



GAS-FIRED COMMERCIAL WATER HEATER **(Ultra Low NOx)**



! 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.
- For your family's comfort, safety and convenience, it is recommended this water heater be installed and serviced by a plumbing professional.



Ambler, PA 19002
Tech Service (800) 334-3393
Service Parts (800) 538-2020
Warranty Service (800) 531-2111

INSTALLATION/OPERATION MANUAL **WITH TROUBLESHOOTING GUIDE**

PLACE THESE INSTRUCTIONS ADJACENT TO WATER HEATER AND NOTIFY OWNER TO KEEP FOR FUTURE REFERENCE

238-50463-00C REV 12/14

SECTION I: IMPORTANT INFORMATION

This gas-fired water heater is design certified by CSA International under the American National Standard, Z21.10.3 (as indicated on the rating plate) and CAN/CGA 4.3-M (as indicated on the rating plate) available from CSA Standards Association, 5060 Spectrum Way, Mississauga, Ontario, CANADA L4W 5N6.

This water heater must be installed in accordance with local codes. In the absence of local codes, it must be installed in compliance with the National Fuel Gas Code (ANSI Z223.1-Latest Edition), or in Canada CAN/CGA B149.1 Natural Gas Installation Code (Latest Edition) or CAN/CGA B149.2 Propane Installation Code (Latest Edition).

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



DANGER

Indicates an imminently hazardous situation, which, if not avoided, will result in death, serious injury or substantial property damage.



CAUTION

Indicates potentially hazardous situation, which, if not avoided, may result in moderate or minor injury or property damage.



WARNING

Indicates a potentially hazardous situation, which, if not avoided, could result in death, serious injury or substantial property damage.

NOTICE

Indicates special instructions on installation, operation or maintenance, which are important but not related to personal injury hazards.

NOTICE

This water heater has a limited warranty. The warranty for this water heater is valid only if the water heater has been installed, maintained and operated in accordance with these instructions.

TABLE OF CONTENTS

SECTION I: IMPORTANT INFORMATION	2	SECTION VIII: ELECTRICAL CONNECTIONS	25
SECTION II: SPECIFICATIONS.....	5	SECTION IX: OPERATING INSTRUCTIONS.....	26
SECTION III: GENERAL INFORMATION.....	6	SECTION X: MAINTENANCE.....	35
SECTION IV: INSTALLATION INSTRUCTIONS	8	SECTION XI: DIAGNOSTIC AND	
SECTION V: VENTING	13	TROUBLESHOOTING GUIDE.....	39
SECTION VI: WATER CONNECTIONS.....	19	SECTION XII: PARTS LIST	58
SECTION VII: GAS CONNECTIONS	23		

DANGER

DO NOT store or use gasoline or other flammable, combustible, or corrosive vapors and/or liquids in the vicinity of this or any other appliance.

This water heater is equipped with an adjustable thermostat to control water temperature. Hot water temperatures required for automatic dishwasher and laundry use can cause scald burns resulting in serious personal injury and/or death. The temperature at which injury occurs varies with the person's age and the time of exposure. The slower response time of disabled persons increases the hazards to them. **NEVER** allow small children to use a hot water tap, or to draw their own bath water. **NEVER** leave a child or disabled person unattended in a bathtub or shower.

Toxic chemical, such as those used for boiler treatment, must not be introduced into potable water used for space heating.

This water heater must not be connected to an existing heating system or component(s) previously used with a non-potable water heating appliance.

All piping components connected to this water heater for space heating applications must be suitable for use with potable water.

WARNING

Improper installation, adjustments, alteration, service or maintenance can cause property damage, personal injury or loss of life. Failure to follow all instructions in the proper order can cause personal injury or death. Read and understand all instructions, including all those provided with the appliance before installing, starting-up, operating, maintaining or servicing this appliance. Keep this manual and literature in legible condition with this water heater for reference by owner and service technician.

This water heater requires regular maintenance and service to operate safely. Follow the instructions contained in this manual.

Installation, maintenance, and service must be performed only by a qualified, skilled and knowledgeable installer or service provider.

Installation is not complete unless a temperature and pressure relief valve is installed into the proper location at the top of this water heater.

It is the responsibility of the installing contractor to see that all controls are correctly installed and are properly operating when the installation is complete.

This water heater is suitable for installation on combustible flooring. Do not install water heater directly on carpeting.

DO NOT operate this water heater without first being certain it is filled with water.

DO NOT tamper with or alter the water heater and/or controls.

DO NOT operate water heater with jumpered or absent controls or safety devices.

DO NOT operate water heater if any external part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system including gas controls, which has been under water.

DO NOT attempt to use this water heater with any gas other than the type listed on the rating plate. Do not attempt to convert this water heater for use with a gas other than the type for which it is equipped. Failure to use the proper gas can create an unsafe condition resulting in property damage, bodily injury, or death. Consult your local gas supplier or gas company if there are any questions.

Incorrect operation of this appliance may create a hazard to life and property and will nullify the warranty.

DO NOT operate this water heater if the input rate exceeds the rate shown on the water heater rating plate.

This water heater contains very hot water under high pressure. Do not unscrew any pipe fittings nor attempt to disconnect any components of this water heater without positively assuring the water is cool and is not under pressure. Always wear protective clothing and equipment when installing, starting up or servicing this water heater to prevent scald injuries. Do not rely on the temperature gauges to determine the temperature. Do not touch any components unless they are cool.

This water heater must be properly vented and connected to an approved vent system in good condition. DO NOT operate water heater with the absence of an approved vent system. A clean and unobstructed vent system is necessary to allow noxious fumes that could cause injury or loss of life to vent safely and will contribute toward maintaining the water heater's efficiency.

WARNING

This water heater needs fresh air for safe operation and must be installed so there are provisions for adequate combustion and ventilation air. Insufficient air supply will cause a recirculation of combustion products resulting in contamination that may be hazardous to life. This will result in carboning or sooting of the combustion chamber, burner, and flue tubes and creates a risk of asphyxiation.

Water heater materials of construction, products of combustion and the fuel contain carbon monoxide, nitrogen oxides, aldehydes and/or other toxic or harmful substances which can cause death or serious injury and which are known to the state of California to cause cancer, birth defects and other reproductive harm. Always use proper safety clothing, respirators and equipment when servicing or working nearby this water heater.

Flammable items, pressurized containers or any other potential fire hazardous articles must never be placed on or adjacent to the water heater. Open containers of flammable material should not be stored or used in the same room with this water heater.

Insulation blankets are not required for this water heater. This water heater meets or exceeds the ASHRAE/IES 90.1b (latest edition) standards with respect to insulation and standby loss requirements.

Setting the water temperature to the maximum set point can result in scalding hot water delivered to the faucets. It is highly recommended that the maximum setpoint be adjusted to the lowest temperature possible for the needs of the installation. See following section in this Installation/Operation Manual to change the maximum setpoint limit (max setpoint). Make sure the water heater control display is not in a public area that can result in the temperature settings being improperly adjusted.

Hydrogen gas can be produced in an operating water heater that has not had water drawn from the tank for a long period of time (generally two weeks or more). Hydrogen gas is extremely flammable. To prevent the possibility of injury under these conditions, we recommend the hot water faucet to be open for several minutes at the kitchen sink before you use any electrical appliance, which is connect to the hot water system. If hydrogen is present, there will be unusual sounds such as air escaping through the pipes as hot water begins to flow. Do not smoke or have open flame near the faucet at the time it is open.

WARNING

Basements, crawl spaces, closets and areas below ground level will serve as pockets for accumulation of leaking gas. Before lighting, smell all around the appliance area for gas. Be sure to smell next to the floor.

IF YOU SMELL GAS:

- DO NOT try to light any appliance.
- DO NOT touch any electric switch; do not use any telephone in your building.
- Immediately call your gas supplier from a telephone in another building. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

DO NOT OPERATE THE APPLIANCE UNTIL THE LEAKAGE IS CORRECTED!

To comply with NSF requirements this water heater is to be: Sealed to the floor with sealant, in a smooth and easily cleanable way.

SECTION II: SPECIFICATIONS

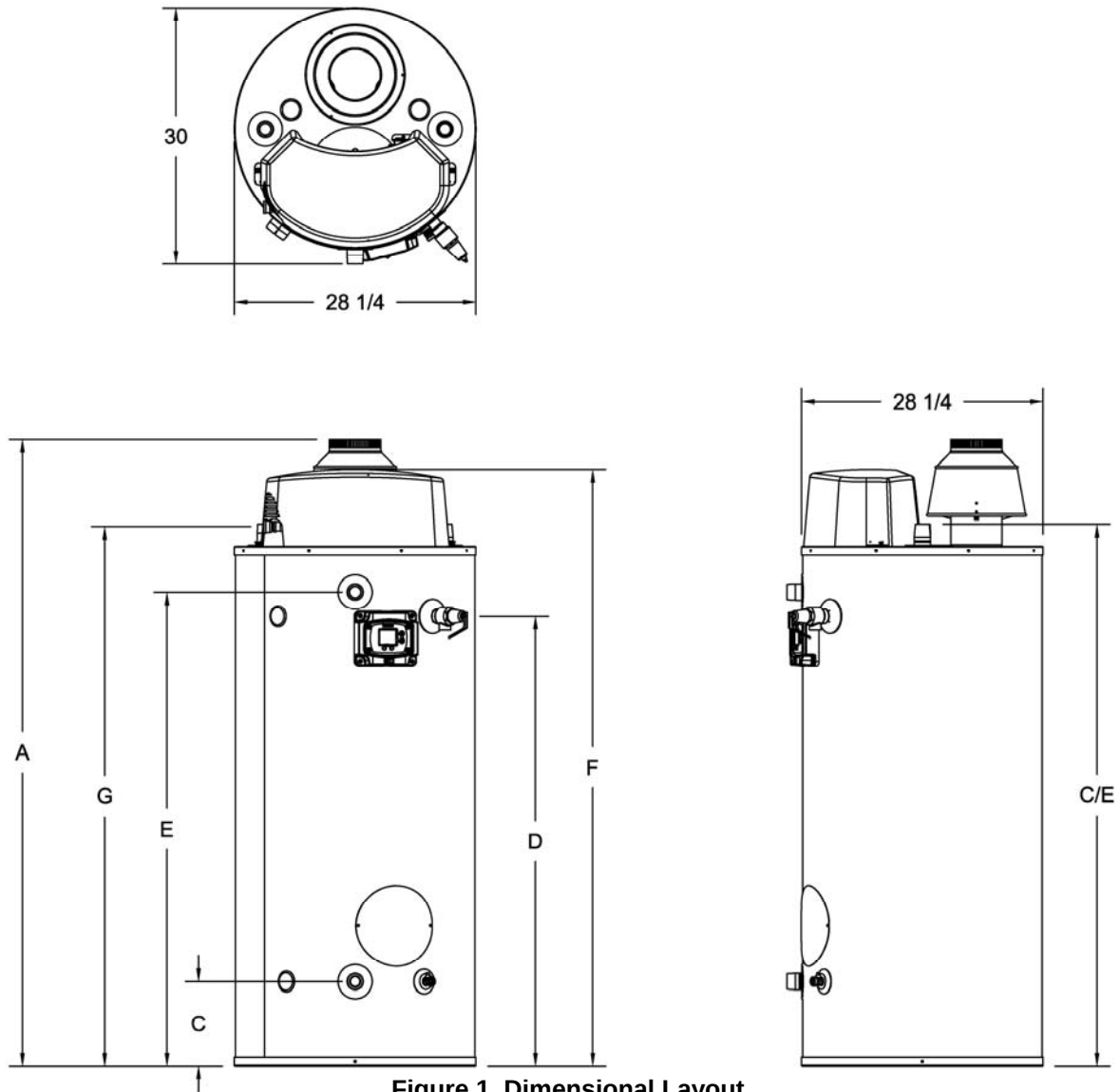


Figure 1. Dimensional Layout.

Table 1. Specifications.

Model Description			1 st Hour Delivery at 100°F Rise (Gal.)	A Floor to Top of Vent (in.)	B Vent Dia. (in.)	C Floor to Cold Water Conn. (in.)	D Floor to T & P (in.)	E Floor to Hot Water Conn. (in.)	F Floor to Top of Water Heater (in.)	G Floor to Gas Conn. (in.)	Water Conn. Dia. (in.)	Gas Conn. Dia. (in.)	Relief Valve (in.)
Model Number	Capacity (Gal.)	Input BTU/Hr. NAT. & L.P.											
UCG100H199	100	199,999	267	73 ¼	6	10	52 ½	55 ½	69 ¾	63 ¾	1 ½	¾	¾
UCG100H270	100	270,000	336	73 ¼	6	10	52 ½	55 ½	69 ¾	63 ¾	1 ½	¾	1
UCG100H399	100	399,999	463	77 ¼	8	10	52 ½	55 ½	69 ¾	63 ¾	1 ½	¾	1

Model Description			1 st Hour Delivery at 56°C Rise Liters	A Floor to Top of Vent (mm)	B Vent Dia. (mm)	C Floor to Cold Water Conn. (mm)	D Floor to T & P (mm)	E Floor to Hot Water Conn. (mm)	F Floor to Top of Water Heater (mm)	G Floor to Gas Conn. (mm)	Water Conn. Dia. (mm)	Gas Conn. Dia. (mm)	Relief Valve (mm)
Model Number	Capacity Liters	Input kW/Hr. NAT. & L.P.											
UCG100H199	379	58.6	1011	1861	152	254	1334	1410	1772	1607	38	19	19
UCG100H270	379	79.1	1272	1861	152	254	1334	1410	1772	1607	38	19	19
UCG100H399	371	117.2	1736	1962	203	254	1334	1410	1772	1607	38	19	25

SECTION III: GENERAL INFORMATION

FEATURES

This water heater contains the following features:

MAIN POWER ON/OFF SWITCH

The front panel of this water heater has an ON/OFF switch, which has markings when the main power is turned on to indicate power to the water heater.

