 2000	2 1/2" Flange

Table 13 - Minimum Pipe Size

Check Valves

Field supplied. Check valves are recommended for installation as shown in Applications.

Isolation Valves

Field supplied. Full port ball valves are required. Failure to use full port ball valves could result in a restricted flow rate through the VWH.

Anti-Scald Mixing Valve

Field supplied. An anti-scald mixing valve is recommended when storing domestic hot water above 115°F.

Steel Flanges

Field supplied. Recommended for unit serviceability.

Temperature and Pressure Relief Valve

Factory supplied on VWH. The T&P relief valve is sized to ASME specifications. Storage tank may require additional relief valves depending on local codes.

The VWH is designed to function in an open loop hot water supply system. We have included a temperature and pressure gauge that allows the user to monitor the system pressure and outlet temperature from the VWH. It is important to note that the VWH has a minimal amount of pressure drop and must be calculated when sizing the circulators.

Install the VWH so the gas ignition system components are protected from water (dripping, spraying, etc.). Allow clearance for basic service of VWH circulator, valves and other components.

Observe the minimum 1" clearance around all uninsulated hot water pipes when openings around pipes are not protected by non-combustible materials.

Basic steps are listed below, with illustration that will guide you through the installation of the VWH.

1. Connect the system return marked "Boiler Return".
2. Connect the system supply marked "Boiler Supply".
3. Install a circulator as shown in Applications (this manual). Make sure the circulator is properly sized for the system and friction loss.
4. Install an expansion tank on the system supply. Consult the expansion tank manufacturer's instruction manual (see Part 4, Section D for water volume) for specific information relating to expansion tank installation. Size the expansion tank for the required system volume and capacity.
5. Install a drain valve at the lowest point of the system. Note: The VWH cannot be drained completely of water without purging the unit with an air pressure of 15 PSI.
6. The temperature and pressure relief valve and temperature and pressure gauge are installed on the VWH. A discharge line should be installed 6" above the drain in the event of a pressure relief. The pipe size must be the same size as the relief valve outlet. **NEVER BLOCK THE OUTLET OF THE SAFETY RELIEF VALVE.**

J. Applications

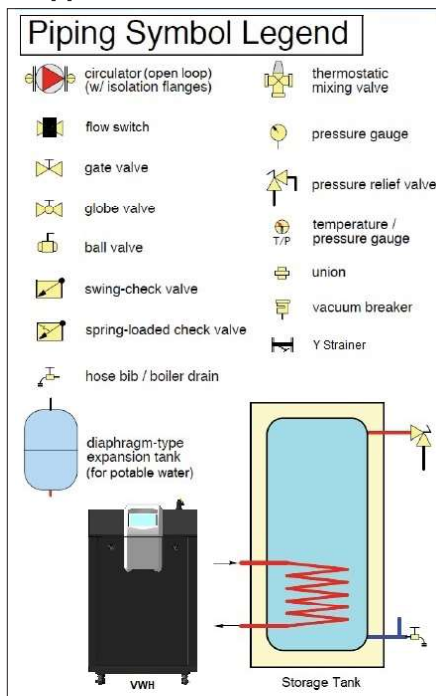


Figure 12 - Piping Legend

FIGURE NOTES:

1. This drawing is meant to show system piping concept only. Installer is responsible for all equipment & detailing required by local codes.
2. VWH circulator must be rated for open loop application. Do not use cast-iron circulators.
3. VWH circulator(s) must operate continuously if Indirect / Pipe Sensor is used. Continuous VWH circulator operation is not necessary if a Tank Sensor / Aquastat is used.
4. The minimum pipe size for connecting a storage tank is 2" for 400 - 1000 Models, 2 1/2" for 1500 - 2000 Models.
5. The minimum pipe size for connecting a VWH is 2" for 400 - 1000 Models, 2 1/2" for 1500 - 2000 Models. When sizing and installing a multiple VWH system, see Multiple VWH Manifold Piping Chart, this manual.
6. All pumps are shown with isolation flanges or full port ball valves for isolation. The alternative is standard flanges with full port ball valves and a separate flow check valve.
7. Install a minimum of 12 diameters of straight pipe upstream of all circulators and check valves.
8. Install vacuum relief valve in accordance with local code requirements.
9. Multiple VWHs and storage tanks shall be installed with reverse return piping (as shown).
10. Expansion tank must be rated for use with potable water.
11. Use either indirect/tank sensor or indirect/pipe sensor mounted on common return to the VWH.
12. Wire the tank or indirect/pipe sensor to the DHW sensor terminals input on the follower VWH addressed as #1.
13. Wire the tank or indirect/pipe sensor connected to the DHW sensor terminals on the follower VWH addressed as #1.

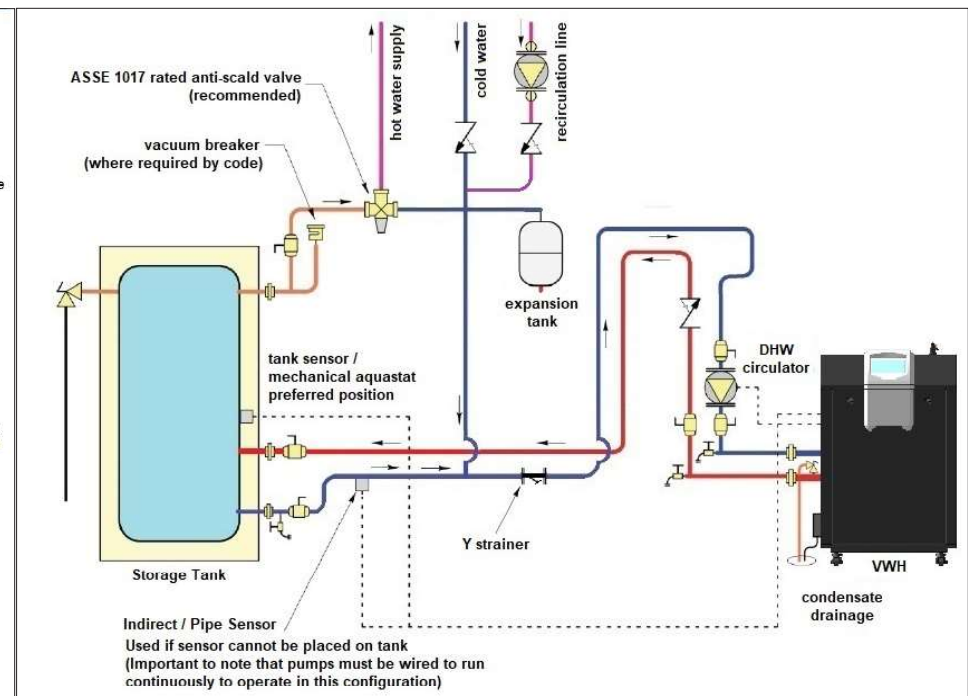


Figure 13 - VWH with Storage Tank

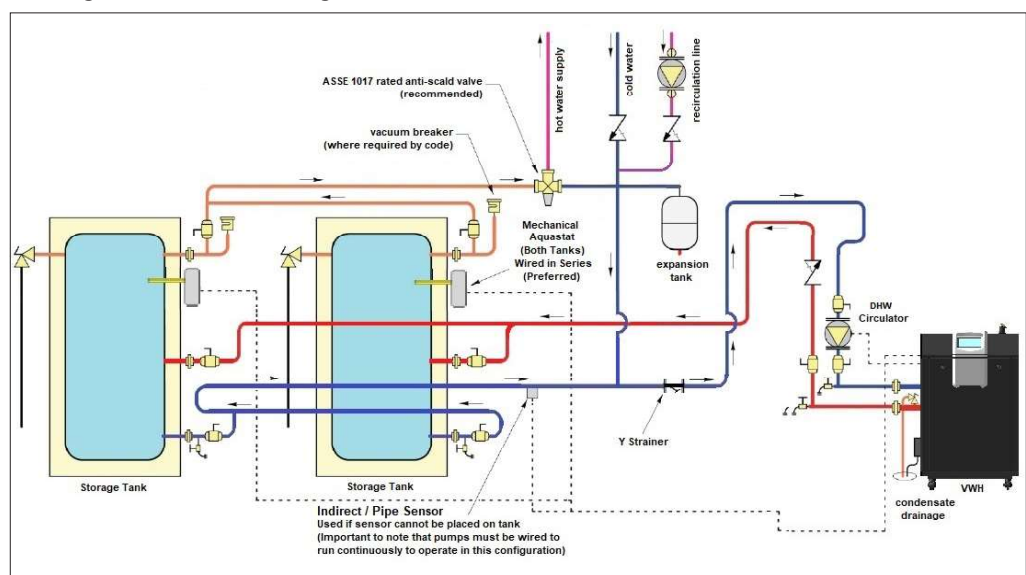


Figure 14 - VWH with Two Storage Tanks

WARNING

An ASSE 1017 thermostatic mixing valve is recommended on all tanks if the hot water temperature leaving the tank is above 119°F. Failure to do so could result in substantial property damage, serious injury, or death.

The piping will not support the weight of the circulators. Refer to the circulator manufacturer's instructions to properly support the circulator. Failure to comply with these instructions could result in property damage, severe personal injury, or death.

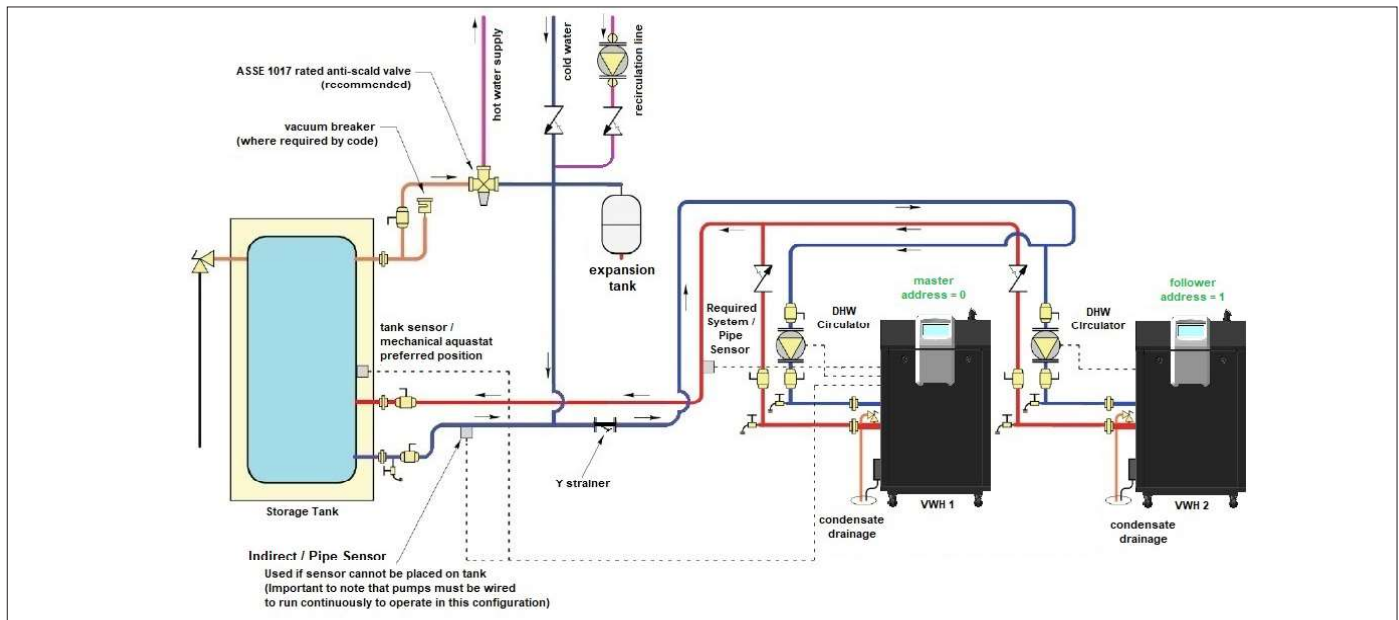


Figure 15 - Two VWHs with Storage Tank

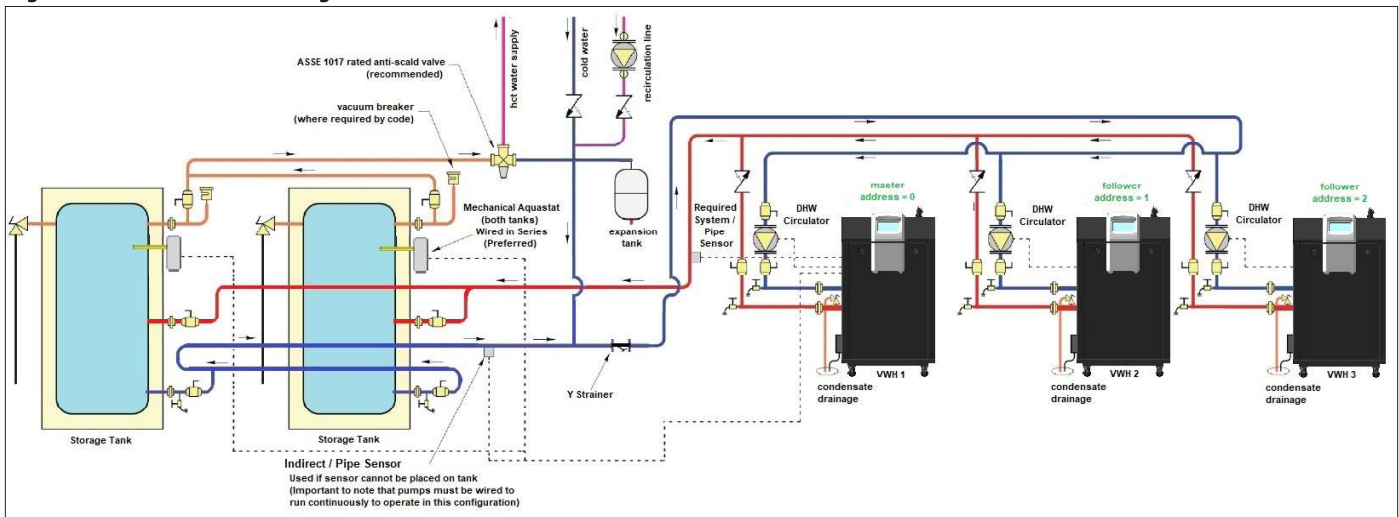


Figure 16 - Three VWHs with Two Storage Tanks

FIGURE NOTES:

1. This drawing is meant to show system piping concept only. Installer is responsible for all equipment & detailing required by local codes.
2. VWH circulator must be rated for open loop application. Do not use cast-iron circulators.
3. VWH circulator(s) must operate continuously if an Indirect / Pipe Sensor is used. Continuous VWH circulator operation is not necessary if a Tank Sensor / Aquastat is used.
4. The minimum pipe size for connecting a storage tank is 2" for 400 - 1000 Models, 2 1/2" for 1500 - 2000 Models.
5. The minimum pipe size for connecting a VWH is 2" for 400 - 1000 Models, 2 1/2" for 1500 - 2000 Models. When sizing and installing a multiple VWH system, see Multiple VWH Manifold Piping Chart, this manual.
6. All pumps are shown with isolation flanges or full port ball valves for isolation. The alternative is standard flanges with full port ball valves and a separate flow check valve.
7. Install a minimum of 12 diameters of straight pipe upstream of all circulators and check valves.
8. Install vacuum relief valve in accordance with local code requirements.
9. Multiple VWHs and storage tanks shall be installed with reverse return piping (as shown).
10. Expansion tank must be rated for use with potable water.
11. Use either indirect/tank sensor or indirect/pipe sensor mounted on common return to the VWH.
12. Wire the tank or indirect/pipe sensor to the DHW sensor terminals input on the follower VWH addressed as #1.
13. Wire the tank or indirect/pipe sensor connected to the DHW sensor terminals on the follower VWH addressed as #1.
14. The indirect/pipe sensor must be placed on common piping to the tank as close to the tank as possible.
15. The indirect/pipe sensor is wired to the system sensor terminals on the master VWH.

WARNING

An ASSE 1017 thermostatic mixing valve is recommended on all tanks if the hot water temperature leaving the tank is above 119°F. Failure to do so could result in substantial property damage, serious injury, or death.

The piping will not support the weight of the circulators. Refer to the circulator manufacturer's instructions to properly support the circulator. Failure to comply with these instructions could result in property damage, severe personal injury, or death.

Part 5 - Venting

DANGER

The VWH must be vented as detailed in this section. Ensure exhaust vent and intake piping complies with these instructions regarding vent system. Inspect finished exhaust vent and intake piping thoroughly to ensure all joints are well secured, airtight, and comply with all applicable code requirements, as well as the instructions provided in this manual. Failure to properly install the vent system will result in severe personal injury or death.

A. General

DANGER

This VWH is certified as a "Category IV" appliance and requires a special venting system. The vent system will operate with a positive pressure in the pipe. Exhaust gases must be piped directly outdoors using the vent materials and rules outlined in these instructions. Do not connect vent connectors serving appliances vented by natural draft into any portion of mechanical draft systems operating under positive pressure. Follow the venting instructions carefully. Failure to do so will result in substantial property damage, severe personal injury, or death.

Exhaust and intake are to be piped separately. This VWH cannot share a common exhaust or intake with multiple appliances. Failure to follow these instructions will result in substantial property damage, severe personal injury, or death.

1. Installation should be made in accordance with the regulations of the Authority Having Jurisdiction, local code authorities, and utility companies which pertain to this type of water heating equipment.
2. Install the venting system in accordance with these instructions and with the National Fuel Gas Code, ANSI Z223.1/NFPA 54, CAN/CGA B149, and / or applicable provisions of local building codes.
3. This VWH must be vented with materials, components, and systems listed and approved for Category IV appliances.

NOTE: To avoid contamination often contained in indoor air, it is best to pipe all intake combustion air directly to the outdoors.

NOTE: Care must be taken to prevent condensate freezing in the exhaust vent pipe system. See local, state, provincial, and national codes for best practices to prevent condensate freezing in the exhaust vent pipe system.

WARNING

Improper seating of vent pipe gaskets can cause eventual gasket failure and exhaust gas leakage. Ensure the exhaust vent pipe is properly beveled and seated before insertion into the flue adapter. Failure to do so could result in property damage, severe personal injury, or death.

Exhaust vent adaptors are not designed as load-bearing devices, and must not be used to support exhaust vent piping. All vent pipes must be properly connected, supported, and the exhaust vent must be pitched a minimum of 1/4" per foot back to the VWH to allow drainage of condensate. Failure to properly support vent piping and follow the information in this statement could result in product damage, severe personal injury, or death.

Vents must be properly supported. VWH exhaust and intake connections are not designed to carry heavy weight. Vent support brackets must be within 1' of the VWH and the balance at 4' intervals. VWH must be readily accessible for visual inspection for first 3' from the VWH. Failure to properly support vents could result in property damage, severe personal injury, or death.

WARNING

Breathing Hazard - Carbon Monoxide Gas



- Do not operate heater if flood damaged.
- Install vent system in accordance with local codes and manufacturers installation instructions.
- Do not obstruct heater air intake or exhaust. Support all vent piping per manufacturers installation instructions.
- Do not place chemical vapor emitting products near unit.
- According to NFPA 720, carbon monoxide detectors should be installed outside each sleeping area.
- Never operate the heater unless it is vented to the outdoors.
- Analyze the entire vent system to make sure that condensate will not become trapped in a section of vent pipe and therefore reduce the open cross sectional area of the vent.

Breathing carbon monoxide can cause brain damage or death. Always read and understand instruction manual.

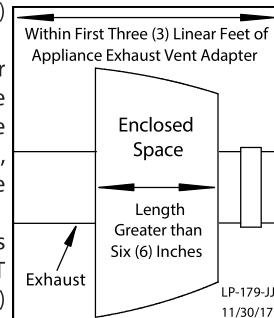
LP-304

DANGER

Due to the extreme flammability of most glues, cements, solvents, and primers used to join plastic exhaust vent and intake pipes, explosive solvent vapors must be cleared from all vent piping before start-up. Avoid using excess cement or primer, as this may pool in the vent pipes. Vent assemblies should be allowed to cure for a period of at least 8 hours before powering a connected appliance. Failure to follow these instructions will result in substantial property damage, severe personal injury, or death. It is the installers' responsibility to understand the hazards associated with explosive solvents and take the necessary precautions to avoid these risks.

WARNING

- Only Stainless Steel exhaust vent pipe material may be insulated.
- DO NOT insulate the first three (3) linear feet of the exhaust vent run.
- DO NOT insulate PVC, CPVC, or Polypropylene exhaust vent pipe material. Doing so will cause increased vent wall temperatures, which could result in vent pipe failure.
- CPVC, Polypropylene, or Stainless Steel pipe material **MUST** be used if the first three (3) linear feet of the exhaust vent run passes through an enclosed space greater than 6" in length, such as a wall or ceiling.*
- If CPVC is used to meet these requirements, the balance may be installed with approved PVC pipe.
- If Polypropylene or Stainless Steel is used to meet these requirements, the balance of the vent run **MUST** be installed with the same material.
- Failure to comply with these requirements could result in property damage, severe personal injury, or death.



*This rule applies when the exhaust vent passes through the enclosed space into another interior space, i.e. through a floor or wall from the mechanical room into another room. This rule **DOES NOT** apply when the exhaust vent passes through the enclosed space immediately to the exterior of the building.

It is required to insert exhaust and intake screens into the vent terminations to prevent blockage caused by debris or birds. Failure to keep terminations clear could result in property damage, severe personal injury, or death.

B. Approved Materials for Exhaust Vent and Intake Pipe

Item	Material	Standards for Installation In:	
		United States	Canada
Pipe and Fittings Approved for Intake ONLY	ABS*	ANSI/ASTM D2661	ANSI/ASTM D2661
Pipe Approved for Intake OR Exhaust Vent	PVC Schedule 40/80	UL-1738 or ANSI/ASTM D1785	UL-1738 or ULC-S636
	PVC-DWV Schedule 40/80	UL-1738 or ANSI/ASTM D2665	
	CPVC Schedule 40/80	UL-1738 or ANSI/ASTM F441	
	Polypropylene	UL-1738 or ULC-S636	
	Stainless Steel AL29-4C	Certified for Category IV and Direct Vent Appliance Venting	
Pipe Fittings	PVC Schedule 40	UL-1738, ANSI/ASTM D2466 or D2665	UL-1738 or ULC-S636
	PVC Schedule 80	UL-1738, ANSI/ASTM D2467 or D2665	
	CPVC Schedule 40	UL-1738 or ANSI/ASTM F438	
	CPVC Schedule 80	UL-1738 or ANSI/ASTM F439	
Pipe Cement	ABS*	ANSI/ASTM D2235	ANSI/ASTM D2235
	PVC	ANSI/ASTM D2564	ULC-S636 Approved Cements and Primers
	CPVC	ANSI/ASTM F493	
Pipe Primer	PVC / CPVC	ASTM F656	

DANGER

- The exhaust and intake components installed with this appliance must be used for near appliance piping BEFORE transitioning to the approved materials listed above. DO NOT REMOVE these installed components. Doing so WILL VOID appliance warranty.
- In the US/Canada, PVC vent pipe and fittings SHALL NOT BE USED within the closet or alcove. Only approved CPVC, Polypropylene, or Stainless Steel vent pipe and fittings may be used.
- PVC / CPVC pipe and fittings of the same diameter are considered interchangeable.
- The use of cellular core PVC (ASTM F891), cellular core CPVC, or Radel® (polyphenolsulfone) in exhaust venting systems is prohibited.
- Covering non-metallic vent pipe and fittings with thermal insulation is prohibited.
- When installing AL29-4C vent piping, DO NOT mix AL29-4C piping from different manufacturers unless using adapters specifically designed for the purpose by the manufacturer.
- DO NOT mix components from different venting systems without proper adapters. The vent system could fail, causing leakage of flue products into the living space. Use only the approved pipe and fitting materials, and primer and cement specifically designed for the material used, as listed in the above table.
- A double wall vent or insulated material may be used when using stainless steel vent material in a freezing climate.
- *ABS may be used for air intake applications ONLY.
- Contact the venting material manufacturer if there is any question about the applicability of the proposed venting material.

Failure to follow these directions will result in substantial property damage, severe personal injury, or death.

Table 14 - Approved Materials for Exhaust Vent and Intake Pipe

CAUTION
High heat sources (generating heat 100°F / 37°C or greater, such as VWH flue pipes, space heaters, etc.) may damage plastic components of the VWH as well as plastic vent pipe materials. Such damages ARE NOT covered by warranty. It is recommended to keep a minimum clearance of 8" from high heat sources. Observe heat source manufacturer instructions, as well as local, state, provincial, and national codes, laws, regulations, and ordinances when installing this VWH and related components near high heat sources.

NOTE: The use of double-wall vent or insulated material for the combustion air intake pipe is recommended in cold climates to prevent the condensation of airborne moisture in the incoming combustion air.

DANGER

You must not use "B" vent in an exhaust application. "B" vent is for intake applications ONLY. Using "B" vent in an exhaust application will result in serious injury or death.

C. Additional Requirements for Installation in Canada

- Installations must be made with a vent pipe system certified to ULC-S636.
- The first three (3) feet of vent pipe from the appliance flue outlet must be readily accessible for visual inspection.
- The components of the certified vent system must not be interchanged with other vent systems or unlisted pipe / fittings.

D. Exhaust Vent and Intake Pipe Location

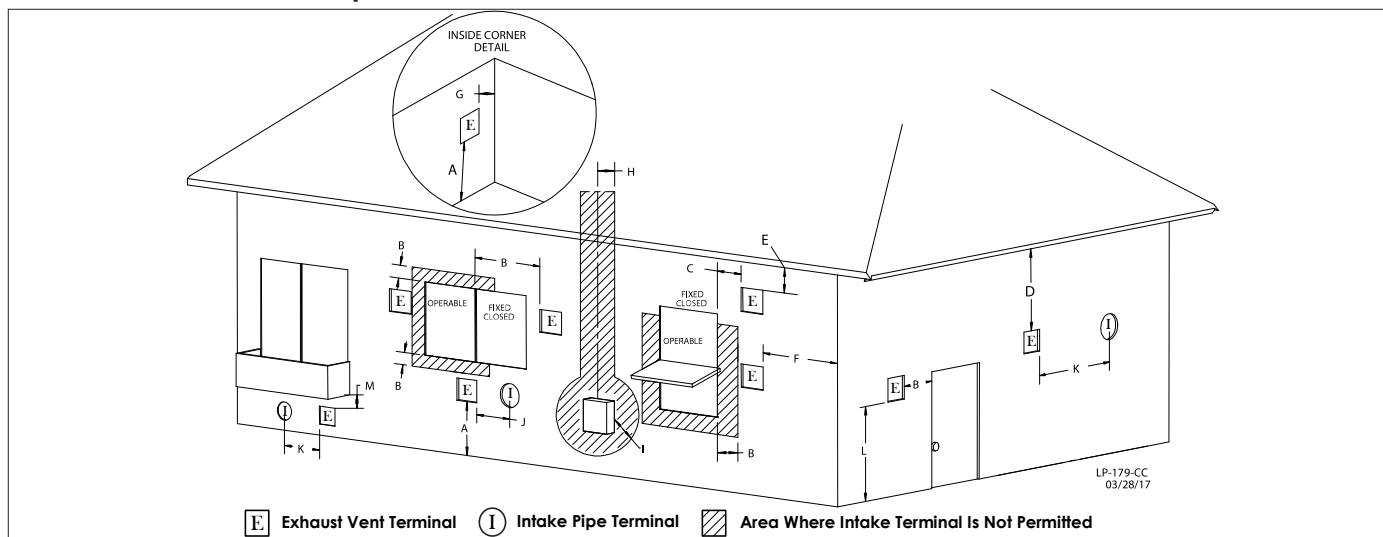


Figure 17 - Exit Terminals for Direct Vent Systems - ANSI Z223.1 / NFPA 54 for US and CAN/CSA B149.1 for Canada

	DESCRIPTION		US	CANADA
A	Clearance above grade, veranda, porch, deck, or balcony		1 foot (30 cm)	
B	Clearance to window or door that may be opened	Direct Vent	1 foot	3 feet (91 cm)
		Power Vent	4 ft below or to side of opening; 1 ft above opening	
C	Clearance to permanently closed window		*	
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance 2 feet (61 cm) from the center line of the terminal		*	
E	Clearance to unventilated soffit		*	
F	Clearance to outside corner		*	
G	Clearance to inside corner		*	
H	Clearance to each side of center line extended above meter / regulator assembly		*	
I	Clearance to service regulator vent outlet		*	Above a regulator within 3 feet (91 cm) horizontally of the vertical center line of the regulator vent outlet to a maximum vertical distance of 15 ft (4.5 m)
J	Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	Direct Vent	1 foot	3 feet (91 cm)
		Power Vent	4 ft below or to side of opening; 1 ft above opening	
K	Clearance to mechanical air supply inlet		3 feet above if within 10 feet horizontally	6 feet (1.83 m)
L	Clearance above paved sidewalk or paved driveway located on public property	Direct Vent	*	7 feet (2.13 m)
		Power Vent	7 feet (2.13 m)	
M	Clearance under veranda, porch deck, or balcony		*	1 foot (30 cm)

Table 15 - Vent Termination Clearances - *NOTE: For clearances not specified in ANSI Z223.1 / NFPA 54 for US and CAN/CSA B149.1 for Canada, please use clearances in accordance with local installation codes and the requirements of the gas supplier.

⚠ WARNING

The building owner is responsible for keeping the exhaust and intake terminations free of snow, ice, or other potential blockages, as well as scheduling routing maintenance. Failure to keep the vent piping terminations clear and properly maintain the heater could result in property damage, severe personal injury, or death.

⚠ WARNING

For each floor containing bedroom(s), a carbon monoxide detector and alarm shall be placed in the living area outside the bedrooms, as well as in the room that houses the heater. Detectors and alarms shall comply with NFPA 720 (latest edition). Failure to comply with these requirements could result in product damage, severe personal injury, or death.

E. Exhaust Vent and Intake Pipe Sizing

- The exhaust vent and intake pipe size is 4", 6", or 8", depending on model.
- The maximum total equivalent length of exhaust vent and intake pipe **should not exceed 125 feet for 400 to 1000 models, and 150 feet for 1500 and 2000 models.**
 - The equivalent length of elbows, tees, and other fittings are listed in the Friction Loss Table.

Friction Loss Equivalent in Piping and Fittings			
Fittings or Piping	Equivalent Feet		
	4"	6"	8"
90 Degree Elbow		5'	
45 Degree Elbow		3'	
Coupling		0'	
Air Inlet Tee		0'	
One Foot of Straight Pipe		1'	
V Series Vent Kit		1'	
AL29 4c Vent Terminal		1'	

Table 16 - NOTE: Consult Polypropylene venting instructions for friction loss and pressure drop equivalents.

- For example: If the exhaust vent is 6" in diameter, has two 90° elbows, and 10 feet of PVC pipe we will calculate:
Exhaust Vent Equivalent Length = $(2 \times 5) + 10 = 20$ feet.
Further, if the 6" intake pipe has two 90° elbows, one 45° elbow, and 10 feet of PVC pipe, the following calculation applies:
Intake Pipe Equivalent Length = $(2 \times 5) + 3 + 10 = 23$ feet.
The total equivalent length is 43 feet, well below the maximum of 125 feet.
 - Effort should be made to keep a minimum difference in equivalent length between the exhaust vent and intake pipe.
3. The minimum total equivalent length is **10 feet for 400 to 1000 models, and 15 feet for 1500 and 2000 models.**

! WARNING

Failure to install the appliance within the minimum and maximum vent length requirements could result in improper product operation and property damage, serious personal injury, or death.

! DANGER

Total maximum equivalent length of exhaust vent and intake pipe must not exceed the lengths defined in this manual. Failure to keep the total equivalent length below the maximum lengths determined in this manual will result in faulty VWH operation, substantial property damage, serious personal injury, or death.

F. Exhaust Vent and Intake Pipe Installation

! WARNING

All joints of positive pressure vent systems must be sealed completely to prevent leakage of flue products into the living space. Failure to do so could result in property damage, serious injury, or death.

- Use only solid PVC, CPVC, or stainless steel pipe or a Polypropylene vent system approved for use with Category IV appliances. ABS pipe material may be used on air intake piping **only**.
- Work from the VWH to exhaust vent or intake air termination. Do not exceed the lengths given in this manual for the vent or air piping.
- Cut pipe to the required lengths and deburr the inside and outside of the pipe ends. Chamfer the outside of each pipe end to ensure even cement distribution when joining.

! WARNING

In order to be compliant with Canadian exhaust flue standards, the manufacturer is now including a System 636 CPVC flue outlet on these appliances.

The exhaust flue outlet on this appliance is made of CPVC material. DO NOT remove the piece of CPVC flue piping that is factory installed on this appliance.

To connect the exhaust flue to the appliance you must follow these guidelines concerning the correct cleaner and adhesive for the installation.

If you plan to use PVC flue material, you must use a universal cleaner and adhesive suitable for use on both CPVC and PVC. If you plan to use CPVC flue material you must use a cleaner and adhesive suitable for CPVC. If the installation of this appliance is taking place in Canada, you must use cleaner and adhesive suitable for use on System 636 piping in addition to the criteria above.

Failure to follow these guidelines could result in appliance exhaust leakage which could cause personal injury or death.

- When using PVC or CPVC pipe, all joints must be properly cleaned, primed, and cemented. Use only cement and primer approved for use with the pipe material. Cement must conform to ASTM D2564 for PVC and ASTM F493 for CPVC pipe.

NOTE: The use of colored primer is recommended.

NOTE: DO NOT CEMENT POLYPROPYLENE PIPE.

Follow manufacturer's instructions for proper installation.

NOTE: Clean and dry the VWH adapters.

DO NOT use primer or cement on the VWH adapters.

- Clean all pipe ends and fittings using a clean dry rag. (Moisture will retard curing and dirt or grease will prevent adhesion.)
- Dry fit piping to ensure proper fit up before assembling any joint. The pipe should go a third to two-thirds into the fitting to ensure proper sealing after cement is applied.
- Priming and Cementing:
 - Handle fittings and pipes carefully to prevent contamination of surfaces.
 - Apply a liberal even coat of primer to the fitting socket and to the pipe end to approximately 1/2" beyond the socket depth.

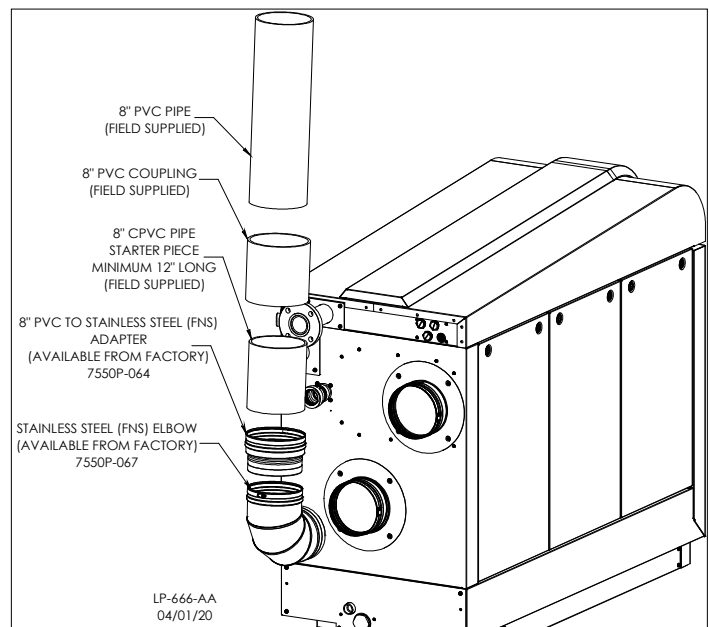


Figure 18 - 1500 and 2000 Models - Near VWH PVC/CPVC Venting (Flue Connections from the Factory are sized for Stainless Steel Venting)

- iii. Apply a second primer coat to the fitting socket.
 - iv. While primer is still wet, apply an even coat of approved cement to the pipe equal to the depth of the fitting socket along with an even coat of approved cement to the fitting socket.
 - v. Apply a second coat of cement to the pipe.
 - vi. While the cement is still wet, insert the pipe into the fitting, if possible twist the pipe a 1/4 turn as you insert it. **NOTE:** If voids are present, sufficient cement was not applied and joint could be defective.
 - vii. Wipe excess cement from the joint removing ring or beads as it will needlessly soften the pipe.
5. Ensure the vent is located where it will not be exposed to prevailing winds.
 6. In all roof venting applications, exhaust discharge must point away from the pitch of the roof.
 7. If the exhaust vent is to be terminated in a walled off area (such as a roof with a parapet wall), ensure the exhaust vent terminates a minimum of 10' from nearest wall and extends level with or above the top of the wall. This will ensure flue gas does not get trapped and possibly recirculated into the intake air pipe, which could contaminate the combustion air.
 8. If it can be avoided do not locate vent directly over public walkways, driveways, or parking lots in climates where freezing conditions are possible. Condensate could drip and freeze, resulting in a slip hazard or damage to vehicles or machinery.
 9. Due to potential moisture build-up, sidewall venting may not be the preferred venting option. To save time and cost, carefully consider venting installation and location.
 10. Horizontal lengths of exhaust vent must slope back towards the appliance not less than 1/4" per foot to allow condensate to drain from the vent pipe.
 11. Do not terminate vent where vapors can accumulate and harm people or pets.
 12. When it can be avoided, do not terminate vent where vapors can damage shrubs or plants. Such damages are not covered by product warranty.
 13. Moisture in the exhaust gas will condense as it leaves the vent terminal. In cold weather this condensate can freeze on the exterior wall, under the eaves, and on surrounding objects, including shrubs. Some discoloration to the exterior of the building is to be expected. However, improper location or installation can result in severe damage to the structure or exterior finish of the building, and increase the opportunity for vent blockages and nuisance shutdowns.
 14. In vacant chimney applications, install and seal a rain cap over existing chimney openings.
 15. All piping must be fully supported. Use pipe hangers at a minimum of 4 foot intervals to prevent sagging of the pipe where condensate may form.
 16. Do not use the heater to support any piping.
 17. A screened straight coupling is provided with the heater for use as an outside exhaust termination.
 18. A screened inlet air tee is provided with the heater to be used as an outside intake termination.
 19. Maximum Snow Level Determination: These installation instructions reference snow levels in establishing a minimum height for the installation of exhaust vent or air intake terminations. Snow levels shall be determined as follows:
 20. The installation location may, by ordinance, designate how snow levels are calculated in that location; or
 21. In the absence of specific ordinances, snow levels shall be calculated from the average monthly maximum depth of snow accumulation as indicated by the National Weather Service's 10 year statistics for the installation location/geographical area.

In addition:

- Total length of vent piping shall not exceed the limits specified in this manual.
- The vent piping for this direct vented appliance is approved for zero clearance to combustible construction.
- The flue products coming from the exhaust vent will create a large plume when the heater is in operation. Avoid venting in areas that will affect neighboring buildings or be considered objectionable.
- DO NOT locate exhaust vent or intake pipe in a parking area where machinery may damage the pipe.
- DO NOT vent near soffit vents, crawl space vents, or other areas where condensate or vapor could create a nuisance or hazard or cause property damage.
- DO NOT vent where condensate vapor could cause damage or could be detrimental to the operation of regulators, relief valve, or other equipment.

In the Commonwealth of Massachusetts and as Required by State and Local Codes:

The vented gas fueled appliance shall not be installed so its combustion, ventilation, or dilution air is obtained from a bedroom or bathroom.

Signage: Whenever any through-the-wall (horizontal or sidewall) vent is installed less than seven feet above the finished grade, a metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight feet above grade directly in line with the exhaust vent terminal. The sign shall read, in print no less than 0.5 inches in size, "GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS".

Marking of Exhaust Vent and Intake Pipe: Piping used for ventilation, make-up, or combustion air intake shall be labeled as follows:

- a. Throughout the entire developed length:
 - i. Labels must be placed every ten feet for exposed/visible piping; or
 - ii. Labels must be placed every three feet for concealed piping.
- b. At all changes of direction;
- c. On each side of a penetration through a partition, wall or ceiling; and
- d. The labels shall be black lettering that:
 - i. Indicates that the piping is used for ventilation, make-up, or combustion air intake, and
 - ii. The letters shall be sized equal to a minimum of the pipe diameter. However, for piping with a diameter exceeding two inches, said lettering does not need to be larger than two inches.

G. Applications

1. Direct Vent Installation of Exhaust and Intake

If installing a direct vent option, combustion air must be drawn from the outdoors directly into the VWH intake, and exhaust must terminate outside. There are three basic direct vent options detailed in this manual: 1. Side Wall Venting, 2. Roof Venting, and 3. Unbalanced Venting.

Be sure to locate the VWH such that the exhaust vent and intake pipe can be routed through the building and properly terminated. Different vent terminals can be used to simplify and eliminate multiple penetrations in the building structure (see Optional Equipment in Venting Section). The exhaust vent and intake pipe lengths, routing and termination methods must all comply with the methods and limits given in the Venting section of this manual.

When installing a combustion air intake from outdoors, care must be taken to utilize uncontaminated combustion air. **NOTE:** To prevent combustion air contamination, see Table 6.