COMBUSTION SYSTEM

This water heater is equipped with a self-compensating negative pressure pre-mix combustion system. As the blower operates, air is drawn in through the air intake and into a venturi, which pulls gas from the gas valve. The gas and air is then mixed in the combustion blower and sent through the transition tube into the burner. The Direct Spark Ignition System (DSI) then ignites the gas/air fuel mixture to produce flue products (combustion). The flame sensor signals the ignition control board (described below), that a flame is present.

HONEYWELL INTEGRATED CONTROL

Consists of a control board and a water heater display. An attractive digital water heater display is on the top front of the water heater for precisely setting and displaying the temperature setpoint and monitoring the status of the water heater. Pressing the temperature UP and DOWN buttons changes the temperature setpoint. The temperature format may be displayed in degrees F or *degrees C*. The water heater display will show diagnostic codes in the event the water heater needs servicing. The temperature readings of the tank sensor can be monitored in Service Mode. Also in Service Mode, the display can show up to 10 previous error codes to further aid in servicing the water heater.

The single control board has plug in wiring harnesses to reduce the chance of mis-wiring. The control board controls all ignition, temperature, and combustion blower functions. The control board controls the combustion blower, ignition timings, and gas valve to control the combustion system in order to maintain the desired tank temperature. The sequence of operation is described in detail in the Diagnostic Section at the back of this Installation and Operating Instruction Manual.

ADJUSTABLE THERMOSTAT

This water heater is equipped with an adjustable thermostat as part of the Integrated Control System to control water temperature. Hot water temperatures required for automatic dishwasher and laundry use can cause scald burns resulting in serious personal injury and/or death.

The temperature may be adjusted from about 70°F (21°C) to about 180°F (82°C). The thermostat was adjusted to 70°F (21°C) before the water heater was shipped from the factory. It is recommended that lower temperatures be used to avoid the risk of scalding. Refer to the “Warnings” and the section on SCALDING in “Section V: Water Connections”. It is further recommended, in all cases, that the water temperature be set for the lowest temperature, which satisfies your hot water requirements for the installation. This will also provide the most energy efficient operation of the water heater and minimizes scale formation.

Setting the water heater temperature at 120°F (49°C) will reduce the risk of scalds. Some states require setting lower temperatures for specific installations.

The top immersion well of the single sensor control also contains a redundant sensor for the high limit (energy cutoff). The high limit circuit interrupts the main burner gas flow should the water temperature exceed approximately 200°F (93°C). Error code “65” will be shown on the water heater control display if the high limit temperature has been exceeded.

Should the high limit switch activate, it must be manually reset. This should only be done by a service technician after the cause of overheating has been corrected. Refer to the section on “Accessing Service Mode on the Display” in the Diagnostic section of this Installation and Instruction Manual.

Contact your qualified installing contractor, service provider or manufacturer listed on the rating plate if continued high limit operation occurs.

LATCHES

The latches allow easy access for servicing the water heater from the top. Simply remove the two latches for servicing and re-latch upon completion. No tools are required to obtain access to the top of the water heater.



Keep clear of combination temperature and pressure relief valve discharge line outlet. The discharge may be hot enough to cause scald injury. The water is under pressure and may splash.

For protection against excessive temperatures and pressure, install temperature and pressure protective equipment required by local codes, but not less than a combination temperature and pressure relief valve certified by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment or materials as meeting the requirements of the Standard for *Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems*, ANS Z21.22 and the Standard *CAN1-4.4 Temperature, Pressure, Temperature and Pressure Relief Valves and Vacuum Relief Valves*. The combination temperature and pressure relief valve must be marked with a maximum set pressure not to exceed the maximum working pressure of the water heater. The combination temperature and pressure relief valve must also have an hourly rated temperature steam BTU discharge capacity not less than the hourly rating of the water heater.

Install the combination temperature and pressure relief valve into the opening provided and marked for this purpose on the water heater.

Note: Some models may already be equipped or supplied with a combination temperature and pressure relief valve. Verify that the combination temperature and pressure relief valve complies with local codes. If the combination temperature and pressure relief valve does not comply with local codes, replace it with one that does. Follow the installation instructions above on this page.

Install a discharge line so that water discharged from the combination temperature and pressure relief valve will exit within six (6) inches (15.2 cm) above, or any distance below the structural floor and cannot contact any live electrical part. The discharge line is to be installed to allow for complete drainage of both the combination temperature and pressure relief valve and the discharge line. The discharge opening must not be subjected to blockage or freezing. DO NOT thread, plug or cap the discharge line. It is recommended that a minimum clearance of four (4) inches (10.2 cm) be provided on the side of the water heater for servicing and maintenance of the combination temperature and pressure relief valve.

Do not place a valve between the combination temperature and pressure relief valve and the tank.

DISHWASHING MACHINE REQUIREMENTS

All dishwashing machines meeting the National Sanitation Foundation requirements are designed to operate with water flow pressures between 15 and 25 pounds per square inch. Flow pressures above 25 pounds per square inch, or below 15 pounds per square inch, will result in improperly sanitized dishes.

The National Sanitation Foundation also recommends circulation of 180°F water. Where this is done, the circulation should be very gentle so that it does not cause any unnecessary turbulence inside the water heater. The circulation should be just enough to provide 180°F water at the point of take-off to the dishwashing machine. Adjust flow by means of the valve in the circulation line.

SACRIFICIAL ANODES – Three sacrificial anode rods have been installed in the tank head to extend tank life. The anode rods should be inspected periodically for corrosion and replaced when necessary to prolong tank life. Water conditions in your area will influence the time interval for inspection and replacement of the anode rods. The use of a water softener may increase the speed of anode consumption. More frequent inspection of the anodes is needed when using softened (or phosphate treated) water. Contact the installing contractor, or service provider that installed the water heater or the manufacturer listed on the rating plate for anode replacement information.

SECTION IV: INSTALLATION INSTRUCTIONS



INSTALLATION OF THIS WATER HEATER REQUIRES ABILITY EQUIVALENT TO THAT OF A LICENSED TRADESPERSON IN THE FIELD INVOLVED. PLUMBING, AIR SUPPLY, VENTING, GAS SUPPLY AND ELECTRICAL WORK ARE REQUIRED.

DO NOT ATTEMPT TO LIGHT ANY GAS APPLIANCE IF YOU ARE NOT CERTAIN OF THE FOLLOWING:

- Liquefied petroleum gases/propane gas and natural gas have an odorant added by the gas supplier that aids in detection of the gas.
- Most people recognize this odor as a “sulfur” or “rotten egg” smell.
- Other conditions, such as “odorant fade” can cause the odorant to diminish in intensity, or “fade”, and not be as readily detectable.
- If you have a diminished sense of smell, or are in any way unsure of the presence of gas, immediately contact your gas supplier from a telephone in another building.
- Gas detectors are available. Contact your gas supplier or plumbing professional for more information.

Liquefied petroleum gases/propane gas is heavier than air and will remain at floor level if there is a leak. Basements, crawl spaces, closets and areas below ground level will serve as pockets for accumulation of leaking gas. Before lighting, smell all around the appliance area for gas. Be sure to smell next to the floor.

IF YOU SMELL GAS:

- Do not try to light any appliance.
- Do not touch any electric switch; do not use any telephone in your building.
- Immediately call your gas supplier from a telephone in another building. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

DO NOT OPERATE THE APPLIANCE UNTIL THE LEAKAGE IS CORRECTED!

This water heater must be located in an area where leakage of the tank, water line connections, or the combination temperature and pressure relief valve will not result in damage to the area adjacent to the water heater or to lower floors of the structure. When such locations cannot be avoided, a suitable drain pan must be installed under the water heater. The drain pan depth must be suitable for draining and collecting water, and have a minimum length and width of at least four (4) inches (10.0 cm) measured from the jacket of the water heater. The drain pan, as described above, can be purchased from your plumbing professional. The water heater might need to be placed on blocks inside drain pan to fit in standard size pan. The drain pan must be piped to an adequate drain. The piping must be at least ¾ inch (2.0 cm) in diameter and pitched for proper drainage.

Water heaters are heat producing appliances. To avoid damage or injury there must be no materials stored against the water heater and proper care must be taken to avoid unnecessary contact (especially by children) with the water heater components. **UNDER NO CIRCUMSTANCES SHALL FLAMMABLE MATERIALS, SUCH AS GASOLINE OR PAINT THINNER BE USED OR STORED IN THE VICINITY OF THIS WATER HEATER, VENT-AIR INTAKE SYSTEM OR IN ANY LOCATION FROM WHICH FUMES COULD REACH THE WATER HEATER OR VENT-AIR INTAKE SYSTEM.**

Failure to adhere to these installation and operating instructions may create a hazard to life and property and will nullify the warranty.

Sacrificial anode rods have been installed in the tank head of the water heater to extend tank life. The removal of these anodes for any reason will nullify the warranty. In areas where water is unusually active, an odor may occur at the hot water faucet due to a reaction between the sacrificial anode and the impurities in the water. If this should happen, alternative anodes may be purchased from the supplier that installed this water heater. This will minimize the odor while protecting the tank. Additionally, the water heater should be flushed with appropriate dissolvers to eliminate any bacteria.

Note: For California installation this water heater must be braced, anchored, or strapped to avoid falling or moving during an earthquake. See instructions for correct installation procedures. Instructions may be obtained from DSA Headquarters Office, 1102 Q Street, Suite 5100, Sacramento, California 95811.

This water heater MUST be installed indoors out of the wind and weather.

This water heater **MUST NOT** be installed in any location where gasoline or flammable vapors are likely to be present, unless the installation is such to eliminate the probable ignition of gasoline or flammable vapors.

CAUTION

The National Fuel Gas Code (ANSI Z233.1- latest edition) or in Canada The Natural Gas Installation Code CAN/CGA (B149.1 - latest edition), expressly prohibits the following:

- a. Installation of a water heater in a bathroom, bedroom, or any occupied room normally kept closed.
- b. Installation of a water heater in a garage, unless the unit is installed so that the burner and ignition devices are at least eighteen (18) inches (45.8 cm) above floor level and protected to avoid damage by a moving vehicle.

If the buildings cold water supply has a back-flow preventer, check valve or water meter with check valve, provisions for thermal expansion of water in the hot water system must be provided.

The location of this water heater is of the utmost importance. Before installing this water heater, you should read the Installation section of these instructions. After reading these Installation and Operating Instructions, select a location for the water heater where the floor is level and is easily accessible to water lines, gas supply (type identified on the rating plate), an adequate open drain, and a chimney or exhaust gas vent. **DO NOT locate the water heater where water lines could be subjected to freezing temperatures. Make sure the cold water pipes are not located directly above the gas control box or any other electrical control so that condensate during humid weather does not drip on the controls.**

This installation must allow access to the front of the water heater and adequate clearance must be provided for servicing and operating this water heater. The water heater may be installed on either a combustible or non-combustible floor. If the water heater is to be installed directly on carpeting, it must be installed on top of a metal or wood panel (or equivalent) extending beyond the full width and depth of the appliance by at least three (3) inches (7.6 cm) in any direction or, if the appliance is to be installed in an alcove or closet, the entire floor must be covered by the panel. The minimum clearances to combustibles for this water heater are given in the following pages. A minimum of 24 inches front clearance must be provided for inspection and servicing. Adequate clearances must be provided for easy access to controls by service personnel to enable proper cleaning, servicing, and operation of the water heater.

Water heater corrosion and component failure can be caused by the heating and breakdown of airborne chemical vapors. Examples of some typical compounds that are potentially corrosive are: spray can propellants, cleaning solvents, refrigerator and air conditioning refrigerants, swimming pool chemicals, calcium and sodium chloride, waxes and process chemicals. These materials are corrosive at very low concentration levels with little or no odor to reveal their presence.

NOTICE

DAMAGE TO THE WATER HEATER CAUSED BY EXPOSURE TO CORROSIVE VAPORS IS NOT COVERED BY THE WARRANTY. DO NOT OPERATE THE WATER HEATER IF EXPOSURE HAS OR WILL OCCUR. DO NOT STORE ANY POTENTIALLY CORROSIVE COMPOUNDS IN THE VICINITY OF THE WATER HEATER.

UNPACKING

1. Inspect carefully for any signs of damage
2. All equipment is carefully manufactured, inspected and packed.
3. Any claims for damage or shortage in shipment must be filed immediately with the manufacturer noted on the rating plate label.

LOCATE WATER HEATER

1. Locate water heater in front of final position before removing crate.
2. LOCATE so that venting connections will be short and direct.
3. THIS WATER HEATER IS SUITABLE FOR INSTALLATION ON COMBUSTIBLE FLOOR.
4. Proper venting practices must be considered when selecting a location for this water heater. For exact venting specifications, please consult the Venting section of these Installation and Operating Instructions.
5. It is recommended that minimum clearances shown in figure 2b be provided on the sides and top of the water heater for servicing and maintenance of the water heater.
6. Increase distances to provide clearance for servicing.

Input	Front, sides and Rear "A"
Less than or equal to 270,000 BTUH	0 in. (0.0 CM)
399,999 BTUH	0 in. (0.0 CM) (2 in. Rear ONLY)

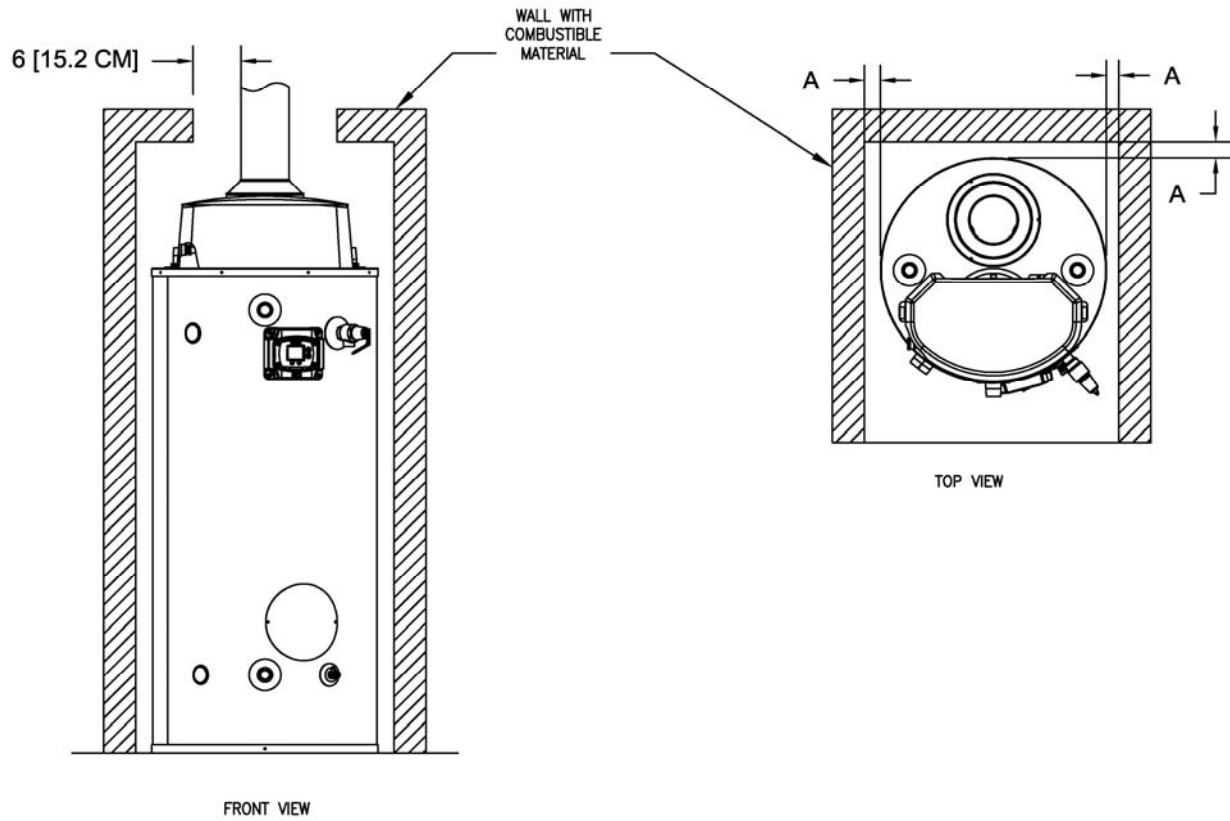


Figure 2a. Minimum Clearance To Combustible Material.

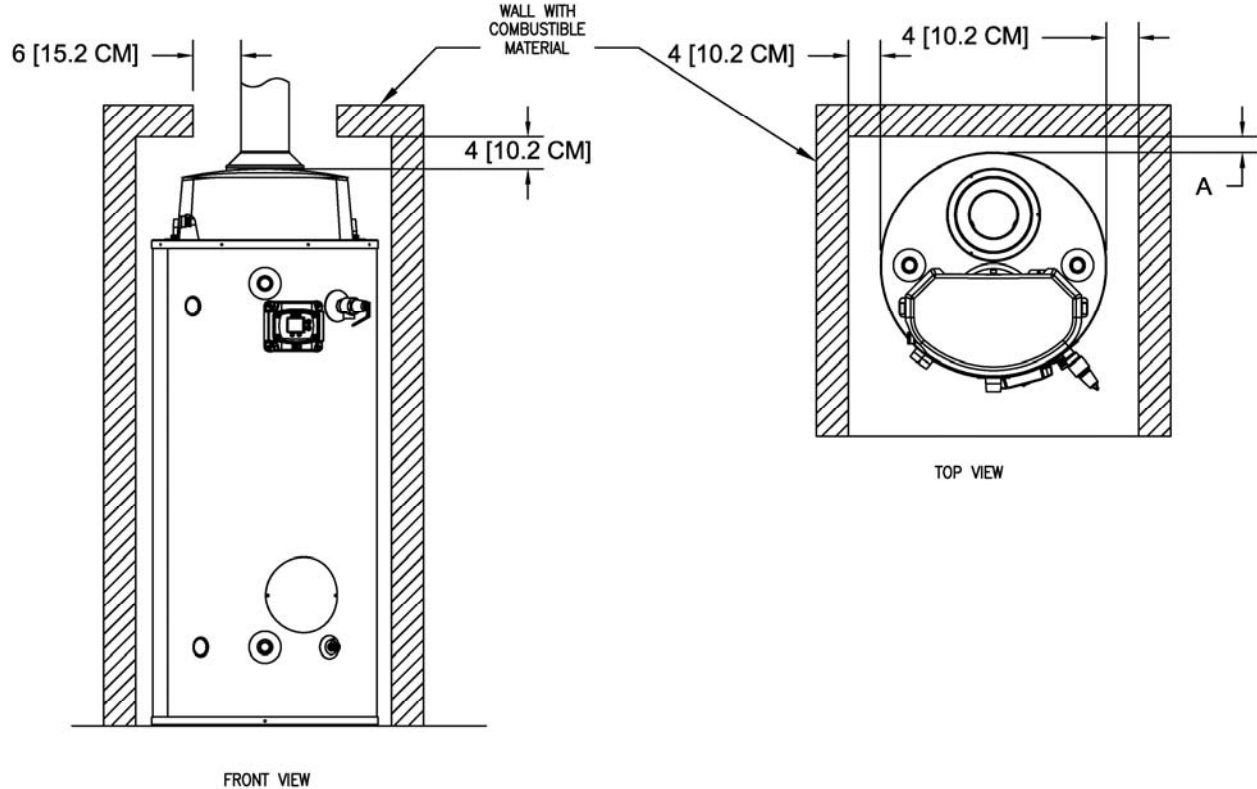


Figure 2b. Recommended Minimum Clearances For Service Access.

REMOVE CRATE

1. Remove all banding and pry off crate sides carefully so as not to damage the water heater.
2. Carefully roll/lift the water heater from the crate base.

CAUTION

Do not drop water heater. Do not bump water heater jacket against floor.

Do not bump exhaust vent pipe against crate or other objects. This will damage the heater and cause it to be inoperable or create nuisance problems.

MOVE WATER HEATER TO PERMANENT POSITION by sliding or walking.

INSTALL TEMPERATURE AND PRESSURE RELIEF VALVE (if not already installed).

DANGER

Temperature setting should not exceed safe temperature at fixtures. See water temperature control warning in Section VI, "Water Connections". If higher preheat temperatures are necessary to obtain adequate booster output, add an ASSE approved mixing device for hot water supplied to fixtures.

WARNING

Temperature and pressure relief valve discharge piping must be piped near floor to eliminate potential of severe burns. Do not pipe in any area where freezing could occur. Do not install any shut-off valves, plugs or caps to the temperature and pressure relief valve or piping.

This water heater must be located in an area where the general public does not have access to set temperatures.

AIR REQUIREMENTS

1. Do not obstruct the flow of ventilating air.
2. For safe operation, adequate air is needed for combustion and ventilation. Sooting may result in serious damage to the water heater and risk of fire or explosion. It can also create a risk of asphyxiation. Such a condition often will result in a yellow, luminous burner flame, causing carboning or sooting of the combustion chamber, burner and flue tubes.

WARNING

IMPORTANT-The flow of combustion and ventilating air must not be obstructed.

MECHANICAL EXHAUSTING OF ROOM AIR - Where an exhaust fan is installed in the same room with this water heater and combustion air is drawn from inside the room, sufficient openings for air must be provided in the walls. **UNDERSIZED OPENINGS WILL CAUSE AIR TO BE DRAWN INTO THE ROOM THROUGH THE WATER HEATER'S VENTING SYSTEM, CAUSING POOR COMBUSTION THAT MAY BE HAZARDOUS TO LIFE. SOOTING MAY RESULT IN SERIOUS DAMAGE TO THE WATER HEATER AND RISK OF FIRE OR EXPLOSION, WHICH CAN ALSO CREATE A RISK OF ASPHYXIATION.** Refer to local codes and /or National Fuel Gas Code (ANSI Z223.1-Latest Edition), or in Canada CAN/CGA B149.1 Natural Gas Installation Code (Latest Edition) or CAN/CGA B149.2 Propane Installation Code (Latest Edition) for proper air opening sizing.

CONFINED SPACES

If the water heater is installed in a confined space (volume is less than 50 ft.³/1000 BTU (15 m³/0.29 kW) per hour of the total input rating of all gas appliances in that space), air must be supplied through two permanent openings. One opening must be within 12 inches (30.5 cm) from the top of the enclosure and one within 12 inches (30.5 cm) of the bottom. The openings must be protected by metal louvers or 1/4" (6.4 mm) min. mesh metal screen. The size of the openings are as follows:

CAUTION

The draft hood relief opening of the water heater and combustion air inlet must be in the same atmospheric pressure zone. Large exhaust fans in kitchens and other locations can lower the air pressure inside an enclosure and interfere with the proper operation and venting of the water heater. In these cases, the water heater should be installed in a separate room with the combustion and ventilation air supplied directly from outdoors as previously described.

1. If the openings communicate directly with an additional room(s) of sufficient volume, each opening must have a minimum free area opening of $1 \text{ in.}^2/1000 \text{ BTU}$ ($2.54\text{cm}^2/0.29\text{kW}$) per hour of the total input rating of all gas appliances in the confined space, but not less than 100 in.^2 (254 cm^2).
2. If the openings communicate with the outdoors through horizontal ducts, each opening must have a minimum free area of $1 \text{ in.}^2/2000 \text{ BTU}$ ($2.54\text{cm}^2/0.59\text{kW}$) per hour of the total rating of all gas appliances in the enclosure.
3. If the openings communicate directly with the outdoors or through vertical ducts with the outdoors, each opening must have a minimum free area of $1 \text{ in.}^2/4000 \text{ BTU}$ ($2.54\text{cm}^2/1.18\text{kW}$) per hour of the total rating of all gas appliances in the enclosure.

ALL AIR FROM INSIDE THE BUILDING

The confined space must be provided with two permanent openings communicating directly with an additional room(s) of sufficient volume so that the combined volume of all spaces meets the criteria for an unconfined space. The total input of all gas utilization equipment installed in the combined space must be considered in making this determination. Each opening must have a minimum free area of $1 \text{ in.}^2/1000 \text{ BTU}$ ($2.54\text{cm}^2/0.29\text{kW}$) per hour of the total input rating of all gas utilization equipment in the confined space, but not less than 100 square inches (254cm^2). One opening must be within 12 inches (30.5 cm) of the top and one within 12 inches (30.5 cm) of the bottom of the enclosure.

UNCONFINED SPACES

In unconfined spaces in buildings, infiltration may be adequate to provide air for combustion, ventilation and dilution of flue gases. However, in buildings of tight construction (for example, weather stripping, heavily insulated, caulked, vapor barrier, etc.), additional air may need to be provided using the methods described above under CONFINED SPACES: All Air From Outdoors or SPECIALLY ENGINEERED INSTALLATIONS.

SPECIALLY ENGINEERED INSTALLATIONS

The requirements noted under CONFINED SPACES above must not necessarily govern when special engineering, approved by the authority having jurisdiction, provides an adequate supply of air for combustion, ventilation, and dilution of flue gases.

CHEMICAL VAPOR CORROSION

Corrosion of the flue ways and vent system will occur if air for combustion contains certain chemical vapors. Such corrosion may result in poor combustion and create a risk of asphyxiation, as well as reducing the life of the water heater. Spray can propellants, cleaning solvents, refrigerator and air conditioning refrigerants, swimming pool chemicals, calcium and sodium chloride, waxes and process chemicals are corrosive. Products of this sort should not be stored near the water heater or outside by the air intake (if applicable).

SECTION V: VENTING

WARNING

The venting system must be installed properly following all local codes or in the absence of local codes, the latest edition of the National Fuel Gas Code (ANSI Z223.1- latest edition), or in Canada, The Natural Gas Installation Code (B149.1-00 latest edition) or CAN/CGA B149.2 Propane Installation Code (Latest Edition).

Failure to properly install the venting system could result in property damage, personal injury, or death.

Carefully inspect the venting system of a replacement water heater installation before connecting to the venting system. All joints in the vent connector must be securely fastened with screws and fit tightly together. Inspect the venting system for signs of deterioration (rust and perforation) and replace any sections that are not in good condition. The chimney must be lined and in good condition. Check to make sure the venting system is properly sized for the water heater. If the venting system was previously sized for another gas appliance that has been removed, the venting system may now be too large. Refer to the latest edition of the National Fuel Gas Code (ANSI Z223.1-latest edition), or in Canada, the Natural Gas and Propane Installation Code (B149.1-00 latest edition) for the correct sizing of venting systems and common venting with another gas appliance. Do not vent this water heater into the venting system of another gas appliance designed to vent under positive pressure.

The water heater should be installed as close as practical to the venting system to minimize the vent connector length required. Refer to local codes for the distance limitations on vent connector lengths. At the completion of the water heater installation, the burner and venting system must be checked for proper operation with all other commonly vented appliances in operation. Check for spillage of flue products around the outside relief opening of the draft hood after several minutes of operation. The flame from a match should be drawn into the draft hood. Do not use the water heater or connected equipment if spillage is detected until the problem is corrected. Refer to the latest edition of the National Fuel Gas Code, or in Canada, the Natural Gas and Propane Installation Code for complete details on the "Procedure to Be Followed to Place Equipment in Operation".

This water heater has been shipped with a draft hood for which it was designed with reference to the horizontal and vertical planes. If removed, the draft diverter must be replaced in the same position and secured to the jacket top by the screws with which it was installed.