Sidewall Venting Options - Direct Vent Installation

Sidewall Venting with Kit

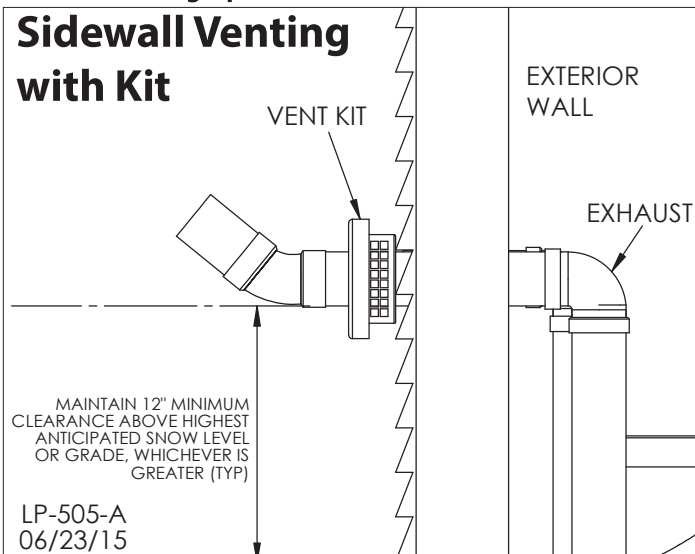
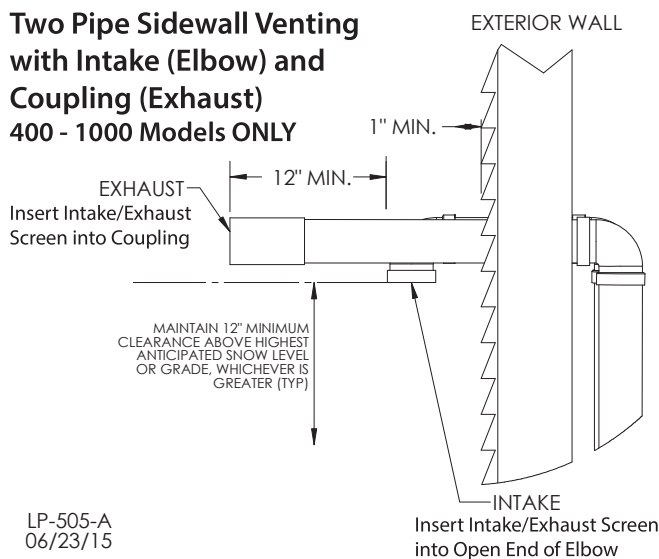


Figure 20 - Sidewall Venting with Tee and Coupling and Optional Kit

Two Pipe Sidewall Venting with Intake (Elbow) and Coupling (Exhaust) 400 - 1000 Models ONLY



Two Pipe Sidewall Venting with Couplings (Intake and Exhaust) 1500 - 2000 Models ONLY!

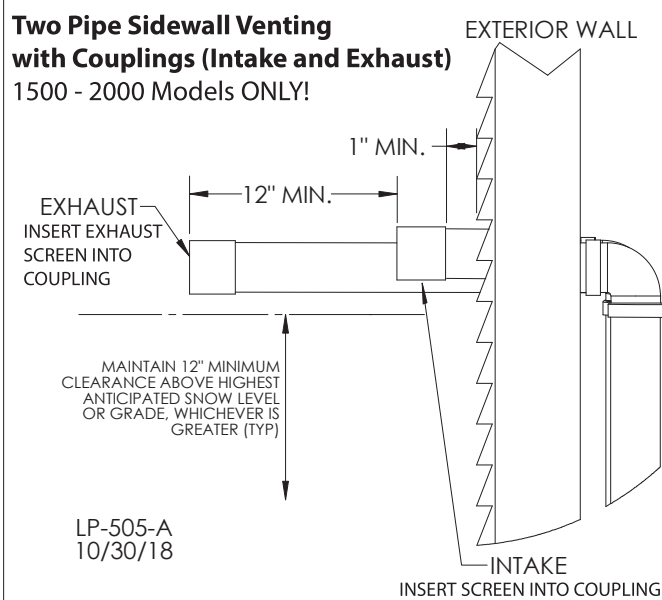


Figure 19 - Sidewall Venting with Elbow and Coupling (400 - 1000 Models) and Couplings Only (1500 - 2000 Models ONLY)

NOTE: These drawings are meant to demonstrate system venting only. The installer is responsible for all equipment and detailing required by local codes.

Ensure the terminations are screened to prevent blockage caused by debris or birds.



WARNING

All vent pipes must be glued, properly supported, and the exhaust pitched a minimum of 1/4" per foot back to the boiler to allow drainage of condensate. When placing support brackets on vent piping, the first bracket must be within 1 foot of the boiler and the balance of 4 foot intervals on the vent pipe. Venting must be readily accessible for visual inspection from the first three feet from the boiler.

Take extra precaution to adequately support the weight of vent pipes terminating through the roof. Failure to properly support roof terminated vent piping could result in property damage, serious personal injury, or death due to flue gas leakage.

An unbalanced vent system can be installed **ONLY** when the exhaust is in the vertical position. Failure to do so could result in serious personal injury or death.

Snorkel Venting (Two Pipe Sidewall Venting Terminations Beneath an Overhang)

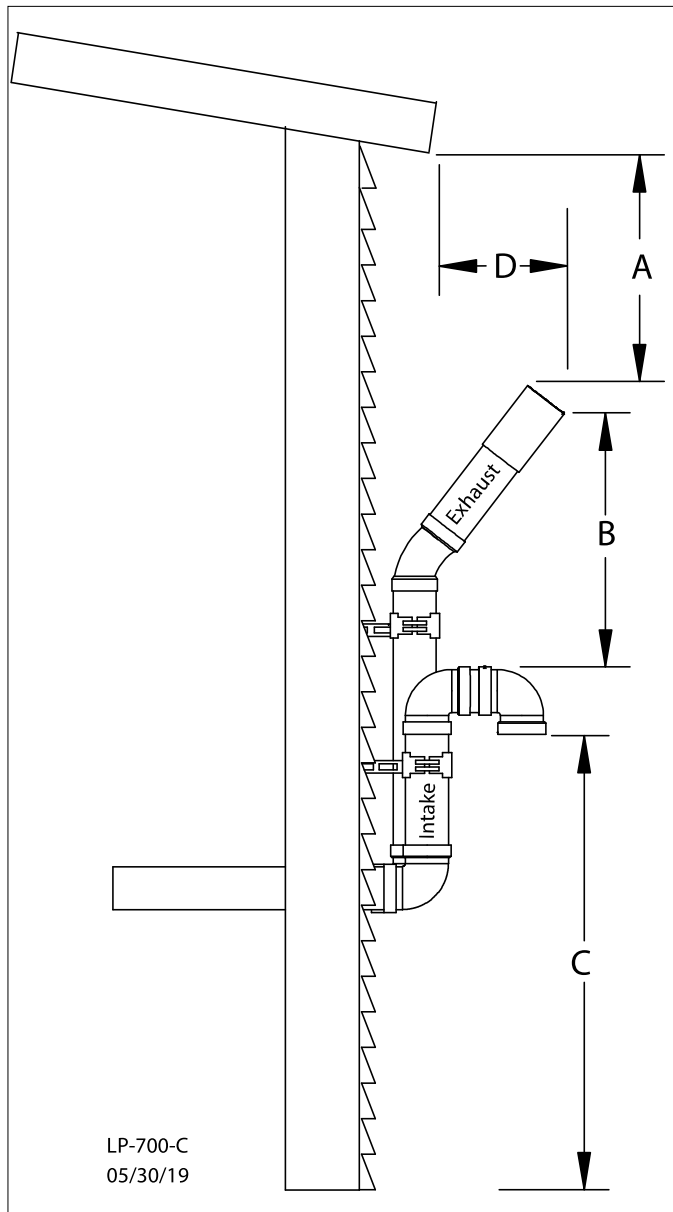


Figure 21 - Two Pipe Sidewall (Horizontal Snorkel) Venting

NOTES:

- For every 1" of overhang, the exhaust vent must be located 1" vertical below the overhang (12" minimum). Overhang means top of building structure (roof) and not two adjacent walls (corner of building).
- Maintain minimum separation between exhaust vent and air intake sidewall terminations, as required by local codes.
- Maintain 12" minimum clearance above highest anticipated snow level or grade (whichever is greater).
- The exhaust vent must extend a minimum of 12" to a maximum of 24" beyond the building.

NOTE: These drawings are meant to demonstrate system venting only. The installer is responsible for all equipment and detailing required by local codes.

Venting Below Grade

For installations that exit the wall below grade:

- Excavate the site to a point where the pipes are to exit as shown in Figure 22.
- Ensure the wall is fully sealed where the pipes penetrate.
- The exhaust vent / air intake piping **MUST** be secured to the side of the building above grade, as shown, to provide rigidity.
- Ensure that the exhaust vent / air intake clearances are maintained.

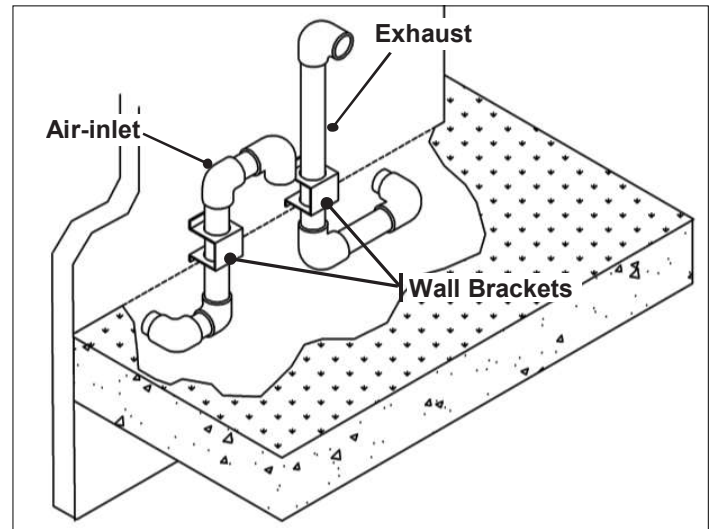


Figure 22 - Venting Below Grade

Outdoor Venting

Vent piping outside the building is permitted under the following conditions:

- The maximum length outside the building is 20 feet (6.1 m). Note that outdoor length must be included in the overall vent length calculation.
- All normal termination clearances are maintained.
- The pipe is supported every 24" (610 mm).
- The exhaust and air intake are sloped back to the appliance 1/2" elevation for every linear foot (13 mm for every linear 305 mm).

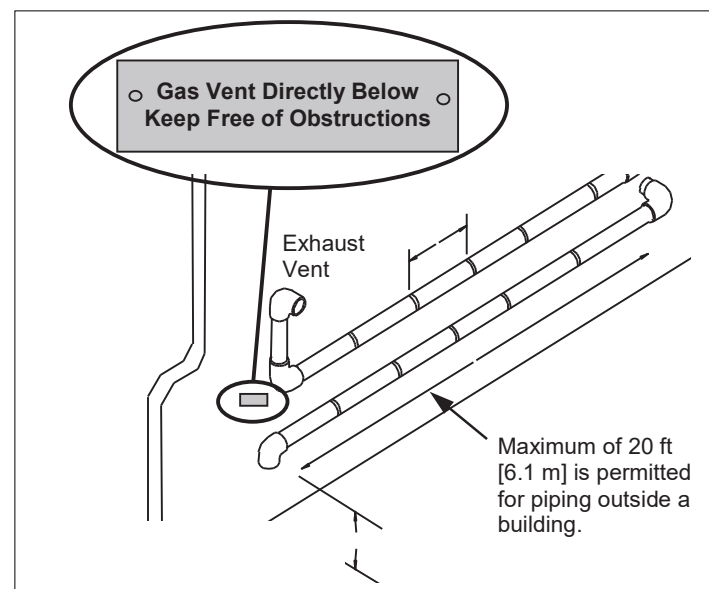


Figure 23 - Outdoor Venting

Roof Venting Options - Direct Vent Installation

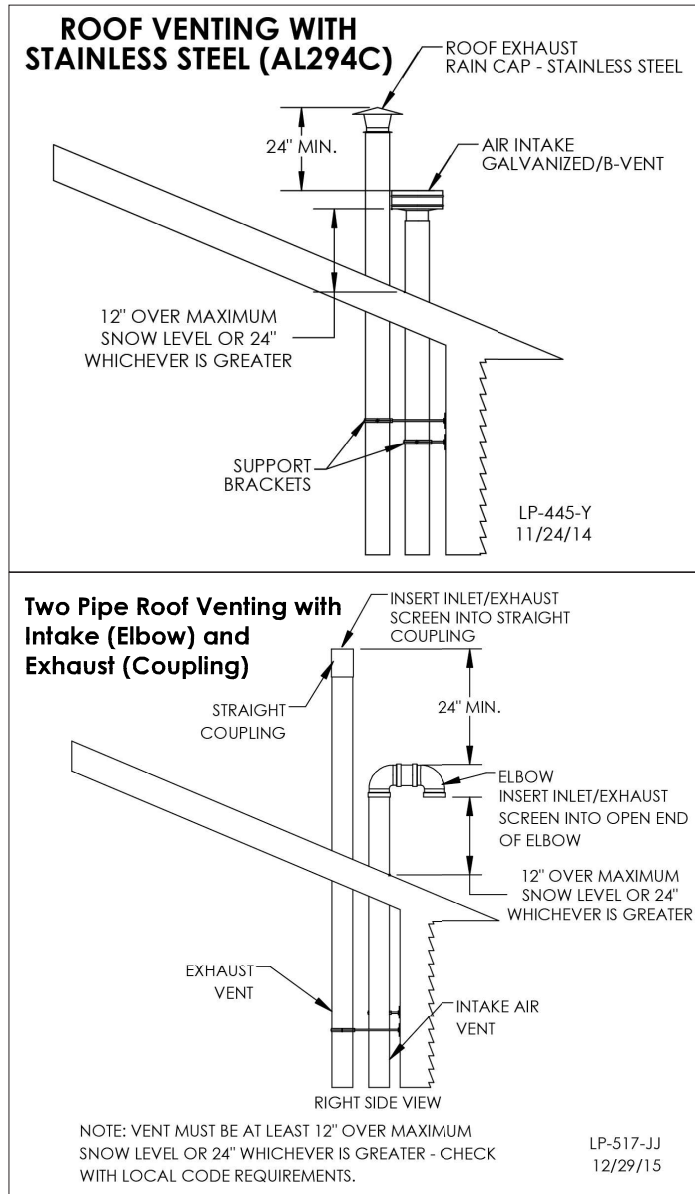


Figure 25 - Roof Venting with Stainless Steel and Tee and Coupling

Unbalanced Venting - Roof Exhaust Termination

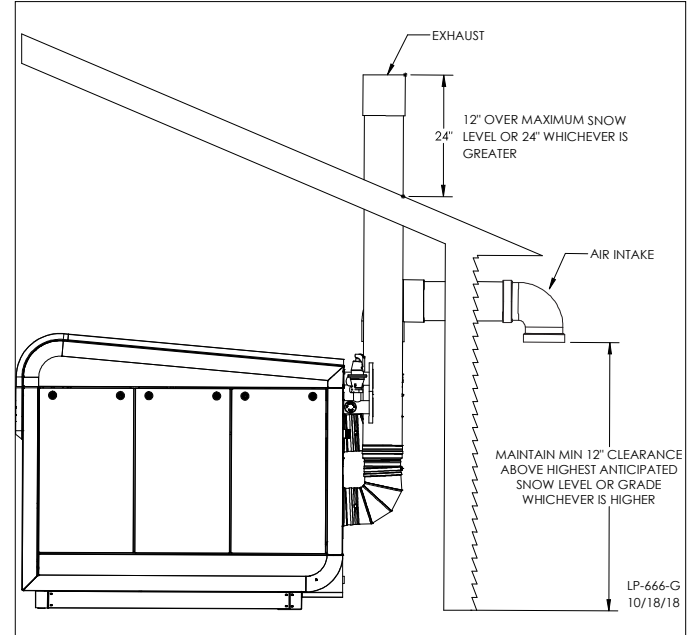


Figure 24 - Unbalanced Venting - Roof Exhaust and Sidewall Intake

NOTE: These drawings are meant to demonstrate system venting only. The installer is responsible for all equipment and detailing required by local codes.

Ensure the terminations are screened to prevent blockage caused by debris or birds.

WARNING

All vent pipes must be glued, properly supported, and the exhaust pitched a minimum of 1/4" per foot back to the boiler to allow drainage of condensate. When placing support brackets on vent piping, the first bracket must be within 1 foot of the boiler and the balance of 4 foot intervals on the vent pipe. Venting must be readily accessible for visual inspection from the first three feet from the boiler.

Take extra precaution to adequately support the weight of vent pipes terminating through the roof. Failure to properly support roof terminated vent piping could result in property damage, serious personal injury, or death due to flue gas leakage.

An unbalanced vent system can be installed **ONLY** when the exhaust is in the vertical position. Failure to do so could result in serious personal injury or death.

2. Power Venting, Room and Indoor Combustion Ventilation Requirements

When using an indoor combustion air installation, the mechanical room **MUST** be provided with properly sized openings, and/or be of sufficient volume to assure adequate combustion air and proper ventilation for all gas fired appliances in the mechanical room to assure adequate combustion air and proper ventilation. The requirements shown here are for the VWH only. Additional gas fired appliances in the mechanical room will require an increase in the net free area and/or volume to supply adequate combustion air for all appliances. This must be done in accordance with the National Fuel Gas Code, NFPA 54 / ANSI Z223.1.

This VWH can be vented using mechanical room air only for combustion. No combustion air openings are needed when the VWH is installed in a space with a volume NO LESS than 50 cubic feet per 1,000 BTU/hr of all installed gas fired appliances and the building **MUST NOT** be of "Tight Construction".

TIGHT CONSTRUCTION: A building with less than .4 ACH (air changes per hour). For buildings of "Tight Construction", provide air openings into the building from the outside.

Indoor and outdoor combustion air may be combined by applying a ratio of available volume to required volume times the required outdoor air opening(s) size(s). This must be done in accordance with the National Fuel Gas Code, NFPA 54 / ANSI Z223.1.

1. If air is taken directly from outside the building with no duct, provide two permanent openings to the mechanical room each with a net free area of one square inch per 4000 BTU/hr input. See Figure 26.

2. If combustion and ventilation air is taken from the outdoors using a duct to deliver the air to the mechanical room, each of the two openings should be sized based on a minimum free area of one square inch per 2000 BTU/hr input. See Figure 27.

3. If air is taken from another interior space combined with the mechanical room:

- Two spaces on same story: Each of the two openings specified should have a net free area of one square inch for each 1000 BTU/hr input, but not less than 100 square inches.
- Two spaces on different stories: One or more openings should have a net free area of two square inches per 1000 BTU/hr.

See Figure 28 for reference.

4. If a single combustion air opening is provided to bring combustion air in directly from the outdoors, the opening must be sized based on a minimum free area of one square inch per 3000 BTU/hr. This opening must be located within 12" of the top of the enclosure. See Figure 29.

Combustion air requirements are based on the latest edition of the National Fuel Gas Code, NFPA 54 / ANSI Z223.1, CGA Standard CAN/CSA B149.1 in Canada. Check all local code requirements for combustion air.

All dimensions based on net free area in square inches. Metal louvers or screens reduce the free area of a combustion air opening a minimum of approximately 25%. Check with louver manufacturers for exact net free area of louvers.

Where two openings are provided, one must be within 12" of the ceiling, and one must be within 12" of the floor of the mechanical room. Each opening must have a net free area as specified in Table 17. Single openings shall commence within 12" of the ceiling. The minimum dimension of air openings should not be less than 3".

Combustion air supply must be completely free of any flammable vapors that may ignite, or chemical fumes which may be corrosive to the VWH. See Table 6 for a list of combustion air contaminants. These chemicals, when burned, form acids which quickly attack the stainless steel heat exchanger, headers, flue connectors, and the vent system. The result is improper combustion and premature VWH failure. Such failure IS NOT covered under warranty.

EXHAUST FANS: Any fan or appliance which exhausts air from the mechanical room may deplete the combustion air supply and/or cause a downdraft in the venting system. Spillage of flue products from the venting system into an occupied living space can cause a very hazardous condition that must be corrected immediately.

Minimum Recommended Combustion Air Supply to Mechanical Room				
Model	Figure 26		Figure 27	
	*Outside Air from 2 Openings Directly from Outdoors ¹		*Outside Air from 2 Ducts Delivered from Outdoors ¹	
	Top Opening, in ²	Bottom Opening, in ²	Top Opening, in ²	Bottom Opening, in ²
400	100	100	200	200
500	125	125	250	250
650	163	163	325	325
800	200	200	400	400
1000	250	250	500	500
1500	375	375	750	750
2000	500	500	1000	1000
Model	Figure 28			Figure 29
	Inside Air from 2 Ducts Delivered from Interior Space ²			*Outside Air from 1 Opening Directly from Outdoors, in ² ¹
	Same Story		Different Stories	
	Top Opening, in ²	Bottom Opening, in ²	Top Opening, in ²	
400	400	400	800	134
500	500	500	1000	168
650	650	650	1300	217
800	800	800	1600	267
1000	1000	1000	2000	335
1500	1500	1500	3000	500
2000	2000	2000	4000	667

Table 17 - Indoor Combustion Air Sizing

The above requirements are for the VWH only; additional gas fired appliances in the mechanical room will require an increase in the net free area and/or volume to supply adequate combustion air for all appliances.

No combustion air openings are needed when the VWH is installed in a space with a volume NO LESS than 50 cubic feet per 1,000 BTU/hr of all installed gas fired appliances. Buildings **MUST NOT** be of "Tight Construction".

¹Outside air openings shall communicate with the outdoors.

²Combined interior space must be 50 cubic feet per 1,000 BTU/hr input. Buildings **MUST NOT** be of "Tight Construction".



CAUTION

Under no circumstances should the mechanical room ever be under negative pressure. Particular care should be taken where exhaust fans, attic fans, clothes dryers, compressors, air handling units, etc., may take away air from the unit. Failure to follow these instructions could result in property damage or personal injury.

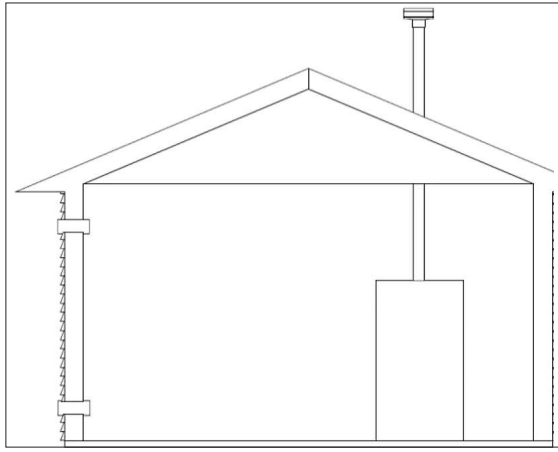


Figure 26 - Combustion Air from Outdoors

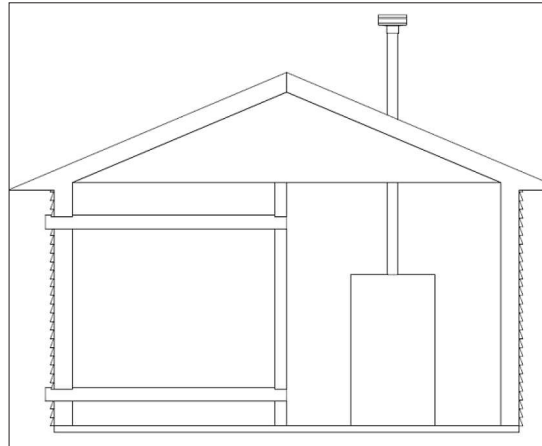


Figure 27 - Combustion Air through Ductwork

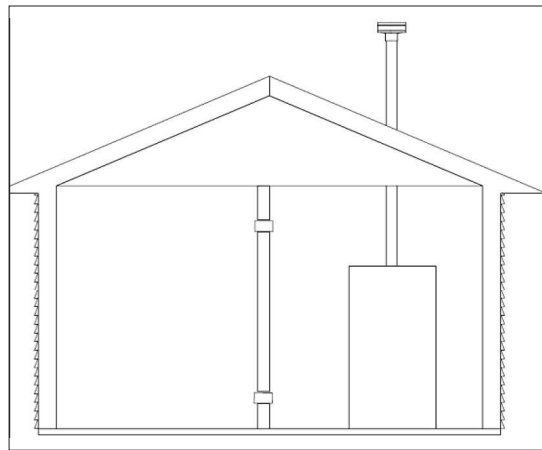


Figure 28 - Combustion Air from Indoors

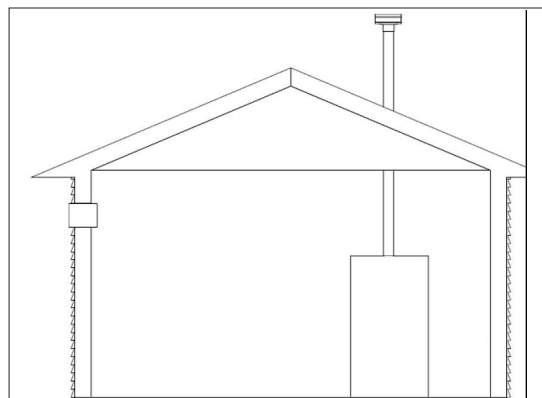



Figure 29 - Combustion Air from Outdoors - Single Opening

⚠ WARNING

Breathing Hazard - Carbon Monoxide Gas



- Do not operate heater if flood damaged.
- Install vent system in accordance with local codes and manufacturers installation instructions.
- Do not obstruct heater air intake or exhaust. Support all vent piping per manufacturers installation instructions.
- Do not place chemical vapor emitting products near unit.
- According to NFPA 720, carbon monoxide detectors should be installed outside each sleeping area.
- Never operate the heater unless it is vented to the outdoors.
- Analyze the entire vent system to make sure that condensate will not become trapped in a section of vent pipe and therefore reduce the open cross sectional area of the vent.

**Breathing carbon monoxide can cause brain damage or death.
Always read and understand instruction manual.**

LP-304

Part 6 - Condensate Removal

CAUTION

This condensing high efficiency boiler has a condensate removal system. Condensate is water vapor derived from combustion products, similar to that produced by an automobile when it is initially started. It is very important that the condensate line is sloped down away from the boiler and to a suitable drain.

The condensate line must remain unobstructed. If allowed to freeze in the line or obstructed in any other manner, condensate can exit from the boiler tee, resulting in potential water damage to property. When installing a condensate pump, select one approved for use with condensing boilers and furnaces. The condensate pump should have an overflow switch to prevent property damage from spillage. Condensate from the boiler will be slightly acidic (pH from 3.2 to 4.5). Check with your local gas company to determine if combustion condensate disposal is permitted in your area. Install a neutralizing filter if required by local codes.

It is very important that condensate piping be no smaller than 3/4". Use a tee at the condensate connection with a branch vertically up and open to the atmosphere to prevent a vacuum that could obstruct the flow of condensate from the boiler. To prevent sagging and maintain pitch, condensate piping should be supported with pipe supports.

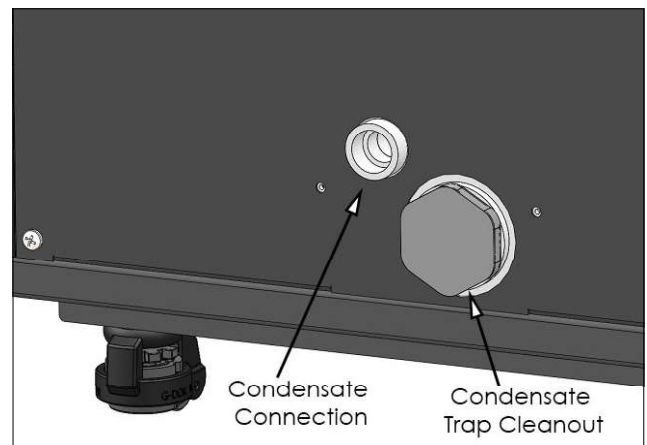


Figure 30 - Condensate Connection and Cleanout Locations

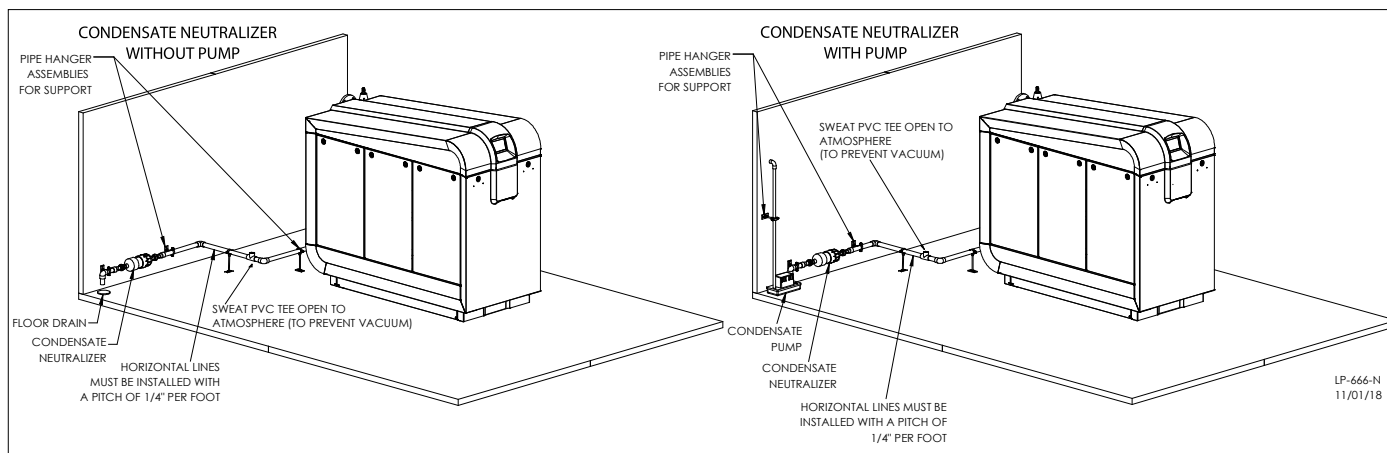


Figure 31 - Condensate Piping

NOTES:

1. Due to its efficient design, the boiler produces condensate (water) as a normal by-product. This condensate is acidic, with a pH level between 2 and 4.5. This condensate must be drained away from the boiler and disposed in accordance with all local regulations.

2. The condensate line should be as short as possible and must be pitched at least $\frac{1}{4}$ " per foot to properly drain. If this cannot be done, increase the condensate line and place a tee in the line to properly reduce vacuum lock in the drain line. Tees should be placed after the condensate neutralizer (if used).

3. Use corrosion-resistant materials to drain condensate. Use flexible plastic hose or tube, PVC, or CPVC pipe. PVC or CPVC pipe must comply with ASTM D1785, F441, or D2665. Cement must comply with ASTM D2564 for PVC pipe or F493 for CPVC pipe. For Canadian applications, use CSA or ULC certified flexible tube, PVC or CPVC pipe, fittings, and cement.

4. If using flexible tube, place an overflow tee in the tube line to prevent condensate backing up into the boiler if the tube should kink. Ensure the overflow tee is positioned near a drain or in a location that will not damage the surrounding area.

5. Do not reduce the size of the condensate line. The line must at minimum equal the diameter of the line included with the appliance.

6. A frozen condensate line could result in a blocked vent condition. It is very important to protect the condensate line from freezing temperatures or any type of blockage. In installations that may encounter sustained freezing conditions, the use of heat tape is recommended to avoid freezing of the condensate line. Longer condensate runs are more prone to freezing.

7. Support of the condensate line may be necessary to avoid blockage of the condensate flow.

8. Local building codes may require an in-line neutralizer to be installed (not included) to treat the condensate. See Figure 31. If required by local authorities, a condensate filter of lime crystals, marble, or phosphate chips will neutralize slightly acidic condensate (p/n 7350P-611 available from HTP). Follow all the installation instructions included with the neutralizer. If a neutralizer is installed, periodic replacement of the limestone (or neutralizing agent) will be required. The rate of depletion of the limestone varies with usage of the boiler. During the first year of boiler operation, check the neutralizer every few months for depletion.

9. Route the drain line to a nearby floor drain, laundry tub, or condensate pump. If the boiler condensate outlet is lower than the drain, you must use a condensate removal pump (kit p/n 554200 available from HTP).

NOTE: If a nearby laundry tub is used as a disposal for waste water from the washing machine, draining the condensate into this tub allows the soapy water discharge to neutralize the acidic condensate.

10. An error will appear on the boiler display if condensate line is blocked. The boiler will not operate with a blocked condensate line. It is extremely important to have this condition repaired by a qualified service technician.

11. Damages due to frozen or blocked condensate lines or leaks ARE NOT covered by warranty.

NOTE: To clean out condensate trap, see Maintenance section.

Part 7 - Wiring - 400 - 1500 Models

WARNING

Install wiring and electrically ground boiler in accordance with the authority having jurisdiction or, in the absence of such an authority, follow the National Electrical Code, NFPA 70, and/or CSA C22.1 Electrical Code-Part 1 in Canada. Failure to follow all applicable local, state, and national regulations, mandates, and building supply codes for guidelines to install the electrical power supply could result in property damage, serious personal injury, or death.

Jumping out control circuits or components WILL VOID product warranty and can result in property damage, personal injury, or death.

It is of extreme importance that this unit be properly grounded. It is very important that the building system ground is inspected by a qualified electrician prior to making this connection. Electrical power must only be turned on when the boiler is completely filled with cold water. Failure to follow these instructions could result in component or product failure, serious injury, or death.

ELECTRICAL SHOCK HAZARD – To ensure safety, turn off electrical power supply at service entrance panel before making any electrical connections to avoid possible electric shock hazard. Failure to do so could result in property damage, serious personal injury, or death.

CAUTION

Label all wires prior to disconnecting them when servicing the boiler. Wiring errors can cause improper and dangerous operation. Failure to follow these instructions may result in property damage or personal injury.

CAUTION

Wiring must be NEC Class 1. If original wiring supplied with the boiler must be replaced, use only TEW 105 °C wire or equivalent. Boiler must be electrically grounded as required by the National Electrical Code, ANSI/NFPA 70 - Latest Edition.

A. Installation Must Comply With

1. National Electrical Code and any other national, state, provincial, or local codes or regulations.
2. In Canada, CSA C22.1, Canadian Electrical Code Part 1, and any local codes.

B. Field Wiring

All connections made to the VWH in the field are done inside the electrical junction box located on the right side of the unit when viewed from the front. Multiple knockout locations are available to route field wires into and out of the electrical junction box.

The control used in the VWH is capable of directly controlling 2 pumps in standard mode and 3 pumps when configured as a cascade master VWH. An external contactor relay or motor starter is required.

The Field Connection Board has separate, clearly marked terminal strips for line voltage and low voltage wiring. Special jacks are provided for trouble-free cascade system wiring using standard CAT3 or CAT5 patch cables.

C. Line Voltage Wiring for Standard VWH

NOTE: A termination plug is included in the CAT 3 / CAT 5 Bus Connection Point, labeled J6 in Figure 35. DO NOT REMOVE THIS PLUG! Doing so will affect VWH operation and void warranty.

1. Connect the incoming power wiring to the line voltage terminal strip in the electrical junction box at terminals L (Line), N (Neutral), and G (Ground) (shown in Figure 33).
2. A line voltage fused disconnect switch may be required to be externally mounted and connected according to local wiring codes.

3. Connect the VWH pump relay COIL contacts as shown in Figure 33 to the terminals marked DL (DHW HOT) and DN (DHW NEUT).
4. Connect an externally provided 120VAC LINE to the COMMON terminal of the VWH pump relay.
5. Connect the NO relay contact to the LINE input of the VWH pump.
6. Connect the Neutral of the externally provided 120VAC to the NEUTRAL input of the VWH pump.
7. Connect the Earth Ground of the externally provided 120VAC to the Earth Ground input of the VWH pump.

D. Alarm Connections

The control includes a dry contact alarm output. This is an SPDT circuit, rated at 5 amps at 120 volts. This contact can be used to activate an alarm light or bell or notify a building management system if the VWH goes into a lockout condition. The circuit between the common and ALARM NC terminals is closed during normal operation and the circuit between the common and ALARM NO is open during normal operation. HTP offers an Alarm System Kit (part # 7350P-602).

E. Low Voltage Connections for Standard VWH

1. All low voltage cables should enter the electrical junction box through the provided knock out holes as shown in Figure 32.
2. Connect all low voltage field devices to the low voltage terminal strip located in the electrical junction box.

F. Tank Sensor or Mechanical Control

Connect the tank sensor or mechanical controls to the terminals marked DHW- and DHW+ in the electrical junction box (shown in Figure 35). The control will automatically determine which type of sensor is connected and operate accordingly.

NOTE: If sensor wires are located in an area with sources of potential electromagnetic interference (EMI), the sensor wires should be shielded, or the wires routed in a grounded metal conduit. If using shielded cable, the shielding should be connected to the common ground of the VWH.

WARNING

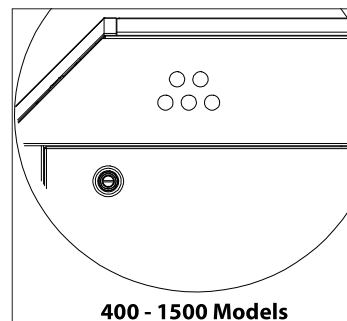
Failure to use the correct sensor may result in tank temperature being either above or below set point, and could result in decreased performance, substantial property damage, or heightened risk of injury or death due to scalds.

Caution should be used to ensure neither of these terminals becomes connected to ground.

G. Indirect/Pipe Sensor

The indirect/pipe sensor can be used to control the temperature of the storage tank when a tank sensor or mechanical control cannot be mounted. The indirect/pipe sensor would be wired into the terminals of the low voltage terminal strip as shown on Figure 35. It is important to note that when an indirect/pipe sensor is used, the circulating pump must be wired to operate continuously; otherwise the VWH will short cycle.

The indirect/pipe sensor can also be used in a cascade system when the sensor is placed on the supply line of multiple VWHs that feed the storage tank. This will control the temperature and modulate the firing rate of the connected VWHs. The indirect/pipe sensor would then be wired into the terminals marked SYS- and SYS+ on the master VWH low voltage strip as shown on Figure 35.



400 - 1500 Models
Figure 32 - Knockout Locations - 400 - 1500 Models Only

H. UL 353 Internal Low Water Cut-Off (Factory Installed)

The supplied internal Low Water Cutoff (LWCO) meets UL 353 requirements to function as a safety, locking out the VWH when water level is inadequate for safe operation. See Service Mode, this manual, for instructions on how to test and reset the Internal LWCO.

I. Wiring of Cascade System Communication Bus

1. A Cascade Bus Termination Plug has been installed on the customer connection board of this VWH. The purpose of this plug is to stabilize communication between multiple VWHs and reduce electrical "noise". See Figure 34 for Cascade Bus Termination Plug installation detail.

NOTE: It is important that the termination plug in multiple VWHs (cascaded units) be installed as depicted in Figure 34. Leave the plug installed in the J6 port on the Master VWH. Remove the plug on intermediate Follower VWHs. Move the plug to the J7 port on the final Follower VWH.

2. Use standard CAT3 or CAT5 computer network patch cables to connect the communication bus between each of the VWHs. These cables are readily available at any office supply, computer, electronic, department or discount home supply store in varying lengths. If you possess the skills you can also construct custom length cables.

NOTE: Shielded three-conductor cable may be used as an alternate method to connect cascade wiring. Connect the three wires of the shielded cable to the screw terminals labelled BUS A, BUS B, and BUS G. Observe proper polarity across all cascaded units. See Figure 35.

NOTE: All termination plugs must be installed as described in Figure 34 to ensure proper cascade operation.

3. It is recommended to use the shortest length cable that will reach between the VWHs and create a neat installation. Do not run unprotected cables across the floor where they may become wet or damaged. Avoid running communication cables parallel and close to or against high voltage (120 volt or greater) wiring. HTP recommends that the maximum length of communication bus cables not exceed 200 feet.

4. Route the communication cables through one of the knockouts in the cabinet.

5. Connect the VWHs in a daisy chain configuration. It is best to wire the VWHs using the shortest wire runs rather than trying to wire them in the order that they are addressed. The communication bus jacks on the customer connection panel are interchangeable so you can use either one or both in any order to connect the cable.

If you have connected the VWHs to each other properly, there will be no open communication connection ports.

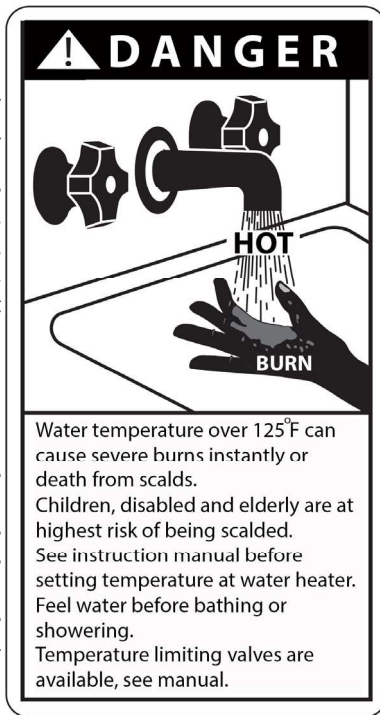
J. Cascade Master Pump and Sensor Wiring

1. Connect the VWH pump relay COIL contacts as shown in Figure 33 to the terminals marked DL (DHW HOT) and DN (DHW NEUT).

2. Connect an externally provided 120VAC LINE to the COMMON terminal of the VWH pump relay.

3. Connect the NO relay contact to the LINE input of the VWH pump.

4. Connect the Neutral of the externally provided 120VAC to the NEUTRAL input of the VWH pump.



5. Connect the Earth Ground of the externally provided 120VAC to the Earth Ground input of the VWH pump.

6. Connect the system pipe sensor to the terminals marked SYS- and SYS+.

7. Connect the tank sensor or mechanical controls to the terminals marked DHW- and DHW+. See Figure 35.

K. Cascade Follower Pump and Sensor Wiring

1. Connect the VWH pump relay COIL contacts as shown in Figure 33 to the terminals marked DL (DHW HOT) and DN (DHW NEUT).

2. Connect an externally provided 120VAC LINE to the COMMON terminal of the VWH pump relay.

3. Connect the NO relay contact to the LINE input of the VWH pump.

4. Connect the Neutral of the externally provided 120VAC to the NEUTRAL input of the VWH pump.

5. Connect the Earth Ground of the externally provided 120VAC to the Earth Ground input of the VWH pump.

If the VWH will be connected to an alarm bell or light:

The normally closed alarm contact may be used to turn a device off if the VWH goes into lockout mode. The alarm contacts are rated 5 amps at 120 VAC.