This water heater must be connected to a lined masonry chimney or venting system approved by local codes or ordinances. The vent connector used to attach the draft hood outlet to the chimney or approved vent must be of the same diameter as the draft diverter outlet or larger. For proper venting in certain installations, a larger vent connector may be needed. Consult venting tables in ANSI standard (Z223.1- latest edition), National Fuel Gas Code and CAN/CGA (B149.1 or B149.2-latest editions) Natural Gas and Propane Installation Code, or local code officials for proper application for your area.

Optional Intake Venting

The venting instructions must be followed to avoid restricted combustion or recirculation of flue gases. Such conditions cause sooting or risks of fire and asphyxiation.

WARNING

The intake vent system must be properly installed. Failure to properly install the vent system could result in property damage, personal injury, or death.

Use only the vent terminals provided or factory authorized terminals for venting this water heater.

The water heater requires its own separate intake venting system.

Do not terminate the venting where noise from intake venting will be objectionable. This includes locations close to or across from windows and doors. Avoid anchoring the intake vent pipes directly to framed walls, floors, or ceilings unless rubber isolation pipe hangers are used. This prevents any vibrations from being transmitted into the living spaces.

Do not exceed the venting distances or the number of elbows listed in this manual. Exceeding the maximum venting distances may cause the water heater to malfunction or cause an unsafe condition.

DO NOT operate this water heater until the venting installation is complete and the piping completed. Failure to complete installation before operation can result in property damage, personal injury, or death.

NOTICE

For installations in Canada, field supplied vent piping must comply with CAN/CGA B149.1 (latest edition) and be certified to the Standard For Type BH, Class II, 65°C, Gas Venting Systems, ULC S636. Components of this listed system shall not be interchanged with other vent systems or unlisted pipe/fittings. All components and specified primers and cements of the certified vent system must be from a single system manufacturer and not intermixed with other system manufacturer's vent system parts. The supplied vent connector and vent termination are certified under ULC S636 and are also certified as part of the water heater. Refer to the following tables for approved venting materials, primers, and cements. All approved primers and cements are to be used within their marked time limitations.

Approved Venting Materials

For installations in the US only

- PVC Sch. 40, 80 (ASTM D-1785)
- PVC DWV (ASTM-D2665)
- CPVC Sch. 40, 80 (ASTM-F441)
- CPVC (ASTM D2846)
- ABS Sch. 40 DWV (ASTM D2661)

For installations in CANADA

- ULC S636 approved CAN-COM VENTING SYSTEM schedule 40 PVC for flue gas venting rated Class II, 65°C (components provided with water heater)
- IPEX ULC S636 approved schedule 40 PVC (all other vent pipe/ fittings)

Approved Primers and Cements

For installations in the US only

- PVC and CPVC Primer (ASTM F-656)
- PVC Cement (ASTM D-2564)
- CPVC Cement (ASTM F493)
- ABS Primer and Cement (ASTM D-2235)

For installations in CANADA

- IPEX ULC S636 approved PVC Primer and Cement for flue gas venting rated Class II, 65°C

NOTICE

Before beginning installation of any vent pipe, read the vent pipe manufacturer's installation instructions.

Do not install the water heater in any location where the ambient temperature may fall below freezing. Water heater must be protected from freezing downdrafts during shutdown periods.



CAUTION

The vent shall terminate a minimum of 12 inches above expected snowfall level to prevent blockage of vent termination.

The horizontal centerline of the exhaust vent terminal (if applicable) **must not** be located lower than the horizontal centerline of the air intake terminal if vented through the same wall.

A service drain loop must be installed in the drain tubing to serve as a condensate trap to prevent flue gases from escaping into the room.

NEVER locate the air intake where exhaust gases from other appliances can be introduced into the intake.



CAUTION

Check to make sure flue gases **do not** recirculate into the air intake terminal when using direct venting. If the water heater is having service issues, flue recirculation may be a contributing factor. Even when the minimum vent terminal separation distances are followed, recirculation may still occur depending upon the location outside the building, the distance from other buildings, proximity to corners, weather conditions, wind patterns, and snow depth. Periodically check to make sure that flue recirculation is not occurring. Signs of flue gas recirculation include frosted or frozen intake terminals, condensate in the intake terminal and venting system, oxidation or white chalk material on the flame sensor or igniter shield. Correction to flue recirculation may involve relocating the air intake to another side of the building, or using inside air for combustion. Check to be sure the intake is not obstructed, especially during periods of below freezing weather.

High levels of dust and debris such as road and construction dust, insects, and tree pollen may clog the burner resulting in poor performance and damage to the water heater. Avoid air intake locations where debris can be created such as exhaust ventilation hoods, gravel parking lots, and near outdoor spotlights that attract bugs. For these installations, an air intake filter kit, part number 239-47330-00A, is available as an accessory service part from the installer of this water heater. The air intake filter kit is not designed to filter out airborne contaminants or chemicals that may damage the water heater.

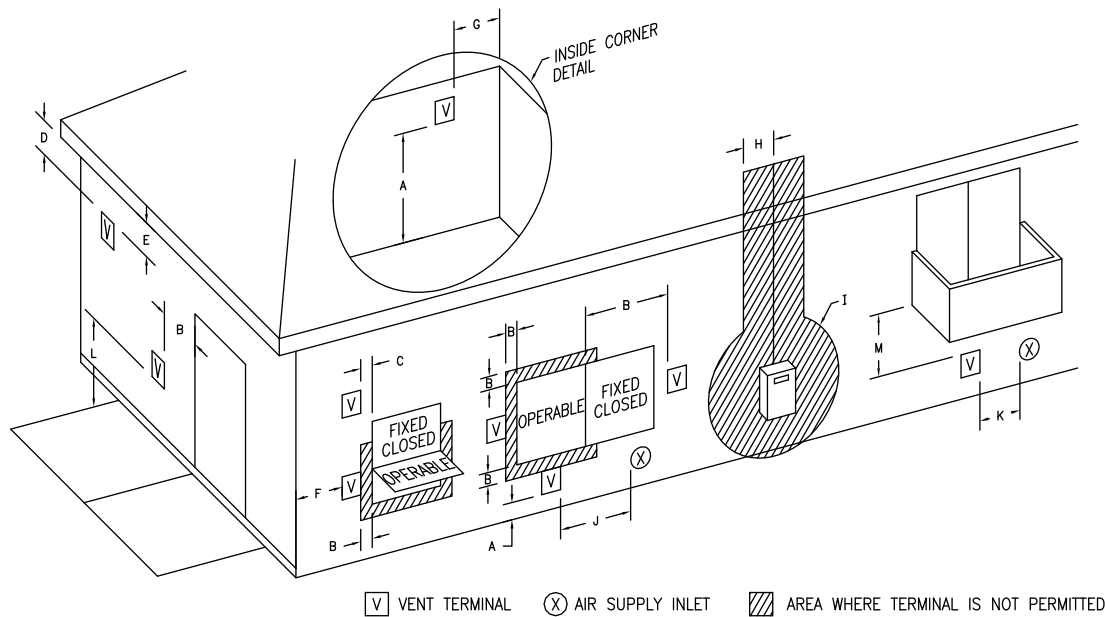


Figure 3. Intake Vent Terminal Clearances (Referencing Other Appliance Venting Locations).

		Canadian Installations ¹	US Installations ²		Canadian Installations ¹	US Installations ²
A=	Clearance above grade, veranda, porch, deck or balcony	12 inches (30 cm)	12 inches (30 cm)	H=	Clearance to each side of center line extended above meter/regulator assembly	3 feet (91 cm) within a height 15 feet (4.6 m) above the meter/regulator assembly
B=	Clearance to window or door that may be opened	36 inches (91 cm)	4 feet (1.2 m) below or to the side of opening; 12 inches (30 cm) above opening	I=	Clearance to service regulator vent outlet or oil tank vent	36 inches (91 cm)
C=	Clearance to permanently closed window	*b	*b	J=	Clearance to non-mechanical air supply inlet to building or the combustion air inlet to any other appliance	36 inches (91 cm)
D=	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (61 cm) from the center line of the terminal	*b	*b	K=	Clearance to a mechanical air supply inlet	6 feet (1.83 m)
E=	Clearance to unventilated soffit	*b	*b	L=	Clearance above paved sidewalk or paved driveway located on public property	7 feet (2.13 m)†
F=	Clearance to outside corner	*b	*b	M=	Clearance under a veranda, porch, deck, or balcony	12 inches (30 cm) ‡
G=	Clearance to inside corner	36 inches (91 cm)*a	36 inches (91 cm)*a			*b

In accordance with the current CAN/CGA-B149 *Installation Codes*.

² In accordance with the current ANSI Z223.1-(Latest Edition)/NFPA 54 *National Fuel Gas Code*.

† A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single-family dwellings and serves both dwellings.

‡ Permitted only if a veranda, porch, deck or balcony is fully open on a minimum of two sides beneath the floor.

*a) A minimum clearance value determined by testing in accordance with section 2.20.

*b) "Clearance in accordance with local installation codes and the requirements of the gas supplier".

Vent pipes serving power vented appliances are classified by building codes as “vent connectors”. Required clearances from combustible materials must be provided in accordance with information in this manual under LOCATION OF WATER HEATER and CLEARANCES, and with National Fuel Gas Code and local codes.

Horizontal Installation

In a horizontal application, it is important that moisture is not to be allowed to buildup in the intake vent pipe. To prevent this from happening, the pipe should be installed with a slight downward slope so the moisture will run back away from the water heater. The vent system **must be** supported every 5 feet of vertical run and every 3 feet of horizontal run of vent pipe length.

CAUTION

Failure to properly support the vent piping with hangers and clamps may result in damage to the water heater or venting system.

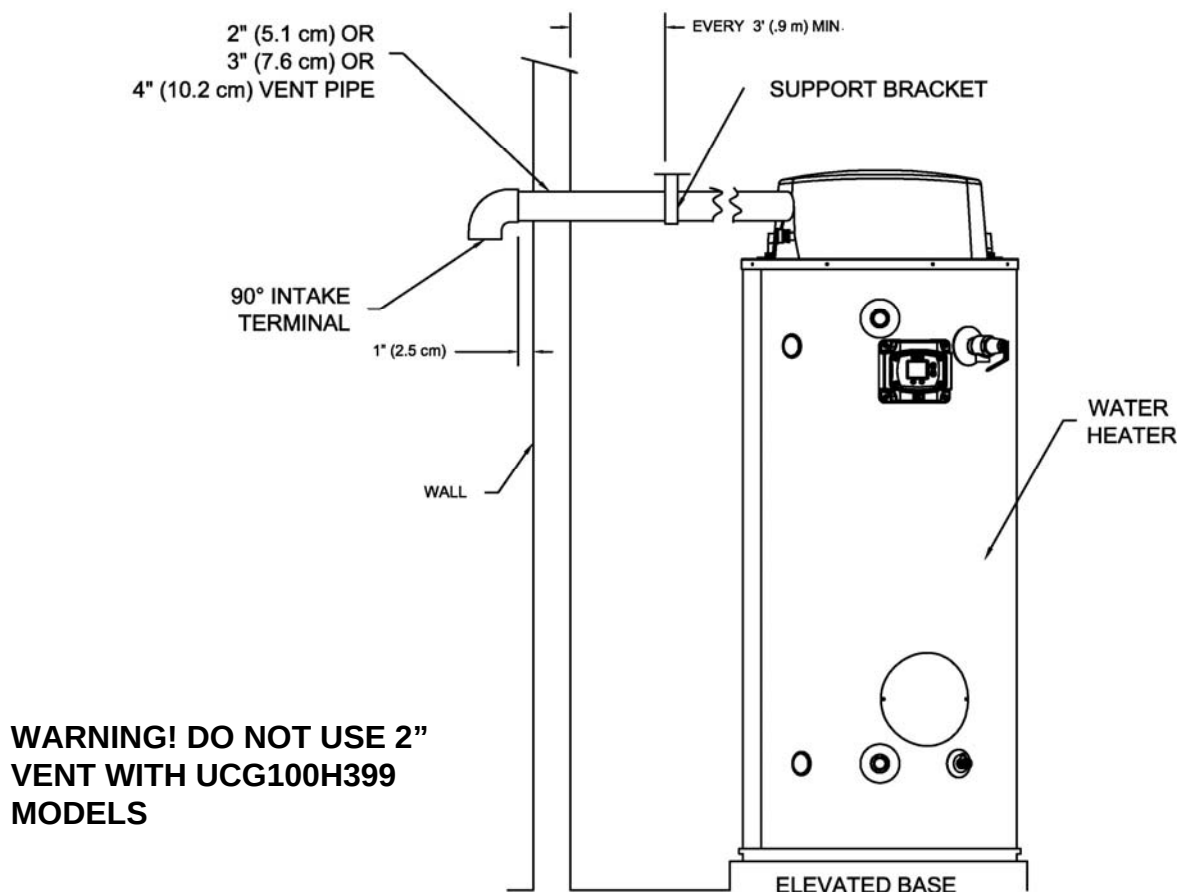


Figure 4. Typical Horizontal Intake Vent System.

Vertical Installation

Vertical venting system **must be** supported every 5 feet of vertical run and every 3 feet of horizontal run of vent pipe length.



CAUTION

Failure to properly support the vent piping with hangers and clamps may result in damage to the water heater or venting system.