1. To connect an alarm device, connect the power for the device to the common (ALARM Center) terminal. Connect the alarm device hot wire to the NO (ALARM NO) terminal. Connect the neutral or return of the alarm device to the neutral or return of the power for the alarm device. See Figure 33.

2. To connect a device that should be powered off during a VWH lockout condition, follow the same instructions as above and use the NC (ALARM NC) terminal rather than the ALARM NO terminal.

NOTE: In a cascade system, the alarm output of the VWH addressed as #1 will activate if any VWH has a lockout condition. The alarm of VWHs addressed #2-7 will only activate if a lockout condition occurs on that specific VWH.

L. Variable Speed Pumping

Variable speed pump support is available on the primary loop of all models. This feature controls pump speed via an analog 0-10VDC signal supplied via the 0-10VA connection on the Field Connection Board.

When this feature is in use, an installer selected Delta T is maintained with the Supply and Return sensors, increasing efficiency and providing better system temperature control. When the difference between the Supply and Return temperatures is greater than the desired setting, the pump will increase speed and flow to compensate. Conversely, if the Delta T is less than the desired setting, the pump will decrease speed and flow to compensate.

NOTE: This feature may be used in Primary / Secondary piping arrangements ONLY!

Variable Speed Pumping Wiring:

1. Connect the VWH pump relay COIL contacts as shown in Figure 33 to the terminals marked DL (DHW) and DN (DHW).

2. Connect an externally provided 120VAC LINE to the COMMON terminal of the pump relay.

3. Connect the NO relay contact to the LINE input of the VWH pump.

4. Connect the Neutral of the externally provided 120VAC to the NEUTRAL input of the pump.

5. Connect the Earth Ground of the externally provided 120VAC to the Earth Ground input of the pump.

6. Connect the 0-10v input wires on the variable speed pump to the 0-10vA output on J9 of the Field Connection Board. Connect the positive pump input wire to J9-24, and the negative wire to J9-25.

NOTE: When making wiring connections, ensure proper polarity or the system will not operate properly.

7. In the Installer Menu, set Installer 56 to "PUMP".

M. Optional 0-10 Volt Building Control Signal

1. A signal from a building management system may be connected to the VWH to enable remote control. This signal should be a 0-10 volt positive-going DC signal. When this input is enabled using the installer menu, a building control system can be used to control the set point temperature or firing rate of the VWH. The control interprets the 0-10 volt signal as follows; when the signal is between 0 and 1.5 volts, the VWH will be in standby mode, not firing. When the signal rises above 1.5 volts, the VWH will ignite. As the signal continues to rise towards its maximum of 10 volts, the VWH will increase in either set point temperature or firing rate depending on the setting of Function 17 in the Installer Menu. See this manual for details on the setting of Functions 16 and 17 for this option. When the signal drops below 1.3 volts the VWH will stop firing.
2. Connect a building management system or other auxiliary control signal to the terminals marked 17, 0-10 VOLT + and 16, 0-10 VOLT – on the Field Connection Board (shown in Figure 35). Caution should be used to ensure that the 0-10 VOLT + connection does not become connected to ground.

N. Optional High Gas Pressure Switch

1. If an optional high gas pressure switch is used, it should be installed on the side of the gas valve. This is normally closed and will open if the pressure goes above 15.5" w.c. on the outlet side.
2. Locate the two pigtails hanging from the electrical box inside of the VWH cabinet. Remove and discard the jumper plug from one of the unused pigtails.
3. Connect the high gas pressure switch to the pigtail that you removed the jumper plug from.

O. Optional Low Gas Pressure Switch

1. If an optional low gas pressure switch is used, it should be installed on the side of the gas valve. This is normally closed and will open if the pressure goes below 2" w.c. on the inlet side.
2. Locate the two pigtails hanging from the electrical box inside of the VWH cabinet. Remove and discard the jumper plug from one of the unused pigtails.
3. Connect the low gas pressure switch to the pigtail that you removed the jumper plug from.

P. Optional High Limit Manual Reset

NOTE: Follow the more detailed instructions included with the high limit manual reset kit for proper installation steps.

1. Thread the control well into the fitting provided on the manifold using teflon thread tape.
2. Insert the control probe into the control well.
3. Secure the high limit manual reset box to the control well.
4. Locate and disconnect the red high limit manual reset wires in the VWH harness from each other. Connect those two red wires to the wires on the manual reset box.
5. When installation is complete, power up the VWH and test the reset according to the provided instructions. If the reset operates properly, set the high limit temperature as described in the provided instructions. When done, create a demand and observe VWH function to verify the installation is working properly.

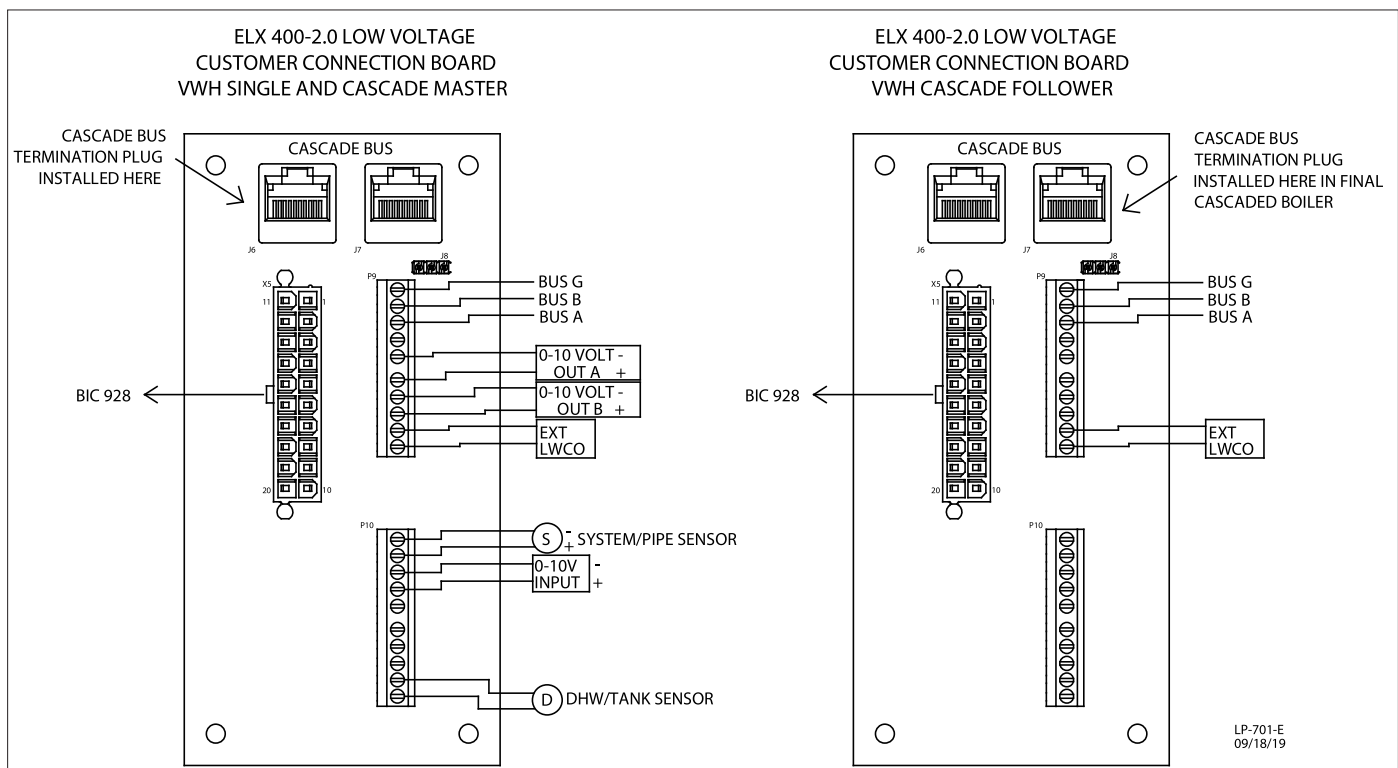
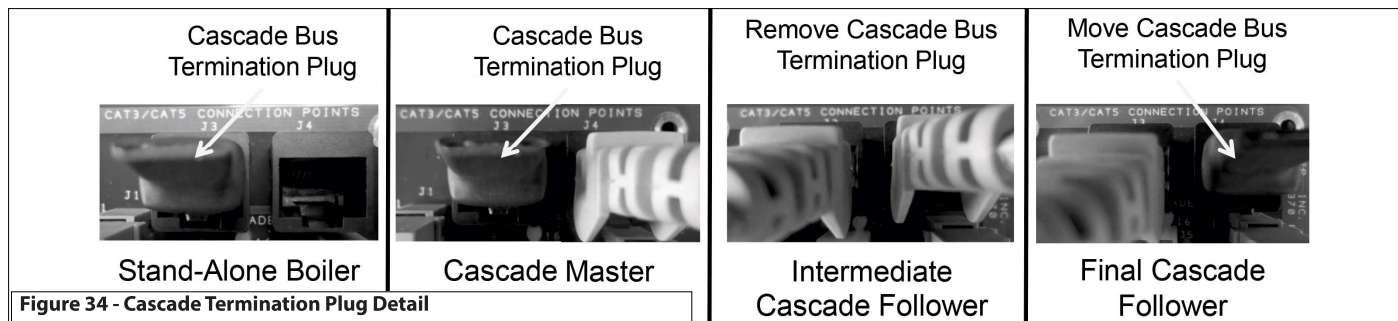
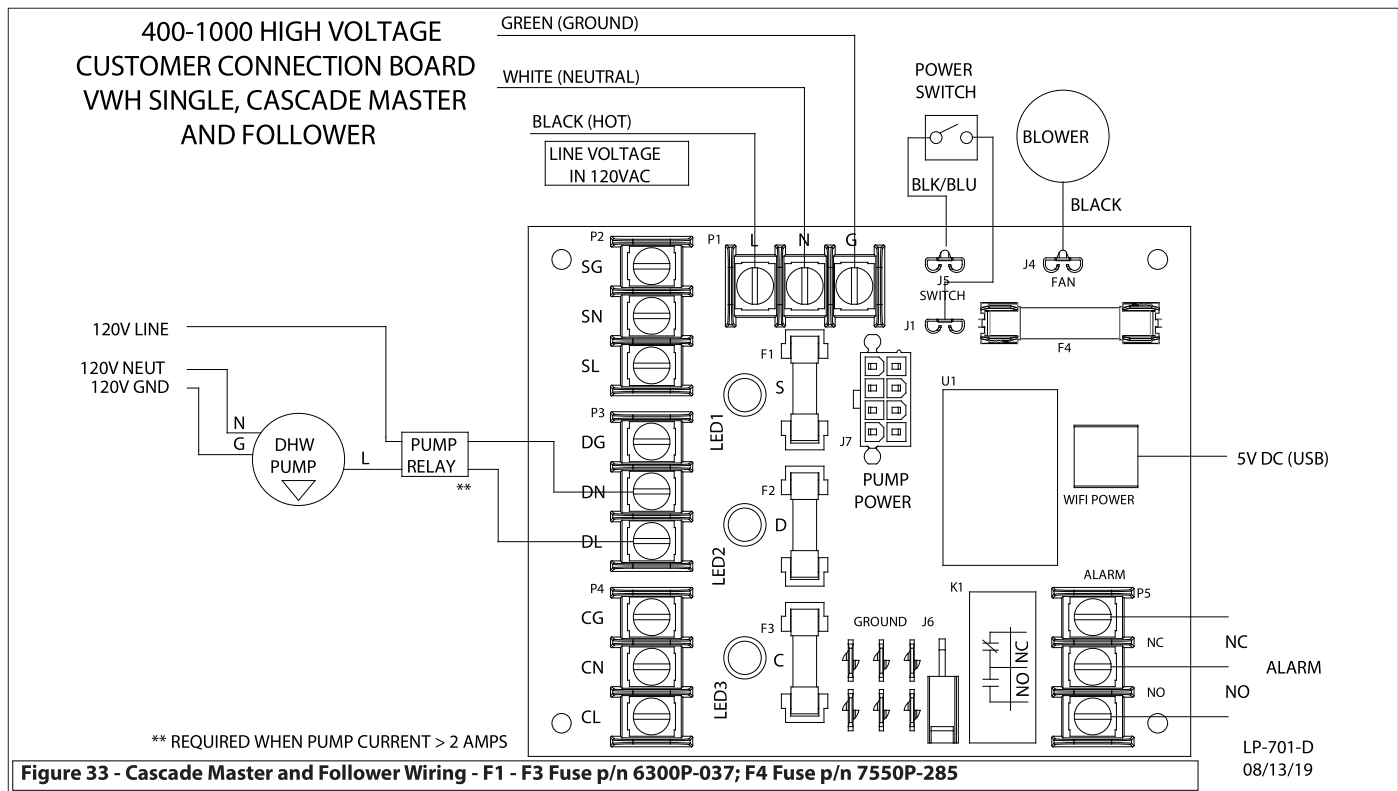


Figure 35 - Cascade Master and Follower Wiring



Part 8 - Wiring - 2000 Models

WARNING

Install wiring and electrically ground boiler in accordance with the authority having jurisdiction or, in the absence of such an authority, follow the National Electrical Code, NFPA 70, and/or CSA C22.1 Electrical Code-Part 1 in Canada. Failure to follow all applicable local, state, and national regulations, mandates, and building supply codes for guidelines to install the electrical power supply could result in property damage, serious personal injury, or death.

Jumping out control circuits or components WILL VOID product warranty and can result in property damage, personal injury, or death.

It is of extreme importance that this unit be properly grounded. It is very important that the building system ground is inspected by a qualified electrician prior to making this connection. Electrical power must only be turned on when the boiler is completely filled with cold water. Failure to follow these instructions could result in component or product failure, serious injury, or death.

ELECTRICAL SHOCK HAZARD – To ensure safety, turn off electrical power supply at service entrance panel before making any electrical connections to avoid possible electric shock hazard. Failure to do so could result in property damage, serious personal injury, or death.

CAUTION

Label all wires prior to disconnecting them when servicing the boiler. Wiring errors can cause improper and dangerous operation. Failure to follow these instructions may result in property damage or personal injury.

CAUTION

Wiring must be NEC Class 1. If original wiring supplied with the boiler must be replaced, use only TEW 105 °C wire or equivalent. Boiler must be electrically grounded as required by the National Electrical Code, ANSI/NFPA 70 - Latest Edition.

A. Installation Must Comply With

1. National Electrical Code and any other national, state, provincial, or local codes or regulations.
2. In Canada, CSA C22.1, Canadian Electrical Code Part 1, and any local codes.

B. Field Wiring

All connections made to the VWH in the field are done inside the electrical junction box located in the front and left sides of the unit. The High Voltage electrical junction box is located on the left side of the VWH, and the Low Voltage Field Connection Board is located to the right of the BIC928 control, on the control panel. Multiple knockout locations are available to route field wires into and out of the electrical junction box.

The control used in the VWH is capable of directly controlling 2 pumps in standard mode and 3 pumps when configured as a cascade master VWH.

An external contactor relay or motor starter is required. The High and Low Voltage Field Connection Boards have separate, clearly marked terminal strips for line voltage and low voltage wiring. Special jacks are provided for trouble-free cascade system wiring using standard CAT3 or CAT5 patch cables.

C. Line Voltage Wiring for Standard VWH

NOTE: A termination plug is included in the CAT 3 / CAT 5 Bus Connection Point, labeled J6 in Figure 41. DO NOT REMOVE THIS PLUG! Doing so will affect VWH operation and void warranty.

1. Connect the 208VAC-3P WYE configuration incoming power wiring to the five pin terminal connector labeled 208VAC 3P IN of the High Voltage Field Connection Board (shown in Figure 38).

Ground goes to the G terminal. Neutral goes to N. The three Hot legs connect to the L1-L3 terminals.

2. A line voltage fused disconnect switch may be required to be externally mounted and connected according to local wiring codes.

VWH Pump Wiring

Connect the Line of an externally provided 120VAC service to the CENTER terminal of the three terminal barrier strip labelled P2 NO (Normally Open).

1. Connect the VWH pump relay COIL Line input to the TOP terminal of P2 NO (Normally Open).
2. Connect the Neutral of an externally provided 120VAC service to the Neutral COIL terminal of the pump relay.
3. Connect the Line of an externally provided 120VAC service to the NO CONTACT of the pump relay.
4. Connect the other NO relay CONTACT to the LINE input of the VWH pump.
5. Connect the Neutral of an externally provided 120VAC service to the Neutral input of the pump.
6. Connect the Earth Ground of the externally provided 120VAC to the Earth Ground input of the pump.

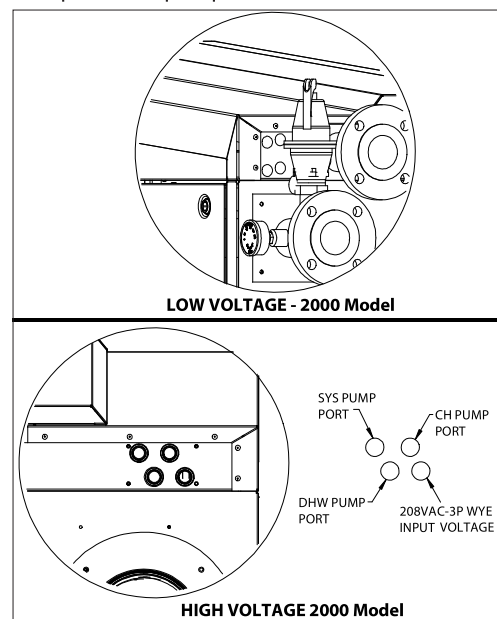


Figure 37 - Knockout Locations - 2000 Model Only

D. Alarm Connections

The control includes a dry contact alarm output. This is an SPDT circuit, rated at 5 amps at 120 volts, and is connected to the three terminal barrier strip labelled X8 ALARM.

This contact can be used to activate an alarm light or bell or notify a building management system if the VWH goes into a lockout condition. The circuit between the ALARM COM and NC terminals is closed during normal operation and the circuit between ALARM COM and NO is open during normal operation. HTP offers an Alarm System Kit (part # 7350P-602).


E. Low Voltage Connections for Standard VWH

1. All low voltage cables should enter the electrical junction box through the provided knock out holes as shown in Figure 37.
2. Connect all low voltage field devices to the low voltage terminal strip located in the electrical junction box.

F. Tank Sensor or Mechanical Control

Connect the tank sensor or mechanical controls to the terminals marked 10 and 11 (DHW SENSOR) in the electrical junction box (shown in Figure 41). The control will automatically determine which type of sensor is connected and operate accordingly.

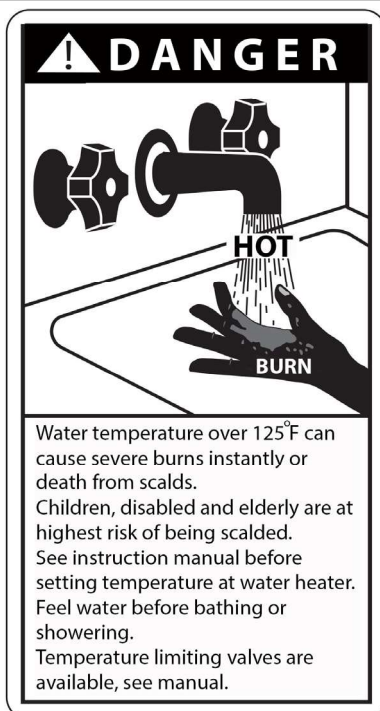
NOTE: If sensor wires are located in an area with sources of potential electromagnetic interference (EMI), the sensor wires should be shielded, or the wires routed in a grounded metal conduit. If using shielded cable, the shielding should be connected to the common ground of the VWH.

 WARNING
<p>Failure to use the correct sensor may result in tank temperature being either above or below set point, and could result in decreased performance, substantial property damage, or heightened risk of injury or death due to scalds.</p>
<p>Caution should be used to ensure neither of these terminals becomes connected to ground.</p>

G. Indirect/Pipe Sensor

The indirect/pipe sensor can be used to control the temperature of the storage tank when a tank sensor or mechanical control cannot be mounted. The indirect/pipe sensor would be wired into the terminals of the low voltage terminal strip as shown on Figure 41. It is important to note that when a indirect/pipe sensor is used, the circulating pump must be wired to operate continuously; otherwise the VWH will short cycle.

The indirect/pipe sensor can also be used in a cascade system when the sensor is placed on the supply line of multiple VWHs that feed the storage tank. This will control the temperature and modulate the firing rate of the connected VWHs. The indirect/pipe sensor would then be wired into the master VWH terminals on the low voltage strip as shown on Figure 41.



H. UL 353 Internal Low Water Cut-Off (Factory Installed)

The supplied internal Low Water Cutoff (LWCO) meets UL 353 requirements to function as a safety, locking out the VWH when water level is inadequate for safe operation. See Service Mode, this manual, for instructions on how to test and reset the Internal LWCO.

I. Wiring of Cascade System Communication Bus

1. A termination plug is included in the CAT 3 / CAT 5 Bus Connection Point, labeled J6 in Figure 40. The purpose of this plug is to stabilize communication between multiple VWHs and reduce electrical "noise". See Figure 40 for Cascade Bus Termination Plug installation detail. **DO NOT REMOVE THIS PLUG!** Doing so will affect VWH operation and void warranty.

NOTE: It is important that the termination plug in multiple VWHs (cascaded units) be installed as depicted in Figure 40. Leave the plug installed in the J6 port on the Master VWH. Remove the plug on intermediate Follower VWHs. Move the plug to the J7 port on the final Follower VWH.

2. Use standard CAT3 or CAT5 computer network patch cables to connect the communication bus between each of the VWHs. These cables are readily available at any office supply, computer, electronic, department or discount home supply store in varying lengths. If you possess the skills you can also construct custom length cables.

NOTE: Shielded three-conductor cable may be used as an alternate method to connect cascade wiring. Connect the three wires of the

shielded cable to the screw terminals labelled BUS A, BUS B, and BUS G. Observe proper polarity across all cascaded units. See Figure 41.

NOTE: All termination plugs must be installed as described in Figure 40 to ensure proper cascade operation.

3. It is recommended to use the shortest length cable that will reach between the VWHs and create a neat installation. Do not run unprotected cables across the floor where they may become wet or damaged. Avoid running communication cables parallel and close to or against high voltage (120 volt or greater) wiring. HTP recommends that the maximum length of communication bus cables not exceed 200 feet.

4. Route the communication cables through one of the knockouts in the cabinet.

5. Connect the VWHs in a daisy chain configuration. It is best to wire the VWHs using the shortest wire runs rather than trying to wire them in the order that they are addressed. The communication bus jacks on the customer connection panel are interchangeable so you can use either one or both in any order to connect the cable.

If you have connected the VWHs to each other properly, there will be no open communication connection ports.

J. Cascade Master Pump and Sensor Wiring

1. On the High Voltage Field Connection Board in the rear of the master, connect the Line of an externally provided 120VAC service to the CENTER terminal of the three terminal barrier strip labelled P5 NO (Normally Open).

2. Connect the VWH pump relay COIL Line input to the TOP terminal of P6 NO (Normally Open).

3. Connect the Neutral of an externally provided 120VAC service to the Neutral COIL terminal of the pump relay.

4. Connect the Line of an externally provided 120VAC service to the NO CONTACT of the pump relay.

5. Connect the COMMON relay CONTACT to the LINE input of the VWH pump.

6. Connect the Neutral of an externally provided 120VAC service to the Neutral input of the pump.

7. Connect the Earth Ground of the externally provided 120VAC to the Earth Ground input of the pump.

8. On the Low Voltage Field Connection Board in the front of the VWH, connect the system pipe sensor to the terminals marked SYS+ and SYS-.

K. Cascade Follower Pump and Sensor Wiring

If the Follower VWH will control the VWH pump:

1. On the High Voltage Field Connection Board in the rear of the follower, connect the Line of an externally provided 120VAC service to the CENTER terminal of the three terminal barrier strip labelled P5 NO (Normally Open).

2. Connect the VWH pump relay COIL Line input to the TOP terminal of P6 NO (Normally Open).

3. Connect the Neutral of an externally provided 120VAC service to the Neutral COIL terminal of the pump relay.

4. Connect the Line of an externally provided 120VAC service to the NO CONTACT of the pump relay.

5. Connect the COMMON relay CONTACT to the LINE input of the VWH pump.

6. Connect the Neutral of an externally provided 120VAC service to the Neutral input of the pump.

7. Connect the Earth Ground of the externally provided 120VAC to the Earth Ground input of the pump.

8. On the Low Voltage Field Connection Board in the front of the VWH, connect the system pipe sensor to the terminals marked SYS+ and SYS-.

If the VWH will be connected to an alarm bell or light:

If desired, an alarm bell or light can be connected to the alarm contacts of the VWH. The normally closed alarm contact may be used to turn a device off if the VWH goes into lockout mode. The

alarm contacts are rated 5 amps at 120 VAC.

To connect an alarm device that should be powered on during a VWH lockout condition, connect the power for the device to the center terminal of the three terminal barrier strip labelled ALARM (X8). Connect the alarm device hot wire to the top terminal of the three terminal barrier strip labelled ALARM (X8). Connect the neutral or return of the alarm device to the neutral or return of the power for the alarm device.

To connect a device that should be powered off during a VWH lockout condition, follow the same instructions as above and use the terminal of ALARM NC rather than the ALARM NO terminal.

NOTE: In a cascade system, the alarm output of the VWH addressed as #1 will activate if any VWH has a lockout condition. The alarm of VWHs addressed #2-7 will only activate if a lockout condition occurs on that specific VWH.

L. Variable Speed Pumping

Variable speed pump support is available on the primary loop of all models. This feature controls pump speed via an analog 0-10VDC signal supplied via the 0-10VA connection on the Customer Connection Board.

When this feature is in use, an installer selected Delta T is maintained with the Supply and Return sensors, increasing efficiency and providing better system temperature control. When the difference between the Supply and Return temperatures is greater than the desired setting, the pump will increase speed and flow to compensate. Conversely, if the Delta T is less than the desired setting, the pump will decrease speed and flow to compensate.

NOTE: This feature may be used in Primary / Secondary piping arrangements ONLY!

Variable Speed Pumping Wiring:

1. On the High Voltage Field Connection Board in the rear of the VWH, connect the Line of an externally provided 120VAC service to the CENTER terminal of the three terminal barrier strip labelled P5 NO (Normally Open).
2. Connect the VWH pump relay COIL Line input to the TOP terminal of P6 NO (Normally Open).
3. Connect the Neutral of an externally provided 120VAC service to the Neutral COIL terminal of the pump relay.
4. Connect the Line of an externally provided 120VAC service to the NO CONTACT of the pump relay.
5. Connect the COMMON relay CONTACT to the LINE input of the VWH pump.
6. Connect the Neutral of an externally provided 120VAC service to the Neutral input of the pump.
7. Connect the Earth Ground of the externally provided 120VAC to the Earth Ground input of the pump.
8. On the Low Voltage Field Connection Board in the front of the VWH, connect the system pipe sensor to the terminals marked SYS+ and SYS-.
9. On the Low Voltage Field Connection Board, connect the 0-10v input wires on the variable speed pump to the terminals marked 0-10vA+ (Positive) and 0-10vA- (Negative).

NOTE: When making wiring connections, ensure proper polarity or the system will not operate properly.

10. In the Installer Menu, set Installer 56 to "PUMP".

M. Optional 0-10 Volt Building Control Signal

1. A signal from a building management system may be connected to the VWH to enable remote control. This signal should be a 0-10 volt positive-going DC signal. When this input is enabled using the installer menu, a building control system can be used to control the set point temperature of the VWH. The control interprets the 0-10 volt signal as follows; when the signal is between 0 and 1.5 volts, the VWH will be in standby mode, not firing. When the signal rises above 1.5 volts, the VWH will ignite. As the signal continues to rise towards its maximum of 10 volts, the VWH will increase in either set

point temperature or firing rate depending on the setting of Function 17 in the Installer Menu. See this manual for details on the setting of Functions 16 and 17 for this option. When the signal drops below 1.3 volts the VWH will stop firing.

2. Connect a building management system or other auxiliary control signal to the terminals marked 0-10 VOLT+ and 0-10 VOLT- on the Low Voltage Field Connection Board.

3. Caution should be used to ensure that the 0-10 VOLT + connection does not become connected to ground.

N. Optional High Gas Pressure Switch

1. If an optional high gas pressure switch is used, it should be installed on the side of the gas valve. This is normally closed and will open if the pressure goes above 15.5" w.c. on the outlet side.

2. Locate the two pigtailed hanging from the electrical box inside of the VWH cabinet. Remove and discard the jumper plug from one of the unused pigtailed.

3. Connect the high gas pressure switch to the pigtail that you removed the jumper plug from.

O. Optional Low Gas Pressure Switch

1. If an optional low gas pressure switch is used, it should be installed on the side of the gas valve. This is normally closed and will open if the pressure goes below 2" w.c. on the inlet side.

2. Locate the two pigtailed hanging from the electrical box inside of the VWH cabinet. Remove and discard the jumper plug from one of the unused pigtailed.

3. Connect the low gas pressure switch to the pigtail that you removed the jumper plug from.

P. Optional High Limit Manual Reset

NOTE: Follow the more detailed instructions included with the high limit manual reset kit for proper installation steps.

1. Thread the control well into the fitting provided on the manifold using teflon thread tape.
2. Insert the control probe into the control well.
3. Secure the high limit manual reset box to the control well.
4. Locate and disconnect the red high limit manual reset wires. Connect the two red wires to the manual reset box.
5. When installation is complete, power up the VWH and test the reset according to the provided instructions. If the reset operates properly, set the high limit temperature as described in the provided instructions. When done, create a demand and observe VWH function to verify the installation is working properly.

2000 MODEL HIGH VOLTAGE CUSTOMER CONNECTION BOARD SINGLE VWH, CASCADE MASTER AND FOLLOWER

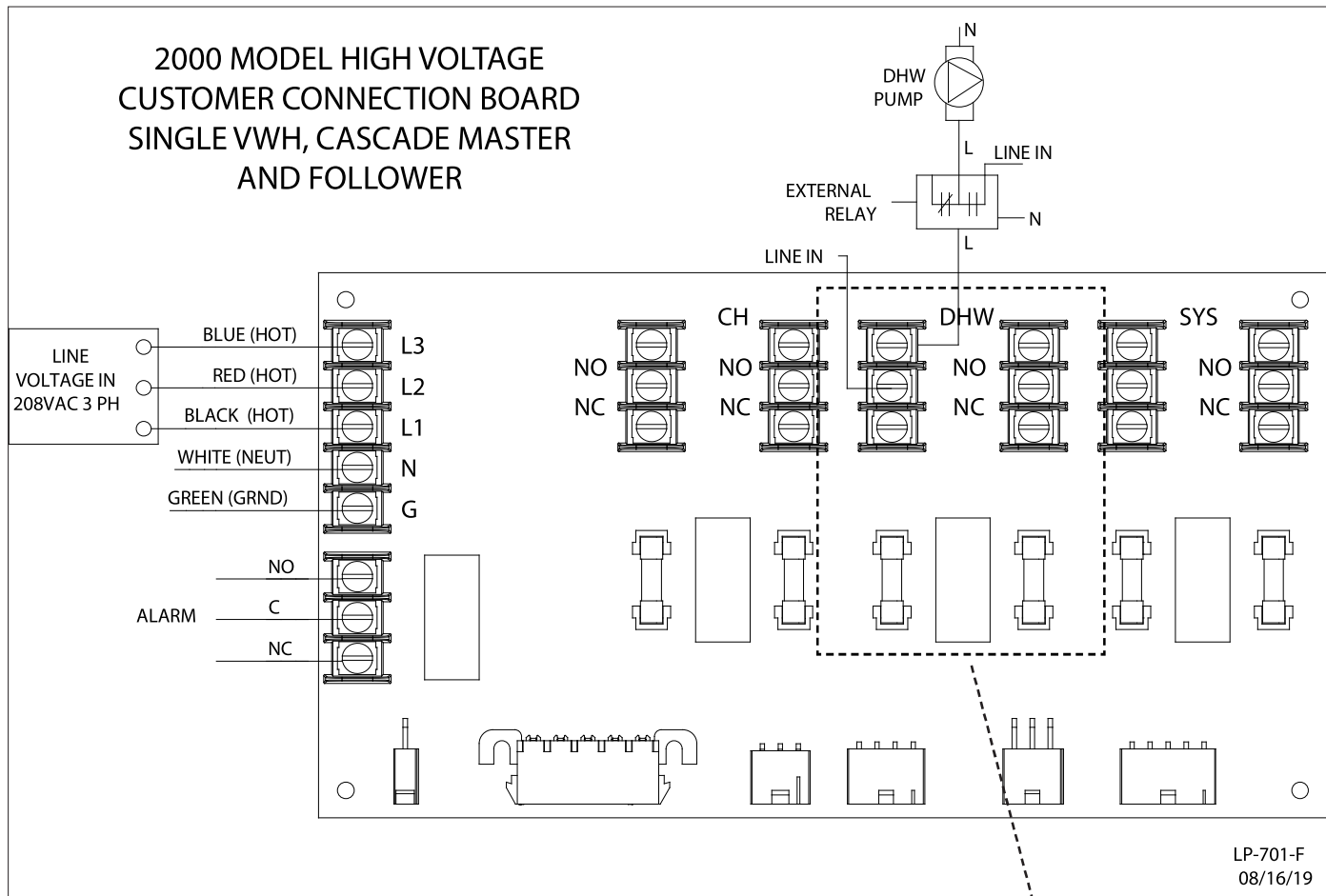


Figure 38 - Cascade Master and Single VWH High Voltage Wiring - 2000 Model - Fuse p/n 7550P-095

Notes for Dry Contact Wiring:

- Each internal relay operates a set of two (2) dry contact terminal blocks.
- Each block has an NO (Normally Open) or NC (Normally Closed) option.
- The pump relay can be connected to either terminal block.
- The other terminal block operates identically to the first, and can be used to operate valves, lights, or other pumps.

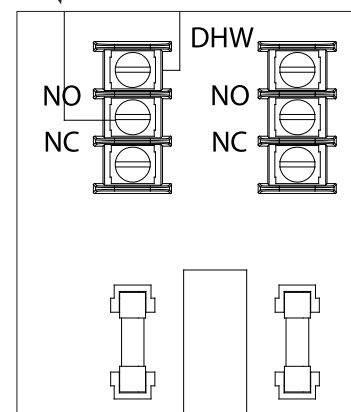


Figure 39 - Dry Contact Wiring
Detail - 2000 Model

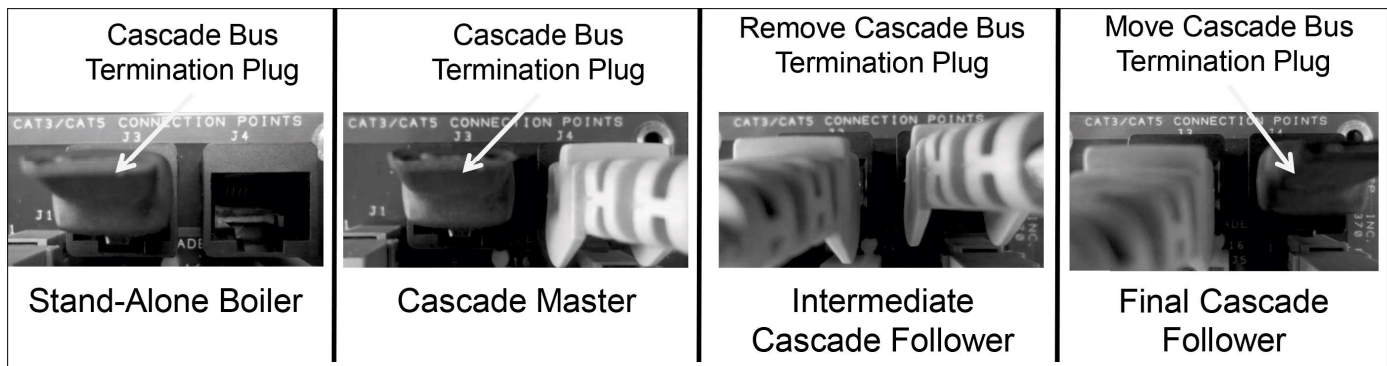


Figure 40 - Cascade Termination Plug Detail

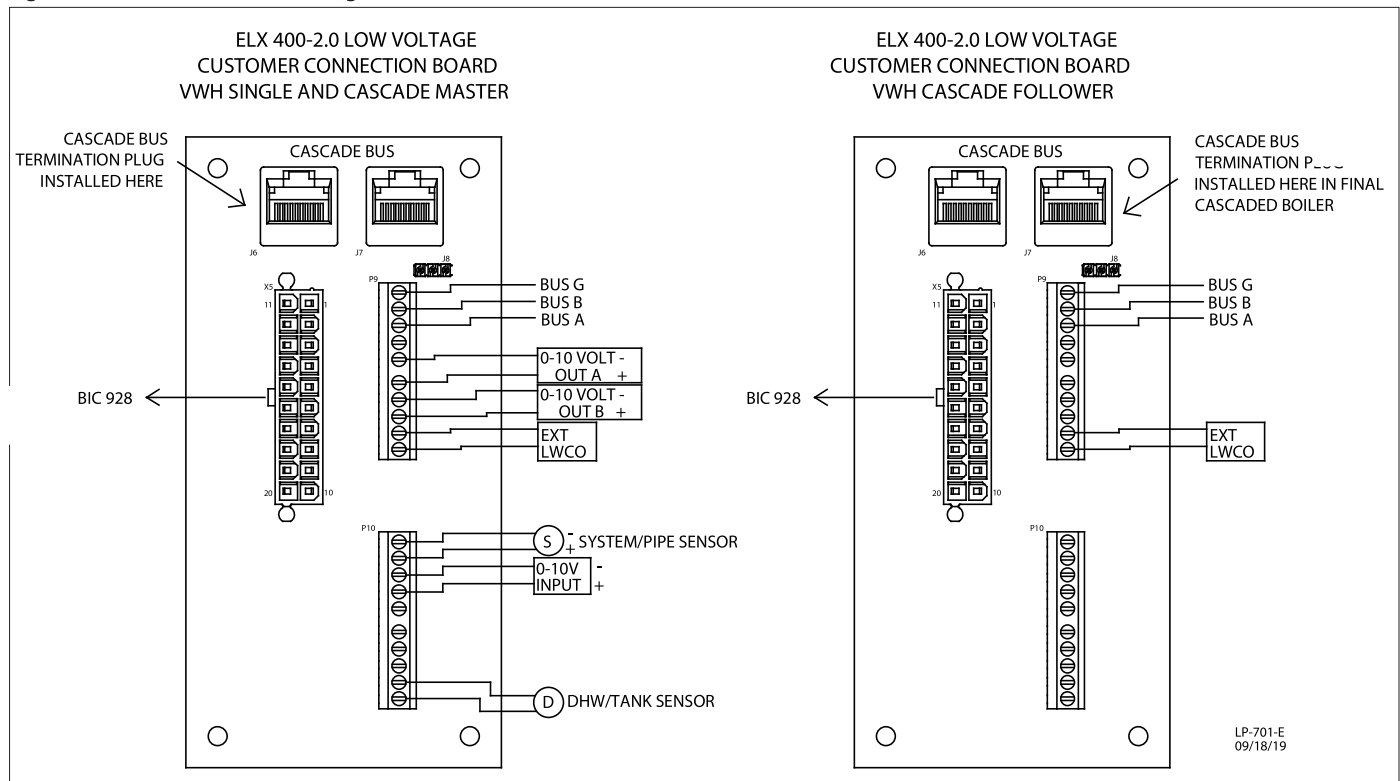


Figure 41 - Cascade Master and Single VWH Low Voltage Wiring, and Cascade Follower Low Voltage Wiring

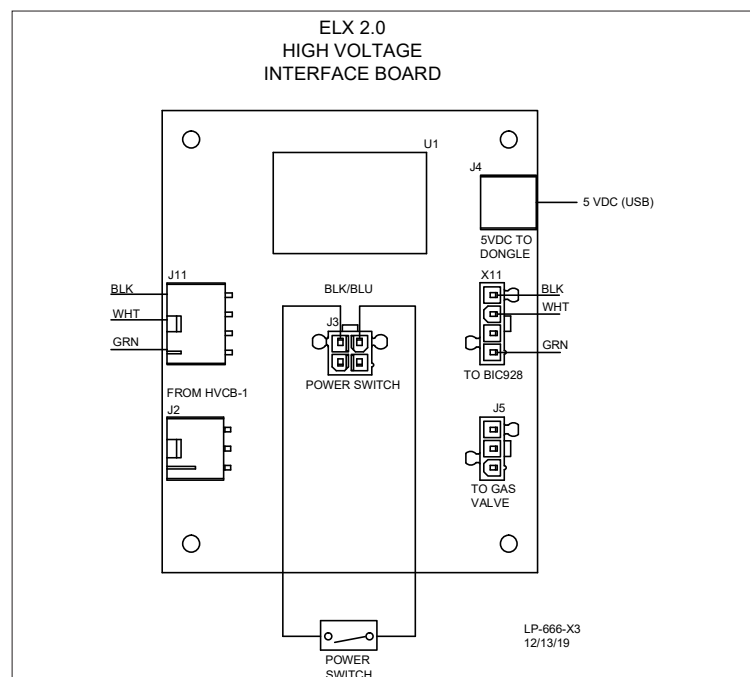
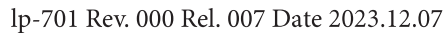


Figure 42 - 2000 Model Interface Board (Factory Wired - For Troubleshooting Purposes)

Figure 43 - Internal Connection Diagram - 2000 Models



Part 9 - Gas Connections

WARNING

FIRE AND/OR EXPLOSION HAZARD

To avoid serious injury or death, the gas line installation and the gas line inlet pressure test must be done by a licensed professional.