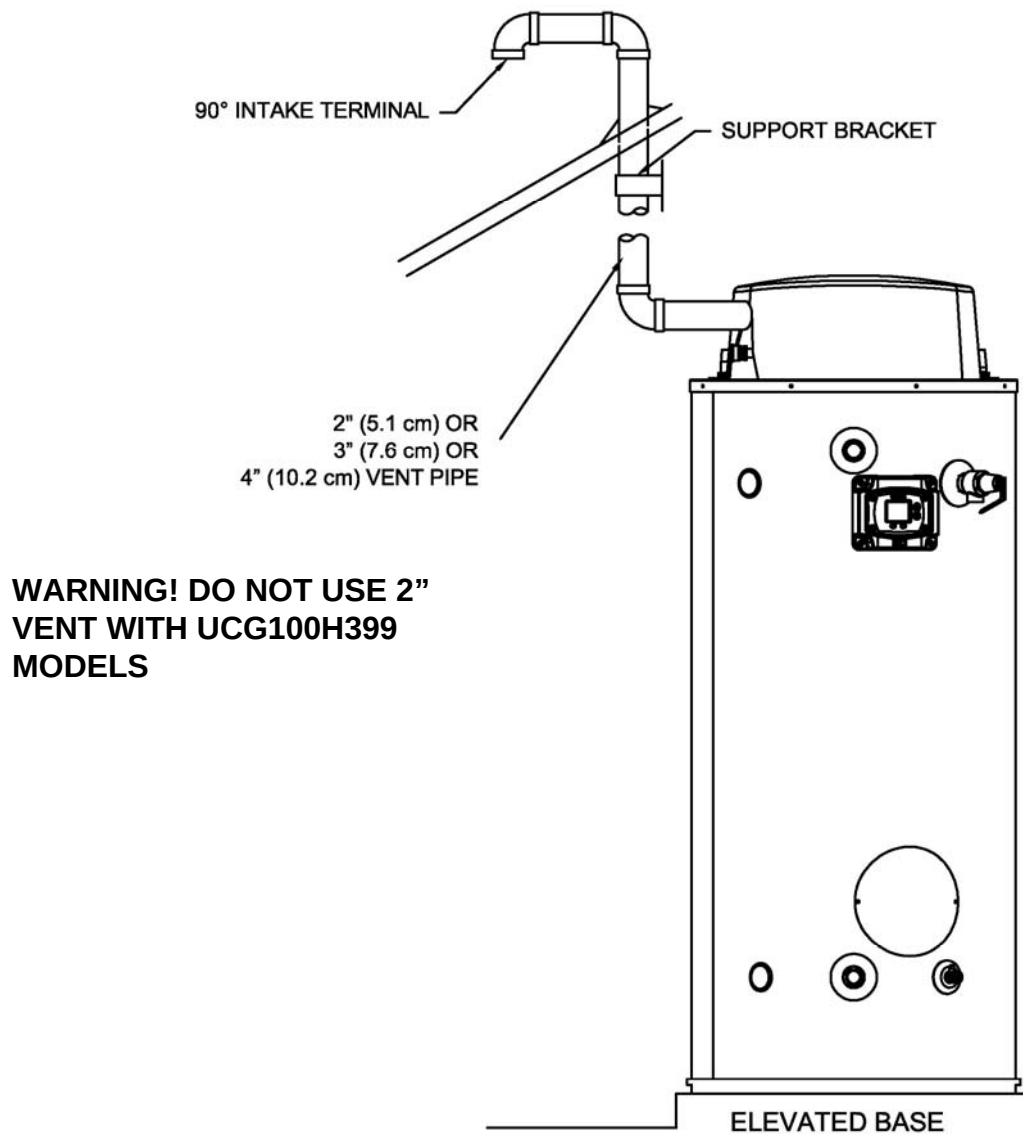
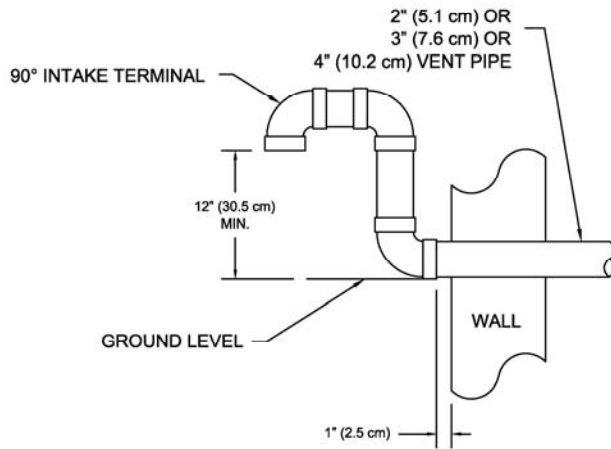


Figure 5. Typical Vertical Intake Vent System Installation.

Through The Wall Venting With Low Ground Clearance:

When venting cannot exit through the wall at a height greater than or equal to 12" (30.5 cm) (and above expected snow level) from the ground, then the installation must be modified as shown below (see Figure 6).



WARNING! DO NOT USE 2" VENT WITH UCG100H399 MODELS

Figure 6. Vent Terminal (Low Ground Clearance).

Maximum Vent Length

Table 2. Maximum Intake Vent Length.

<i>Model Number</i>	<i>Max Vent Length (feet) 2"</i>	<i>Max Vent Length (feet) 3"</i>	<i>Max Vent Length (feet) 4"</i>
UCG100H199	20	50	75
UCG100H270	20	50	75
UCG100H399	N/A	25	50

Determining required vent length

1. Determine the total length of straight vent pipe (in feet) required for the intake.
2. Add 5 feet of venting for every 90° elbow.
3. Add 2 ½ feet of venting for every 45° elbow.
4. **Total vent length cannot exceed "Max Vent Length" on the venting table shown above.**

Example of Total Vent Length for UCG100H199 installation:

A 3" venting system has a total of three 90-degree elbows and a total straight pipe length of 30 feet.
Equivalent vent length for elbows: 3 x 5 feet = 15 feet.

Total equivalent vent distance = 30 feet + 15 feet = 45 feet total equivalent vent length. This is below the maximum allowed distance of 50 feet for this model using 3" vent.

SECTION VI: WATER CONNECTIONS

NOTE: *BEFORE PROCEEDING WITH THE INSTALLATION, CLOSE THE MAIN WATER SUPPLY VALVE.*

After shutting off the main water supply, open a faucet to relieve the water line pressure to prevent any water from leaking out of the pipes while making the water connections to the water heater. After the pressure has been relieved, close the faucet. The COLD water inlet and HOT water outlet are identified on the front of the water heater. Make sure the diptube is in place before making the cold water connection. Make the proper plumbing connections between the water heater and the plumbing system to the house. Install a shut-off valve in the cold water supply line.

CAUTION

If sweat fittings are to be used, **DO NOT** apply heat to the nipples on the side of the water heater. Sweat the tubing to the adapter before fitting the adapter to the water heater connections. It is imperative that heat is not applied to the nipples containing a plastic liner.

WARNING

FAILURE TO INSTALL AND MAINTAIN A NEW, LISTED TEMPERATURE AND PRESSURE RELIEF VALVE WILL RELEASE THE MANUFACTURER FROM ANY CLAIM WHICH MIGHT RESULT FROM EXCESSIVE TEMPERATURE AND PRESSURES.

NOTICE

If this water heater is installed in a closed water supply system, such as the one having a back-flow preventer in the cold water supply, provisions must be made to control thermal expansion. **DO NOT** operate this water heater in a closed system without provisions for controlling thermal expansion. Warranties do not cover damages from thermal expansions such as pressure bulges and/or deformities. Your water supplier or local plumbing inspector should be contacted on how to control this situation.

After installation of the water lines, open the main water supply valve and fill the water heater. While the water heater is filling, open several hot water faucets to allow air to escape from the water system. When a steady stream of water flows through the faucets, close them and check all water connections for possible leaks. **NEVER OPERATE THE WATER HEATER WITHOUT FIRST BEING CERTAIN IT IS FILLED WITH WATER.**

Table 3. Scald Times.

APPROXIMATE TIME/TEMPERATURE RELATIONSHIPS IN SCALDS	
120°F (49°C)	More than 5 minutes
125°F (52°C)	1½ to 2 minutes
130°F (54°C)	About 30 seconds
135°F (57°C)	About 10 seconds
140°F (60°C)	Less than 5 seconds
145°F (63°C)	Less than 3 seconds
150°F (66°C)	About 1½ seconds
155°F (68°C)	About 1 second

WARNING

Keep clear of combination temperature and pressure relief valve discharge line outlet. The discharge may be hot enough to cause scald injury. The water is under pressure and may splash.

For protection against excessive temperatures and pressure, install temperature and pressure protective equipment required by local codes, but not less than a combination temperature and pressure relief valve certified by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment or materials as meeting the requirements of the Standard for *Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems*, ANSI Z21.22 and the Standard *CAN1-4.4 Temperature, Pressure, Temperature and Pressure Relief Valves and Vacuum Relief Valves*. The combination temperature and pressure relief valve must be marked with a maximum set pressure not to exceed the maximum working pressure of the water heater. The combination temperature and pressure relief valve must also have an hourly rated temperature steam BTU discharge capacity not less than the hourly rating of the water heater.

Install the combination temperature and pressure relief valve into the opening provided and marked for this purpose on the water heater.

Note: Some models may already be equipped or supplied with a combination temperature and pressure relief valve. Verify that the combination temperature and pressure relief valve complies with local codes. If the combination temperature and pressure relief valve does not comply with local codes, replace it with one that does. Follow the installation instructions above on this page.

Install a discharge line so that water discharged from the combination temperature and pressure relief valve will exit within six (6) inches (15.2 cm) above, or any distance below the structural floor and cannot contact any live electrical part. The discharge line is to be installed to allow for complete drainage of both the combination temperature and pressure relief valve and the discharge line. The discharge opening must not be subjected to blockage or freezing. **DO NOT** thread, plug or cap the discharge line. It is recommended that a minimum clearance of four (4) inches (10.2 cm) be provided on the side of the water heater for servicing and maintenance of the combination temperature and pressure relief valve.

Do not place a valve between the combination temperature and pressure relief valve and the tank.

Hydrogen gas can be produced in an operating water heater that has not had water drawn from the tank for a long period of time (generally two weeks or more). Hydrogen gas is extremely flammable. To prevent the possibility of injury under these conditions, we recommend the hot water faucet to be open for several minutes at the kitchen sink before you use any electrical appliance which is connected to the hot water system. If hydrogen is present, there will be an unusual sound such as air escaping through the pipes as hot water begins to flow. Do not smoke or have open flame near the faucet at the time it is open.

SCALDING

This water heater can deliver scalding temperature 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 temperature water. By setting the thermostat on this water heater to obtain the increased temperature water required by these appliances, you may create the potential for scald injury. To protect against injury, you should install an ASSE approved mixing valve in the water system. This valve will reduce point of discharge temperature by mixing cold and hot water in branch supply lines. Such valves are available from the manufacturer of this water heater or a local plumbing supplier. Please consult with a plumbing professional for installation of mixing valves.



! 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.

Review this instruction manual before setting temperature at water heater.

Feel water before bathing or showering.

Temperature limiting valves are available.

TO FILL THE WATER HEATER

1. Close the water heater drain valve by turning the knob clockwise. If alternative water connections are provided but not used, make certain they are plugged (i.e. rear connections).
2. Open the cold water supply shut-off valve.
3. Open several hot water faucets to allow air to escape from the system.
4. When a steady stream of water flows from the faucets, the water heater is filled. Close the faucets and check for water leaks at the water heater drain valve, combination temperature and pressure relief valve and the hot and cold water connections.
5. To restore operation of water heater refer to operating instruction label on the water heater.

TO DRAIN THE WATER HEATER

Should it become necessary to completely drain the water heater, make sure you follow the steps below:

1. Reduce the thermostat setpoint to the lowest setting. Depress the control panel rocker switch on the front of the control box to the "OFF" position and disconnect the power to the water heater.
2. Shut off the gas supply to the water heater.
3. Close the cold water supply shut-off valve.
4. Open the drain valve on the water heater by turning the slot on the valve counter-clockwise. The drain valve has threads on the end that will allow the connection of a standard hose coupling.
5. Open a hot water faucet to allow air to enter the system.

To refill the water heater, refer to "To Fill the Water Heater

ALTERNATE SPACE HEATING WATER CONNECTIONS



DANGER

Toxic chemical, such as those used for boiler treatment, **must not** be introduced into potable water used for space heating.

This water heater **must not** be connected to an existing heating system or component(s) previously used with a non-potable water heating appliance.

All piping components connected to this water heater for space heating applications must be suitable for use with potable water.



WARNING

When the system requires water for space heating at temperatures higher than required for other means, an ASSE approved mixing valve must be installed to temper the water for those uses in order to reduce the scald hazard potential.

Failure to properly pipe this water heater may result in improper operation and damage to the water heater or structure.

Oxygen contamination of this water heater will cause corrosion of iron and steel components, and can lead to water heater failure.

Connect the system supply and return piping to the water heater.

Refer to Figure 7 and Figure 8 for installation examples. Maintain a minimum 1/2" clearance from hot water piping to combustible materials.

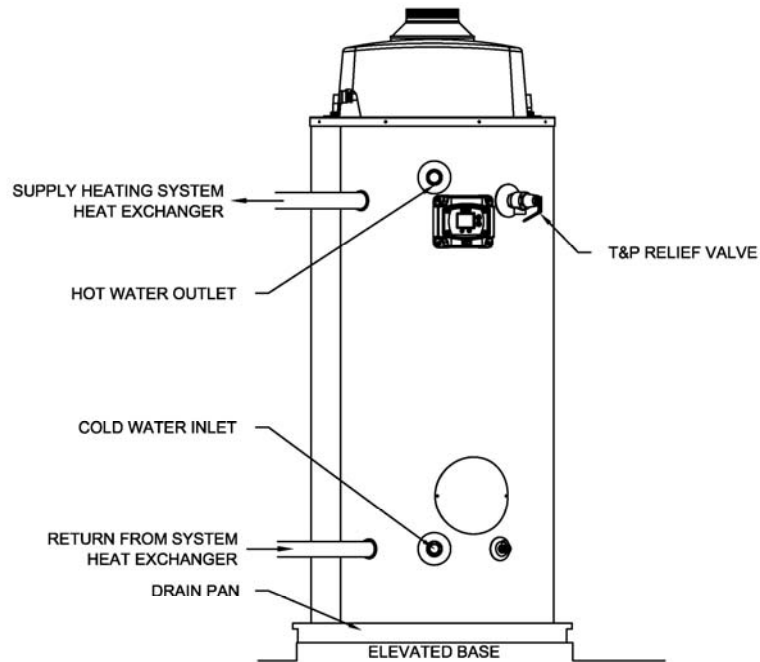


Figure 7. Alternate Space Heating Connections.

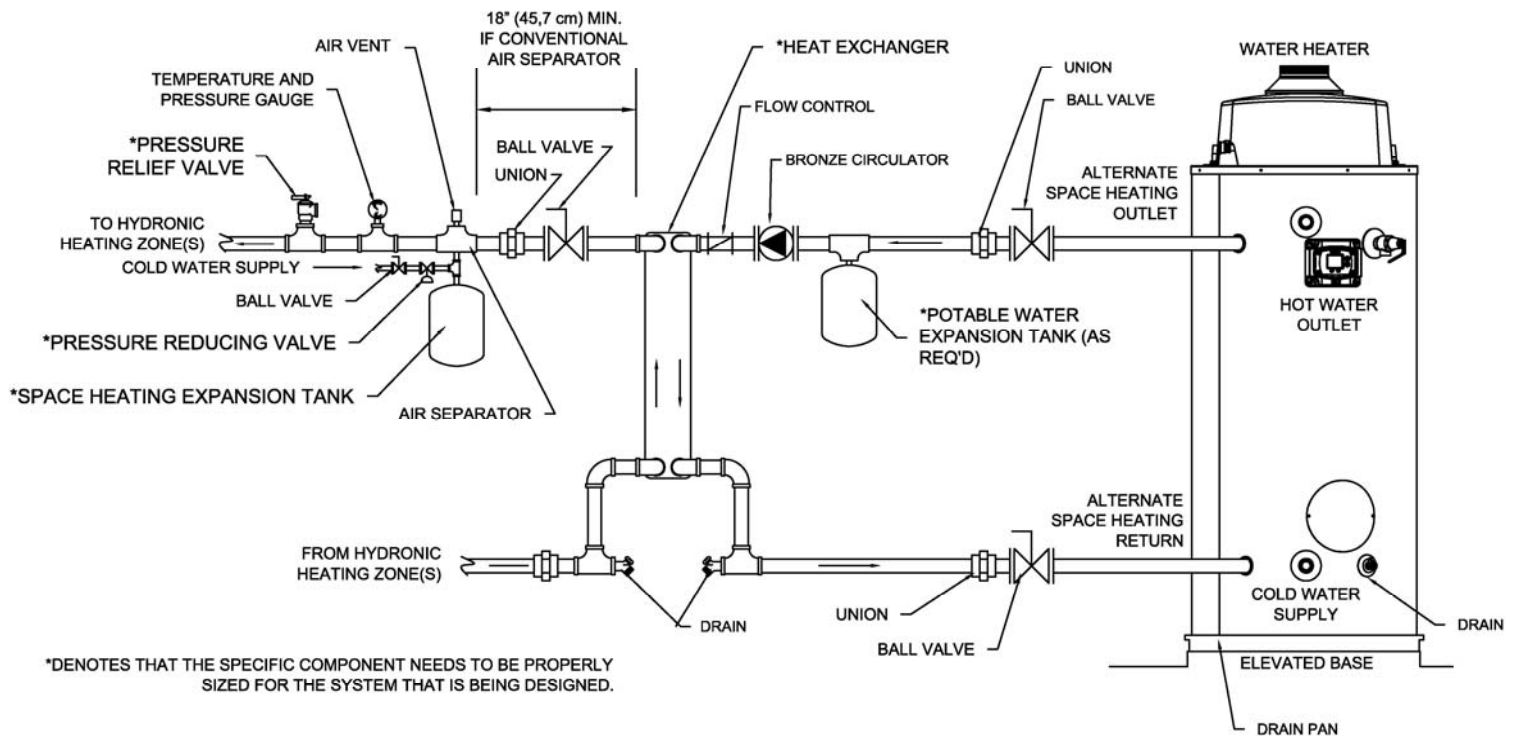


Figure 8. Typical Plumbing Schematic for Zoned Heating.

SECTION VII: GAS CONNECTIONS

The gas supply lines must meet all requirements of the National Fuel Gas Code (ANSI Z223.1-Latest Edition), or in Canada CAN/CGA B149.1 Natural Gas Installation Code (Latest Edition) or CAN/CGA B 149.2 Propane Installation Code (Latest Edition).

The maximum permissible gas supply pressure is fourteen (14.0) inches (3.5 kPa) water column for natural and propane gas.

1. Connect this water heater only to the type of gas as shown on the rating plate. Use clean black iron pipe or equivalent material approved by local codes and ordinances. (Dirt and scale from the pipe can enter the gas valve and cause it to malfunction). The inlet gas line must have a minimum length of three (3) inches (7.6 cm) drip leg (sediment trap) installed as close to the water heater's gas valve as possible. A ground joint union must be installed as close to the water heater as possible in the gas supply line feeding the water heater to permit servicing of the water heater. Compounds used on the threaded joints of the gas piping must be resistant to the action of liquefied petroleum gases/propane gas. **DO NOT** apply pipe dope to the gas valve inlet and make certain that no pipe dope has become lodged in the inlet screen of the gas valve. Extreme care must be taken to ensure no pipe dope enters the gas valve. Avoid excessive torque when tightening the gas supply line to the gas valve. Excessive torque may result in cracking of the gas valve housing and could create a gas leak. The suggested maximum torque is 31.5 ft. lbs. (4.4 kg-m).



WARNING

The manufacturer of this water heater will not be liable for any damage or injury caused as a result of a cracked gas inlet as a result of excessive torque.

2. This water heater and its gas connection must be leak tested before placing the water heater in operation. Check for gas leaks with a soap and water solution and a brush or a commercial leak detector fluid. **NEVER USE A MATCH OR OPEN FLAME FOR TESTING!**



CAUTION

The water heater and individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of the system at test pressures in excess of 1/2 psi (3.5 kPa). The water heater must be isolated from the gas supply piping system by closing its manual shutoff valve during any pressure testing of the gas supply system at test pressures equal to or less than 1/2 psi (3.5 kPa). The supply line must be capped when not connected to the water heater.

3. While checking for leaks care must be taken to prevent solution from contacting the electrical connections at the control. If electrical connections at the control become wet, they must be thoroughly dried before attempting to operate the water heater.

GAS METER SIZE – NATURAL GASES ONLY

Be sure that the gas meter has sufficient capacity to supply the full rated gas input of the water heater as well as the requirements of all other gas fired equipment supplied by the meter. If the gas meter is too small, ask the gas company to install a larger meter having adequate capacity.

If copper supply lines are used, they must be internally tinned and certified for gas service.

GAS PRESSURE REGULATION

Main line gas pressure to the water heater should be between a maximum 14.0 inch W.C. and a minimum supply pressure as shown on the rating plate. The inlet gas pressure must not exceed the maximum value. In some installations, a regulator sized for the input rating of the water heater will need to be installed just ahead of the inlet gas connection to the water heater to reduce excess gas pressure or surges in gas pressure.

BEFORE PLACING THE WATER HEATER IN OPERATION, CHECK FOR GAS LEAKAGE. USE SOAP AND WATER SOLUTION OR OTHER MATERIAL ACCEPTABLE FOR THE PURPOSE OF LOCATING GAS LEAKS.



WARNING

DO NOT USE MATCHES, CANDLES, FLAME OR OTHER SOURCES OF IGNITION FOR THIS PURPOSE.



WARNING

Water heaters are heat-producing appliances. To avoid damage or injury there must be no materials stored against the water heater or direct vent system, and proper care must be taken to avoid unnecessary contact (especially by children) with the water heater and direct vent system. **UNDER NO CIRCUMSTANCES SHOULD FLAMMABLE MATERIALS, SUCH AS GASOLINE OR PAINT THINNER BE USED OR STORED IN THE VICINITY OF THIS WATER HEATER OR IN ANY LOCATION FROM WHICH FUMES COULD REACH THE WATER HEATER.**

Installation or service of this water heater requires ability equivalent to that of a licensed tradesman in the field involved. Plumbing, air supply, venting, gas supply and electrical work are required.

Light the unit in accordance with the operating instructions label attached to the water heater.

Under no circumstances should the input rate exceed the input rate shown on the water heater rating plate. Over firing could result in damage or sooting of the water heater.

If the unit is exposed to the following, do not operate water heater until all corrective steps have been made by a factory authorized independent service contractor or qualified service professional.

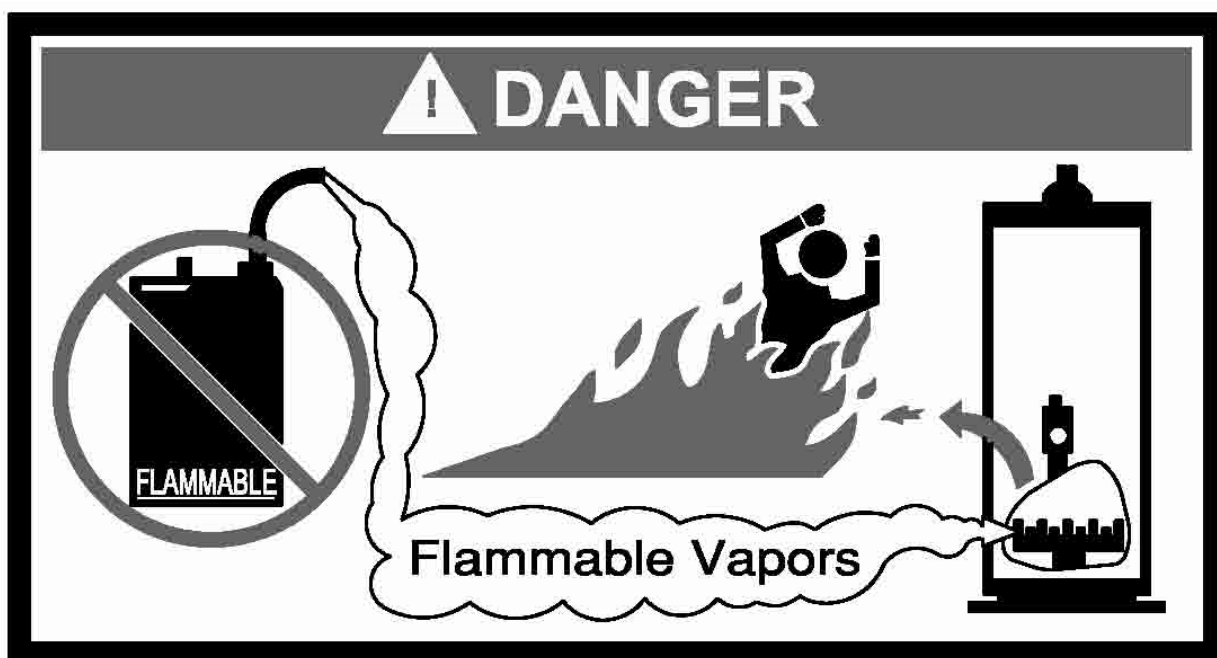
1. Flooding to or above the level of the burner or controls
2. External firing
3. Damage
4. Firing without water
5. Sooting

NEVER OPERATE THE WATER HEATER WITHOUT FIRST BEING CERTAIN IT IS FILLED WITH WATER AND A TEMPERATURE AND PRESSURE RELIEF VALVE IS INSTALLED IN THE RELIEF VALVE OPENING OF THE WATER HEATER.



WARNING

Do not run out of propane gas. Damage to the water heater may occur.



SECTION VIII: ELECTRICAL CONNECTIONS



WARNING

Turn off or disconnect the electrical power supply to the water heater before servicing. Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

All electrical wiring must be installed and grounded in accordance with local codes, or in the absence of local codes, the National Electrical Code, ANSI/NFPA 70 and/or CSA C22.2 Electrical Code.

The water heater must be wired to a 120 VAC, 60 Hz, 15A power supply. The water heater **must be** wired on a separate circuit and breaker. If a flexible line cord and plug is permitted by local code, then provide a three wire grounding type receptacle within reach of the line cord provided on the control box. Do not plug the line cord into a receptacle that can have the power supply interrupted by a switch that is used to control lights or another appliance.

If wiring in conduit is required, cut the line cord close to the control board and make the appropriate wiring connections. Install an electrical conduit connector on the outside jacket of the water heater. Refer to the wiring diagram for the correct connections to each wire lead.



CAUTION

This water heater **must** be wired on a separate circuit. Failure to wire on a separate circuit may cause improper operation or failure of the electrical components of the water heater. Refer to the "Electrical Connections" section of the Installation and Operating Instructions Manual for complete instructions on electrical wiring and connections to the water heater.

Do not energize the electric circuit before the water heater tank is filled with water.