It is very important that the boiler is connected to the type of gas noted on the rating plate. "LP" for liquefied petroleum, propane gas, or "NG" for natural gas. Do not do a gas conversion without an approved gas conversion kit (not included). Prior to turning the gas on, all gas connections must be approved by the local gas supplier or utility, in addition to the governing authority.

Make sure the gas line pressures are within normal limits. Pressures outside normal limits can result in poor performance and hazardous operating conditions, property damage, personal injury, or death.

UL recognized fuel gas detectors are recommended in all enclosed propane and natural gas applications where there is a potential for an explosive mixture of fuel gas to accumulate. The installation of these detectors should be made in accordance with the detector manufacturer's recommendations, and/or local laws. Failure to install fuel gas detectors in these applications could result in fire, explosion, property damage, severe personal injury, or death.

Never use an open flame (match or lighter) to check for gas leaks. Use a soapy solution to test connection.

Do not use Teflon tape on gas line pipe thread. Use a pipe compound rated for use with natural gases. Apply sparingly on male pipe ends, leaving the two end threads bare and flow unobstructed.

Support gas supply piping with hangers, not by the boiler or its accessories. The boiler gas valve and blower will not support the weight of the piping. Make sure the gas piping is protected from physical damage and freezing, where required.

Failure to follow these instructions could result in property damage, gas leakage, fire, explosion, serious personal injury, or death.

The gas supply shall have a minimum of no less than 3.5" water column, a maximum inlet pressure of no greater than 14" water column (350 mm) (10.5" w.c. [2.6 kPa] for 1500 and 2000 models), and ½ pound pressure (3.5 kPa). The entire piping system, gas meter, and regulator must be sized properly to prevent excessive pressure drop (greater than 0.5" WC) as stated in the National Fuel Gas Code. This information is listed on the rating plate.

NOTICE

Do not operate the boiler on Natural Gas or LP gas with average sulfur rates greater than 30 mg/m³. Doing so could result in improper product operation and failure, and WILL VOID the boiler warranty.

The gas connection on the boiler is 1" NPT for 400 - 650 models, 1 1/4" NPT for 800 - 1000 models, 1 1/2" NPT for 1500 models, and 2" NPT 2000 models. It is mandatory that this fitting is used for connection to a field fabricated drip leg as shown in the illustration per the National Fuel Gas Code. You must ensure that the entire gas line to the connection at the boiler is no smaller than the unit supplied connection.

Once all inspections have been performed, the piping must be leak tested. If the leak test requirement is a higher test pressure than the maximum inlet pressure, you must isolate the boiler from the gas line. In order to do this, shut the gas off using factory and field-installed gas cocks. This will prevent high pressure. Failure to do so may damage the gas valve. In the event the gas valve is exposed to a pressure greater than ½ PSI, 14" w.c. (3.5 kPa) (10.5" w.c. [2.6 kPa] for

1500 and 2000 models), the gas valve must be replaced. Never use an open flame (match, lighter, etc.) to check gas connections.

A. Gas Piping

1. Run the gas supply line in accordance with all applicable codes.
2. Locate and install manual shutoff valves in accordance with state and local requirements.
3. In Canada, the Manual Shutoff must be identified by the installing contractor.
4. It is important to support gas piping as the unit is not designed to structurally support a large amount of weight.
5. Purge all gas lines thoroughly to avoid start up issues with air in the lines.
6. Sealing compound must be approved for gas connections. Care must be taken when applying compound to prevent blockage or obstruction of gas flow which may affect the operation of the unit.

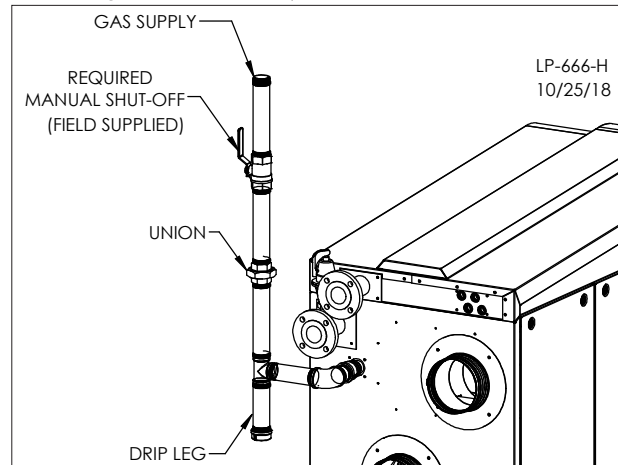


Figure 44 - Gas Connection, 1500 - 2000 Models

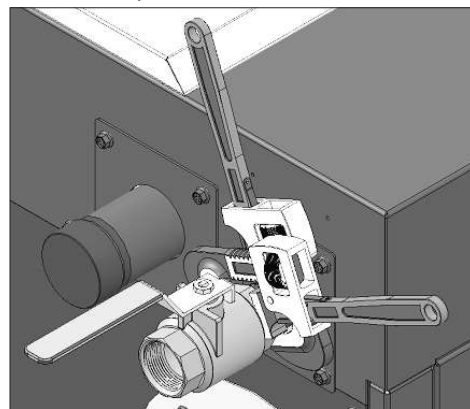


Figure 45 - Tightening Gas Connection - 400 - 1000 Models

CAUTION

Use two wrenches when tightening gas piping at the boiler: One to prevent the boiler gas line from turning. Failure to prevent the boiler gas connection from turning could result in the breaking of tack-welds on the gas pipe plate, damage to the gas line components, substantial property damage, severe personal injury, or death.

CSA or UL listed flexible gas connections can be used when installing the boiler. Flexible gas connections have different capacities and must be sized correctly for the connected boiler firing rates. Consult with the flex line supplier to assure the line size is adequate for the job. Follow local codes for proper installation and service requirements.

B. Gas Table

Refer to Table 18 to size the supply piping to minimize pressure drop between the meter or regulator and unit. Maximum capacity of pipe in cubic feet of gas per hour cannot have a pressure drop greater than .5 w.c.

NOTE: For greater capacities, see NFPA 54, The National Fuel Gas Code.

Natural Gas Supply Piping Capacity Chart - Schedule 40 metallic pipe size in nominal inches														
(0.6 Specific gravity gas; 0.5" WC pressure drop)														
Pipe Size (Inches)	Capacity in Cubic Ft. Hr. by Length of Pipe in Straight Feet													
	10	20	30	40	50	60	70	80	90	100	125	150	175	200
1	678	466	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1 1/4	1390	957	768	657	583	528	486	452	424	400	N/A	N/A	N/A	N/A
1 1/2	2090	1430	1150	985	873	791	728	677	635	600	532	482	443	412
2	4020	2760	2220	1900	1680	1520	1400	1300	1220	1160	1020	928	854	794
2 1/2	6400	4400	3530	3020	2680	2430	2230	2080	1950	1840	1630	1480	1360	1270
3	11300	7780	6250	5350	4740	4290	3950	3670	3450	3260	2890	2610	2410	2240
4	23100	15900	12700	10900	9660	8760	8050	7490	7030	6640	5890	5330	4910	4560
5	41800	28700	23000	19700	17500	15800	14600	13600	12700	12000	10600	9650	8880	8260

Table 18 - Gas Supply Piping Size Chart for VWHs - from NFPA 54, The National Fuel Gas Code

C. Additional Precaution for Excess Flow Valve (EFV)

If an excess flow valve (EFV) is in the gas line, check the manufacturer's minimum and maximum flow capacity ratings. An improperly sized EFV will not allow for a full flow of gas to the VWH and will cause the VWH to malfunction. See Figure 46.



Figure 46 - Excess Flow Valve (EFV)

! WARNING

When performing a pressure test on the gas line piping, be sure the VWH is disconnected or isolated if the test pressure is expected to exceed 1/2 PSI (14" WC), as damage to the gas valve could occur. Such damage could result in fire, property damage, serious personal injury, or death.

D. Check Inlet Gas Pressure

The gas valve is equipped with an inlet gas pressure tap that can be used to measure the gas pressure to the unit. To check gas pressure, perform the steps listed below:

1. **IMPORTANT!** Before you connect to the inlet pressure, shut off the gas and electrical power to unit.
2. Loosen the pressure tap with a small screwdriver. Refer to Figures 47 and 48 for location.
3. Each unit is equipped with a needle valve that will accept a 5/16 ID hose to connect to a digital manometer or liquid gauge to measure incoming pressure from 0-35" w.c.
4. Turn on the gas and power up the unit.
5. Put the unit into manual test mode. In test mode, monitor pressure to assure it does not drop below 1 inch from its idle reading. If gas pressure is out of range or pressure drop is excessive, contact the gas utility, gas supplier, qualified installer, or service agency to determine correct action that is needed to provide proper gas pressure to the unit. If Gas Pressure is within normal range proceed to Step 6.
6. Exit test mode, then turn power off and shut off gas supply at the manual gas valve before disconnecting the hose from the gas monitoring device. Tighten screw on the pressure tap and turn gas on. Check for leaks with soapy solution. Bubbles will appear on the pipe to indicate a leak is present.

! WARNING

Ensure the pressure tap screw is properly tightened to prevent gas leaks.

Strain on the gas valve and fittings may result in vibration, premature component failure and gas leakage.

Ensure that the high gas pressure regulator is at least 6 – 10 feet upstream of the appliance.

DO NOT adjust or attempt to measure gas valve outlet pressure. The gas valve is factory-set for the correct outlet pressure and requires no field adjustment.

Failure to follow these instructions could result in damage to the valve and cause substantial property damage, fire, explosion, severe personal injury, or death.

The gas piping must be sized for the proper flow and length of pipe to avoid pressure drop. The gas meter and regulator must be properly sized for the total gas load. If you experience a pressure drop greater than 1" w.c. (.87 kPa), the meter, regulator or gas line may be undersized or in need of service. You can attach a manometer to the incoming gas drip leg after removing the cap. The gas pressure must remain between 3.5" (.87 kPa) and 14" (3.5 kPa) (10.5" w.c. [2.6 kPa] for 1500 and 2000 models) during stand-by (static) mode and while in operating (dynamic) mode.

If an in-line regulator is used, it must be a minimum of 10 feet from the boiler. It is very important that the gas line is properly purged by the gas supplier or utility. Failure to properly purge the lines, or improper line sizing, will result in ignition failure. This problem is especially noticeable in NEW installations and empty tank situations. This situation can also occur when a utility company shuts off service to an area to provide maintenance to their lines. This gas valve must not be replaced with a conventional gas valve under any circumstances.

400 - 1500 Models - Natural or LP Gas	
Minimum - Maximum Pressure	3.5" - 14" WC
2000 Models - Natural Gas ONLY!	
Minimum - Maximum Pressure	3.5" - 10.5" WC

Table 19 - Gas Pressure Requirements

NOTICE

Do not fire (operate) the boiler until all connections have been completed and the heat exchanger is filled with water. Doing so will damage the boiler and void the warranty.

E. VWH Gas Valve

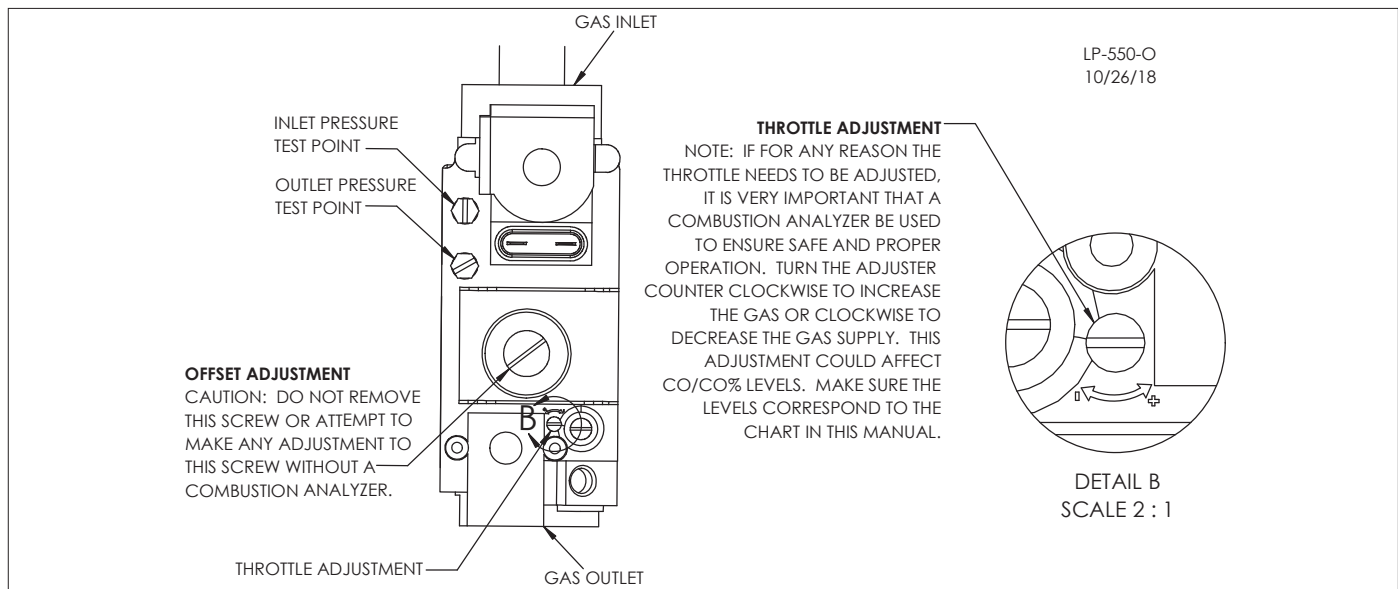


Figure 47 - 400 and 500 Model Gas Valve

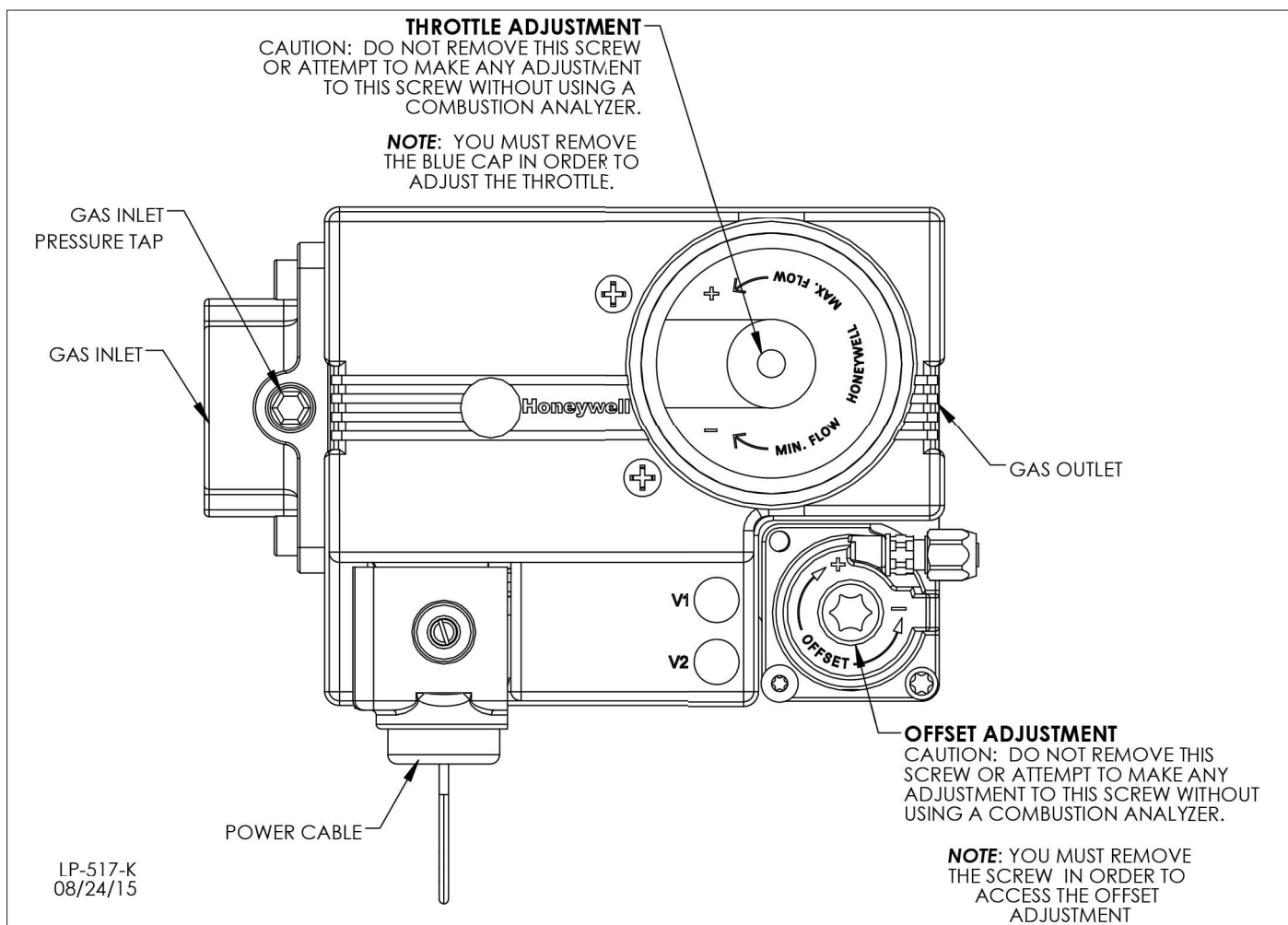


Figure 48 - 650 - 2000 Model Gas Valve - If Necessary, Use #40 Torx to Adjust Offset and Hex to Adjust the Throttle

! DANGER

Do not do a gas conversion on this VWH without an officially approved conversion kit and instructions supplied by HTP. Failure to use a conversion kit when converting the VWH to fire on Natural or Propane gas will result in extremely dangerous burner operation, leading to fire, explosion, severe personal injury, or death.

! DANGER

Adjustments to the throttle screw or offset may only be made by a qualified gas technician using a calibrated combustion analyzer capable of measuring CO₂ and CO. Failure to follow this instruction will result in fire, explosion, property damage, severe personal injury, or death.

Part 10 - Start-Up Preparation

WARNING

Thoroughly clean and flush any system that has used glycol before installing the VWH. Provide the customer with a material safety data sheet (MSDS) on the fluid used.

A. Check / Control Water Chemistry

CAUTION

Chemical imbalance of the water supply may affect efficiency and cause severe damage to the appliance and associated equipment. Water quality must be professionally analyzed to determine whether it is necessary to treat the water. Various solutions are available to adjust water quality. Adverse water quality will affect the reliability of the system. In addition, operating temperatures above 135°F will accelerate the build-up of lime scale and possibly shorten appliance service life. Failure of an appliance due to lime scale build-up, low pH, or other chemical imbalance IS NOT covered by the warranty.

The water must be potable, free of corrosive chemicals, sand, dirt, and other contaminants. It is up to the installer to ensure the water does not contain corrosive chemicals or elements that can damage the heat exchanger. Potable water is defined as drinkable water supplied from utility or well water in compliance with EPA secondary maximum contaminant levels (40 CFR Part 143.3) as shown in the table below. If the water contains contaminants higher than outlined by the EPA, water treatment is recommended and additional, more frequent maintenance may be required.

If you suspect that your water is contaminated in any way, discontinue use of the appliance and contact an authorized technician or licensed professional.

Contaminant	Maximum Allowable Level	Contaminant	Maximum Allowable Level
Total Hardness (Commercial Use - 140°F and above water temperature)	120 mg/l (7 grains/gallon)	pH	6.5-8.5
		Sulfate	205 mg/l
		Total Dissolved Solids (TDS)	500 mg/l
Aluminum	0.05 to 0.2 mg/l	Zinc	5 mg/l
Chloride	100 mg/l		
Copper	1 mg/l		
Iron	0.3 mg/l	Dissolved Carbon Dioxide (CO ₂)	15 mg/l or PPM
Manganese	0.05 mg/l		

CAUTION

Do not use petroleum-based cleaning or sealing compounds in the appliance system. Damage to elastomer seals and gaskets in the system could occur, resulting in substantial property damage.

B. Check for Gas Leaks

WARNING

Before starting the VWH, and during initial operation, smell near the floor and around the VWH for gas odorant or any unusual odor. Remove VWH front door and smell interior of VWH enclosure. Do not proceed with startup if there is any indication of a gas leak. Repair any leaks at once.

WARNING

PROPANE ONLY – The propane supplier mixes an odorant with the propane to make its presence detectable. In some instances the odorant can fade, and the gas may no longer have an odor. Before startup (and periodically thereafter), have the propane supplier verify the correct odorant level in the gas.

C. Condensate Removal

1. The VWH is a high efficiency condensing appliance. Therefore, the unit has a condensate drain. Condensate fluid is nothing more than water vapor, derived from combustion products, similar to that produced by an automobile when it is initially started.

Condensation is slightly acidic (typically with a pH of 3 to 5) and must be piped with the correct materials. Never pipe the condensate using steel, copper, brass or other materials that will be subject to corrosion. Plastic PVC or CPVC pipe are the only approved materials. A condensate neutralizer, if required by local authorities, can be made up of lime crystals, marble or phosphate chips that will neutralize the condensate. This may be done by the installer or you may purchase a condensate neutralizer from HTP (7350P-611).

2. The VWH is equipped with a female socket weld fitting connection ($\frac{3}{4}$ " in 400 to 1000 models and 1" in 1500 and 2000 models) that must be piped to a local drain. It is very important that the condensate line is sloped downward away from the VWH to a suitable inside drain. If the condensate outlet on the appliance is lower than the drain, you must use a condensate removal pump, available from HTP (554200). This pump is equipped with two leads that can be connected to an alarm or another type of warning device to alert the user of a condensate overflow, which, if not corrected, could cause property damage.

3. If a long horizontal run is used, it may be necessary to create a vent in the horizontal run to prevent a vacuum lock in the condensate line.

4. Do not expose the condensate to freezing temperatures.

5. It is very important you support the condensation line to assure proper drainage.

D. Filling and Testing the VWH System

WARNING

The VWH must be full of water and the system fully purged BEFORE firing the burner. When filling the system, open hot water outlets to release air in the storage tanks and piping. All air has been purged from the system when water runs freely from the outlets. Firing the VWH when it is not full of water will damage the heat exchanger, and could result in property damage, serious personal injury, or death. Such damages ARE NOT covered by VWH warranty.

- Fill the system only after ensuring water chemistry meets the requirements listed in this manual.
- Make certain the drain valves are completely closed.
- Open the shut-off valve in the cold water supply line.
- Open the hot water outlets to allow air to vent from the VWH, storage tanks, and piping.


CAUTION

It is important to purge the system of air to avoid damage to the VWH.

- Allow sufficient time for the system to completely fill with water.
- At initial fill and during VWH startup and testing, check system thoroughly for leaks. Repair all leaks before proceeding further.

E. Final Checks Before Starting VWH


- 1. Read Startup Procedures within this manual for proper steps to start VWH. (See Startup Report to record steps for future reference.)
- 2. Verify the VWH and system are full of water and all system components are correctly set for operation.

**WARNING**

Ensure the VWH is full of water before firing the burner. Failure to do so will damage the VWH. Such damage IS NOT covered by warranty, and could result in property damage, severe personal injury, or death.

- 3. Fill condensate trap with water.
- 4. Verify electrical connections are correct and securely attached.
- 5. Inspect exhaust vent and intake piping for signs of deterioration from corrosion, physical damage or sagging. Verify exhaust vent and intake piping are intact and correctly installed per Venting Section and local codes.

Part 11 - Start-Up Procedure

**WARNING**

FOR YOUR OWN SAFETY READ BEFORE OPERATING

- 1. This VWH does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
- 2. BEFORE OPERATING: Smell all around the VWH area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

3. WHAT TO DO IF YOU SMELL GAS

- Do not try to light any appliance.
- Do not touch any electric switch, do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas suppliers' instructions.
- If you cannot reach your gas supplier, call the fire department.
- Turn off the gas shutoff valve (located outside the VWH) so that the handle is crosswise to the gas pipe. If the handle will not turn by hand, don't try to force or repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.

- 4. Do not use this VWH if any part has been under water. Immediately call a qualified service technician to inspect the VWH and to replace any part of the control system and any gas control that has been damaged.
- 5. The VWH shall be installed so the gas ignition system components are protected from water (dripping, spraying, rain, etc.) during VWH operation and service (circulator replacement, condensate trap, control replacement, etc.)

Failure to follow these instructions could result in property damage, serious personal injury, or death.

If you discover any evidence of a gas leak, shut down the VWH at once. Find the leak source with a bubble test and repair immediately. Do not start the VWH again until the leak is repaired. Failure to comply could result in substantial property damage, severe personal injury, or death.

A. Control Overview

The control is one of the primary safety devices of the VWH. It monitors the safety sensors of the VWH to assure safe and efficient operation.

The control has many features associated with system design. This section addresses programming features, including History, Status, User Settings and Installer Settings, to help in customizing your control. It is important to fully understand control capabilities before customization, as its factory defaults may already fit your system design and not require any adjustment at all.

B. Navigation of the Touch Screen Display

The touch screen display allows the installer to quickly navigate between appliance status screens and operating parameters, easing programming and troubleshooting. The display also provides informative messages about the operation of the appliance that are useful to both the installer and user. Many operating parameters can be viewed and adjusted with the display. The Home screen is described below.

Home Screen

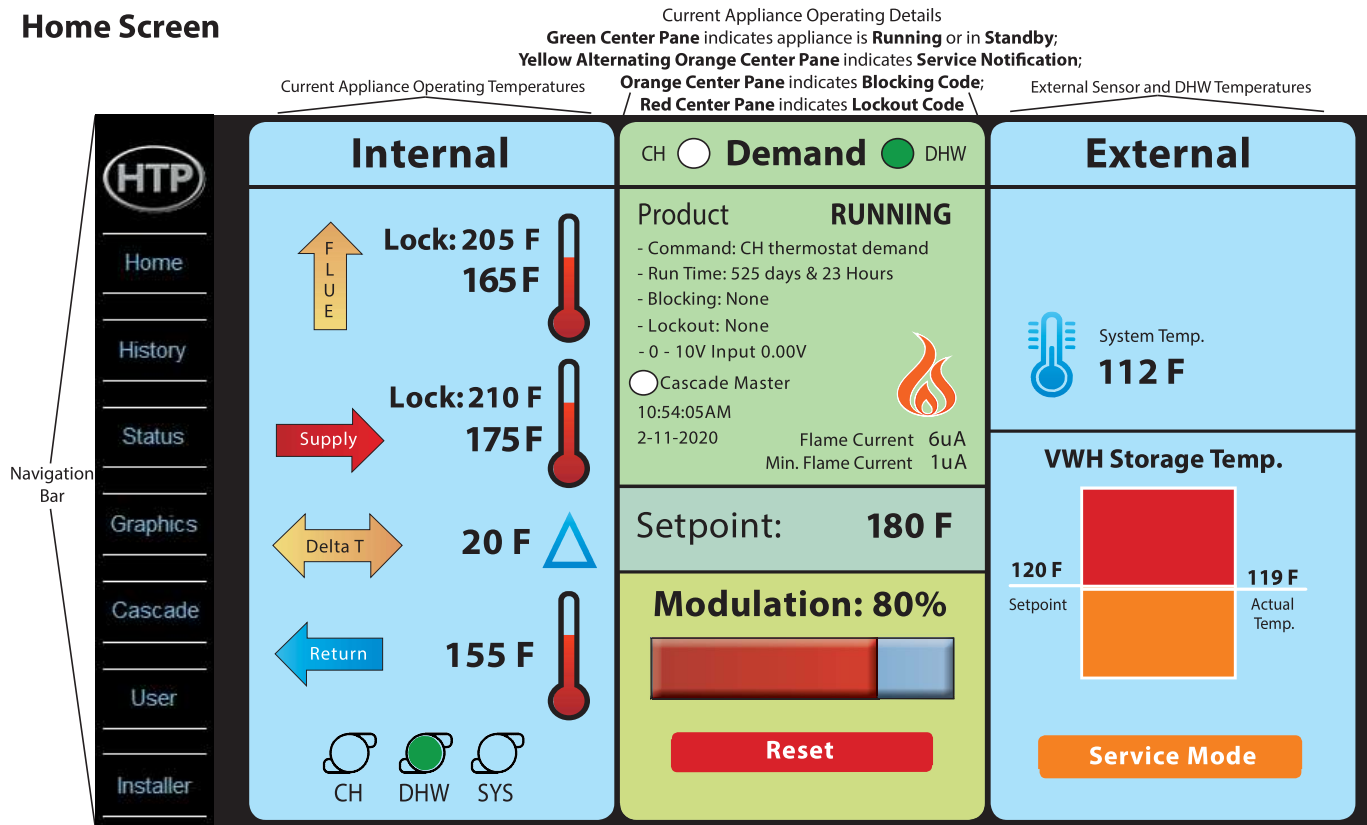


Figure 49 - Display Home Screen

Navigation Bar

The Navigation Bar allows the installer / user to move quickly through the appliance control screens. The screens accessed by tapping these icons are described in depth below:

HTP Logo and Home

Tapping the HTP Logo or Home will return the installer / user to the Home Screen. The Home Screen allows the installer / user quick access to appliance internal operating temperatures, external temperature sensor readings, current CH and DHW setpoints and actual temperatures, appliance modulation percentage, operation details, and a Reset key.

History

The History screens allow the installer / user to view important items from the appliance's history, including serial number, power on hours, ignition attempts, and the ten (10) most recent appliance Blocking and Fault codes.

Status

The Status screens detail the appliance's current operating stats, including fan speed and temperature settings, and input and output settings.

Graphics

The Graphics function allows the installer / user to select and view real time system analytics. This function helps the installer / user fine tune system operation and aids in troubleshooting.

Cascade

Cascade lets the installer / user view cascade system stats, including the current operating status of all the VWHs installed in the cascaded system.

User

The User function allows the installer / user to quickly set operating settings such as the VWH setpoint, differential, offset, and DHW settings with easy to use slider bars.

Installer

Installer is accessed with a password, allowing the installer to customize the installation and offering quick access to set the Outdoor Reset Curve. Pump Service Mode and LWCO Test Mode are also accessed through the Installer function.

NOTE: Installer should only be accessed by a qualified service technician.

Reset

Tap Reset to clear any lockout code and return the appliance to normal operation.

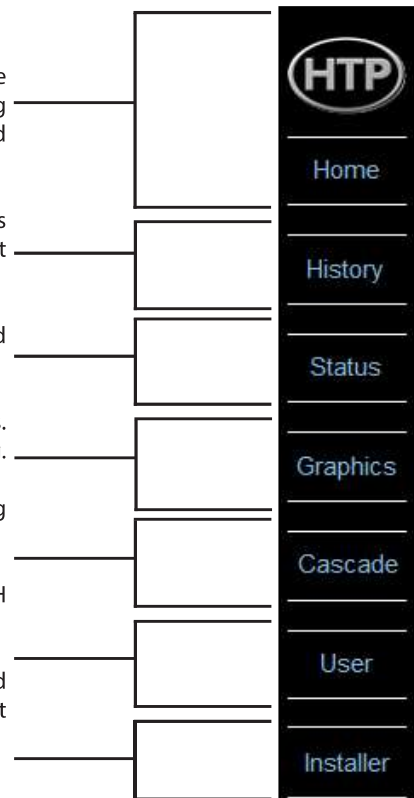


Figure 50 - Display Navigation Bar

C. Single VWH Initial Start-Up and Operation

When power is applied to the VWH, the control first completes a power-up systems check and boots up the display. During this time the combustion fan may run.

After boot up is complete the display will show the Home Screen and its accompanying data, including firing rate, modulation rate, and current VWH supply temperature. A green center pane indicates the VWH is in ready operating condition and either running or in standby, awaiting a demand for heat. If a fault is detected the center pane will display the appropriate blocking code (orange center pane) or lockout code (red center pane).

NOTE: A service notification will result in a center pane that alternates between yellow and orange.

When a demand for heat is received, the control begins the following demand sequence. The VWH first turns on the pump. The control will measure the supply temperature. If it is below the set point temperature minus the ignition differential the control will ignite the burner.

After the burner is lit, the control modulates the firing rate to control the supply water temperature and meet the heat demand. When the thermostat or indirect water heater temperature is met, the control will extinguish the burner and run the combustion fan to purge gasses from the combustion chamber. In addition, the pump will run for a pump post purge interval. The control will then be in standby, waiting to process the next demand for heat.

During this process, the control will extinguish the burner if it senses a dangerous or unsafe condition. If the control determines that a dangerous or unsafe condition has occurred, the control may lock out the VWH and prevent it from igniting until a maintenance person diagnoses the problem, repairs it, and resets the control. In the event that the control goes into lockout, it will show a diagnostic code on the display, illuminate the red indicator, and close the alarm relay contacts to aid in recognition of the condition, diagnosis, and repair.

D. Cascaded System Initial Start-Up and Operation

Operation is slightly different if the VWH is part of a cascaded system. The control of each VWH in a cascaded system completes its own power up system check. One of the VWHs in the cascade system is designated as the master VWH. After the master VWH completes its power up sequence, it checks the communication bus to see if any other VWHs are present. If other VWHs are present, the master control determines these follower VWH addresses. The master VWH control will recheck the bus every few seconds as long as it is powered up to update the status of the connected VWHs. The master VWH control processes all heat demands and dictates which of the follower VWHs should light and what firing rate the followers should try to achieve.

When the master VWH receives a demand for heat, it determines which VWH is first in the firing sequence and sends that VWH a command to begin a demand sequence. That VWH will then begin a demand sequence as described above. Once the VWH ignites, the master VWH control will increase the firing rate command to that VWH until the system sensor temperature is at the set point temperature plus the differential, or that VWH is at a high firing rate. If the command from the master VWH control gets to the high firing rate of the follower VWH, but the system sensor is below the required temperature, the master VWH control will then tell the next VWH in the firing sequence to begin its demand sequence. The master VWH control will then begin to ramp up the firing rate command of that VWH. This process will continue while there is a demand until all VWHs in the cascade system are at high fire or the desired temperature of the system sensor is reached. If the system sensor temperature reaches set point and differential before all VWHs are at high fire, the master control will modulate the cascade command signal to maintain the system sensor at set point and differential until the demand is complete. Demand is complete when the system

sensor is equal to the set point temperature. The master VWH control will extinguish all VWHs that may be lit. If the demand decreases, the firing rate command and amount of VWHs lit will decrease exactly opposite as described above.

Whenever the master VWH control needs to fire a follower VWH, it sends a firing rate command to that VWH. The follower VWH will respond to the command until its supply sensor temperature gets to be 5°F above the set point temperature plus the differential, at which point the individual VWH will modulate on its own so as not to overheat. As a result, it is not uncommon to see the cascade output at maximum but individual VWHs firing at less than their maximum firing rate.

E. Lockout Condition - Cascade System

Each VWH in the cascade system is responsible for its own safety functions. If any individual VWH control senses an unsafe condition, it will extinguish the burner and, if necessary, go into a lockout condition. In this way, every VWH in the system has its individual safety controls intact and operational, even if the firing of the VWH is under control of the master VWH. If any VWHs are in a lockout condition, including the master VWH in the cascade system, the master control will recognize the lockout condition and skip over the VWH in the firing sequence.

In the event that the system sensor fails, all VWHs in the system will ignite simultaneously when there is a demand, and each VWH will individually regulate firing rates to maintain the master set point temperature at the individual supply sensors built into the VWH. If this should happen, the master VWH will display an E03 Blocking code, indicating that the system supply sensor has failed.

F. Cascade System Programming

1. If the VWH is used alone, skip this section.

2. Programming the Master VWH:

- Make sure there is no demand for heat being supplied to the VWH.
 - Apply power to the VWH.
 - Tap **Installer** in the display Navigation Bar to enter the Installer Menu.
 - Tap NEXT and navigate to Installer #15. Ensure the Cascade Address is set to 0.
- NOTE:** The Master VWH MUST be addressed as 0.
- Ensure Installer #23, Cascade Mode, is set to 1, cascade (ex: 0 for OFF, 1 for a cascade system).
 - Exit the Installer Menu.

3. Programming Follower VWHs:

NOTE: READ THE FOLLOWING BEFORE PROGRAMMING THE FOLLOWER VWHs

- The master VWH will share its alarm output with the follower VWH addressed as 1.
 - If one of the follower VWHs has an indirect fired water heater connected to it, the address of this VWH must be 2 or greater.
 - It is recommended but not necessary to address VWHs in the order that they are wired.
 - No two VWHs can have the same address.
 - It is not required to use all consecutive address numbers. Example: In a 2 VWH system with an indirect connected to the follower, the follower address would be 2 (address 1 is not used).
 - Maximum amount of VWHs in a cascaded system is eight (8).
- Make sure there is no demand for heat being supplied to the master VWH.
 - Apply power to the follower VWH you are working on.
 - Tap **Installer** in the display Navigation Bar to enter the system setting program.
 - Tap NEXT and navigate to Installer #15. Set the Cascade Address to 1 for the first follower, 2 for the second follower, etc. depending on which VWH you are programming based on the above notes. This establishes the VWH as a follower in a cascaded system and enables data to be transferred as needed for the system to function at full capability.

- e. Ensure Installer #23, Cascade Mode, is set to 1, cascade (ex: 0 for OFF, 1 for a cascade system).
f. Exit the Installer Menu.

G. Operating Instructions

Before operating the unit, it is important to verify that the gas line and water lines are connected to the VWH and fully purged. If you smell gas, STOP! Follow the safety instructions listed in the first part of this section. If you do not smell gas, follow the next steps.

1. Turn down the thermostats before applying power to the VWH. If 0–10 volt or other inputs are used, make sure that they are set so there is no call for heat while programming.

NOTE: An input of 1.5V is the minimum input to initiate a call for heat on the VWH.

2. Power on the VWH or VWHs if a cascade system is used.

3. Next, check the User settings. Adjustments and factory defaults are outlined within this section. If a cascade system is used, it is important that all the VWHs have the same User settings.

4. Next, check the System settings. Adjustments and factory defaults are outlined within this section. If a cascade system is used, it is important that the master VWH is programmed with the correct System settings.

5. Create a demand on the VWH or VWHs if a cascade system is used. The user can monitor system functions when the VWHs are operational.

6. If any VWH fails to start refer to the troubleshooting section in the back of this manual.

H. Programming User Settings

User Setting Program Access

NOTE: Programming the VWH control is not possible when the VWH is firing. Make sure any input which can create a demand on the VWH, such as the tank thermostat, is turned off so the VWH will remain idle to allow programming.

NOTE: To change User Settings enter Access Code **600** when prompted.

User Setting Program Navigation - MOST SETTINGS NOT APPLICABLE ON VWH MODELS

Use the touch screen sliders or input prompts to change the VWH settings. Press **SAVE** to store changes. Listed below are the User Settings that can be programmed into the control.

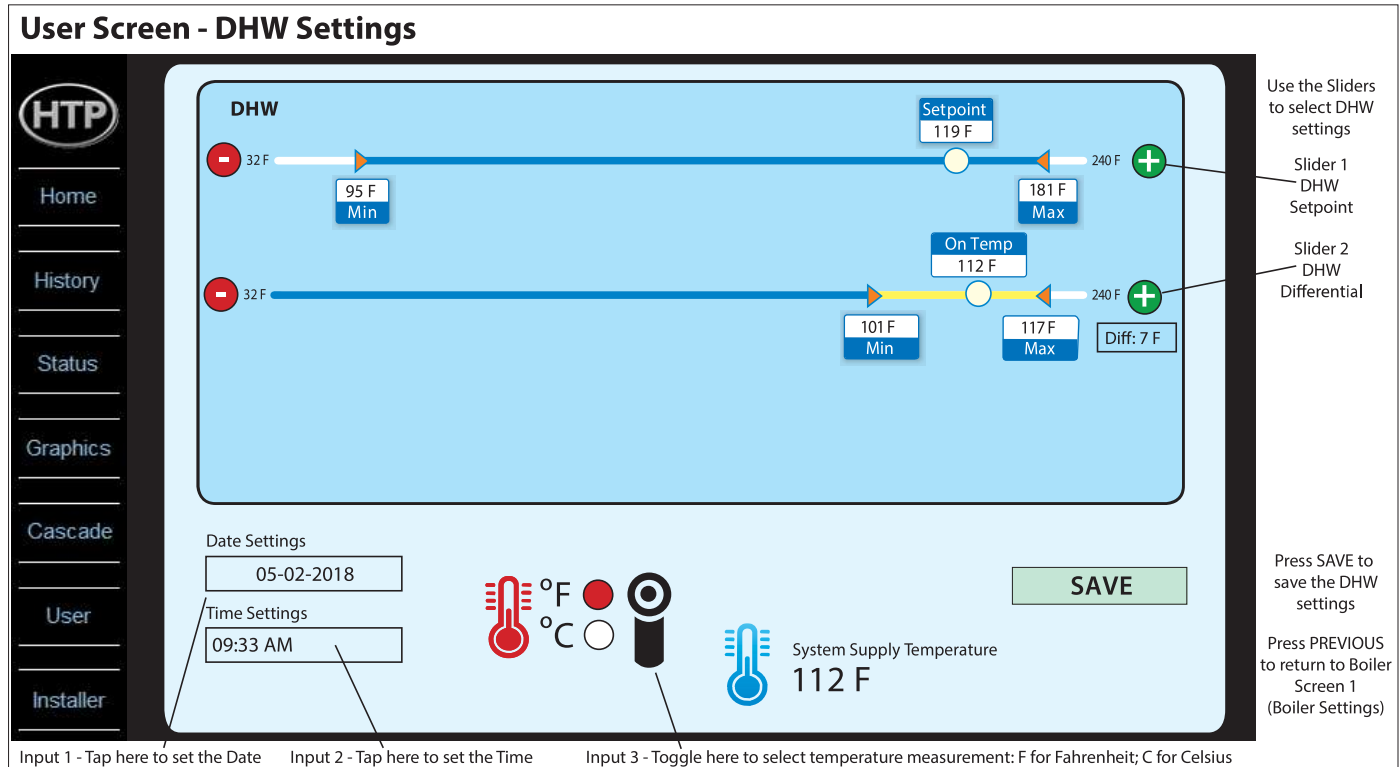


Figure 51 - User Screen 2 - DHW Settings

Setting	Description
Slider 1 DHW Setpoint 119 °F	Adjusts the DHW set point from 95°F to 181°F (Factory Default 119°F). NOTE: After changing the setpoint and tapping SAVE, the differential slider will change as well, maintaining the differential range. When changing the setpoint ensure the differential remains at the desired setting.
Slider 2 DHW Differential 7 °F	Adjusts the “differential”, or the temperature below setpoint at which the VWH will light (On Temp) during a call for DHW. This is user adjustable between Setpoint minus 2 (burner lights at 2F below Setpoint) and Setpoint minus 18F (burner lights at 18F below setpoint). (Factory Default Setpoint minus 18°F). In the example above, a setpoint of 119F and differential of 7F is desired. The setpoint slider is set at 119F, and then the On Temp slider is set at 112F (119 - 112 = 7). Tap SAVE. NOTE: The current differential from 2 - 18°F is displayed in a text box to the right and slightly below the slider.

Setting	Description
Input 1 Date Settings	Allows the user to set the date. See below for setting the date.
Input 2 Time Settings	Allows the user to set the time. See below for setting the time.
Input 3 Temperature Display C or F	Toggle the switch near the °F or °C to switch temperature measurement from Fahrenheit to Celsius (Default is Fahrenheit).

Table 20 - User Screen Program Navigation

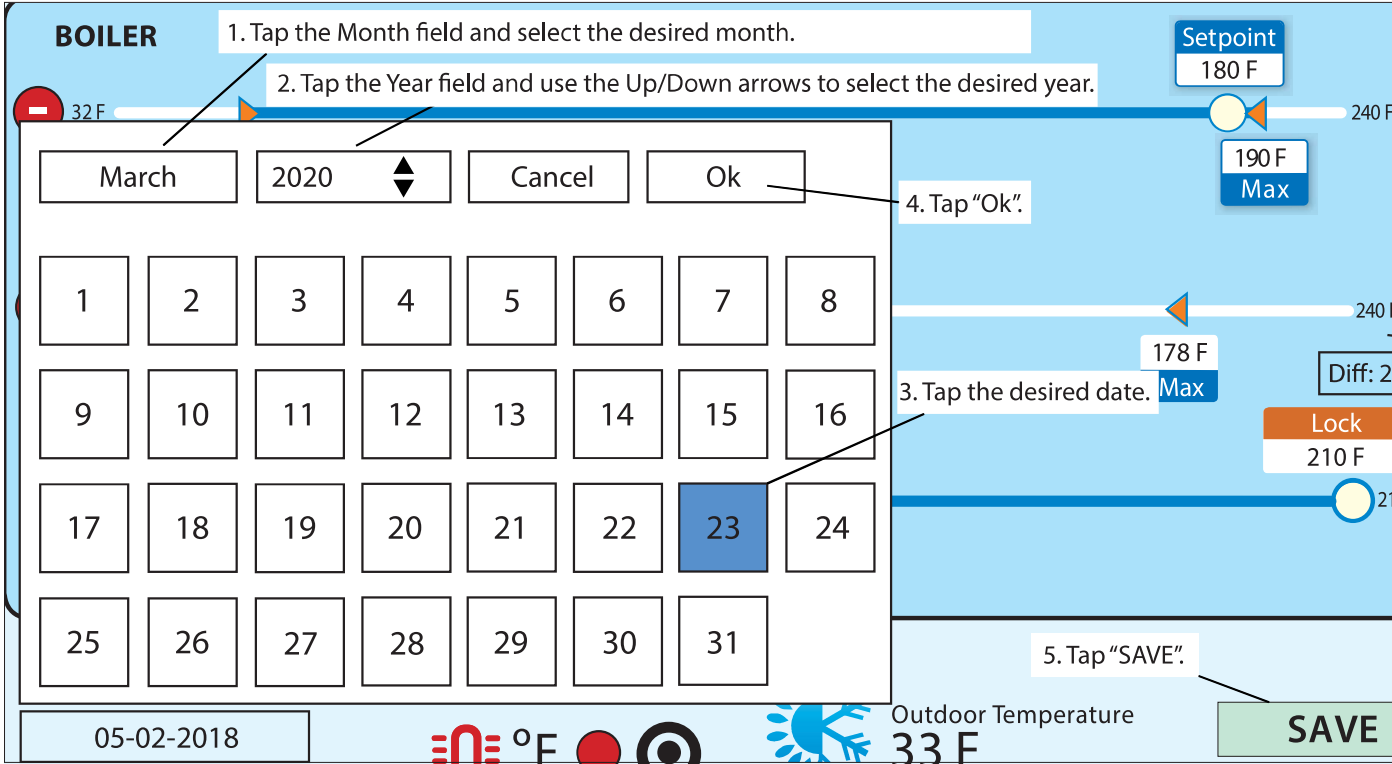


Figure 52 - Setting the Date

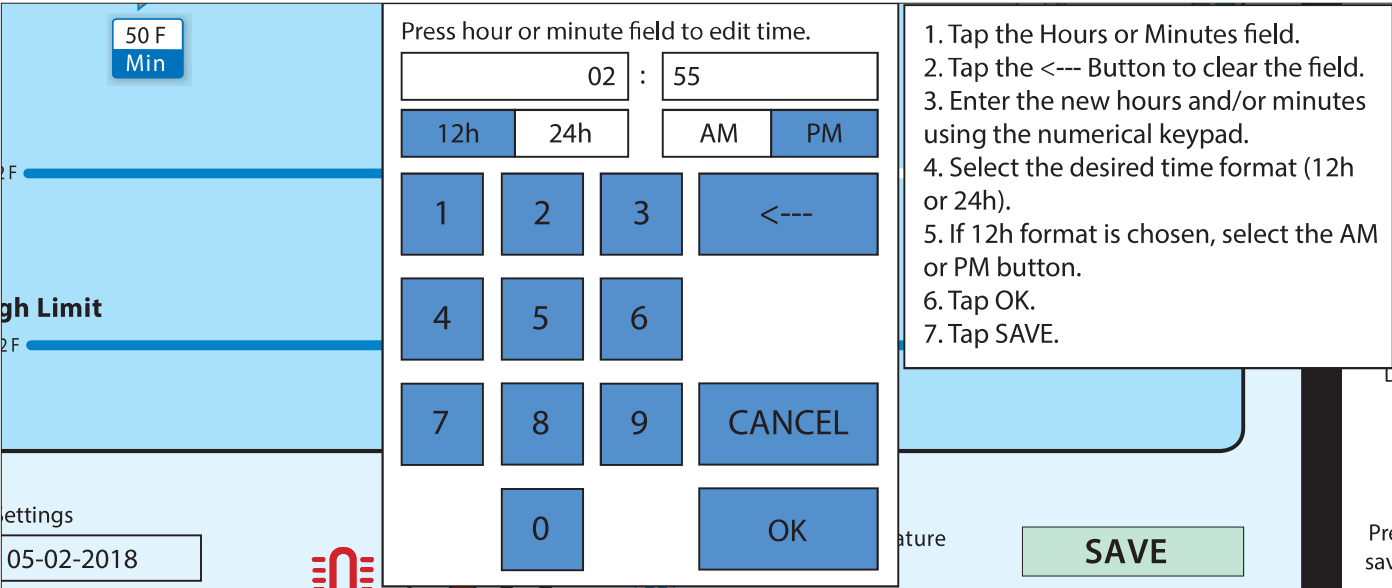


Figure 53 - Setting the Time

I. Programming Installer Settings

Installer Setting Program Access

NOTE: Programming the VWH control is not possible when the VWH is firing. Make sure any input which can create a demand on the VWH, such as the tank thermostat, is turned off, so the VWH will remain idle to allow programming.


NOTE: To change Installer Settings enter Access Code **925** when prompted.

Installer Setting Program Navigation

Use the input prompts to change the Installer settings. Press **SAVE** to store changes. Press **NEXT** to advance to the next screen, and **PREVIOUS** to go back a screen.

Installer - Installer Menu

The Installer Menu provides the installer with a number of settings to customize system operation. These settings are as follows:



- Home
- History
- Status
- Graphics
- Cascade
- User
- Installer

Installer Menu

Installer #	Description	Possible Values	Current Values	Units
1	Mode		INDIRECT	
3	DHW Tank Max Temp	95 to 185	180.5	F
6	DHW Post Pump Time	0 to 10	0	Min
7	Warm Weather Off	41 to 122	68.0	F
8	Min Outdoor Temp	-42 to 32	5.0	F
9	Max Supply Temp	77 to 190	179.6	F
10	Max Outdoor Temp	32 to 110	68.0	F
11	Min Supply Temp	32 to 190	95.0	F
12	Min Boiler Temp	32 to 190	68.0	F

PREVIOUS
DISCARD
SAVE
NEXT

Press PREVIOUS to return to the previous screen Press DISCARD to return unsaved changes to default settings Press SAVE to save settings before moving to another screen Press NEXT to advance to the next screen

Tap on an Installer value to view options and/or change the value

Figure 54 - Installer - Installer Menu Screen

Installer #	Description	Detail
1	Mode	This is the Factory Program Mode. INDIRECT indicates that the control is configured correctly. This setting cannot be changed.
3	DHW Tank Max Temp	This is the maximum temperature that can be selected in VWH settings for the DHW tank. Factory Default is 180°F. (Range: 95°F to 185°F)
6	DHW Post Pump Time	The indirect pump has the ability to post purge energy from the VWH to run the pump after the set point has been achieved. Please note that running the pump for a time greater than 5 minutes may cause tank energy to be released back to the heat exchanger. Factory Default of 1 Minute. (Range: 0 – 10 minutes)
7	Warm Weather Shutoff	Not applicable on this product.
8	Min Outdoor Temp	Not applicable on this product.
9	Max Supply Temp	Not applicable on this product.
10	Max Outdoor Temp	Not applicable on this product.
11	Min Supply Temp	Not applicable on this product.
12	Min Boiler Temp	Not applicable on this product.
13	CH Post Pump Time	Not applicable on this product.
14	DHW Priority	Not applicable on this product.
15	Cascade Address	Bus addressing VWHs (maximum VWHs allowed is eight (8) in a cascade system). Master VWH address is 0 and Follower VWHs are addressed 1 thru 7. Default: 0 (Range: 0 – 15). NOTE: DO NOT USE ADDRESSES 8 - 15.

Installer #	Description	Detail
16	Optional Inputs	Allows the user to select optional inputs to control or monitor the system. Default: OFF (Range: Off / 0-10 Volt / Booster Board).
17	0-10 Volt Function	Controls DHW storage tank setpoint. 1.5v will change the setpoint to equal the lower DHW limit (95F), 10v will change the setpoint to the DHW setpoint in the User Menu. Default is 119F. Max is 180F. If Fan Speed is selected, then 1.5v will cause the VWH to run at low fire (min fan speed) and 10v will cause the VWH to go to high fire (max fan speed). Factory Default = Temperature (Range: Temperature or Fan Speed).
18	Step Modulation Mode	Not applicable on this product.
19	Boiler Supply DHW	Not applicable on this product.
20	Water Safety Input	The user can select various water safety inputs used in the VWH system. Default: Water Flow (Range: OFF / Water Pressure / Water Flow).
21	Error Outdoor Sensor	Not applicable on this product.
22	Adjust Boiler Output %	Adjusts the VWH output down from 100% to 50%. Factory Default: 100%. (Range: 50% – 100%)
23	Cascade Mode	Allows the user to select cascade mode. Select 0 if VWH is operating alone. Choose 1 to establish a cascaded system. Factory Default: 0 (Range: 0 - 8). Ex: 0 for OFF, 1 for ON. NOTE: DO NOT USE NUMBERS 2 - 8. Doing so will result in a COMMON FLUE BLOCK error code. Always select 0 if VWH is operating alone or with Vision 3 panel.
24	Cascade Rotation	Sets the number of hours before the first VWH in the cascade firing rotation will be changed. NOTE: If this is set to 0, the firing order of the VWHs will not rotate. Factory Default: 48 hours (Range: 0 – 240 hours).
25	Cascade DHW Mode	Not applicable on this product.
26	System Freeze Protection	NOTE: This parameter is only active if the VWH is a cascade master. Allows the user to set the freeze protection when a system pump is used. Factory Default: OFF. Selection of temperature activates freeze protection. (Range: OFF, -58°F – 104°F).
27	Error System Sensor	Sets the control to display a blocking or fault code if the system sensor is open or shorted. NOTE: This does not stop the VWH (or VWHs) from running. Factory Default: ON (Range: ON / OFF).
28	Freeze Protection	Allows the user to set freeze protection on the VWH. Factory Default: ON (Range: ON / OFF).
29	DHW Modulation Mode	Not applicable on this product.
30	Extra Boiler Mode	Allows for a non HTP VWH to be controlled when the cascade output has risen above the percent of the cascade firing rate set in this parameter. Factory Default: OFF (Range: OFF, 50% - 100%).
31	System Sensor Mode	Suppresses the 'NO FOLLOWER' display message if the VWH is used as a cascade master VWH with no follower VWHs connected. Factory Default: OFF (Range: ON / OFF).
32	Service Schedule	Selects a service date or time based on the VWH run hours to program the VWH maintenance schedule. Factory Default: OFF (Range: OFF / Run Hours / Date).
33	Service Schedule Year	If the date function was selected, allows the user to set the year of the next service reminder.
	Service Schedule Hours	If the run hour function was selected, allows the user to set the number of run hours before the next service reminder.
34	Service Schedule Month	If the date function was selected, sets the month of the next service reminder.
35	Service Schedule Day	If the date function was selected, sets the day of next service reminder.
36	Telephone	Allows the user to input a telephone number that will display when maintenance is required.
37	Modbus Mode	Enables Modbus/BACnet Mode on the appliance. Factory Default: OFF (Range: ON, OFF, AUTO). See Modbus/BACnet Instructions (lp-548) for details. NOTE: Turning this Mode "ON" without a connected and powered Modbus communication adapter (p/n 7350P-636) will result in improper appliance operation. Service calls associated with this ARE NOT covered by warranty.

NOTE: Modbus Mode must be enabled on the appliance as outlined above for the following parameters to be viewed and changed.

38	Modbus Address	<p>Sets the Modbus/BACnet address. The address space is comprised of 256 addresses. These are defined as follows:</p> <ul style="list-style-type: none"> Address 0 is a broadcast address. The master can send data to address 0 and all followers will process the data. Addresses 1 – 247 are free to be assigned to Modbus devices on the bus. Each address can be assigned to only one Modbus device on the bus.
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Installer #	Description	Detail
39	Modbus Speed	The Modbus speed (communication speed) can be set on the control display to either 9600 or 19200 baud. All HTP appliances, as well as any other device on the same bus and the Modbus/BACnet master, must have the same baud rate setting. Select the highest baud rate that offers the most reliable communication performance over the bus.
40	Modbus / Stop Parity	NOTE: This setting only applies to Modbus operation. The BACnet protocol does not utilize parity for communication and this setting will have no effect. The parity/stop bits parameter of the Modbus/BACnet adapter must match the rest of the devices on the bus. Although it is common to set serial devices to use no parity, setting the parity to even or odd may improve communications reliability on all connected devices on the bus.

NOTE: The following parameters are displayed regardless if Modbus Mode is enabled.

53	Damper Valve Logic Enabled	DO NOT USE
54	Boost Time (Same Value as the Boost Slider in the Outdoor Reset Screen)	Not applicable on this product.
55	CH Pump Priority	Not applicable on this product.
56	0-10VA Output Configure	Controls the operation of the 0-10V A output on the Field Connection Board. Factory Default: PUMP (Range: BOIL POWER / CASC POWER / FAN SPEED / ALARM / TEMPERATURE / FLAME / PUMP).
57	0-10VA Output Offset	This value is added to the OFFSTATE VOLT OA1 value, to determine the total voltage output required at the minimum case. Factory Default: 1.5 (Range: 0.0 to 9.9)
58	0-10VB Output Configure	Controls the operation of the 0-10V B output on the Field Connection Board. Factory Default: BOIL POWER (Range: BOIL POWER / CASC POWER / FAN SPEED / ALARM / TEMPERATURE / FLAME).

The following information details the **0-10V Output** parameters described in Function 56 that can be read at a Building Management System.

BOIL POWER - 0-10V output is proportional to VWH firing rate. 0V = Not Firing, 1.5V = Minimum Firing Rate, 10V = Maximum Firing Rate

CASC POWER - When configured on the Cascade Master, 0-10V is proportional to the firing rate of the Cascaded System. 0V = Not Firing, 1.5V = Minimum Firing Rate (One VWH Lit), 10V = Maximum Firing Rate of all Connected VWHs

FAN SPEED - Output is proportional to VWH fan speed. 0V = Fan is Off, 1.5V = Minimum Fan Speed, 10V = Maximum Fan Speed

ALARM - 0V = Alarm is Off, 10V = Alarm is On

TEMPERATURE - Output follows VWH temperature setting based on outdoor reset. 0V = Minimum VWH Temperature for Maximum Outdoor Temperature Setting. 10V = CH (or cascade) temperature setting. This number will vary with the outdoor temperature so that the user can know what setpoint temperature the VWH is trying to achieve.

FLAME - Equals VWH Flame Current. 0V = 0ua, 10V = 10ua.

PUMP - This output controls CH pump speed to maintain the desired Delta T. 0V = OFF, 2V (or output offset value greater than 2) = Minimum Pump Speed, 10V = Maximum Pump Speed.

59	0-10VB Output Offset	This value is added to the OFFSTATE VOLT OB1 value, to determine the total voltage output required at the minimum case. Factory Default: 1.5 (Range: 0.0 to 9.9)
60	CH dT Setting	Determines the desired temperature difference between the SUPPLY and RETURN temperatures. Factory Default: 19F (Range: 0 - 47F)
61	Offstate Voltage OA1	Determines the voltage present in OA1 when the pump is supposed to be OFF. Factory Default: 0.0 (Range: 0.0 to 9.9)

Table 21 - System Setting Program Navigation

J. Resetting the Maintenance Schedule

It is highly recommended to call for service when the Home Screen center pane alternates yellow and orange on the display. After service is performed, reset the schedule for the next required service by using the following steps.

Press **Installer**. Tap next until prompted to enter a password. Enter "928". Press MAINTENANCE RESET button in the upper right corner of the Service screen to reset the selected Service Schedule.

NOTE: The Service Screen may also be directly accessed by tapping the SERVICE MODE button in the lower right corner of the Home Screen.

K. Service Mode - Setting and Verifying the Combustion Setting - Testing the Internal LWCO

NOTE: Service Mode can be accessed from the Home Screen or by scrolling through the Installer Settings. Input Access Code **928** when prompted to enter Service Mode.

Service Mode is intended to simplify fan testing, purging air from the water lines, testing the LWCO, and gas adjustment. The following figures and tables include details on use as well as recommended combustion settings by fuel type and VWH fan speeds. Automatic modulation does not take place while the controller is in Service Mode. However, the VWHs will modulate down if the program set point is reached while running in Service Mode. It is recommended to enter Service Mode with the largest load possible to create such a heat demand that Service Mode will not be interrupted. To enter Service Mode tap Installer in the display Navigation Bar; then tap NEXT until you reach the Service Mode screens detailed in Figure 55, or use the SERVICE MODE button at the Home Screen.

NOTE: The VWH will automatically exit Service Mode after 20 minutes of operation.

Press the black up ^ and down v arrows to increase and decrease fan speed fifty (50) RPM. Press the red up ^ arrow to go directly to max fan speed and high fire. Press the blue down v arrow to go directly to min fan speed and low fire. Model fan speeds are displayed in Table 23.

Setting and Verifying the Combustion Setting

Enter Service Mode. At high fire, use a calibrated combustion analyzer to test CO/CO₂ measurements. Ensure the measurements meet those detailed in Table 22. If unable to reach these measurements, remove the calibrated combustion analyzer and bring it outdoors into fresh air. When the analyzer reads zero, conduct the test again. If still unable to get the required readings shown in the combustion chart, adjust the throttle screw on the gas valve in ¼ turn increments either in the positive (+) (counter-clockwise to increase fuel or CO₂) or negative (-) (clockwise to decrease CO₂) direction. When the CO/CO₂ measurements meet those in Table 22 at high fire, conduct the test at low fire. Record the combustion measurements in this manual for future reference.

Combustion Settings on 400 - 1000 Models		
Fan Speed	Natural Gas (NG)	
	Low	High
Carbon Monoxide (CO) PPM	Less than 200	
Carbon Dioxide (CO ₂) %	9 - 10 1/2	8 1/2 - 9 1/2
Fan Speed	Propane (LP)	
	Low	High
Carbon Monoxide (CO) PPM	Less than 200	
Carbon Dioxide (CO ₂) %	10 - 11	9 1/2 - 10 1/2
Combustion Settings on 1500 Models		
Fan Speed	Natural Gas (NG)	
	Low	High
Carbon Monoxide (CO) PPM	Less than 200	
Carbon Dioxide (CO ₂) %	8 - 9	8 1/2 - 9 1/2
Fan Speed	Propane (LP)	
	Low	High
Carbon Monoxide (CO) PPM	Less than 200	
Carbon Dioxide (CO ₂) %	9 - 10	9 1/2 - 10 1/2
Combustion Settings on 2000 Models		
Fan Speed	Natural Gas (NG)	
	Low	High
Carbon Monoxide (CO) PPM	Less than 200	
Carbon Dioxide (CO ₂) %	8 - 9	8 1/2 - 9 1/2

Table 22 - Combustion Settings - All Models

WARNING

Adjustments to the throttle screw or offset may only be made by a qualified gas technician using a calibrated combustion analyzer capable of measuring CO₂ and CO. Failure to follow this instruction could result in fire, explosion, property damage, severe personal injury, or death.

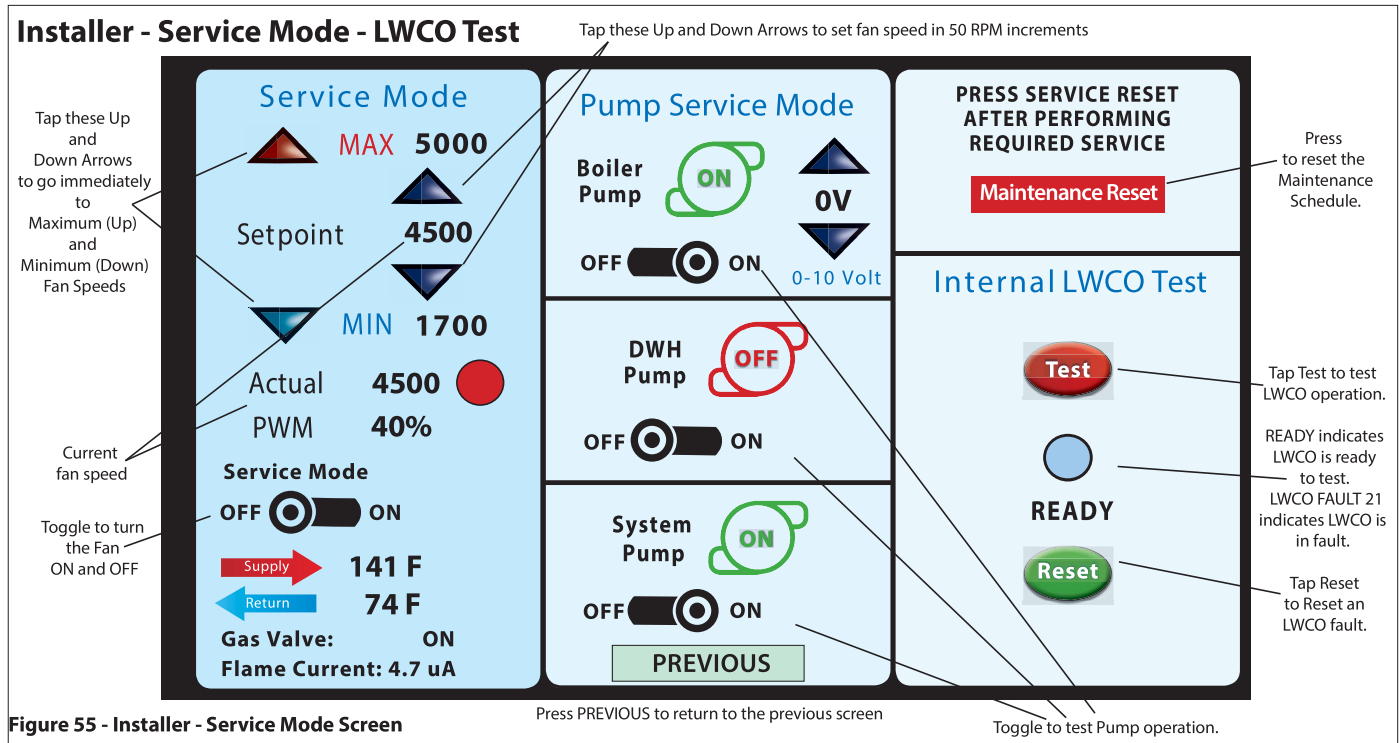
Fan Speeds (RPM)				
Model	Fuel Type	Ignition	Min	Max
ELX-400	NG	3000	1500 (+/- 50)	7600 (+/- 100)
	LP			
ELX-500	NG	3000	1600 (+/- 50)	8600 (+/- 100)
	LP			
ELX-650	NG	3000	1800 (+/- 50)	7800 (+/- 100)
	LP			
ELX-800	NG	3000	1810	8100
	LP	3500	1680	8800
ELX-1000	NG	2500	1850 (+/- 50)	9000 (+/- 100)
	LP	3500		
ELX-1500	NG	3000	1400 (+/- 50)	6800 (+/- 100)
	LP			
ELX-2000	NG	2000	1250	6400

Table 23 - Fan Speeds - All Models

Testing the UL 353 Approved Internal LWCO

In Service Mode, locate Internal LWCO Test in the lower right hand corner of the screen. If the screen indicates that the Internal LWCO is READY to test, tap Test. See Figure 55. If the Internal LWCO trips properly, the screen will read LWCO FAULT F21. See Figure 55. Now tap Reset to reset the LWCO and clear the fault.

To leave Service Mode, tap PREVIOUS to stay in the Installer menu or press Home.



Part 12 - VWH Monitoring

A. Status Screens

The VWH control has the ability to review system status. To access the Status screens, tap Status in the display Navigation Bar. Tap NEXT or PREVIOUS to swap between the screens. Tap Home in the display Navigation Bar to exit the Status screens.

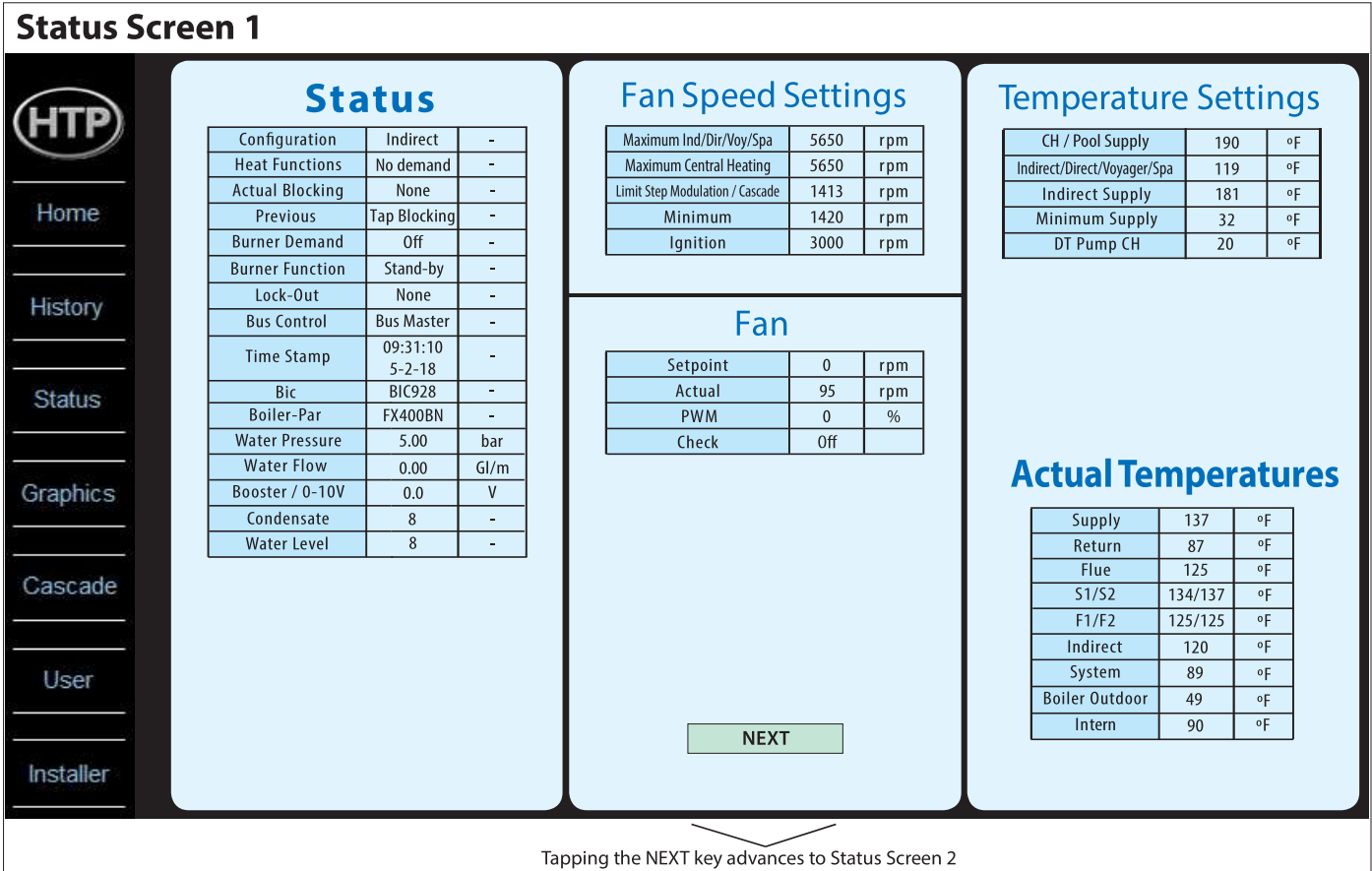


Figure 56 - Status Screen 1

Status Table	
Display	Description
Configuration	This is the factory setting of the appliance. It should always read "Indirect".
Heat Functions	Lets the user know if the appliance is servicing a demand for heat. In this example, there is no demand.
Actual Blocking	This would display a blocking code if the appliance was currently in a blocking state.
Previous	Displays most recent blocking code. In this example, "Tap blocking" was the most recent.
Burner Demand	Will display a demand on the burner. In this example there is currently no demand.
Burner Function	Displays the current burner state. Burner is in stand-by in this example.
Lock-Out	Displays if the appliance is in lockout.
Bus Control	This displays the bus state of the appliance. The appliance in this example is the bus master.
Time Stamp	Displays the time and date.
Bic	Refers to the current control revision. "BIC928" in this example.
Boiler-Par	Refers to the parameter set programmed into the appliance.
Water Pressure	Not Used.
Water Flow	Not Used.
Booster / 0-10V	Displays the voltage on the optional input. This voltage is only relevant if an external 0-10 volt signal is being used to control the VWH.
Condensate	0 indicates an empty condensate trap. A number above 50 triggers a Condensate Full Lockout.
Water Level	Displays the "electrical resistance" between the LWCO probe, through the water, to ground. A value of 80 and above indicates a lack of water in the appliance (open circuit). A perfect connection to ground would indicate a level of 0.

Table 24 - Status Screen 1 - Status Table

Fan Speed Settings	
Display	Description
Maximum Ind/Dir/Voy/Spa	These settings describe the appliance fan speed settings. These settings are for reference only. Fan Speed Settings are programmed into the control at the factory and cannot be changed in the field.
Maximum Central Heating	
Limit Step Modulation / Cascade	
Minimum	
Ignition	

Table 25 - Status Screen 1 - Fan Speed Settings

Fan Table	
Display	Description
Setpoint	This is the current setpoint of the fan as determined by the control.
Actual	This displays the actual fan RPMs.
PWM	This is the current percentage of power being applied to the fan.
Check	Will display "OK" if fan speed is within operating limits.

Table 26 - Status Screen 1 - Fan Table

Temperature Settings Table	
Display	Description
CH / Pool Supply	Current CH Setpoint
Indirect/Direct/Voyager/Spa	Current DHW Setpoint
Indirect Supply	Maximum temperature that the VWH can supply to the indirect DHW HX input.
Minimum Supply	Minimum temperature that the VWH can supply to the indirect DHW HX input.
DT Pump CH	Current dT setting in degrees when a delta T pump has its 0-10v wires connected to P9-6 and P9-6 on the low voltage connection board.

Table 27 - Status Screen 1 - Temperature Settings Table

Actual Temperatures Table	
Display	Description
Supply	Shows the actual supply temperature measured by the supply sensor.
Return	Shows the actual return temperature measured by the return sensor.
Flue	Displays the current VWH flue temperature.
S1 / S2	Shows the actual temperatures measured at the appliance by the dual supply sensor (S1 = supply A and S2 = supply B).
F1 / F2	Shows the actual temperatures measured at the appliance by the dual flue sensor (F1 = Flue A and F2 = Flue B).
Indirect	Displays the actual temperature measured by the tank or return sensor (HTP 7250P-325). If a mechanical aquastat is used in place of the recommended sensor, it will display "N/C" if the aquastat is open because the DHW tank is satisfied. If the aquastat is closed it will display ON.
System	This screen displays the system sensor reading. The control will cascade the VWHs up to this set point depending on demand. If there is no system sensor this will display "N/C".
Boiler Outdoor	The current outdoor temperature is displayed. If there is no outdoor sensor connected to the VWH, this line will display "N/C" in place of the temperature. If the outdoor sensor is shorted, this line will display "ON" in place of the temperature.
Intern	Ambient board temperature of BIC928 control, as measured by the on-board Comfort Microprocessor.

Table 28 - Status Screen 1 - Actual Temperatures Table

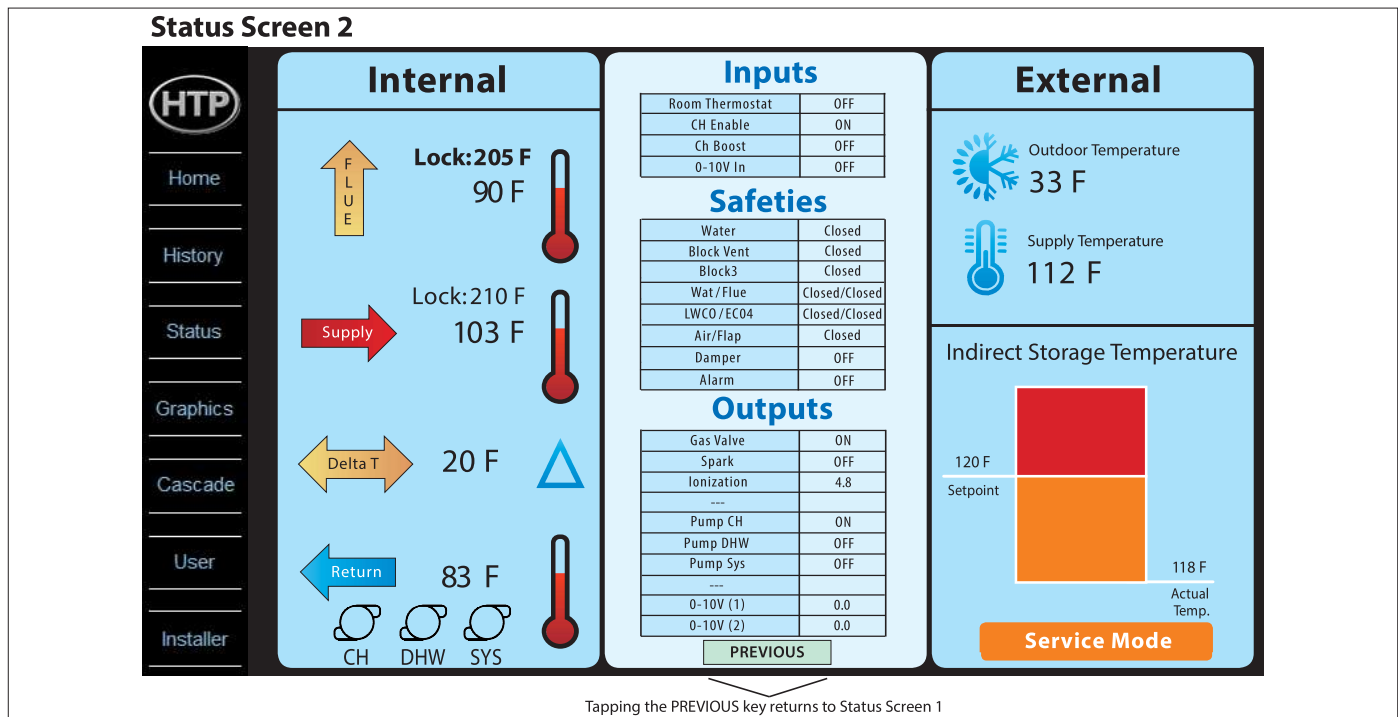


Figure 57 - Status Screen 2 - NOTE: For Reference Use ONLY.

Status Screen 2 - Internal

Internal describes the current temperature readings read by the flue, supply, and return sensors, as well as the Delta T setting and the flue and supply lockout temperatures.

Inputs Table	
Display	Description
Room Thermostat	Displays whether the room thermostat is on or off.
CH Enable	Displays whether CH Enable is on or off.
CH Boost	Displays On or Off if CH Boost is engaged.
0-10V In	Displays whether 0-10V Input is on or off. Displays ON if 0-10V is enabled.

Table 29 - Status Screen 2 - Inputs

Safeties Table	
Display	Description (Normal Operation Displays "Closed")
Water	Displays "Open" when the Water/Flow/Press input is open (e.g. when the flow switch does not detect flow).
Block Vent	Displays "Open" when the Blocked Vent Pressure Switch (BVPS) input is open (e.g. flue blockage and high flue pressure).
Wat / Flue	Displays "Closed/Open" when the flue temp limit input is open. Displays "Open/Open" when either the target wall (Burner door), external LWCO, or water temp limit input is open.
LWCO / ECO4	Displays "Closed/Open" when the target wall (burner door) input is open. Displays "Open/Open" when the external LWCO input is open.
Air / Flap	This signal tells the control when the damper vane is in the open or closed position. It is unused but is present for future functionality. It will appear as open or closed.
Damper	Displays when the Flue damper is powered on or off. This will appear as "Closed" during normal operation.
Alarm	Displays whether the alarm is on or off.

Table 30 - Status Screen 2 - Safeties - NOTE: See below for further detail.

HMI Status Screen 2 - Safeties									
Open Signal	I/O	928 Pins	Water	Block Vent	Block 3	Wat/Flue	LWCO/ECO4	Air/Flap	Damper
Flue temp limit - NOTE: The Flue ECO has been replaced with a jumper in the LV harness.	ID1	X7-10, X7-20	Closed	Closed	Closed	Closed/ Open	Closed/Closed	Closed	Closed
Burner Door ECO	ID2	X7-8, X7-18	Closed	Closed	Closed	Open/Open	Closed/ Open	Closed	Closed
Man Reset HL	ID3	X7-9, X7-19	Closed	Closed	Closed	Open/Open	Closed/Closed	Closed	Closed
Flap closed/APS - NOTE: Unused	ID4	X7-6, X7-16	Closed	Closed	Closed	Closed/Closed	Closed/Closed	Open	Closed
BVPS	ID5	X6-9, X6-18	Closed	Open	Closed	Closed/Closed	Closed/Closed	Closed	Closed
H/L Gas pressure	ID6	X6-8, X6-17	Closed	Closed	Open	Closed/Closed	Closed/Closed	Closed	Closed
Flowswitch	ID8	X7-1, X7-11	Open	Closed	Closed	Closed/Closed	Closed/Closed	Closed	Closed
External LWCO	ID14	X7-7, X7-17	Closed	Closed	Closed	Open/Open	Open/Open	Closed	Closed

Outputs Table	
Display	Description
Gas Valve	Displays whether the gas valve is on or off.
Spark	Displays whether the spark is on or off.
Ionization	Displays the current flame ionization current.
---	---
Pump CH	Displays whether the CH Pump is on or off.
Pump DHW	Displays whether the DHW Pump is on or off.
Pump Sys	Displays whether the Pump Sys is on or off.
---	---
0-10V (1)	Displays the 0-10V (1) output voltage.
0-10V (2)	Displays the 0-10V (2) output voltage.

Table 31 - Status Screen 2 - Outputs

Status Screen 2 - External

External describes the current outdoor temperature and system temperature readings, as well as DHW Temperature setpoint and actual DHW temperature.

B. History Screens

The VWH control also has the ability to review its current history. To access the History screens, tap History in the display Navigation Bar. Tap NEXT or PREVIOUS to swap between the screens. Tap Home in the display Navigation Bar to exit the History screens.