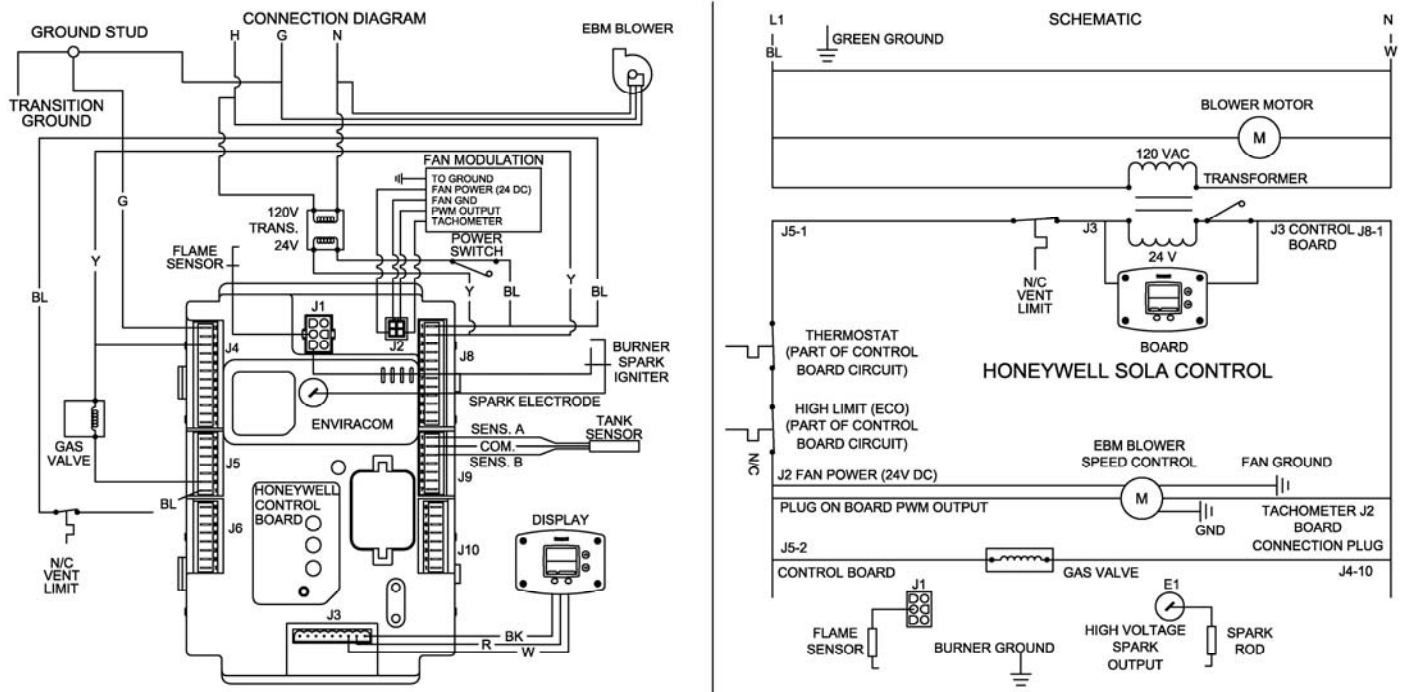


Figure 9. Wiring Diagram and Schematic.

SECTION IX: OPERATING INSTRUCTIONS

Lighting And Shutdown Instructions



WARNING

Water heaters are heat-producing appliances. To avoid damage or injury there must be no materials stored against the water heater or vent system, and proper care must be taken to avoid unnecessary contact (especially by children) with the water heater and vent system. **UNDER NO CIRCUMSTANCES SHOULD FLAMMABLE MATERIALS, SUCH AS GASOLINE OR PAINT THINNER BE USED OR STORED IN THE VICINITY OF THIS WATER HEATER OR IN ANY LOCATION FROM WHICH FUMES COULD REACH THE WATER HEATER.**

Installation or service of this water heater requires ability equivalent to that of a licensed tradesman in the field involved. Plumbing, air supply, venting, gas supply and electrical work are required.

Light the unit in accordance with the operating instructions label attached to the water heater.

Under no circumstances should the input rate exceed the input rate shown on the water heater rating plate. Over firing could result in damage or sooting of the water heater.

If the unit is exposed to the following, do not operate water heater until all corrective steps have been made by a factory authorized independent service contractor or qualified service professional.

1. Flooding to or above the level of the burner or controls
2. External firing
3. Damage
4. Firing without water
5. Sooting

NEVER OPERATE THE WATER HEATER WITHOUT FIRST BEING CERTAIN IT IS FILLED WITH WATER AND A TEMPERATURE AND PRESSURE RELIEF VALVE IS INSTALLED IN THE RELIEF VALVE OPENING OF THE WATER HEATER.

GENERAL INSTRUCTIONS

TO FILL THE WATER HEATER

1. Close the water heater drain valve by turning the knob or valve stem clockwise. If alternative water connections are provided but not used, make certain they are plugged (i.e. rear connections).
2. Open the cold water supply shut-off valve.
3. Open several hot water faucets to allow air to escape from the system.
4. When a steady stream of water flows from the faucets, the water heater is filled. Close the faucets and check for water leaks at the water heater drain valve, combination temperature and pressure relief valve and the hot and cold water connections.

SEQUENCE OF OPERATION

1. Thermostat starts with heating cycle
2. Blower ON
3. Blower pre-purge
4. Spark rod sparks to the burner and gas valve opens – burner ignition
5. Main burner ON
6. Flame signal confirmed
7. Thermostat satisfied
8. Gas valve closes - Main burner OFF
9. Blower post-purge

LIGHTING AND SHUT-DOWN INSTRUCTIONS

FOR YOUR SAFETY READ BEFORE LIGHTING

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

A. This appliance 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.

B. **BEFORE OPERATING** smell all around the appliance for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

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.

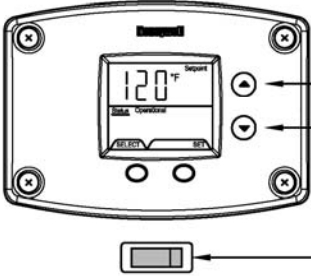
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

C. Turn off main power to the water heater.

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.

LIGHTING INSTRUCTIONS

1. STOP! read the safety information above on this label.
2. Set the thermostat to lowest setting.
3. Turn off all electrical power to the appliance.
4. This appliance 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.
5. Turn off the main power switch.
6. Wait (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.
7. Turn on main power switch.
8. Set the thermostat to desired setting.



TEMPERATURE UP

TEMPERATURE DOWN

MAIN POWER SWITCH

TO TURN OFF GAS TO APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off the main power switch.

Figure 10. Lighting Instruction Label.

Table 4. TEMPERATURE ADJUSTMENT.

APPROXIMATE TIME/TEMPERATURE RELATIONSHIPS IN SCALDS	
120°F (49°C)	More than 5 minutes
125°F (52°C)	1½ to 2 minutes
130°F (54°C)	About 30 seconds
135°F (57°C)	About 10 seconds
140°F (60°C)	Less than 5 seconds
145°F (63°C)	Less than 3 seconds
150°F (66°C)	About 1½ seconds
155°F (68°C)	About 1 second



DANGER

Hotter water increases the risk of scald injury. Scalding may occur within five (5) seconds at a temperature setting of 140°F (60°C). To protect against hot water injury, install an ASSE approved mixing valve in the water system. This valve will reduce point of discharge temperature by mixing cold and hot water in branch water lines. A licensed plumbing professional or local plumbing authority should be consulted.

This water heater is equipped with an energy cut out device to prevent overheating. Should overheating occur or the gas supply fail to shut off, turn off the manual gas control valve to the appliance and call a qualified service technician.



CAUTION

This water heater, when set at a lower temperature setting, is not capable of producing hot water of sufficient temperature for sanitizing purposes.

NOTICE

The lower the temperature setting, the greater the energy efficiency, both to heat the water and to maintain the storage temperature during standby periods. Lower water temperatures also extend tank life. Remember, no water heating system will provide exact temperatures at all times. Allow a few days of operation at this setting to determine the correct temperature setting consistent with the requirements for the installation.

Condensation does not mean your tank is leaking. Over 40% of reported tank leaks on installation are proven to be condensation. To avoid unnecessary expense and inconvenience, make sure the tank is leaking before calling a service person.



CAUTION

Combustion Air/Gas Ratio: Efficiency

This water heater is factory equipped with a Honeywell gas valve/air mixing venturi system designed and set to maintain appropriate combustion excess air level (air/gas ratio) under normal operating conditions. The water heater excess air level is field adjustable in order to optimize water heater efficiency. When the excess air level is adjusted, an accurate and recently calibrated combustion gas analyzer, which correctly measures carbon monoxide (CO) and carbon dioxide (CO₂) levels in the exhaust gas, as well as an accurate gas pressure manometer, are mandatory. Carbon dioxide levels in the exhaust gas greater than 11.5% provide high efficiency. Carbon Monoxide levels increase with increasing CO₂ levels. Only individuals, installers or service technicians properly trained, qualified and experienced with adjusting the Honeywell gas/air mixing venturi system, and with access to accurate equipment, should attempt to adjust the air/gas ratio. See service manual for instructions.



DANGER

DO NOT adjust the air/gas ratio unless you are qualified, experienced and properly trained in the Honeywell gas valve/air mixing venturi system air/gas ratio adjustment process and are using accurate, certified CO₂, CO and gas pressure measurement equipment.

If the factory set air/gas ratio is changed, the exhaust gas concentration of CO₂ and CO and the gas control gas pressure MUST be monitored and properly adjusted no less than every 6 months thereafter.

TEMPERATURE ADJUSTMENT (24V CONTROL SYSTEM)

The water heater temperature setting is adjusted by using the control display mounted to the front of the water heater. The water heater thermostat is set at the lowest setpoint of 70°F when shipped from the factory. The control display shows the temperature setpoint in degrees Fahrenheit (°F) or degrees Celsius (°C), and the status of the water heater ("Idle" or "Heating"). If the water heater is functioning normally, the display will also show "Operational".

For energy efficient operation of your water heater, the suggested initial temperature setting is 120°F (49°C). During the winter season, or any cold period, you may desire a higher temperature setting to adjust for the colder incoming water. This adjustment, however, may cause additional condensation to form on the cooler tank surface. This does not mean the tank is leaking. During summer months, the warmer incoming water temperatures will benefit the performance of your water heater and reduce the amount of condensation developed.

Condensation does not mean your tank is leaking. Over 40% of reported tank leaks on installation are proven to be condensation. To avoid unnecessary expense and inconvenience, make sure the tank is leaking before calling a service person.

WARNING

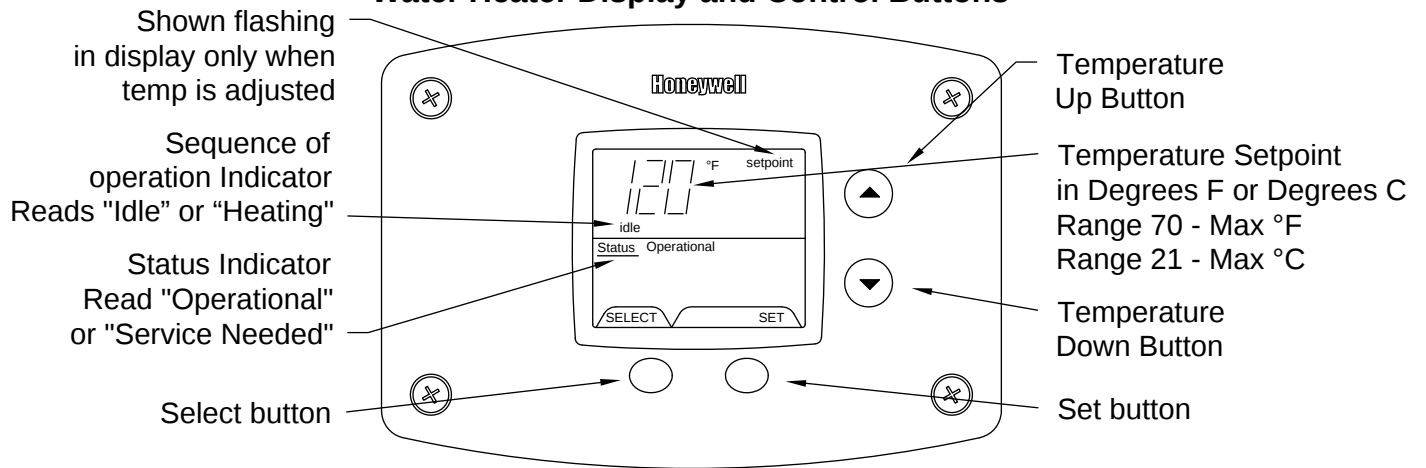
If the water heater display does not show "Operational" in the "Status" indicator, there may be an operating malfunction with the water heater. If this is the case, a numeric code will be displayed. Refer to the label next to the display for the definition of the error code and call your plumbing professional or service agent to service the water heater. Do not try to reset the water heater without having a qualified service person to diagnose and correct the problem. If the display is blank or does not show an error code, make sure there is power to the water heater.

Setting the water temperature to the maximum set point can result in scalding hot water delivered to the faucets. It is highly recommended that the maximum setpoint be adjusted to the lowest temperature possible for the needs of the installation. See following section to change the maximum setpoint limit (max setpoint). Make sure the water heater control display is not in a public area that can result in the temperature settings being improperly adjusted. See previous warning on scalds and an ASSE approved mixing valve.

NOTICE

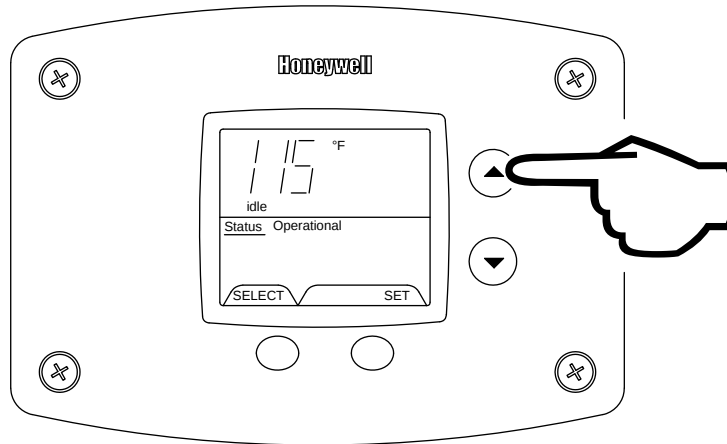
When the maximum setpoint is reached, the display will show "Max Setpoint" without the setpoint value. The maximum setting is equal to approximately 180°F (82°C).
The default temperature setpoint from the factory is 70°F (21°C).