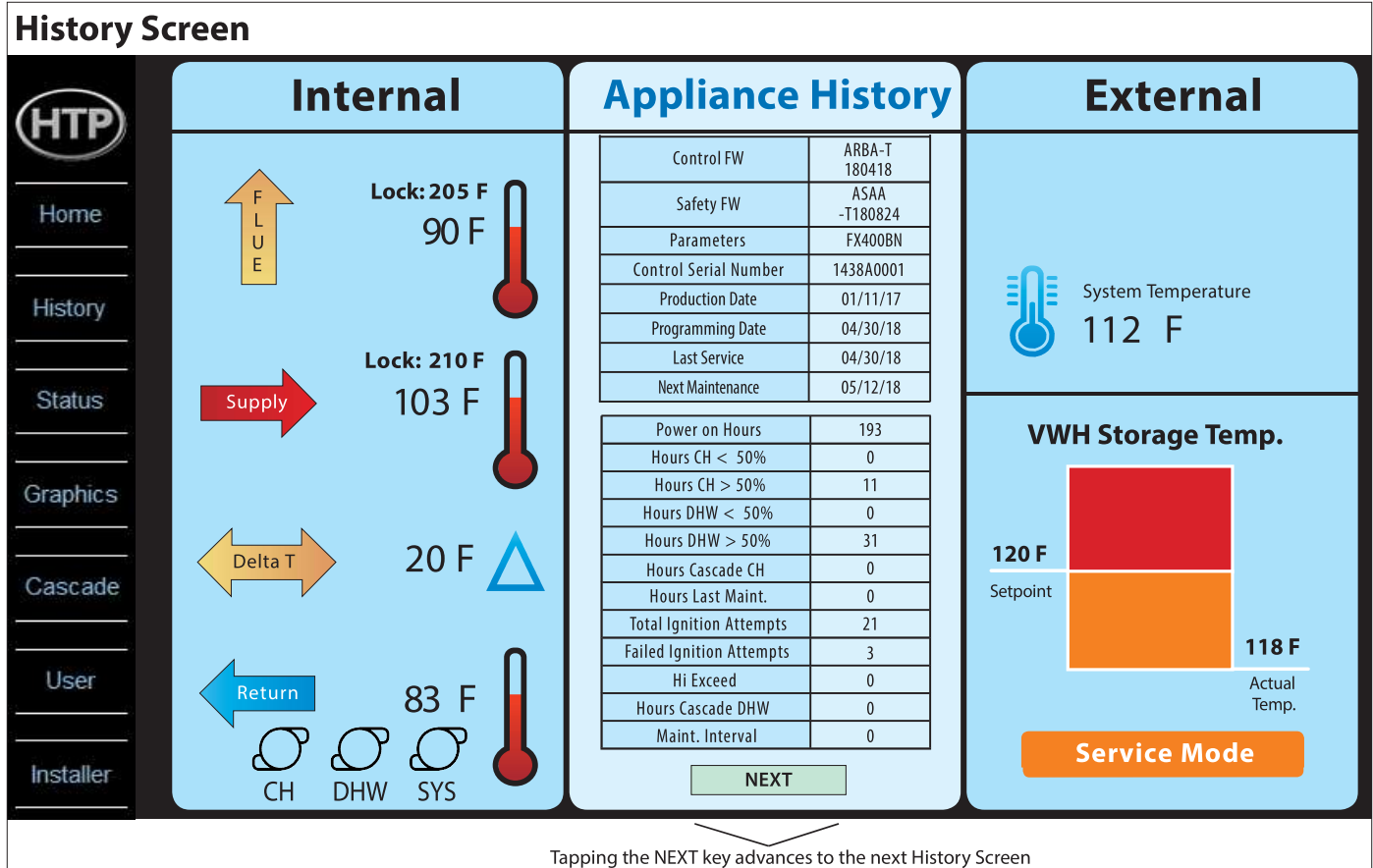


Figure 58 - History Open Screen

History Screen - Internal and External

The History Open Screen displays the current Internal and External temperatures. These are the same as those displayed and described in the Status section.

Appliance History Table	
Display	Description
Control	Displays control details, including the Comfort and Safety firmware revisions programmed into the control.
Parameters	Displays the programmed appliance model number parameter set.
Serial Number	Displays the appliance serial number.
Production Date	Displays the appliance production date.
Programming Date	Displays when the appliance was last programmed.
Last Service Date	Displays when the appliance was last serviced.
Next Maintenance	Displays the next appliance service date.
Power On Hours	Displays the total appliance power on hours.
Hours CH < 50%	Displays the total hours that the appliance has met a CH demand at below 50% power.
Hours CH > 50%	Displays the total hours that the appliance has met a CH demand at greater than 50% power.
Hours DHW < 50%	Displays the total hours that the appliance has met a DHW demand at below 50% power.
Hours DHW > 50%	Displays the total hours that the appliance has met a DHW demand at greater than 50% power.
Hours Cascade CH	Displays the total hours that the appliance has met a Cascade CH demand.
Hours Last Maint	Displays the total hours since the last time the appliance was maintained.
Total Ignition Attempts	Displays the total appliance ignition attempts.
Failed Ignition Attempts	Displays the total appliance ignition failures.
Hi Exceed	Displays the number of times the high limit has been exceeded.
Hours Cascade DHW	Displays the total hours that the appliance has met a Cascade DHW demand.
Maint Interval	Displays the interval time for the time until the next Maintenance notice.

Table 32 - History Screen - Appliance History Table

History Screen - Faults Screen

Tap NEXT at the History Screen to display the ten (10) most recent lock-out faults along with the date and time when they occurred. There is a list of fault codes as well as their total amount of occurrences. Internal temperatures are also provided for troubleshooting purposes.

History Screen - Blocks Screen

Tap Show Blocks at the History Faults Screen to display the ten (10) most recent blocking codes along with the date and time when they occurred. There is a list of fault codes as well as their total amount of occurrences. Internal temperatures are also provided for troubleshooting purposes. Tap Show Faults to return to the History Faults Screen. Tap PREVIOUS to return to the History Screen.

History Faults and Blocks Screens

Will read "Last 10 Blocks" after tapping "Show Blocks"

Internal

HTP

Home

History

Status

Graphics

Cascade

User

Installer

FLUE

Lock: 205 F

90 F

Supply

Lock: 210 F

103 F

Delta T

20 F

Return

83 F

CH DHW SYS

Last 10 Faults

1	F24 Target Wall	02:22:2020 17:34
2	F02 Supply Sensor interrupted	02:22:2020 12:12
3	F02 Supply Sensor interrupted	02:22:2020 12:21
4	F02 Supply Sensor interrupted	02:22:2020 12:25
5	None	-
6	None	-
7	None	-
8	None	-
9	None	-
10	None	-

Show Blocks

PREVIOUS

Fault Codes

CODES		TOTAL
F00 ECO 1 Water	0	0
F01 ECO 2 Flue Temp.	0	1
F02 Supply Sensor	3	4
F03 Return Sensor	0	0
F04 Flue Sensor	0	0
F04 Flue Sensor n.c.	0	0
F05 Supply Maximum	0	0
F06 Return Maximum	0	0
F09 No Ignition	0	0
F10 Flame Fault	0	0
F11 False Flame	0	0
F13 Fan Speed Low	0	0
F14 Fan Speed High	0	0
F15 Aps Stuck Open	0	0
F16 Aps Stuck Closed	0	0
F17 Flue Maximum	0	0
F20 Water Level 1	0	0
F21 Water Level 2	0	0
F22 External LWCO	0	0
F24 Burner Door	1	1
F26 Gas Pressure	0	0
F28 Burner Temp.	0	0
F30 Burner Sensor	0	0

NEXT

This table lists all Lockout Fault and Blocking Codes as well as how many times the codes have occurred

Tapping Show Blocks advances to the Last 10 Blocks screen - Tapping Previous returns to the previous History Screen

Figure 59 - History Faults and Blocks Screens

C. Graphics Screen

Tap Graphics in the display Navigation Bar to open the Graphics function. The Graphics function allows the installer / user to select, record, and view real time system analytics. This function helps the installer / user fine tune system operation and aids in troubleshooting.

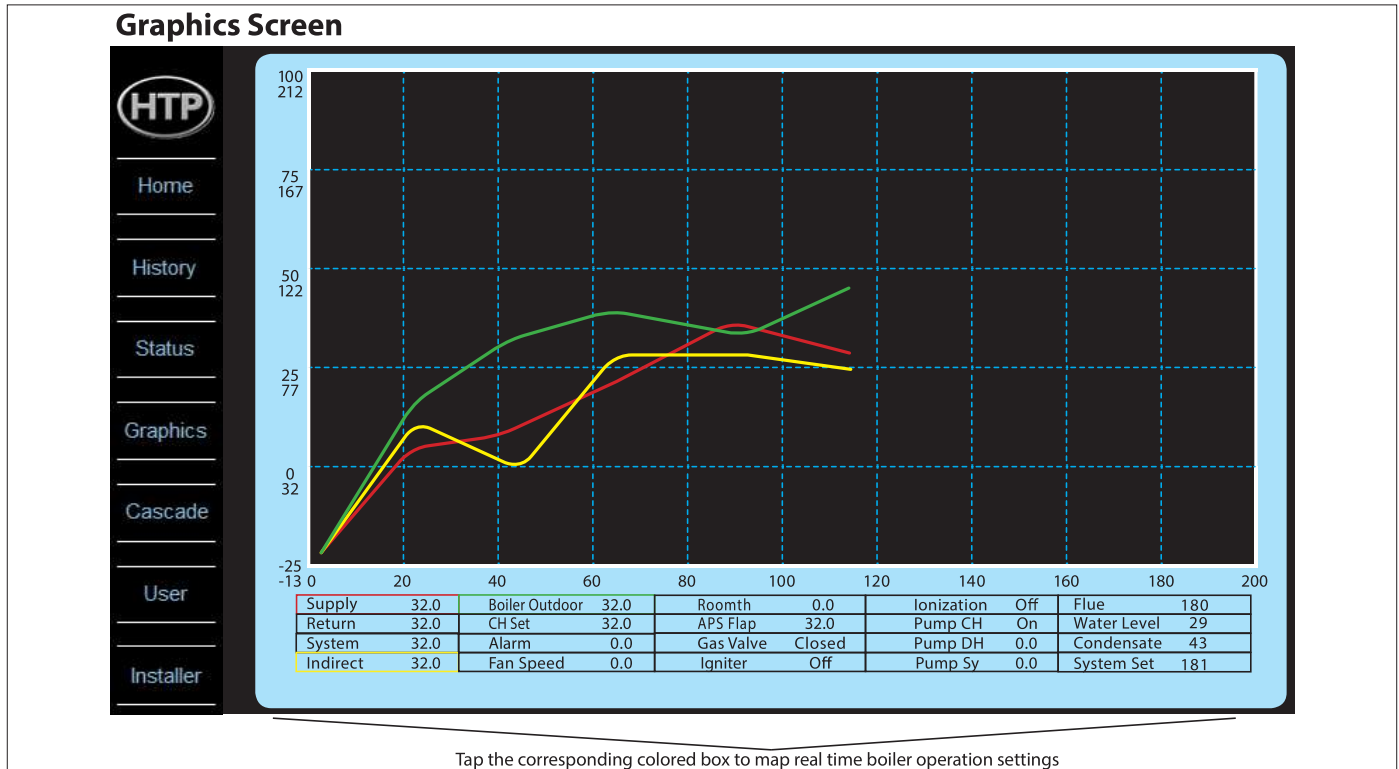


Figure 60 - Graphics Screen

D. Cascade Screen

To access Cascade system status and settings, tap Cascade in the display Navigation Bar. Tap NEXT or PREVIOUS to swap between the screens. **NOTE:** If the VWH is not in Cascade mode, all indicators (ie pumps) will be disabled, and Outdoor temperature and System temperature will be displayed as N/C.

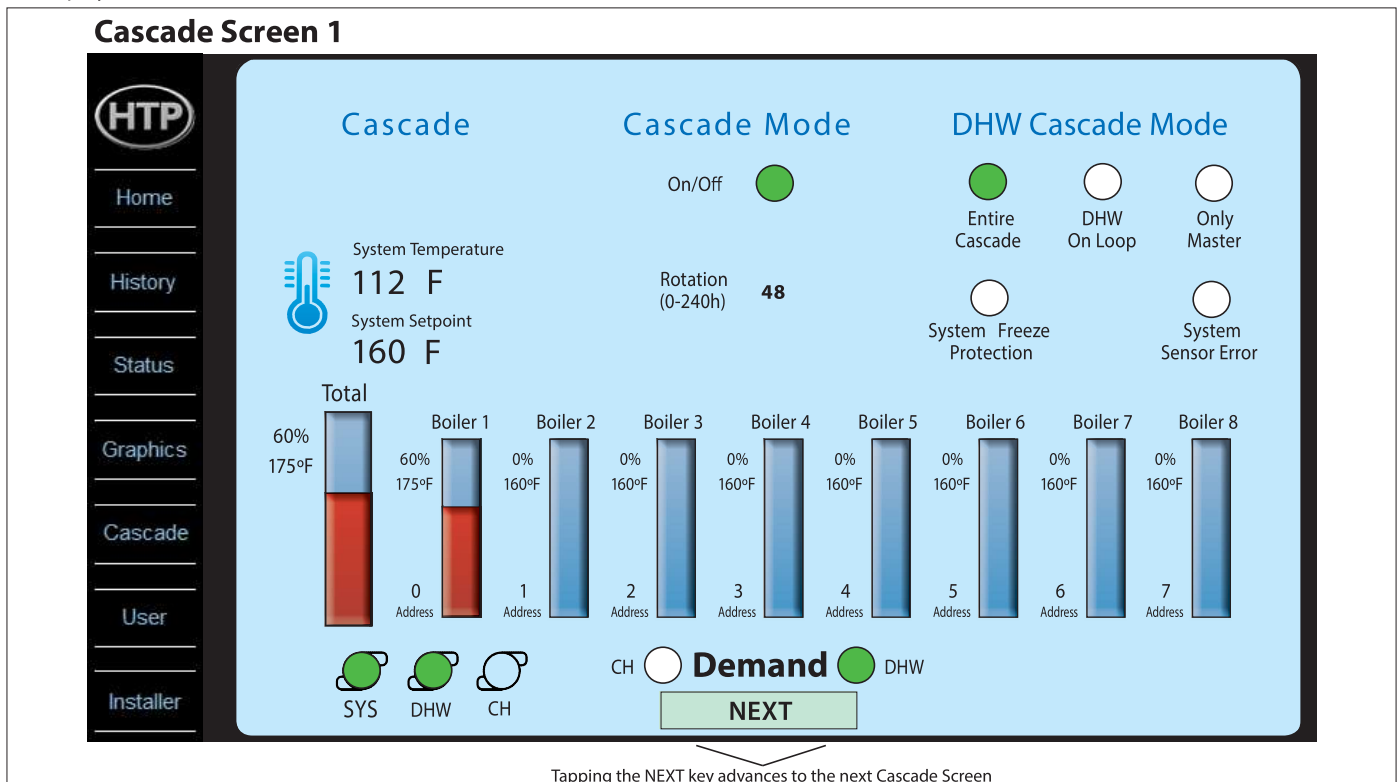


Figure 61 - Cascade Screen 1

Cascade Screen 1

Cascade Screen 1 shows the current system supply and outdoor temperature readings, states whether Cascade Mode is On or Off, as well as whether DHW Cascade Mode is On or Off and the enabled DHW Cascade Mode setting. System Freeze Protection enable and System

Sensor code are shown here. The Cascade Mode rotation hours are shown here. The operating percentages of connected appliances is shown towards the bottom of the screen, along with whether the SYS, DHW, or CH pumps are enabled and whether the system is meeting a CH or DHW demand. The above screen shows a single VWH system. One VWH is operating at 60% of total modulation capacity.

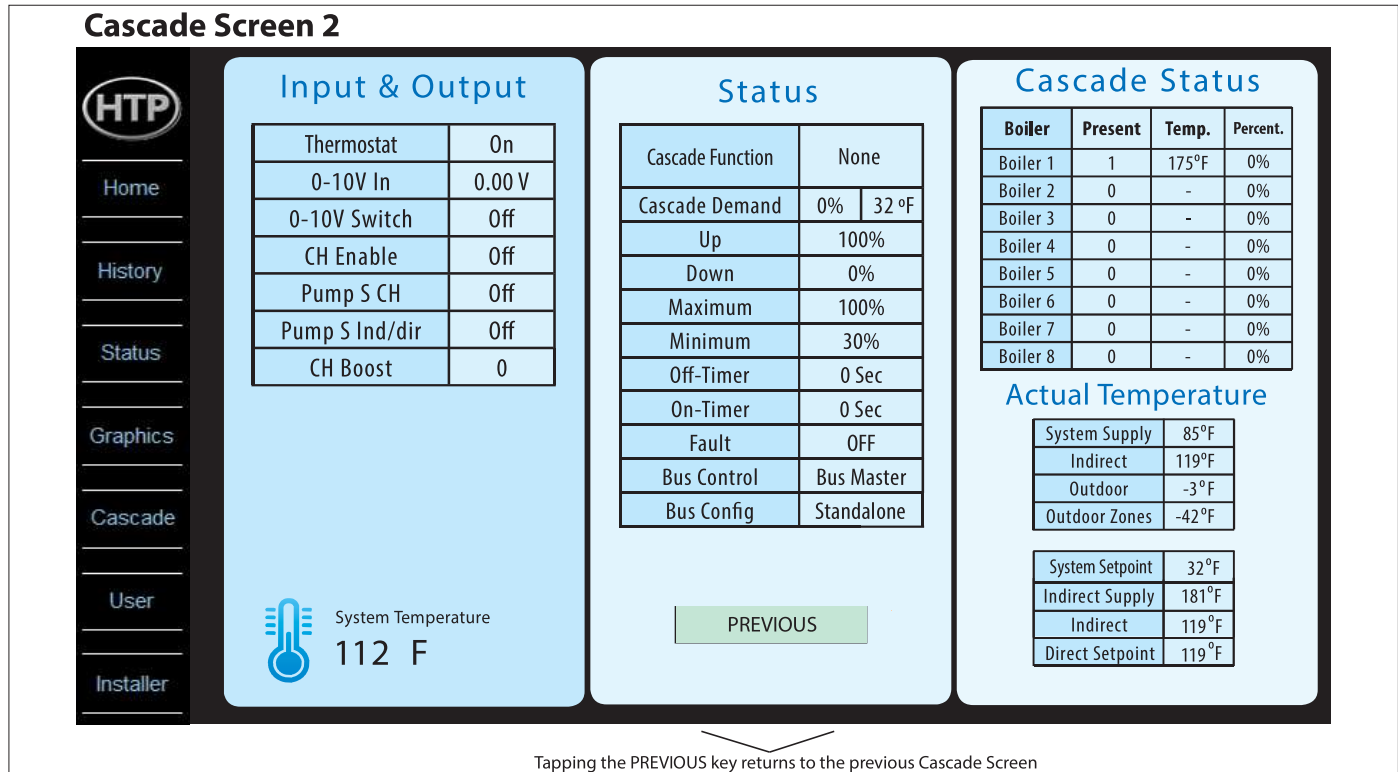


Figure 62 - Cascade Screen 2

Cascade Screen 2

Cascade Screen 2 replicates many items that can be found on other display screens, including the current Outdoor and System temperatures and Actual Temperature readings. The Cascade Status table offers a text representation of the visual and textual Cascade Status from Cascade Screen 1.

Input and Output Table	
Display	Description
Thermostat	*Displays whether the room thermostat is on or off.
0-10V In	Displays current 0-10V voltage input.
0-10V Switch	Displays whether 0-10V is On or Off.
CH Enable	Displays whether CH Enable is on or off.
Pump S CH	Displays whether CH Pump is on or off.
Pump S Ind/dir	Displays whether DHW Pump is on or off.
CH Boost	Displays whether CH Boost is engaged.

Table 34 - Cascade Screen 2 - Input and Output Table - *Will only display if not in Cascade Mode

Status Table	
Display	Description
Cascade Function	This indicates whether the cascade function is turned on.
Cascade Demand	Displays the entire percentage of cascaded system demand. Ex: 3 VWH system at max power equals 300%.
Up	Power level at which that VWH will switch on the next VWH (Default = 100%).
Down	Power level at which the last VWH will switch off (Default = 0%).
Maximum	Maximum power allowed per VWH (Default = 100%).
Minimum	Minimum power allowed per VWH. Below this setting the VWH will switch off (Default = 30%).
Off-Timer	Timer to prevent switching off the next VWH (Default = 0 sec).
On-Timer	Timer to prevent switching on next VWH (Default = 0 sec).
Fault	Indicates ON when VWH is in an Alarm state, OFF when the Alarm is cleared.
Bus Control	This displays the bus state of the appliance. The appliance in this example is the bus master.
Bus Config	This displays the bus configuration of the appliance. The appliance in this example is standalone.

Table 33 - Cascade Screen 2 - Status Table

Part 13 - Troubleshooting

Unresponsive Screen - Ensure the screen is not installed too tightly into the housing, as the screen may be recording a continuous touch at the edges. Turn the VWH power off at the main power supply and loosen the screen slightly by backing out the nuts behind the housing. If the problem persists calibrate the screen. See below.

Touchscreen Calibration - Turn the power switch off at the VWH. While touching the screen with one finger turn the power back on. The screen will go into calibration mode. Follow the instructions on the screen to complete calibration.

NOTE: If any sensor detects an abnormal condition or an internal component fails during the operation of the VWH, the display may show an blocking or fault message and code.

IMPORTANT: If you see blocking or fault codes on your display readout, call a technician immediately. The message may indicate a more serious problem will occur soon.

NOTE: A service notification will result in a center pane that alternates between yellow and orange.

A. Blocking

A Blocking message and code may be the result of a condition that must be manually corrected or by a temporary condition that will resolve itself.

The VWH control will be operable. The center pane of the Home Screen will be **Orange** and the “**Blocking**” message will display. When the condition is corrected or corrects itself the display will revert to its normal readout and operation. Be sure to observe the operation of the unit for a period of time to ensure correct operation and no reoccurrence of the code.

The controller will display a blocking code and message when a blocking condition occurs. These codes, descriptions, and recommended corrective actions are described in Section C.

B. Fault (Lockout)

A Fault (Lockout) message and code is the result of a condition that the control has evaluated as not safe to restart the VWH. In this case, the VWH control will be locked out. The center pane of the Home Screen will be **Red** and the “**Lockout**” message will display. The alarm output will also activate. Most fault conditions cause the CH pump to run in an attempt to cool the VWH.

The controller will display a fault code and message when a lock-out condition occurs. These fault codes, descriptions, and recommended corrective actions are described in Section C.

After the fault condition has been repaired by a qualified technician press and hold RESET on the display for more than 1 second to clear the fault and resume operation. Be sure to observe the operation of the unit for a period of time to assure correct operation and no reoccurrence of fault message.



WARNING

If overheating occurs or the gas supply fails to shut off, do not turn off electrical power to the circulating pump. This may aggravate the problem and increase the likelihood of VWH damage. Instead, shut off the gas supply to the VWH at the gas service valve. Failure to do so may result in property damage, personal injury, or death.

When servicing or replacing components that are in direct contact with VWH water, be certain that:

- There is no pressure in the VWH. (Pull the release on the relief valve. Do not depend on the pressure gauge reading.
- The VWH water is not hot.
- The electrical power is disconnected.
- The gas is shut off.

Failure to make these checks could result in substantial property damage, serious personal injury, or death.

DO NOT USE THIS APPLIANCE IF ANY PART HAS BEEN SUBMERGED IN WATER. Immediately call a qualified service technician. The appliance **MUST BE** replaced if it has been submerged. Attempting to operate an appliance that has been submerged could create numerous harmful conditions, such as a potential gas leakage causing a fire and/or explosion, or the release of mold, bacteria, or other harmful particulates into the air. Operating a previously submerged appliance could result in property damage, severe personal injury, or death.

NOTE: Appliance damage due to flood or submersion is considered an Act of God, and IS NOT covered under product warranty.



CAUTION

Label all wires prior to disconnecting them when servicing the VWH. Wiring errors can cause improper and dangerous operation. Failure to follow these instructions may result in property damage or personal injury.

NOTE: If system return temperatures are maintained below the dew point, condensation will form on the VWH cabinet and cause some components to rust.

C. User Interface Display

Lockout Codes

Code	Message	Description	Possible Remedy
F00	ECO 1 Water	F00 indicates the water in the VWH has overheated. The VWH will not restart until it cools sufficiently and a technician determines and repairs the cause of overheating and pushes RESET on the display. This is a serious safety issue as indicated by the illuminated red light and the word LOCKOUT flashing on the display. During this lockout fault, the pump will be on in an effort to cool the VWH down.	<ol style="list-style-type: none"> 1. Check circulator pump operation. 2. If the circulator pump is running, ensure there is water in the system and that the water is moving through the system as intended. Ensure that all correct ball valves and or zone valves are open or closed as intended. 3. Observe the temperature/pressure gauge. If the water is not too hot and this message is displayed, check the wiring to the water ECO sensor and repair if necessary. If the wiring is ok and this code is still present and the water is not excessively hot, replace the ECO sensor.

Code	Message	Description	Possible Remedy
E03	System Supply Sensor	E03 indicates a problem with the system sensor circuit. The circuit could be open or shorted. Possible reasons for this error are: 1. There is no system sensor connected to the Master VWH. 2. The system sensor is faulty. 3. There is a short circuit in the system sensor wiring; possibly from a staple placed through the wire, or damage to the wire causing both conductors to touch. 4. The system sensor wiring is open due to defect or damage.	Disconnect the system sensor from the wiring and measure its resistance. Compare the measured resistance to the table in this manual to see if it corresponds to the temperature of the sensor. If the resistance does not agree with the table, replace the sensor. If the sensor is OK, disconnect the sensor wiring from both the VWH and the sensor and check continuity using an ohmmeter. Repair or replace as necessary. If this error is present, the VWHs in the cascaded group will run and ignite simultaneously when there is a heat demand. Each VWH will modulate to maintain set point temperature on its own supply sensor. This code automatically resets when repair is complete. This code will not display if system setting function ERROR SYSTEM SENS is set to OFF.
F01	Flue Temp ECO	The dual flue sensor contains two sensing elements within a single body. F01 indicates that one or both halves of the supply temperature sensor has failed OR the difference between the dual sensor readings is greater than 18°F. This is a serious safety issue and the VWH will not restart until a qualified service technician replaces the sensor and pushes the RESET button on the display. This situation is indicated by the red center pane of the Home screen. The word LOCKOUT will also be displayed. During this lockout fault, the pump will be on.	1. Check the electrical connections to each half of the thermistor on the outlet manifold. Verify 3.3 VDC by checking in Molex connector. If there is not 3.3 VDC, check the harness. If harness and sensors are OK, replace the control. NOTE: The VWH will reset automatically. Verify thermistor resistance values of each half of the dual sensor by referencing the chart in this manual. 2. Replace the thermistor if necessary.
	Flue temp / wat lv	Indicates possible low voltage harness error.	1. Confirm the jumper from X7-10 to X-20 in the low voltage harness is intact. 2. Visually inspect and test the low voltage harness for continuity.
F02	Lockout: F02 Supply Sensor	The dual supply sensor contains two sensing elements within a single body. F02 indicates that one or both halves of the supply temperature sensor has failed OR the difference between the dual sensor readings is greater than 18°F. This is a serious safety issue and the VWH will not restart until the sensor is replaced by a technician and he pushes the RESET button on the display. This situation is indicated by the red center pane of the Home screen and the displayed phrase Lockout: F02 Supply Sensor. During this lockout fault, the pump will be on.	1. Check the electrical connections to each half of the thermistor on the outlet manifold. Verify 3.3 VDC by checking in Molex connector. If there is not 3.3 VDC, check the harness. If harness and sensors are OK, replace control. NOTE: The VWH will reset automatically. Verify thermistor resistance values of each half of the dual sensor by referencing chart in this manual. 2. Replace thermistor if necessary.
F03	Lockout: Return Sensor	F03 indicates the return temperature sensor of the VWH has failed. The VWH will not restart until a technician replaces the sensor and pushes RESET on the display. This is a serious safety issue as indicated by the red center pane of the Home screen and the displayed phrase Lockout: F03 Return Sensor. During this lockout fault, the pump will be on.	1. Check circulator pump operation. 2. Ensure adequate flow through the VWH by accessing the status menu and determining there is less than a 50°F rise from the return thermistor to the supply thermistor. 3. Troubleshoot thermistor by following the steps in F02.
F04	Lockout: F04 Flue Sensor Interrupted	F04 indicates that the flue temperature sensor of the VWH has failed. The VWH will not restart until a technician replaces the sensor and pushes RESET on the display. This is a serious safety issue as indicated by the red center pane of the Home screen and the displayed phrase Lockout: F04 Flue Sensor Interrupted. During this lockout fault, the pump will be on.	Inspect the flue sensor for physical damage or corrosion and replace it if necessary. Check the electrical connection to the flue sensor and repair as necessary. Measure the resistance of the sensor and refer to the sensor resistance table in this manual. The temperature on the chart should be close to the temperature in the flue. If not, replace the flue sensor.

Code	Message	Description	Possible Remedy
F05	<p>Blocking: Supply Temperature High</p> <p>OR</p> <p>Lockout: F05 Supply Maximum</p>	<p>F05 indicates the VWH supply temperature is excessive. When accompanied by the red center pane of the Home screen and the displayed phrase Lockout: F05 Supply Maximum, this code indicates the supply sensor temperature has exceeded 210°F and a serious safety issue exists. The VWH will not restart until a technician determines and repairs the cause of excessive temperature and pushes RESET on the display. If the center pane of the Home screen is orange, and the displayed phrase Blocking: Supply Temperature High, the supply temperature of the VWH is at or above 199°F. The message will clear automatically when the temperature drops below 194°F. During the time that this fault is displayed, the pump will be on.</p>	<ol style="list-style-type: none"> 1. Check circulator pump operation. 2. Ensure adequate flow through the VWH by accessing the status menu and determining there is less than a 50°F rise from the return thermistor to the supply thermistor. 3. Check the direction of flow off the VWH circulator. (See Piping Details in this manual.) 4. Troubleshoot the dual supply thermistor by following steps in F02.
F06	<p>Blocking: Return Temperature High</p> <p>OR</p> <p>Lockout: F06 Return Maximum</p>	<p>This display indicates that the VWH return temperature is excessive. This code indicates that the return sensor temperature has exceeded 210°F and a serious safety issue exists when accompanied by the red center pane of the Home screen and displayed phrase Lockout: F06 Return Maximum. The VWH will not restart until a technician determines and repairs the cause of excessive temperature and pushes RESET on the display. If the center pane of the Home screen is orange and the word Blocking is displayed, the supply temperature of the VWH is at or above 199°F. The message will clear automatically when the temperature drops below 194°F. During the time that this message or lockout fault is displayed, the pump will be on.</p>	<ol style="list-style-type: none"> 1. Check circulator pump operation. 2. Ensure adequate flow through the VWH by accessing the status menu and determining there is less than a 50°F rise from the return thermistor to the supply thermistor. 3. Check the direction of flow on VWH circulator. (See Piping Details in this manual.) 4. Troubleshoot thermistor by following steps in F02.
F09	Lockout: F09 No Ignition	<p>The VWH tried to ignite four times during one heat call and failed. This is a serious safety issue as indicated by the red center pane of the Home screen and the displayed phrase Lockout: F09 No Ignition. The VWH will reset automatically after an hour. The VWH may also be restarted after a technician determines and repairs the cause of ignition failure and pushes RESET on the display. During this lockout fault, the pump will remain on.</p>	<ol style="list-style-type: none"> 1. Watch the igniter through the observation window. 2. If there is no spark, check the spark electrode for the proper 1/4" gap between the burner. 3. Remove any corrosion from the spark electrode. 4. If there is a spark but no flame, check the gas supply to the VWH. 5. If there is a flame, check the flame current. 6. Check any flue blockage or condensate blocks. 7. Replace the ignitor.
F10	Lockout: F10 Flame Fault	<p>The flame was lost 3 times while the VWH was firing during one (1) demand call. This is a serious safety issue as indicated by the red center pane of the Home screen and the displayed phrase Lockout: F10 Flame Fault. The VWH will reset automatically after an hour. The VWH may also be restarted after a technician determines and repairs the cause of ignition failure and pushes RESET on the display. During this lockout fault, the pump will be on.</p>	<ol style="list-style-type: none"> 1. Monitor gas pressure to the unit while in operation. 2. Assure the flame is stable when lit. 3. Check if the display readout changes from "GAS VALVE ON" to "RUN" within a few seconds of VWH ignition. 4. Check the FLAME signal on the display. It should be above 1.2uA when the VWH is firing. 5. If the signal reads less than 1.2uA, clean the spark probe. 6. If the problem persists and the "FLAME" signal is still less than 2.5uA, replace the spark igniter probe. 7. The flame signal should be steady after the VWH has been firing for 1 minute and is normally at 5.0 to 9.0. If the flame signal is not steady, disassemble the burner door and check the burner and its sealing gaskets.

Code	Message	Description	Possible Remedy
F11	Lockout: F11 Flame Signal in Standby/ Purge	There is flame during a call for heat, but prior to the ignition sequence. This is a serious safety issue as indicated by the red center pane of the Home screen and the displayed phrase Lockout: F11 Flame Signal in Standby/Purge. The VWH will not restart until a technician determines and repairs the cause and pushes RESET on the display. During this lockout fault, the pump will be on.	<ol style="list-style-type: none"> 1. Look into window. If there is flame, turn the gas off to the unit at the service valve and replace the gas valve. 2. If the flame signal on the status menu is greater than 1.2uA when the burner is not lit, replace the spark ignitor. 3. If the flame signal is not present after turning off the gas supply, check the gas valve electrical connection. 4. Check for condensate backup. Repair condensate system as necessary. If condensate has partially filled the combustion chamber, the refractory wall may be damaged and should be replaced. 5. Turn the gas on at the service valve after corrective action is taken. 6. If the refractory wall falls against the spark ignitor, it may conduct the signal to ground, giving a false reading.
F14	Lockout: F14 Fan Speed High	The fan is not running at the speed determined by the control. Fan speed has been more than 30% faster than the commanded speed for more than 10 seconds. This is a serious safety issue as indicated by the red center pane of the Home screen and the displayed phrase Lockout: F14 Fan Speed High. This VWH will not restart until a technician determines and repairs the cause and pushes RESET on the display. During this lockout fault, the pump will be on.	<ol style="list-style-type: none"> 1. Check the combustion fan wiring. 2. Measure DC voltage from the red fan wire (POS) to the light blue wire (ground) while it is connected to the fan. It should be 24V +/- 1v volts. If it is lower than 23 volts, check for excessive external loads connected to the VWH sensor terminals 3. Disconnect the 5 pin plug from the fan and check the voltage on the red wire again. If it is now 24 volts, replace the fan. If it is still below 23 volts replace the VWH control board.
F20	Lockout: F20 Water Level 1 (Condensate)	The condensate trap is full. This is a serious safety issue as indicated by the red center pane of the Home screen and the phrase Lockout: F20 Water Level 1. The VWH will not restart until a technician determines and repairs the cause and pushes RESET on the display. During this lockout fault, the pump will be off.	<ol style="list-style-type: none"> 1. Check condensate lines for obstructions. 2. Check float switch in condensate reservoir. 3. Check wiring from condensate reservoir to 928 control and repair as necessary.
F21	Lockout: F21 Water Level 2 (Internal LWCO Fault)	This fault indicates the water level in the VWH is low. This is a serious safety issue as indicated by the red center pane of the Home screen and the displayed phrase Lockout: F21 Water Level 2. To test LWCO function, enter the Service Mode. If the LWCO is Ready, tap Test. Tap Reset to clear the code.	<ol style="list-style-type: none"> 1. Check VWH feed water system to be sure it is supplying make-up water to the VWH system. 2. Ensure all air is bled from the system. 3. Check for leaks in the VWH and system piping and repair as necessary. 4. Inspect low water cutoff probe and wiring for damage and repair and replace as necessary.
F22	Lockout: F22 External LWCO (EXT LWCO Fault)	<p>This code is generated when the External Low Water Cutoff is installed and the water level in the VWH is low. This is a serious safety issue as indicated by the red center pane of the Home screen and the displayed phrase Lockout: F22 External LWCO.</p> <p>When this code is displayed, the VWH will not respond to a demand for heat. The pump icons on the lower left corner of the display indicate the status of the pumps. The pump will remain on when this code is displayed.</p>	<p>IF EXT LWCO is installed:</p> <ol style="list-style-type: none"> 1. Check VWH feed water system. Ensure it is supplying make-up water to the VWH system. 2. Be sure all air is bled from the system. 3. Check for leaks in the VWH and system piping and repair as necessary. 4. Inspect low water cutoff wiring for damage and repair as necessary. 5. Ensure EXT LWCO has power applied to the power input terminals. 6. Press Reset button on LWCO. If code reoccurs, replace EXT LWCO. <p>IF EXT LWCO is NOT installed:</p> <p>Inspect the jumper from terminals 20 and 21 on the Field Connection Board for damage or loose connections.</p>
F24	Burner Door	This code indicates that the burner door switch has tripped. The burner door switch trips if there is excessive heat on the heat exchanger.	<ol style="list-style-type: none"> 1. Use an ohmmeter to check the burner door switch for continuity. First disconnect the switch and determine if it has tripped. If the switch has no continuity it has tripped: <ol style="list-style-type: none"> a. Check bolts on hx door. If door is not tight, a minor combustion leak will cause elevated door temperatures. b. Check for warm spots on the heat exchanger with an infrared thermal sensor. c. Check for a cracked / damaged refractory. d. Investigate the flue for blockages. e. Repair / replace components as necessary. 2. If switch has not tripped, push RESET on the VWH. If the VWH tries to ignite or ignites and only runs for a short time and an error code returns, measure temperature surface with an infrared thermal sensor. If the temperatures are low (below 300 F) and the sensor has not tripped then it is most likely a loose wire connection. Check all wires and terminations for loose or broken connections. 3. If the door is cool and the switch continues to trip the switch is faulty and needs to be replaced.

Code	Message	Description	Possible Remedy
F26	Gas Pressure	The following switches are optional equipment that may be installed on VWH. These devices have indicator lights that illuminate if tripped. High gas pressure switch – Trips if there is excessive gas pressure on the outlet side of the gas valve and must be manually reset. Low gas pressure switch – Trips if there is low gas pressure on the inlet side of the gas valve and must be manually reset.	1. If an indicator light is illuminated, investigate the source of the code for that particular switch. 2. With VWH in service mode, measure the gas pressure in the supply line with a gas pressure meter. Monitor the gas pressure during both low and high fire conditions for correct pressure range. 3. If there are no optional switches or none of the indicator lights is illuminated on the optional switches, use an ohmmeter to test each of the switches one at a time. Turn the power off to the VWH and disconnect the switch to be tested from the VWH to determine which has tripped. When you find the tripped switch investigate the cause of the fault based on the purpose of the switch.
F31	Program Error	There was a code while programming the control and the memory is corrupt. The VWH control will not function in this state and the pump will be off as indicated on the bottom line. This code only occurs if a technician is programming the control and the programming function fails. The only way to recover from this code is to reprogram the control. If this code occurs at any time other than when a technician is servicing the VWH, the control has failed and must be replaced by a qualified technician.	The control must be reprogrammed. If programming does not solve the problem, the control must be replaced.
F41	Hard Fault Cond	This code indicates there is an internal fault in the circuit within the control connected to the condensate switch.	1. Inspect the ground wires for damage or loose connections. 2. Inspect the condensate wiring for damage and repair as necessary. 3. Ensure no high voltage wires are routed in parallel with the condensate low voltage wiring. 4. Replace control.
F42	Hard Fault LWCO	This code indicates there is an internal fault in the LWCO circuit.	1. Inspect the ground wires for damage or loose connections. 2. Inspect the LWCO wiring for damage and repair as necessary. 3. Ensure no high voltage wires are routed in parallel with the LWCO low voltage wiring. 4. Replace control.
F43	AD Saft Fault	The temperature of either the flue or supply sensors has risen nine degrees in 100 milliseconds and not returned to normal within 1 second.	Ensure the connections to the flue and supply sensors are intact. If wires are intact, check sensor resistance. If the problem persists or the sensors are out of normal resistance range, replace the sensors.
FOU	Outdoor Sensor	There is an issue with the outdoor sensor. It is shorted, damaged, or disconnected from the VWH.	1. Check outdoor sensor connections and wiring. Ensure the sensor and wiring are intact and that the sensor is connected to the VWH. 2. Check the outdoor sensor resistance with an ohmmeter. See table in this manual for correct outdoor sensor resistance. 3. Replace the outdoor sensor.
The following blocking codes will block operation until the control determines the situation safe for VWH operation.			
FL	Blocking: Tap Block	This indicates the flow switch is not activated.	1. Ensure VWH contains water and all valves are open. 2. Check the VWH circulator and ensure it is in good operating condition (operating, wiring intact, etc.). 3. Inspect the wiring to the flow switch for damage and repair as necessary. 4. Disconnect one wire from the flow switch and test for continuity across the switch while flow is confirmed to be present. 5. Remove flow switch and inspect switch paddle for proper operation.
E07	Blocking: Flue Temp	This display indicates that the flue sensor temperature is above 210°F. When this code is displayed, the VWH will not respond to a demand for heat. When the flue temperature decreases below 194°F, the display will return to normal and allow the VWH to respond to a heat demand. The bottom line indicates the status of the pump. The pump will remain on when this code is displayed.	Check the flue for obstructions or any sign of damage, especially signs of excessive heat. Repair as necessary. Run the VWH and check the flue temperature with an external thermometer. If the flue temperature on the thermometer does not agree with the flue temperature displayed in the status menu, inspect the wiring to the flue temperature sensor in the VWH and repair as necessary. If the wiring is intact, replace the flue sensor. If the flue temperature is excessive on the status menu and the test thermometer reads the same, check and adjust combustion controls on the VWH.

Code	Message	Description	Possible Remedy
TT	Blocking: Supply Temperature	TT indicates there is a demand for heat on the VWH, the pump is powered on, and the supply sensor temperature is too high for the VWH to ignite. This occurs because the water temperature measured by the supply sensor is higher than the tank temperature – CH diff setting.	This message will stay present until the water temperature measured by the supply sensor is less than the tank temperature – CH diff setting.
	Blocking: Supply Temperature	This screen indicates a demand for heat from the DHW circuit. The pump is powered on and the supply sensor temperature is too high for the VWH to ignite. This occurs because the water temperature measured by the supply sensor is higher than the tank temperature – DHW diff setting.	This message will stay present until the water temperature measured by the supply sensor is less than the BOILER SUPPLY – VWH supply differential (5°F) or DHW SETPOINT is satisfied and no longer calls for heat.
FLU	Blocking: Blocked Vent	Blocking: Blocked Vent indicates excessive flue pressure. This code resets automatically after the high pressure condition is resolved.	1. Assure the flue is not blocked. 2. Check the switch wiring by applying a jumper in place of the switch. If the code clears with the jumper in place, REPLACE the flue switch and connect the wires to the new switch BEFORE running VWH.
WARNING: Do not use jumper to remedy an FLU code. Faulty switch MUST be replaced. Failure to follow this instruction could result in serious personal injury or death.			
E07	Flue Temp High	E07 indicates the flue sensor temperature is excessive and above 204°F. When Blocking: Burner Temp is displayed the VWH will begin to modulate down on vent temp rather than supply temp. When the flue temperature decreases below 194°F, the display will return to normal and allow the VWH to modulate back up to 100% if required.	1. Check the flue for obstructions and any sign of damage, especially signs of excessive heat. Repair as necessary. 2. Run the VWH and check the flue temperature with an external thermometer. If the flue temperature on the thermometer does not agree with the flue temperature displayed in the status menu, inspect the wiring to the flue temperature sensor in the VWH and repair as necessary. If the wiring is intact replace the flue sensor. 3. If the flue temperature is excessive on the status menu and the test thermometer reads the same, check and adjust combustion controls on the VWH.
	Common Flue Block	Common Flue Block indicates an error with Installer Menu 23.	1. Navigate to Installer Menu 23. 2. Select 0 if VWH is operating alone. Choose 1 to establish a cascaded system. NOTE: DO NOT USE NUMBERS 2 - 8. Doing so will result in an error code. Always select 0 if VWH is operating alone or with Vision 3 panel.

Table 35 - VWH Blocking and Fault Codes

Troubleshooting a Non-Responsive Display

1. Clean the screen with a soft, damp towel and test for response.
2. If there is no response, ensure there is no debris trapped around the edges of the display/bezel junction.
3. Ensure the gasket is correctly correctly and not protruding onto the active touch surface.
4. Power the VWH off and on. On power up, if the display goes into the calibration procedure it thinks it is being touched. If the display does not enter the calibration procedure, skip to step 6.
5. If the display enters calibration, loosen the 4 HMI mounting screws slightly. Then repeat steps 3 and 4.
6. Power the VWH off. Rest your stylus on the HMI and power the VWH on.
7. Touch the 3 green dots with your stylus. After the HMI is up check the display for responses.

Outdoor Sensor (7250P-319)		Return Sensor (7100P-004)	Indirect Sensor (7250P-325)	Supply Sensor (7700P-073)	Flue Temp. Sensor (7550P-147)
Temperature (°F)	Resistance (ohms)	Temperature (°F)		Resistance (ohms)	
-22	171800	32		32624	
-13	129800	41		25381	
-4	98930	50		19897	
5	76020	59		15711	
14	58880	68		12493	
23	45950	77		10000	
32	36130	86		8056	
41	28600	95		6530	
50	22800	104		5324	
59	18300	113		4365	
68	14770	122		3599	
77	12000	131		2982	
86	9804	140		2483	
95	8054	149		2079	
104	6652	158		1748	
113	5522	167		1476	
		176		1252	
		185		1066	
		194		912	
		203		782	
		212		674	

Table 36 - Sensor Temperature Resistance

Part 14 - Maintenance

A. Procedures

Periodic maintenance should be performed once a year by a qualified service technician to assure that all the equipment is operating safely and efficiently. The owner should make necessary arrangements with a qualified heating contractor for periodic maintenance of the VWH. The installer must also inform the owner that a lack of proper care and maintenance of the VWH may result in a hazardous condition.

WARNING

The combustion chamber insulation in this product contains ceramic fiber material. Ceramic fibers can be converted to cristobalite in very high temperature applications. The International Agency for Research on Cancer (IARC) has concluded, "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)."

- Avoid breathing dust and contact with skin and eyes.
- Use a NIOSH certified dust respirator (N95). This type of respirator is based on the OSHA requirements for cristobalite at the time this document was written. Other types of respirators may be needed depending on job site conditions. Current NIOSH recommendations can be found on the NIOSH website: <http://www.cdc.gov/niosh/homepage.html>. NIOSH approved respirators, manufacturers, and phone numbers are also listed on this website.
- Wear long-sleeved, loose fitting clothing, gloves, and eye protection.
- Apply enough water to the combustion chamber lining to prevent dust.
- Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly.

NIOSH stated First Aid.

- Eye: Irrigate immediately.
- Breathing: Fresh air.

WARNING

BEFORE EACH HEATING SEASON a trained and qualified service technician should perform the inspections as per the VWH inspection and maintenance schedule in this manual. Failure to do so could result in death or serious injury.

B. Combustion Chamber Coil Cleaning Instructions

*Before beginning this procedure, have on hand the following items:

- a nylon, stainless steel, or brass brush (not steel)
- an FDA approved liquid lime scale remover in a spray bottle
- gloves and eye protection

1. Shut down the VWH by using the following steps:

- a. Shut the power off to the VWH at the circuit breaker.
- b. Close the gas valve external to the unit. Shut down the unit, and wait for it to be cool to the touch.
- c. Open the condensate trap cleanout outside the VWH, so flow from condensate reservoir can be observed.
- d. Disconnect electrical connections from the gas valve, spark electrode, flame rectification probe, and combustion blower. Make note of connections.

CAUTION

Label all wires prior to disconnecting them when servicing the VWH. Wiring errors can cause improper and dangerous operation. Failure to follow these instructions may result in property damage or personal injury.

- e. Disconnect the incoming flex line to the gas valve.
- f.
 - i. For 400 - 1000 Models: Remove the six (6) 10MM bolts from the burner plate assembly.
 - ii. For 1500 - 2000 Models: Remove the eight (8) 10MM bolts from the burner plate assembly with a 12mm Allen key.

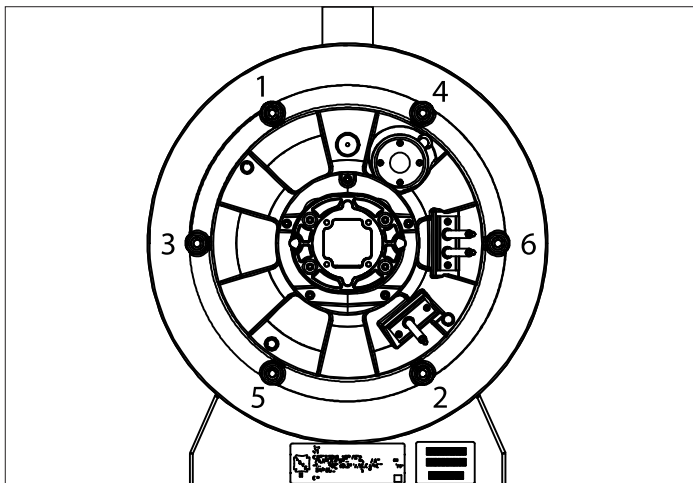


Figure 63 - Heat Exchanger Detail - Burner Door Torque Sequence

- g.
- For 400 - 500 Models: Loosen the band clamp from the air intake assembly. Then pull the entire combustion assembly towards you, while removing or pushing aside any wiring to allow removal of the assembly. Set aside in a safe location for eventual reinstallation.
 - For 650 - 1000 Models: Pull the entire combustion assembly towards you and then down to disconnect from the air intake assembly. Then remove or push aside any wiring to allow removal of the assembly. Set aside in a safe location for eventual reinstallation.
 - For 1500 - 2000 Models: First, remove the five (5) screws attaching the cabinet post to the left side of the VWH cabinet assembly. Then remove the post. Then remove the three (3) screws attaching the air intake assembly. The heat exchanger features a hinged sliding device to ease service. First remove the pin located to the left of the door. This locks the hinge in place. After the pin is removed the door will swing at the hinge, providing better access to the inside of the heat exchanger. **BE CAREFUL NOT TO DAMAGE THE COMBUSTION ASSEMBLY, WHICH IS MOUNTED TO THE DOOR, WHEN OPENING AT THE HINGE.** After the pin is removed: (1) Lift the air intake pipe. (2) Spin air intake pipe while sliding the combustion assembly out. (3) Swing the assembly open to allow access to the combustion chamber. (4) Slide the assembly back toward the heat exchanger and use the removed pin to secure in the open position while performing maintenance. See Figure 64.

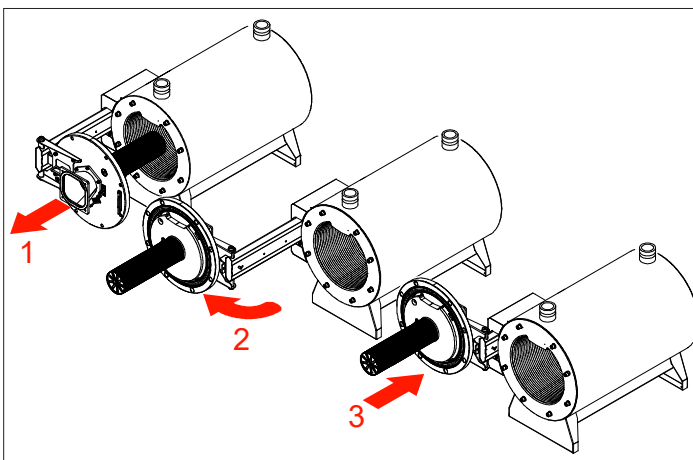


Figure 64 - 1500 - 2000 Model Heat Exchanger Detail - Sliding Out the Combustion Assembly

⚠ WARNING

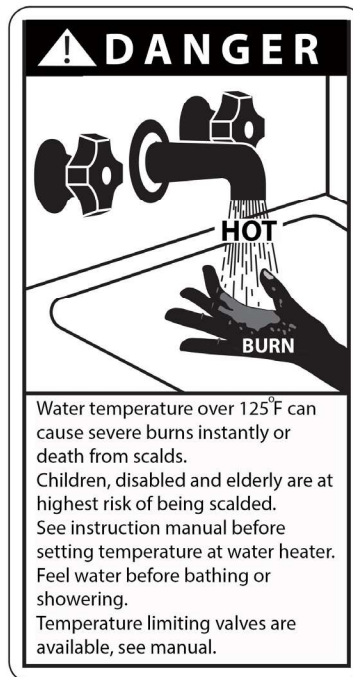
Do not use solvents to clean any of the burner components. The components could be damaged, resulting in unreliable or unsafe VWH operation, substantial property damage, severe personal injury, or death.

2. Spray the coils liberally with the FDA approved liquid lime scale remover. Confine the spray to the area being cleaned. Avoid getting the ceramic target wall wet. If the condensate system is blocked, use a vacuum to clear it.

3. Scrub coils of any buildup with a nylon, stainless steel, or brass brush. Do not use a steel brush. Vacuum the debris from the coils.

4. Spray the coils again with clear tap water. Confine the spray to the area being cleaned. Flush the combustion chamber with fresh water until it runs clear from the condensate reservoir. At this point, the VWH should be ready to be reassembled.

- Inspect gaskets.
- Reinstall the combustion assembly.
- Reinstall and tighten the bolts to the burner plate using staggered tightening sequence. See Figure 63 and Table 37.
- Reconnect all wiring connections.
- Use pipe dope or tape to reconnect the flex line to the gas valve. (IMPORTANT: CHECK FOR GAS LEAKS!)
- Reinstall the air intake.
- Restore gas and power to the VWH.
- Turn VWH power on and create a heat demand. When VWH is lit observe condensate flow from the VWH. Be sure the VWH is operating properly.
- Reinstall the condensate trap cleanout trap.



400 - 1000 Models Torque Ratings

Location	# of Screws	Screw Size	Torque
Burner Door	6	M10 X 20	36.88 ft.lb [50 N.m.]
Ignition Electrode	2	M4 X 10	1.84 ft.lb [2.5 N.m.]
Ionization Electrode	2	M4 X 10	1.84 ft.lb [2.5 N.m.]

1500 - 2000 Models Torque Ratings

Location	# of Screws	Screw Size	Torque
Burner Door	8	M14 X 20	36.88 ft.lb [50 N.m.]
Ignition Electrode	2	M4 X 10	1.84 ft.lb [2.5 N.m.]
Ionization Electrode	2	M4 X 10	1.84 ft.lb [2.5 N.m.]

Table 37 - Torque Ratings for Specific Components by Model

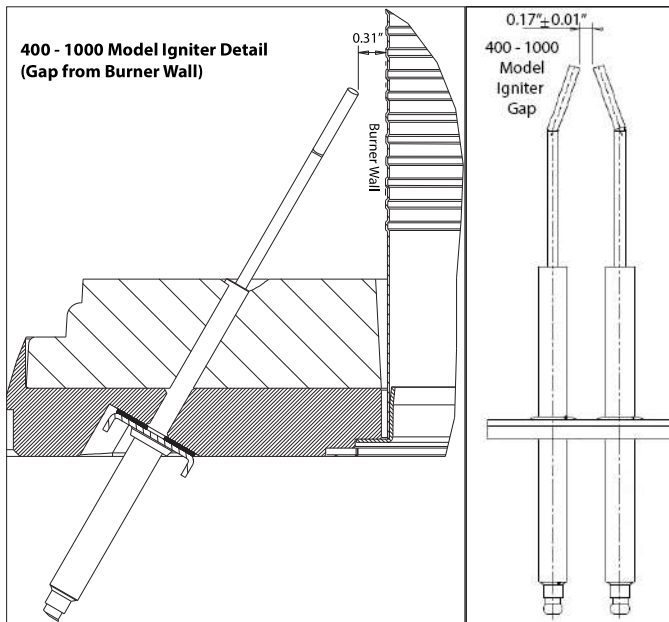


Figure 65 - 400 - 1000 Model Igniter Gap Details

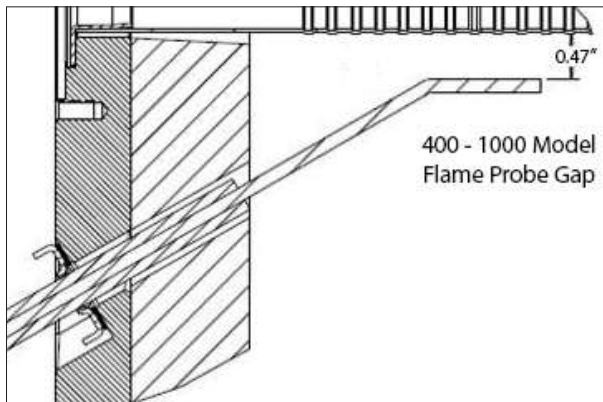


Figure 66 - 400 - 1000 Model Flame Probe Gap from Burner Wall Details

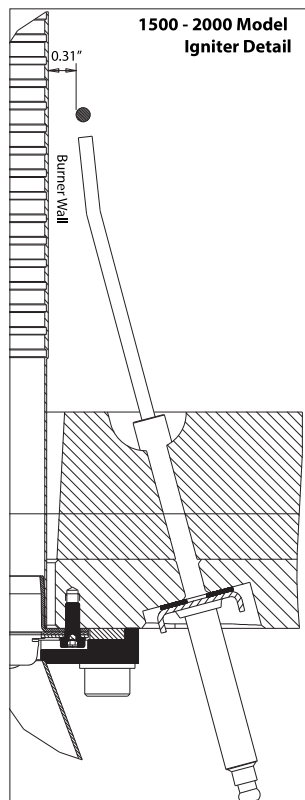


Figure 67 - 1500 - 2000 Model Igniter Gap Details

C. Cleaning the Water Side of the Heat Exchanger

*Before beginning this procedure, have on hand the following items:

- Part number 7550P-606 - Flush Kit
- an FDA approved liquid lime scale remover (approved for use with stainless steel heat exchangers)
- bucket
- circulation pump
- three (3) hoses
- gloves and eye protection

Flushing the heat exchanger is a complicated procedure that should only be performed by a qualified installer / service technician.

NOTE: Improper maintenance WILL VOID warranty.

1. Disconnect electrical power to the appliance.
2. Close the shutoff valves on both the return and supply lines to isolate the appliance.
3. Open the drain valve on the appliance. Drain the appliance. Keep the drain valve open.
4. Remove the flow switch from the appliance. See Figure 68.
5. Install the gasket and brass adapter for the hose connection (included with part # 7550P-606) onto the flow switch fitting. See Figure 68-A.
6. Connect one hose to the drain valve (Figure 68-B) and place the free end in a bucket. Connect one of the hoses to the circulation pump outlet and the hose connection adapter installed on the flow switch fitting. Connect the other hose to the circulation pump inlet and place the free end in the bucket.
7. Pour the heat exchanger cleaning solution into the bucket. Ensure the cleaning solution is approved for potable water systems.
8. Turn on the pump. Operate the pump and allow the cleaning solution to circulate through the appliance for at least 1 hour at a rate of 4 gallons per minute. This will remove any possible harmful scale deposits.
9. Rinse the cleaning solution from the appliance as follows:
 - a. Remove the free end of drain hoses from the bucket.
 - b. Properly dispose of the cleaning solution.
 - c. Fill the bucket with clean water.
 - d. Place the removed hoses back in the bucket.
 - e. Turn on the pump.
 - f. Allow water to flow through the water heater for 5 minutes.
10. Disconnect all hoses.
11. Remove the gasket and brass adapter from the appliance.
12. Close the drain valve.
13. Reinstall the flow switch on the appliance.
14. Connect electrical power to the appliance.
15. Open the shutoff valves.
16. Initiate a call for heat and observe appliance operation. Check for leaks and ensure the appliance is operating properly. Repair leaks as necessary.

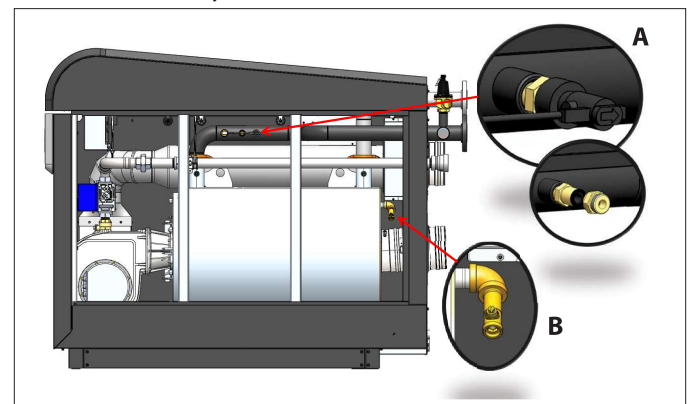


Figure 68 - Drain Kit Details

Part 15 - Shutdown

A. Shutdown Procedure

If the burner is not operating, disconnect the electrical supply.

If the burner is operating, lower the set point value to 70°F and wait for the burner to shut off. Continue to wait for the combustion blower to stop, so all latent combustion gases are purged from the system. This should take a maximum of 40 to 90 seconds.

NOTE: If the VWH is to be shut down for an extended period of time in freezing conditions, it is recommended to drain the heating system of water. When water freezes it expands, which could degrade the heating system components or cause the heat exchanger to leak.

CAUTION

Freeze related damages are not covered by product warranty.

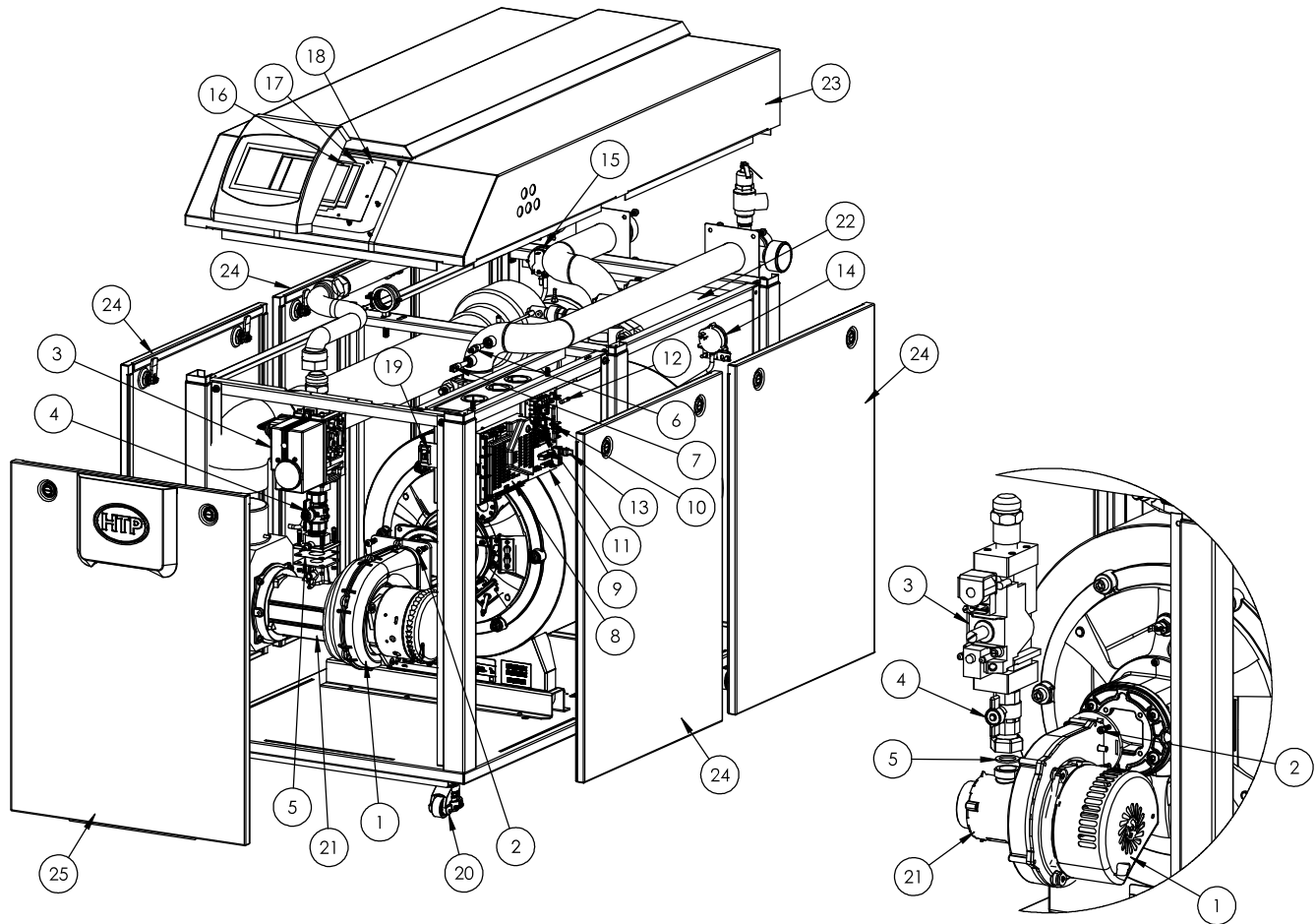
B. Failure to Operate

Should the burner fail to light, the control will perform two more ignition trials prior to entering a lockout state. Note that each subsequent ignition trial will not occur immediately. After a failed ignition trial, the blower must run for approximately 10 seconds to purge the system. Therefore, a time period of approximately 40 to 90 seconds will expire between each ignition trial.

If the burner lights during any one of these three ignition trials, normal operation will resume. If the burner lights, but goes off in about 4 seconds, check the polarity of the wiring. See electrical connection section.

If the burner does not light after the third ignition trial, the control will enter a lockout state. This lockout state indicates that a problem exists with the VWH, the controls, or the gas supply. Under such circumstances, a qualified service technician should be contacted immediately to properly service the VWH and correct the problem. If a technician is not available, pressing and holding RESET on the display for more than 1 second will remove the lockout state so additional trials for ignition can be performed. The unit will try to re-light once every 6 minutes.

Part 16 - Replacement Parts



ELX-400, 500 ONLY

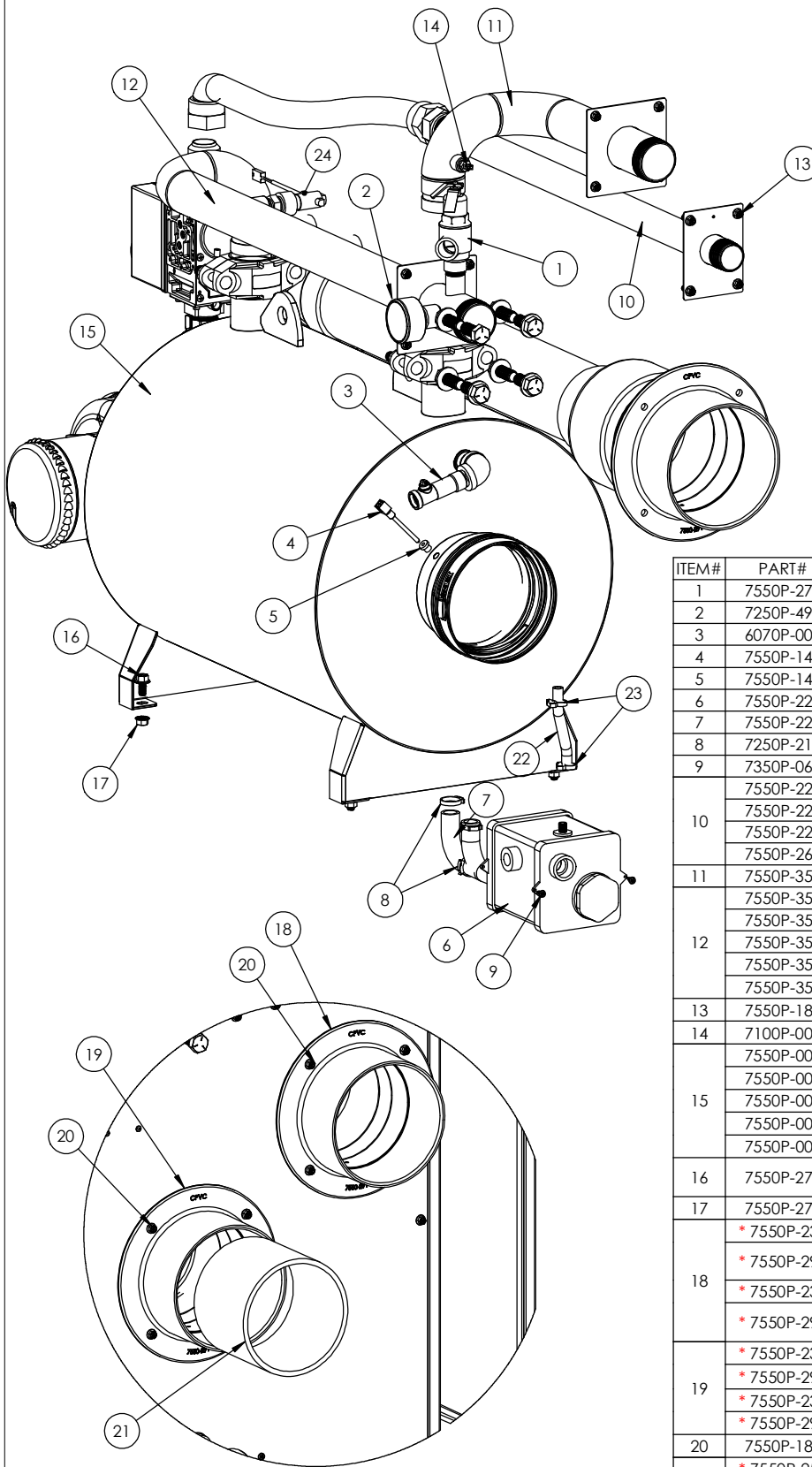
ITEM#	PART#	DESCRIPTION	ITEM#	PART#	DESCRIPTION
1	7550P-215 7550P-209 7550P-210	COMBUSTION BLOWER w/GASKET, SCREWS (400) COMBUSTION BLOWER w/GASKET, SCREWS (500) COMBUSTION BLOWER w/GASKET, SCREWS (650-1000)	17	7550P-447	GASKET - DISPLAY - 7"
2	7250P-478 7550P-268	SCREWS (400/500)- COMBUSTION BLOWER SCREWS (650-1000) - COMBUSTION BLOWER	18	7550P-060	TOUCH SCREEN BRACKET
3	7550P-313 7550P-211 6300P-009	GAS VALVE w/CABLE (400, 500) GAS VALVE (650) GAS VALVE (800/1000)	19	7500P-087	POWER SWITCH
4	7350P-079 7350P-099	GAS SHUT-OFF VALVE (400/500) GAS SHUT-OFF VALVE (650/800/1000)	20	7550P-219	SWIVEL CASTERS
5	8600P-044 6300P-072	GASKET - VALVE TO AIR MIXER (400,500) GASKET - FLANGE TO VENTURI (650-1000)	21	7550P-200 7550P-201 7550P-202 7550P-203 7550P-204 7550P-205 7550P-206 7550P-207 7550P-314 7550P-208	AIR/GAS MIXER W/ LABELS - 400 NG AIR/GAS MIXER W/ LABELS - 400 LP AIR/GAS MIXER W/ LABELS - 500 NG AIR/GAS MIXER W/ LABELS - 500 LP AIR/GAS MIXER W/ LABELS - 650 NG AIR/GAS MIXER W/ LABELS - 650 LP AIR/GAS MIXER W/ LABELS - 800NG AIR/GAS MIXER W/ LABELS - 800LP AIR/GAS MIXER W/ LABELS - 1000NG AIR/GAS MIXER W/ LABELS - 1000LP
6	7350P-089	LOW WATER CUT-OFF PROBE	22	* 7550P-327 * 7550P-127	BACK PANEL (400 - 1000) REV 000 BACK PANEL (400 - 1000) REV 001 +
7	7700P-073	DUAL TEMPERATURE SENSOR - HIGH LIMIT	23	7550P-993 7550P-991	TOP PANEL (includes Mohawk) (400, 500) TOP PANEL (includes Mohawk) (650, 800, 1000)
8	SEE TABLE	INTEGRATED BOILER CONTROL	24	7550P-994 7550P-990	SIDE PANEL (400, 500) SIDE PANEL (650, 800, 1000)
9	7550P-054	LOW VOLTAGE BOARD	25	7550P-992	FRONT PANEL (400 - 1000)
10	6300P-037	FUSES - 2 AMP			
11	7550P-337	HIGH VOLTAGE CUSTOMER CONNECTION BOARD			
12	7550P-285	FUSES - 15A			
13	7350P-230	CAT5 PLUG			
14	7550P-221	PRESSURE SWITCH			
15	7550P-220 7700P-038	INTAKE PRESSURE SWITCH (400, 500) INTAKE PRESSURE SWITCH (650-1000)			
16	7550P-050	DISPLAY - 7"			

* INDICATES FINISHED GOOD REVISION

OTHER ITEMS NOT SHOWN	
PART #	DESCRIPTION
7550P-287	LEAD - SPARK
7550P-216	EXTERNAL SPARK TRANSFORMER
7550P-214	DISPLAY CABLE

LP-701-H
08/27/20

Figure 69 - 400 - 1000 Model Replacement Parts



* INDICATES FINISHED GOOD REVISION

ITEM#	PART#	DESCRIPTION
1	7550P-278	PRESSURE RELIEF VALVE - 150 PSI
2	7250P-499	TEMPERATURE/PRESSURE GAUGE
3	6070P-009	DRAIN VALVE
4	7550P-147	FLUE TEMPERATURE SENSOR
5	7550P-148	RUBBER GROMMET
6	7550P-226	CONDENSATE ASSEMBLY
7	7550P-222	HOSE - CONDENSATE
8	7250P-210	HOSE CLAMP (2)
9	7350P-063	SCREWS - #10 X 1/2" SELF TAPPING
10	7550P-225	GAS PIPING ASSY - 1" (400, 500)
	7550P-224	GAS PIPING ASSY - 1" (650)
	7550P-223	GAS PIPING ASSY - 1-1/4" (800)
	7550P-263	GAS PIPING ASSY - 1-1/4" (1000)
11	7550P-350	2" WATER RETURN S.S. PIPE
12	7550P-355	2" WATER SUPPLY S.S. PIPE (400)
	7550P-354	2" WATER SUPPLY S.S. PIPE (500)
	7550P-353	2" WATER SUPPLY S.S. PIPE (650)
	7550P-352	2" WATER SUPPLY S.S. PIPE (800)
	7550P-351	2" WATER SUPPLY S.S. PIPE (1000)
13	7550P-189	SCREW - 1/4-20" X 3/4" LONG
14	7100P-004	RETURN SENSOR
15	7550P-001	HEAT EXCHANGER (400)
	7550P-002	HEAT EXCHANGER (500)
	7550P-003	HEAT EXCHANGER (650)
	7550P-004	HEAT EXCHANGER (800)
	7550P-005	HEAT EXCHANGER (1000)
16	7550P-275	SCREW - 3/8-16" X 3/4" LONG SERRATED/FLANGED
17	7550P-276	NUT - 3/8-16" SERRATED/FLANGED
18	* 7550P-235	METAL INTAKE ADAPTER - 6" REV 000
	* 7550P-291	PLASTIC INTAKE/EXHAUST ADAPTER - 6" REV 001 +
	* 7550P-237	METAL INTAKE ADAPTER - 4" REV 000
	* 7550P-290	PLASTIC INTAKE/EXHAUST ADAPTER - 4" REV 001 +
19	* 7550P-236	METAL FLUE ADAPTER - 6" REV 000
	* 7550P-291	PLASTIC INTAKE/EXHAUST ADAPTER - 6" REV 001 +
	* 7550P-239	METAL FLUE ADAPTER - 4" REV 000
	* 7550P-290	PLASTIC INTAKE/EXHAUST ADAPTER - 4" REV 001 +
20	7550P-189	SCREW - 1/4-20 X 3/4" LONG
21	* 7550P-257	CPVC PIPE - 4" DIA (400/500) REV 000
	* 7550P-279	CPVC PIPE - 6" DIA (650-1000) REV 000
22	7550P-186	PVC TUBING (w/HOSE CLAMPS)
23	7550P-168	HOSE CLAMP
24	7550P-063	FLOW SWITCH

Figure 70 - 400 - 1000 VWH Heat Exchanger Replacement Parts

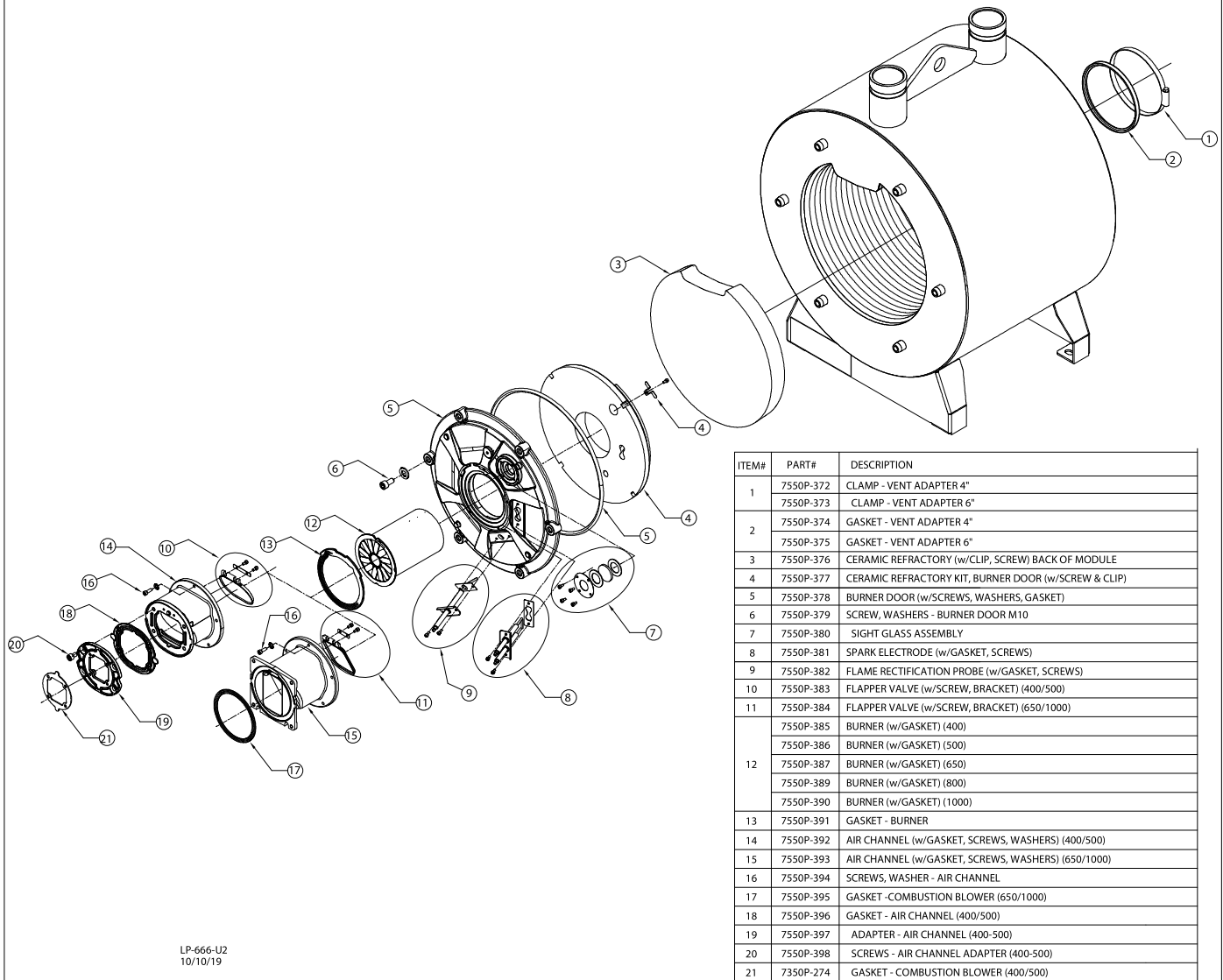
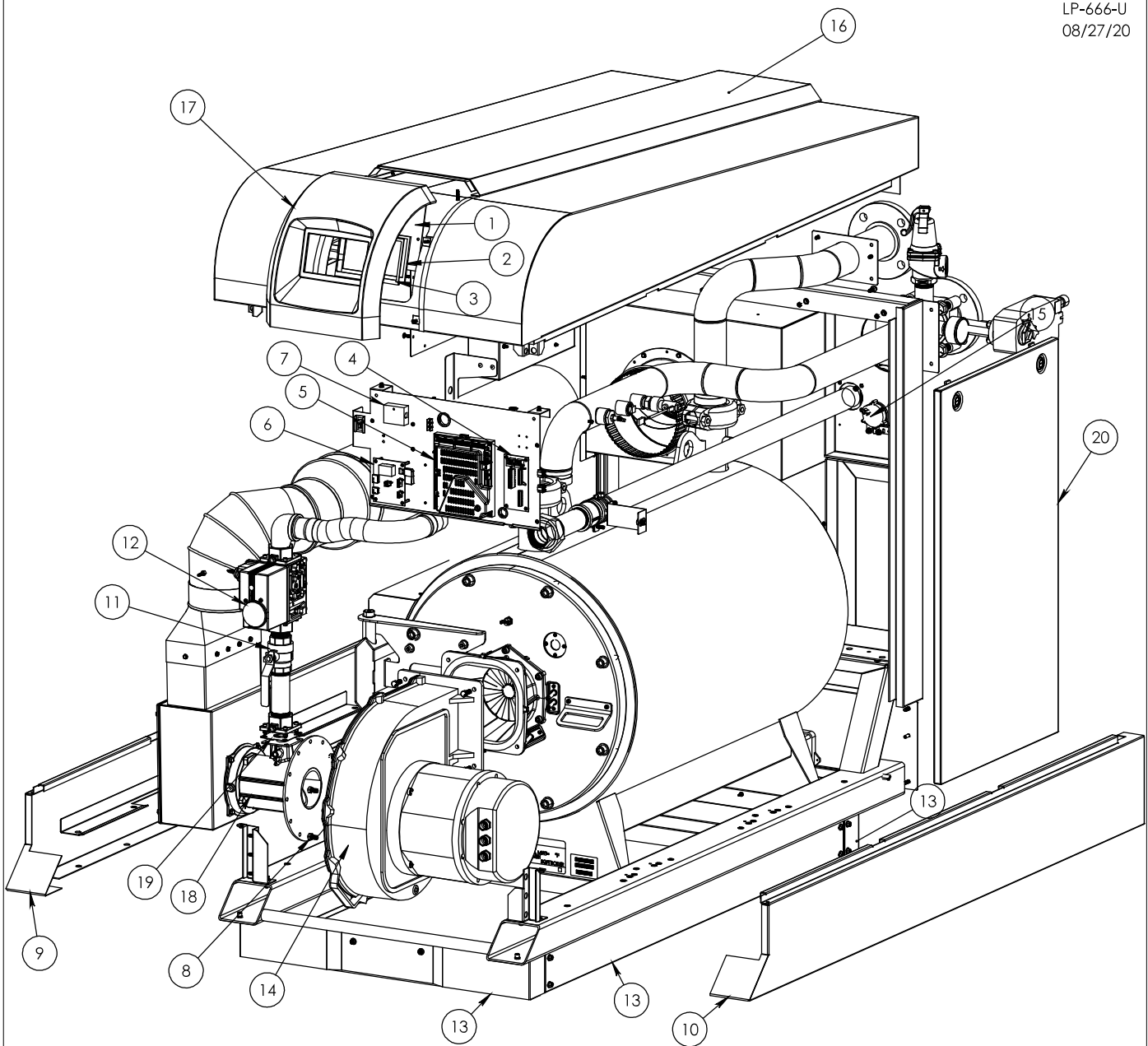


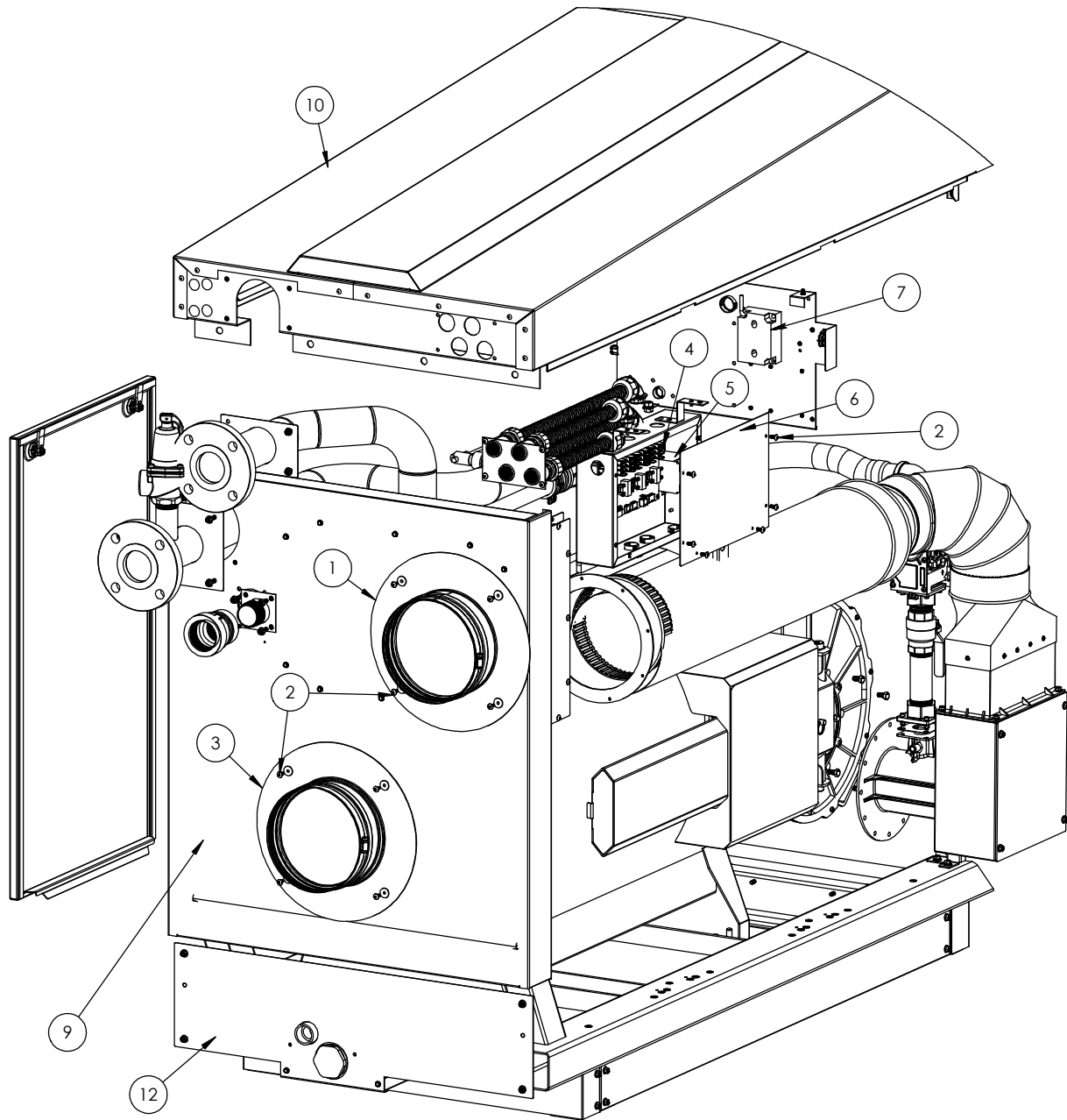
Figure 71 - 400 - 1000 Heat Exchanger Replacement Parts



ITEM#	PART#	DESCRIPTION
1	7550P-060	TOUCH SCREEN BRACKET
2	7550P-050	TOUCH SCREEN DISPLAY
3	7550P-447	GASKET - LCD DISPLAY
4	7550P-054	LOW VOLTAGE BOARD
5	SEE CHART	CONTROL BOARD
6	7550P-053 7550P-337	HIGH VOLTAGE BOARD 2 (2000) HIGH VOLTAGE CUSTOMER CONNECTION BOARD (1500)
7	7550P-998	HTP LINK WI-FI DONGLE KIT
8	7550P-140 7550P-554	SCREW- HEX HEAD M8X16, 6 PER (2000) SCREW- HEX HEAD M8X14, 6 PER (1500)
9	7550P-076 7550P-501	LEFT BASE PANEL (2000) LEFT BASE PANEL (1500)
10	7550P-077 7550P-502	RIGHT BASE PANEL (2000) RIGHT BASE PANEL (1500)
11	6300P-017	GAS BALL VALVE 1-1/4"
12	7550P-246	GAS VALVE W/1-1/4" ADAPTER

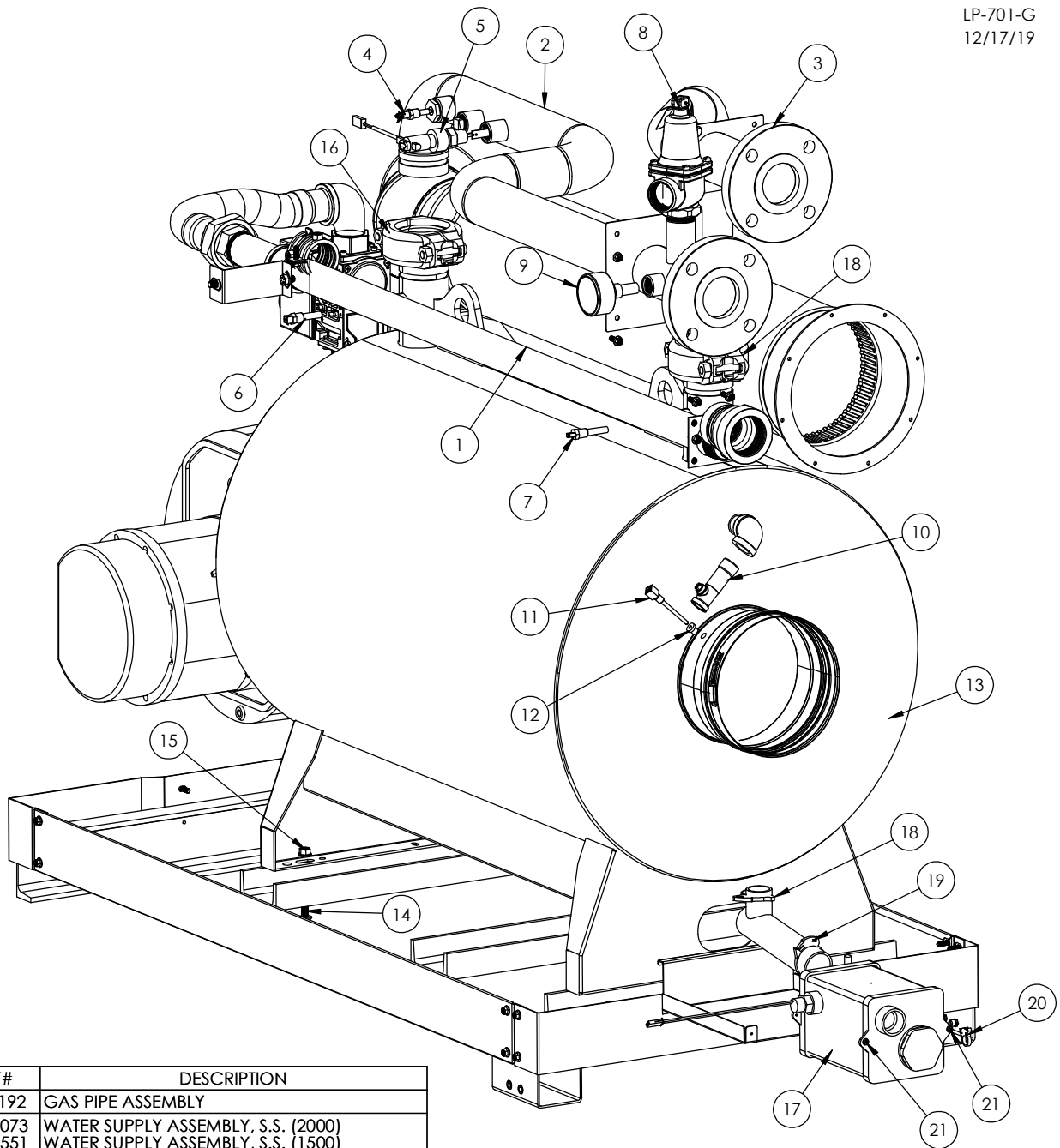
ITEM#	PART#	DESCRIPTION
13	7550P-079 7550P-509	BASE SKIRTS WITH BOLTS (2000) BASE SKIRTS WITH BOLTS (1500)
14	7550P-065 7550P-535	BLOWER (2000) BLOWER (1500)
15	7550P-221	PRESSURE SWITCH (BLOCKED VENT)
16	7550P-129 7550P-542	TOP MOHAWK WITH GASKETS (2000) TOP MOHAWK WITH GASKETS (1500)
17	7550P-125	BEZEL WITH GASKET (LESS CONTROLS)
18	7550P-309 7550P-310 7550P-442	AIR/GAS MIXER W/ LABELS - 1500NG AIR/GAS MIXER W/ LABELS - 1500LP AIR/GAS MIXER W/ LABELS - 2000NG
19	6300P-072	GASKET - FLANGE TO VENTURI
20	7550P-162 7550P-503	SIDE PANEL (2000) SIDE PANEL (1500)
21	7550P-214	DISPLAY CABLE (NOT SHOWN)

Figure 72 - 1500 - 2000 Model Replacement Parts



ITEM#	PART#	DESCRIPTION
1	7550P-531	8" INTAKE ADAPTER
2	7550P-137	SCREW - 10-32 X 1/2" LONG
3	7550P-072	VENT ADAPTER
4	7550P-052	HIGH VOLTAGE BOARD 1
5	8800P-108	CONTACTOR
6	7550P-119	COVER - HIGH VOLTAGE BOX
7	7550P-216	EXTERNAL SPARK TRANSFORMER
8	7550P-541	SPARK LEAD (NOT SHOWN)
9	7550P-085	BACK PANEL
10	7550P-150	TOP COVER (LESS CONTROLS) (2000)
	7550P-504	TOP COVER (LESS CONTROLS) (1500)
11	7550P-163	FRONT DOOR (NOT SHOWN)
12	7550P-120	LOWER BACK PANEL

Figure 73 - 1500 - 2000 Model Replacement Parts (Looking from Rear)



ITEM#	PART#	DESCRIPTION
1	7550P-192	GAS PIPE ASSEMBLY
2	7550P-073 7550P-551	WATER SUPPLY ASSEMBLY, S.S. (2000) WATER SUPPLY ASSEMBLY, S.S. (1500)
3	7550P-074	WATER RETURN ASSEMBLY, S.S.
4	7350P-089	LOW WATER CUT-OFF PROBE
5	7550P-063	HIGH TURNDOWN FLOW SWITCH
6	7700P-073	DUAL TEMPERATURE SENSOR - HIGH LIMIT
7	7100P-004	HIGH TEMPERATURE SENSOR
8	7550P-277	TEMPERATURE & PRESSURE RELIEF VALVE, 1"
9	7250P-499	TEMPERATURE/PRESSURE GAUGE 250 PSI
10	6070P-009	DRAIN VALVE
11	7550P-147	FLUE TEMPERATURE SENSOR
12	7550P-148	RUBBER GROMMET
13	7550P-007	MODULE
14	7550P-275	HEX HEAD BOLTS - 3/8-16" (4 PER)
15	7550P-276	LOCKNUT - 3/8-16" SERRATED (4 PER)
16	7550P-062	2-1/2" GROOVE LOCK FITTING
17	7550P-051	CONDENSATE ASSY
18	7550P-173	HOSE CLAMP - 1-1/2"
19	7550P-174	HOSE CLAMP - 1-3/4"
20	7550P-168	HOSE CLAMP - 3/4"
21	7350P-063	SCREWS #10 X 1/2"

Figure 74 - 1500 - 2000 Model Replacement Parts (Looking from Front)

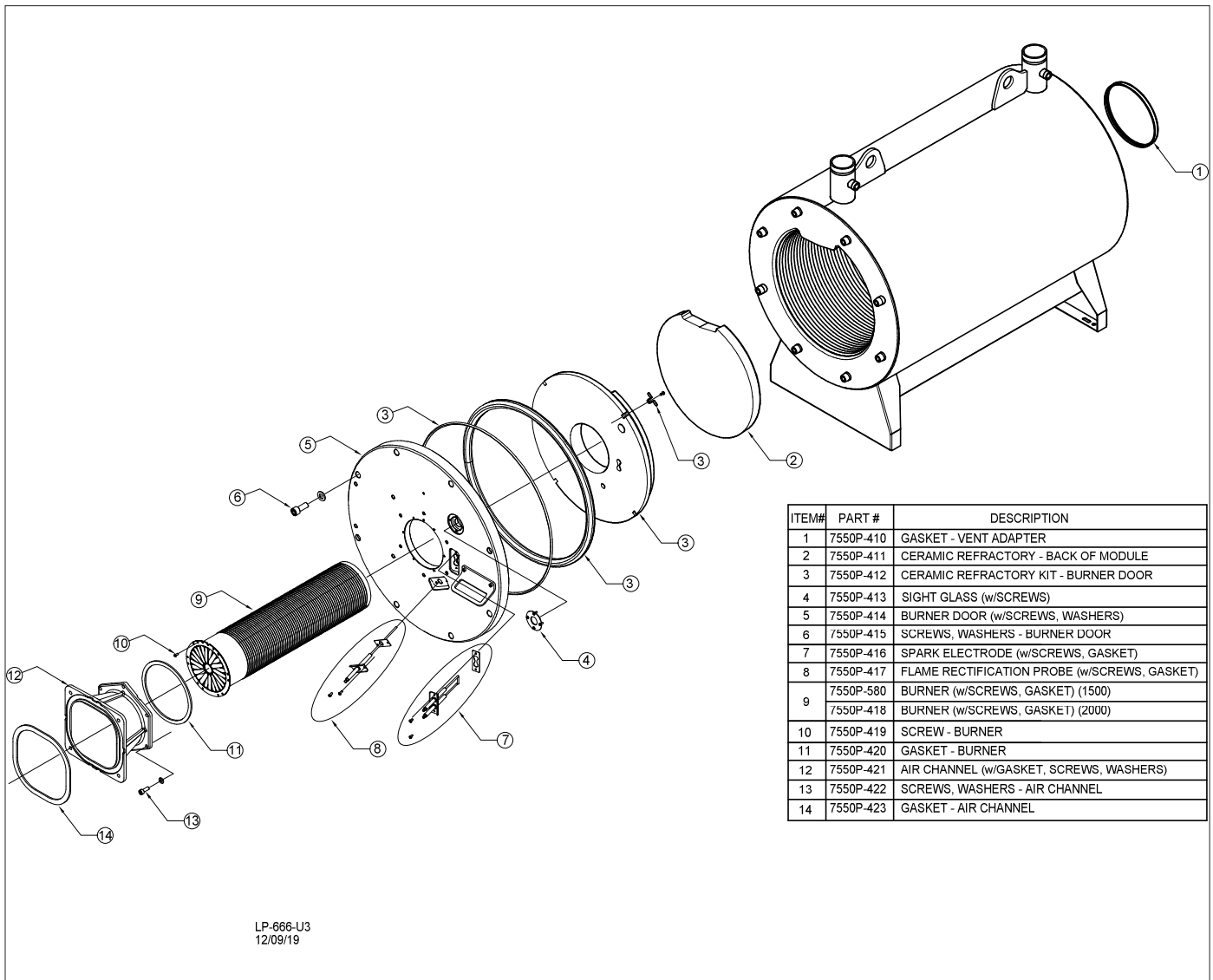


Figure 75 - 1500 - 2000 Model Heat Exchanger Replacement Parts

Model	Control Board Part Numbers	Model	Control Board Part Numbers
400 VWH NG	7550P-2106	800 VWH NG	7550P-2118
400 VWH LP	7550P-2107	800 VWH LP	7550P-2119
500 VWH NG	7550P-2110	1000 VWH NG	7550P-2122
500 VWH LP	7550P-2111	1000 VWH LP	7550P-2123
650 VWH NG	7550P-2114	1500 VWH NG	7550P-2126
650 VWH LP	7550P-2115	2000 VWH NG	7550P-2130

Table 38 - Control Board Replacement Part Numbers

Model	Part Description	Control Board Part Numbers
400 - 500	Low Voltage Harness	7550P-311
400 - 500	High Voltage Harness	7550P-312
650 - 1000	Low Voltage Harness	7550P-513
650 - 1000	High Voltage Harness	7550P-514
1500	Low Voltage Harness	7550P-510
1500	High Voltage Harness	7550P-511
2000	Low Voltage Harness	7550P-101
2000	High Voltage Harness	7550P-102

Table 39 - Wire Harness Replacement Part Numbers

Model	Part Description	Location	Part Numbers
400 - 1000	GLASS CARTRIDGE FUSE, TIME DELAY, 5X20MM, 2A, 250V	Customer Connection Board F1 - F3	6300P-037
1500 - 2000	GLASS CARTRIDGE FUSE, FAST BLOW, 5X20MM, 5A, 250V	Customer Connection Board FS1 - FS6	7550P-095
1500 - 2000	GLASS CARTRIDGE FUSE, FAST BLOW, 3AG, 6X32MM, 15A, 250V	High Voltage Box	7550P-285
All Models	GLASS CARTRIDGE FUSE, TIME DELAY, 5X20MM, 6.3A, 250V	Control Board	7250P-378
All Models	GLASS CARTRIDGE FUSE, TIME DELAY, 5X20MM, 800mA, 250V	Control Board	7550P-096

Table 40 - Replacement Fuses

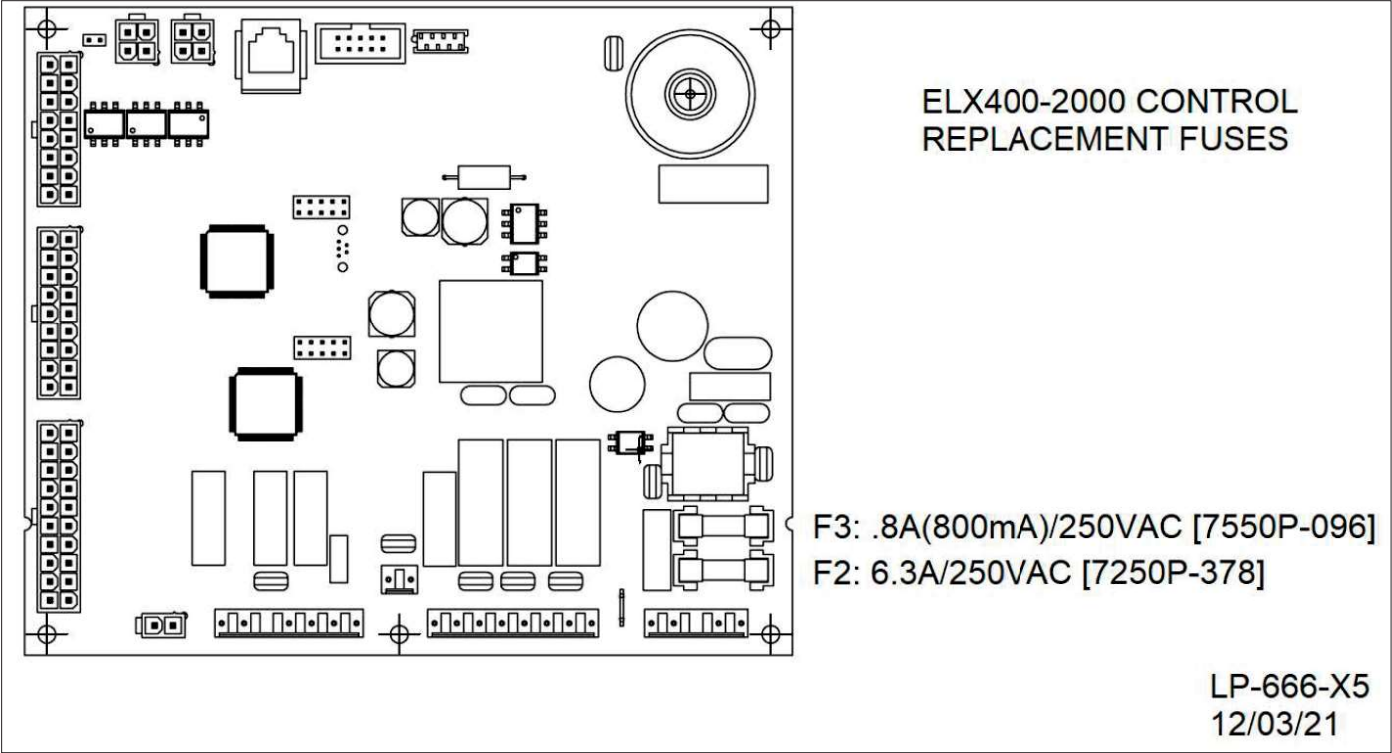


Figure 76 - 400 - 2000 Model Control Replacement Fuses

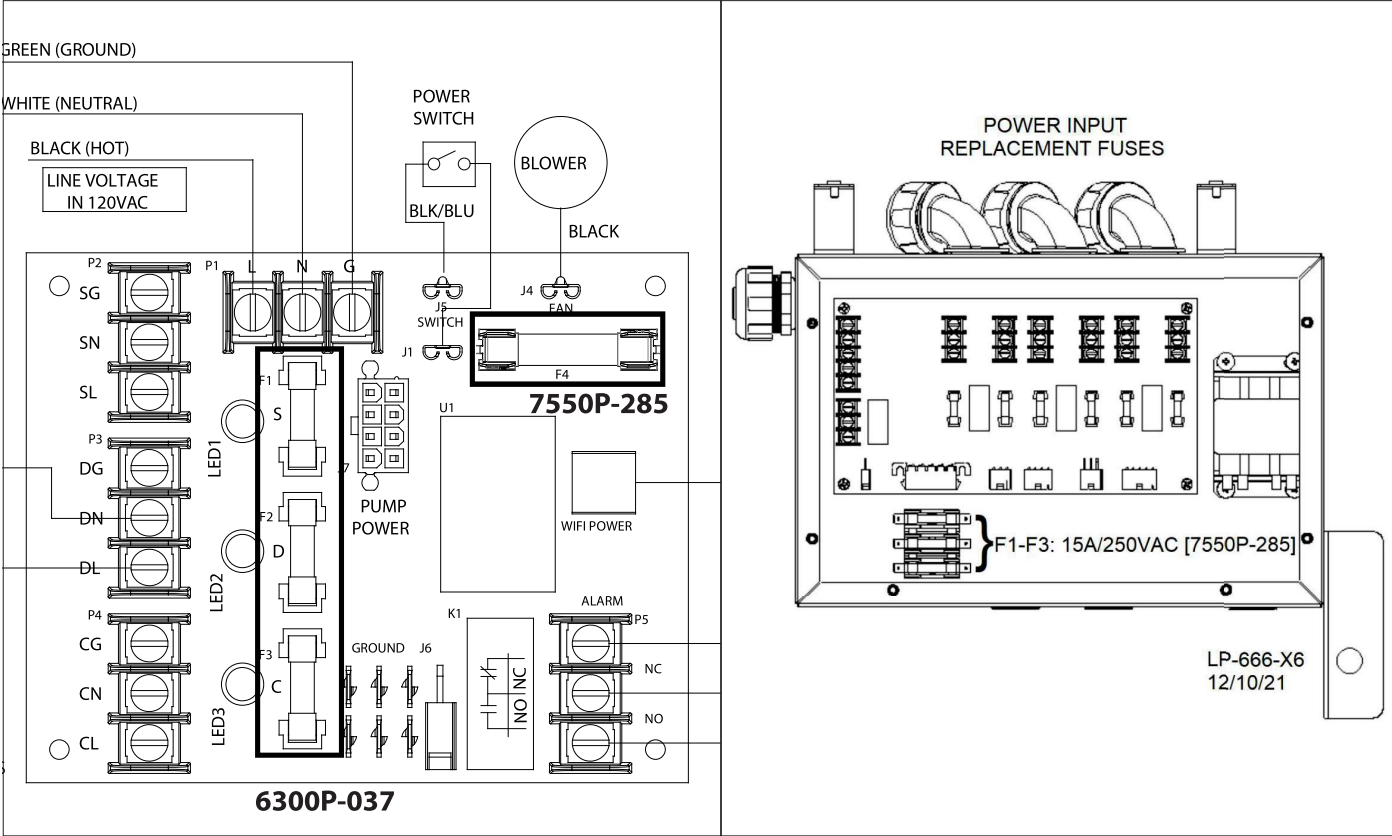


Figure 77 - 400 - 1000 Model High Voltage Box Replacement Fuses


Figure 78 - 1500 - 2000 Model High Voltage Box Replacement Fuses

Part 17 - Installation Checklist

Light Off Activities		Date Completed:	
1. Fill the Heating System	Check all piping and gas connections. Verify all are tight.		
	Pressurize system (12 - 15 psi).	PSI	
	Add water to prime condensate cup.		
	Verify near VWH piping is properly supported.		
	Percentage of glycol in system (0 - 50%)		
2. Check Gas Pipe	Leak test using locally approved methods (consult jurisdictional code book).		
	Check incoming gas pressure.	Static WC	
	Check the "drop" on light off (less than 1"WC).	Dynamic WC	
3. Check Combustion	Check and adjust (if necessary) carbon dioxide content.	%CO2 High Fire	%CO2 Low Fire
	Check and adjust (if necessary) carbon monoxide content.	ppm CO High Fire	ppm CO Low Fire
4. Check Electrical Connections	Ensure all electrical connections of line voltage (pumps, etc.) and low voltage circuits (system sensor, outdoor sensor, etc.) are properly wired.		
5. Verify System Operation	Turn up thermostat to verify wiring connections.		
6. Record Ionization Current	Check uA reading in the status menu (see Start-Up section, this manual).	uA High Fire	uA Low Fire
7. System Setting	Verify system settings.	CH Setpoint	CH Differential
8. Indirect Water Heater	Verify safety and operation of the indirect water heater. Record settings.	DHW Setpoint	DHW Differential
Notes:			

Table 41 - Installation Checklist

Part 18 - Maintenance Report

CAUTION	
In unusually dirty or dusty conditions, care must be taken to keep the VWH cabinet door in place at all times. Failure to do so VOIDS the warranty.	
 WARNING	
Allowing the VWH to operate with a dirty combustion chamber will hurt operation. Failure to clean the heat exchanger as needed by the installation location could result in VWH failure, property damage, personal injury, or death. Such product failures ARE NOT covered under warranty.	

The VWH requires minimal periodic maintenance under normal conditions. However, in unusually dirty or dusty conditions, periodic vacuuming of the cover to maintain visibility of the display and indicators is recommended.

Periodic maintenance should be performed once a year by a qualified service technician to assure that all the equipment is operating safely and efficiently. The owner should make necessary arrangements with a qualified heating contractor for periodic maintenance of the VWH. Installer must also inform the owner that the lack of proper care and maintenance of the VWH may result in a hazardous condition.

Inspection Activities		Date Last Completed			
Piping		1st Year	2nd Year	3rd Year	4th Year*
Near VWH piping	Check VWH and system piping for any sign of leakage; make sure pipes are properly supported.				
Vent	Check condition of all vent pipes and joints. Ensure the vent piping terminations are free of obstructions and blockages.				
System		1st Year	2nd Year	3rd Year	4th Year*
Visual	Do a full visual inspection of all system components.				
Functional	Test all functions of the system (Heat, Safeties).				
Temperatures	Verify safe settings on VWH or anti-scald valve.				
	Verify programmed temperature settings.				
Glycol (If Applicable)	Check glycol for the correct concentration, pH, and inhibitor level.				
Electrical		1st Year	2nd Year	3rd Year	4th Year*
Connections	Check wire connections. Make sure connections are tight.				
Smoke and CO Detector	Verify devices are installed and working properly. Change batteries if necessary.				
Circuit Breakers	Check to see that the circuit breaker is clearly labeled. Exercise circuit breaker.				
Switch and Plug	Verify ON/OFF switch and convenience plug are both functional.				
Chamber / Burner		1st Year	2nd Year	3rd Year	4th Year*
Combustion Chamber	Check burner tube and combustion chamber coils. Clean according to maintenance section of manual. Vacuum combustion chamber. Replace any gaskets that show signs of damage.				
Spark Electrode	Clean. See Figures 65 - 67. Clean probe with plumbers cloth to remove oxides.				
Combination Ignitor and Flame Probe	Check ionization in uA (d7 in Status Menu in Start-Up Procedures). Record high fire and low fire. Clean probe with plumbers cloth to remove oxides.				
Condensate		1st Year	2nd Year	3rd Year	4th Year*
Neutralizer	Check condensate neutralizer. Replace if necessary.				
Condensate Pipe	Disconnect condensate pipe. Clean out dirt. Fill with water to level of outlet and reinstall. (NOTE: Verify the flow of condensate, making sure that the hose is properly connected during final inspection.)				
Gas		1st Year	2nd Year	3rd Year	4th Year*
Pressure	Measure incoming gas pressure.				
Pressure Drop	Measure drop in pressure on light off (no more than 1"WC).				
Check Gas Pipe for Leaks	Check gas piping. Test for leaks and signs of aging. Make sure all pipes are properly supported.				
Combustion		1st Year	2nd Year	3rd Year	4th Year*
CO / CO2 Levels	Check CO and CO2 levels in exhaust. See Start-Up Procedures for ranges. Record at high and low fire.				
Safeties		1st Year	2nd Year	3rd Year	4th Year*
ECO (Energy Cut Out)	Check continuity on flue and water ECO. Replace if corroded.				
Sensors	Check wiring. Verify through ohms reading.				
Final Inspection		1st Year	2nd Year	3rd Year	4th Year*
Check List	Verify that you have completed entire check list. WARNING: FAILURE TO DO SO COULD RESULT IN SERIOUS INJURY OR DEATH.				
Homeowner	Review what you have done with the homeowner.				

Table 42 - *Continue annual maintenance beyond the 4th year as required.

VWH Limited Warranty

Five year warranty to assure your complete satisfaction.

HTP warrants each VWH and its parts to be free from defects in materials and workmanship according to the following terms, conditions, and time periods. UNLESS OTHERWISE NOTED THESE WARRANTIES COMMENCE ON THE DATE OF INSTALLATION. This limited warranty is only available to the **original consumer purchaser** (hereinafter "Owner") of the VWH, and is non-transferable.

VWH Warranty	Coverage Period	Coverage Rate	Components Covered
	Year 1	100%	All Components
	Years 1 - 5	100%	Pressure Vessel Only

Coverage Explanation

A. During the first year after the date of manufacture, HTP warrants that it will repair or replace, at its option and at 100% coverage, any defective or malfunctioning component of the VWH that is found to have failed due to manufacturer's defect.

B. During the first five years after the date of manufacture, HTP warrants that it will repair or replace, at its option and at 100% coverage, any defective or malfunctioning pressure vessel that is found to have failed due to manufacturer's defect.

Coverage Terms and Conditions

1. This warranty applies only to the components (including the pressure vessel) of the VWH, and does not apply to any VWH installation.
2. Replacement components will be of the nearest comparable model available at the time of replacement.
3. Replacement components (other than the pressure vessel) will be warranted for ninety (90) days. A replacement pressure vessel will be warranted for the unexpired portion of the applicable warranty period of the original pressure vessel.
4. In the event of a leakage of water from a replacement pressure vessel due to defective material or workmanship, malfunction, or failure to comply with the above warranty, HTP reserves the right to refund to the Owner the published wholesale price available at the date of manufacture of the original pressure vessel, at the applicable coverage rate detailed in the Basic or Extended Coverage sections above.
5. If government regulations, industry certification, or similar standards require the replacement component(s) to have features not found in the defective component(s), the Owner will be charged the difference in price represented by those required features. If the Owner pays the price difference for those required features and/or to upgrade the size and/or other features available on new replacement component(s), the Owner will also receive a complete new limited warranty for that replacement component(s).
6. This warranty extends only to VWHs utilized in water heating applications that have been properly installed by qualified professionals based upon the manufacturer's installation instructions.
7. It is expressly agreed between HTP and the Owner that repair, replacement, or refund are the exclusive remedies of the Owner.

Owner Responsibilities

The Owner or Qualified Installer / Service Technician must:

1. Have a relief valve bearing the listing marks of the American Society of Mechanical Engineers (ASME) installed with the VWH assembly in accordance with federal, state, and local codes.
2. Have a vacuum relief valve certified to ANSI Z21.22 - Relief Valves for Hot Water Supply Systems installed with the VWH assembly in accordance with federal, state, and local codes and in installations prone to vacuum related damages.
3. Maintain the VWH in accordance with the maintenance procedure listed in the manufacturer's provided instructions. Preventive

maintenance can help avoid any unnecessary breakdown of the VWH and keep it running at optimum efficiency.

4. Maintain all related system components in good operating condition.
5. Use the VWH in an open system, or in a closed system with a properly sized and installed thermal expansion tank.
6. Use the VWH at water pressures not exceeding the working pressure shown on the rating plate.
7. Keep the VWH free of damaging scale deposits.
8. Make provisions so if the VWH or any component or connection thereto should leak, the resulting flow of water will not cause damage to the area in which it is installed.

Warranty Exclusions

This limited warranty will not cover:

1. Any VWH purchased from an unauthorized dealer or online retailer.
2. Any VWH not installed by a qualified heating installer/service technician, or installations that do not conform to ANSI, CSA, and/or UL standards, as well as any applicable national or local building codes.
3. Service trips to teach you how to install, use, maintain, or to bring the VWH installation into compliance with local building codes and regulations.
4. The workmanship of any installer. The manufacturer disclaims and does not assume any liability of any nature caused by improper installation, repair, or maintenance.
5. Electricity or fuel costs, or increased or unrealized savings for same, for any reason whatsoever.
6. Any water damage arising, directly or indirectly, from any defect in the VWH or component part(s) or from its use.
7. Any incidental, consequential, special, or contingent damages or expenses arising, directly or indirectly, from any defect in the VWH or the use of the VWH.
8. Failure to locate the VWH in an area where leakage of the VWH or water line connections and the relief valve will not result in damage to the area adjacent to the VWH or lower floors of the structure, as well as failure to install the VWH with properly designed containment measures.
9. Any failed components of the heat system not manufactured by HTP as part of the VWH.
10. VWHs repaired or altered without the prior written approval of HTP.
11. Damages, malfunctions, or failures resulting from improper installation, or failure to install the VWH in accordance with applicable building codes/ordinances or good plumbing and electrical trade practices; or failure to operate and maintain the VWH in accordance with the manufacturer's provided instructions.
12. Damages, malfunctions, or failures resulting from failure to operate the VWH at pressures not exceeding the working pressure shown on the rating label.
13. Failure to operate the VWH in an open system, or in a closed system with a properly sized and installed thermal expansion tank.
14. Failure or performance problems caused by improper sizing of the VWH, expansion device, piping, or the gas supply line, the venting connection, combustion air openings, electric service voltage, wiring or fusing.
15. Damages, malfunctions, or failures caused by improper conversion from natural gas to LP gas or LP gas to natural gas.
16. Damages, malfunctions, or failures resulting from vacuum conditions.
17. Damages, malfunctions, or failures caused by operating the VWH with modified, altered, or unapproved parts.
18. Damages, malfunctions, or failures caused by abuse, accident, fire, flood, freeze, lightning, electrochemical reaction, acts of God and the like.
19. Failures (leaks) caused by operating the VWH in a corrosive or contaminated atmosphere.

20. Damages, malfunctions, or failures caused by operating the VWH with an empty or partially empty tank ("dry firing"), or failures caused by operating the VWH when it is not supplied with potable water, free to circulate at all times.
21. Failure of the heater due to the accumulation of solid materials and lime deposits.
22. Any damage or failure resulting from improper water chemistry. WATER CHEMISTRY REQUIREMENTS - Water pH between 6.5 and 8.5. Hardness less than 7 grains (120 mg/L). Chloride concentration less than 100 ppm (mg/L). TDS less than 500 ppm (mg/L).
23. Any damages, malfunctions, or failures resulting from the use of dielectric unions.
24. Production of noise, taste, odors, discoloration, or rusty water.
25. VWHs replaced for cosmetic reasons.
26. Components of the VWH that are not defective, but must be replaced during the warranty period as a result of reasonable wear and tear.
27. Components of the VWH that are subject to warranties, if any, given by their manufacturers; HTP does not adopt these warranties.
28. Damages, malfunctions, or failures resulting from the use of any attachment(s) not supplied by HTP.
29. VWHs installed outside the fifty states (and the District of Columbia) of the United States of America and Canada.
30. VWHs moved from the original installation location.
31. VWHs that have had their rating labels removed.

Procedures for Warranty Service Requests

Any claim for warranty assistance must be made immediately upon finding the issue. First, please consult the HTP Warranty Wizard (<https://htp.secure.force.com/warrantywizard/>) to check warranty eligibility. You may also contact HTP Technical Support at 1-800-323-9651 for questions or assistance. Warranty coverage requires review and approval of the issue with HTP Technical Support or through the Warranty Wizard prior to a full unit replacement. Any claim for warranty reimbursement will be rejected if prior approval from HTP is not obtained in advance of a full unit replacement. Final determination will be made as part of the warranty claim process.

When submitting a warranty claim the following items are required:

- 1. Proof of purchase or installation of the product** – Typically a copy of the invoice from the installing contractor, the receipt of the purchase of the product, or an original certificate of occupancy for a new home.
- 2. Clear pictures (or video) of the following:**
 - a. Serial number tag (sticker)
 - b. The product
 - c. The product issue / failure whenever possible
 - d. A picture of the piping near the product
 - e. For gas fired products, a picture of the venting, including how it exits the building

All claims will be reviewed by HTP within three (3) business days. If additional information is required and requested by the HTP Claims Department you will have thirty (30) days to provide it. When all requested information is provided HTP will respond within three (3) business days. The claim will be automatically closed if requested information is not provided within thirty (30) days. Claims will not be reopened without HTP Warranty Supervisor approval.

During the claims process a product that must be replaced will be given a designation of either a) field scrap, or b) return to HTP. If the product must be returned to HTP, the returned product must arrive at HTP within thirty (30) days of the date of our request to return the product. After receipt of the returned product HTP may require as many as thirty (30) additional days for product testing. **NOTE: Any components or heaters returned to HTP for warranty analysis will become the property of HTP and will not be returned, even if credit is denied.**

If you have questions about the coverage of this warranty, please

contact HTP at the following address or phone number: HTP, 272 Duchaine Blvd., New Bedford, MA, 02745, Attention: Warranty Service Department, 1(800) 323-9651.

Service, Labor, and Shipping Costs

Except when specifically prohibited by the applicable state law, the Owner, and not the Manufacturer, shall be liable for and shall pay for all charges for labor or other expenses incurred in the removal, repair, or replacement of the VWH or any component part(s) claimed to be defective or any expense incurred to remedy any defect in the product. Such charges include, but are not necessarily limited to:

1. All freight, shipping, handling, and delivery costs of forwarding a new VWH or replacement part(s) to the owner.
2. All costs necessary or incidental in removing the defective VWH or component part(s) and installing a new VWH or replacement part(s).
3. All administrative fees incurred by the Owner, as well as material required to complete, and/or permits required for, installation of a new VWH or replacement part(s), and
4. All costs necessary or incidental in returning the defective VWH or component part(s) to a location designated by the manufacturer.

Limitations of Your HTP Warranty and Remedies

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND ARE GIVEN AND ACCEPTED TO THE FURTHEST EXTENT UNDER APPLICABLE LAW IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND ANY OBLIGATION, LIABILITY, RIGHT, CLAIM OR REMEDY IN CONTRACT OR TORT, WHETHER OR NOT ARISING FROM HTP'S NEGLIGENCE, ACTUAL OR IMPUTED. THE REMEDIES OF THE OWNER SHALL BE LIMITED TO THOSE PROVIDED HEREIN TO THE EXCLUSION OF ANY OTHER REMEDIES INCLUDING WITHOUT LIMITATION, INCIDENTAL OR CONSEQUENTIAL DAMAGES, SAID INCIDENTAL AND CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO, PROPERTY DAMAGE, LOST PROFIT OR DAMAGES ALLEGED TO HAVE BEEN CAUSED BY ANY FAILURE OF HTP TO MEET ANY OBLIGATION UNDER THIS AGREEMENT INCLUDING THE OBLIGATION TO REPAIR AND REPLACE SET FORTH ABOVE. NO AGREEMENT VARYING OR EXTENDING THE FOREGOING WARRANTIES, REMEDIES OR THIS LIMITATION WILL BE BINDING UPON HTP. UNLESS IN WRITING AND SIGNED BY A DULY AUTHORIZED OFFICER OF HTP. THE WARRANTIES STATED HEREIN ARE NOT TRANSFERABLE AND SHALL BE FOR THE BENEFIT OF THE OWNER ONLY.

No Other Warranties

This warranty gives you specific legal rights, and you may also have other rights that vary from state to state. Some states do not allow the exclusion or limitation of incidental or consequential damages so this limitation or exclusion may not apply to you.

These are the only written warranties applicable to the VWH manufactured and sold by HTP. HTP neither assumes nor authorizes anyone to assume for it any other obligation or liability in connection with said VWHs. HTP reserves the right to change specifications or discontinue models without notice.

Maintenance Notes

[illegible]

Customer Installation Record Form

The following form should be completed by the qualified installer / service technician for you to keep as a record of the installation in case of a warranty claim. After reading the important notes at the bottom of the page, please also sign this document.

Customer's Name	
Date of Installation	
Installation Address	
Product Name / Serial Number(s)	
Comments	
Installer's Code / Name	
Installers Phone Number	
Signed by Installer	
Signed by Customer	
Installation Notes	

IMPORTANT

Customer: Please only sign after the qualified installer / service technician has fully reviewed the installation, safety, proper operation, and maintenance of the system. If the system has any problems please call the qualified installer / service technician. If you are unable to make contact, please call your sales representative.

Distributor / Dealer: Please insert contact details.