Water Heater Display and Control Buttons



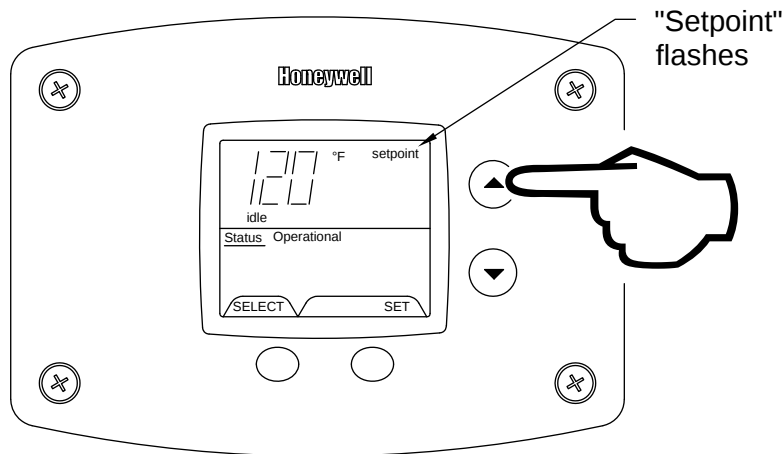
To Increase Setpoint Temperature

Step 1: Depress and hold "Temperature Up" button until desired setpoint temperature appears in the display.



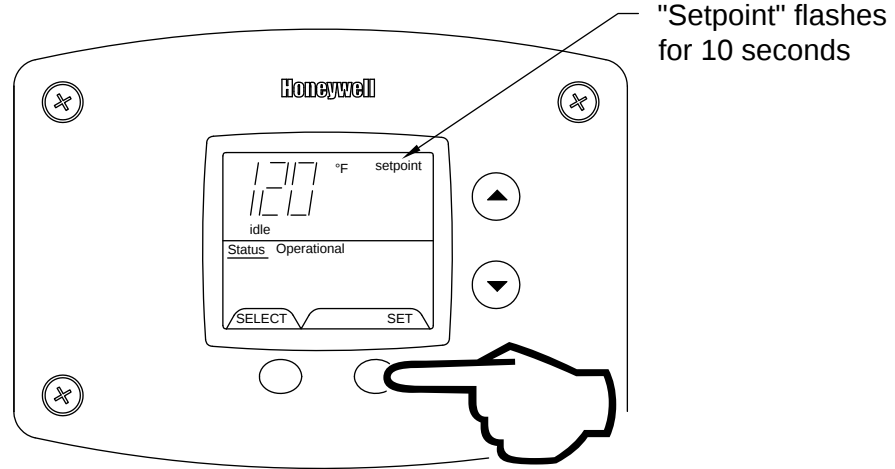
Step 1

Step 2: "Setpoint" indicator begins flashing in the display after pressing "Temperature Up" button.



Step 2

Step 3: Press "SET" button for new setting to take effect immediately. "Setpoint" will stop flashing. If the "SET" button is not pressed, the new temperature setting will take effect in approximately 10 seconds.

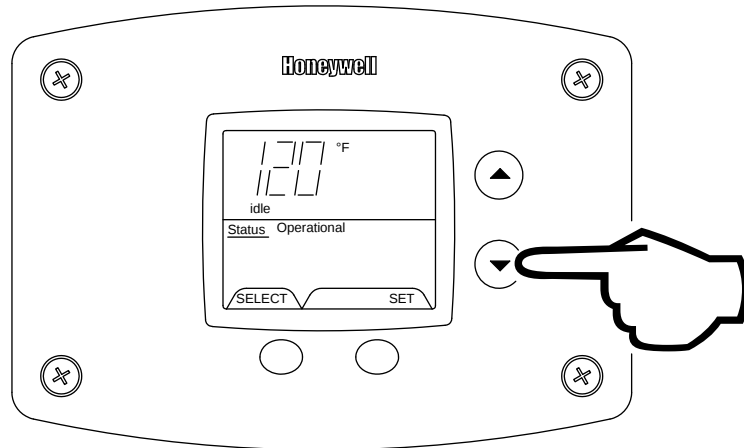


Step 3

Press SET Button for setting to take effect immediately

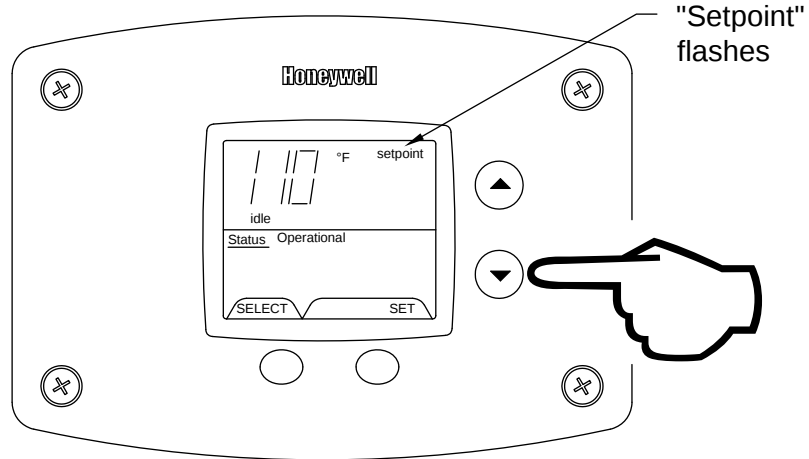
To Decrease Setpoint Temperature

Step 1: Depress and hold "Temperature Down" button until desired setpoint temperature appears in the display.



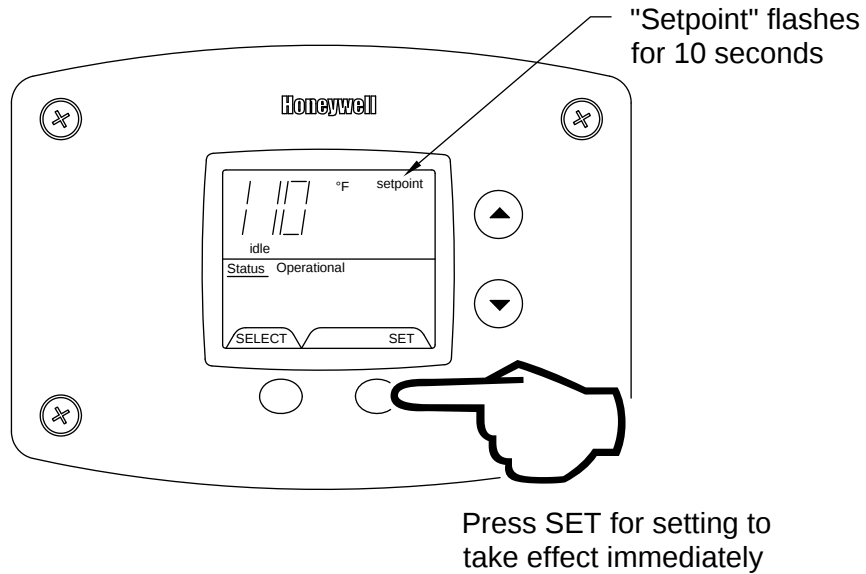
Step 1

Step 2: "Setpoint" indicator begins flashing in the display after pressing "Temperature Down" button.



Step 2

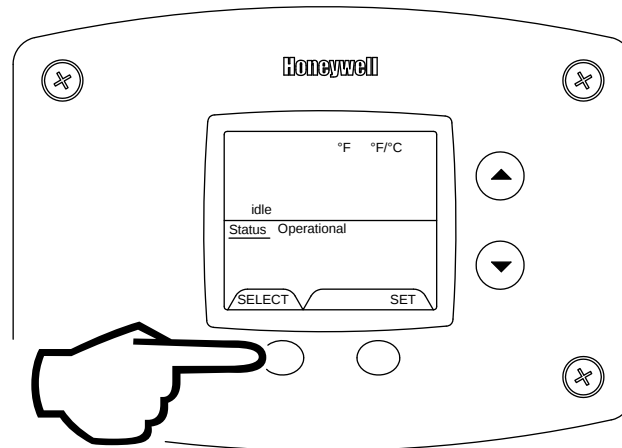
Step 3: Press "SET" button for new setting to take effect immediately. The setpoint will stop flashing. If the "SET" button is not pressed, the new temperature setting will take effect in approximately 10 seconds.



Step 3

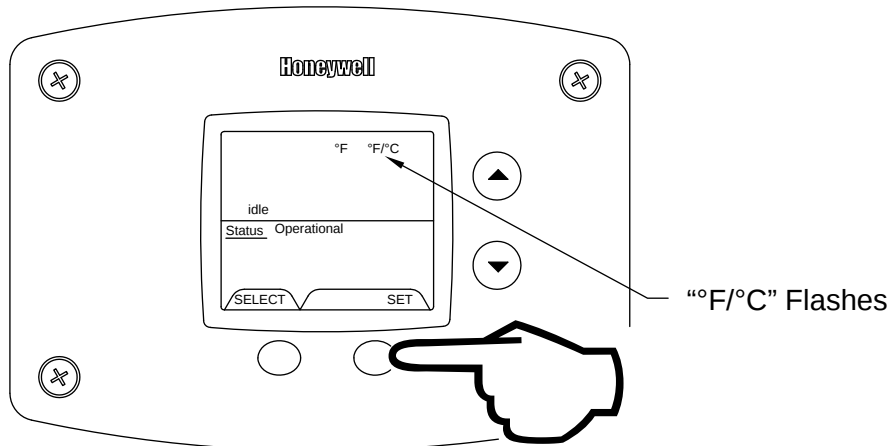
To Change Temperature Format in Display from °F to °C or °C to °F:

Step 1: Press "SELECT" button until "°F/°C" is displayed.



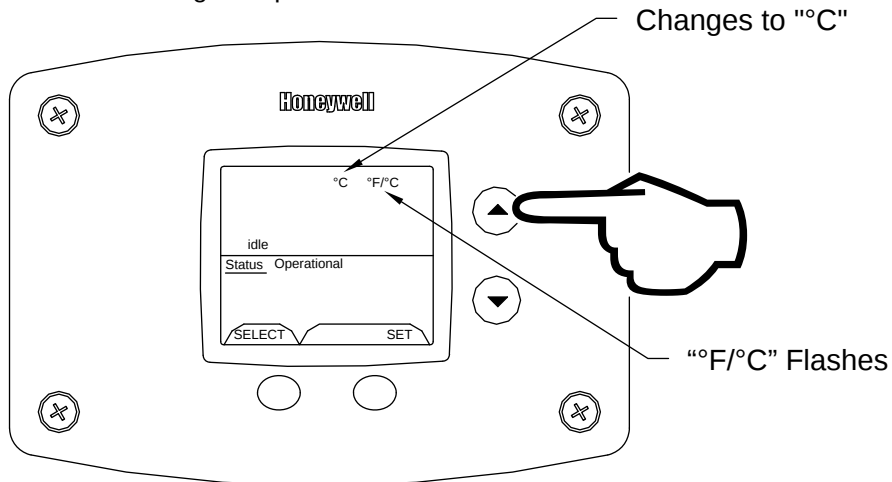
Step 1

Step 2: Press "SET" button to change temperature format. Symbol "°F/°C" will flash.



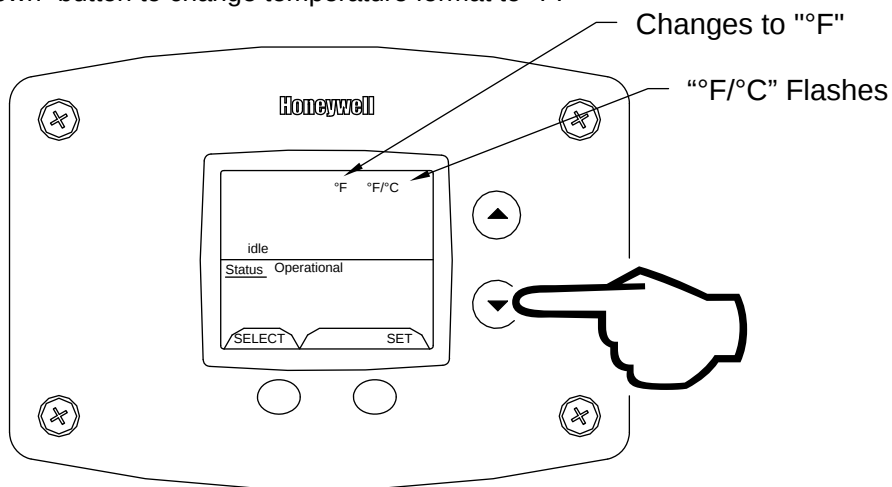
Step 2

Step 3a: Press "Temperature Up" button to change temperature format to °C.



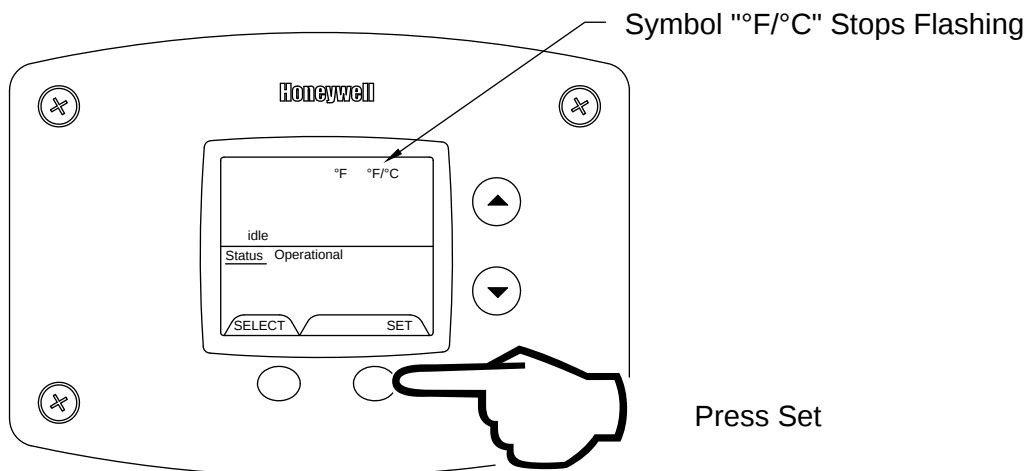
Step 3a

Step 3b: Press "Temperature Down" button to change temperature format to °F.



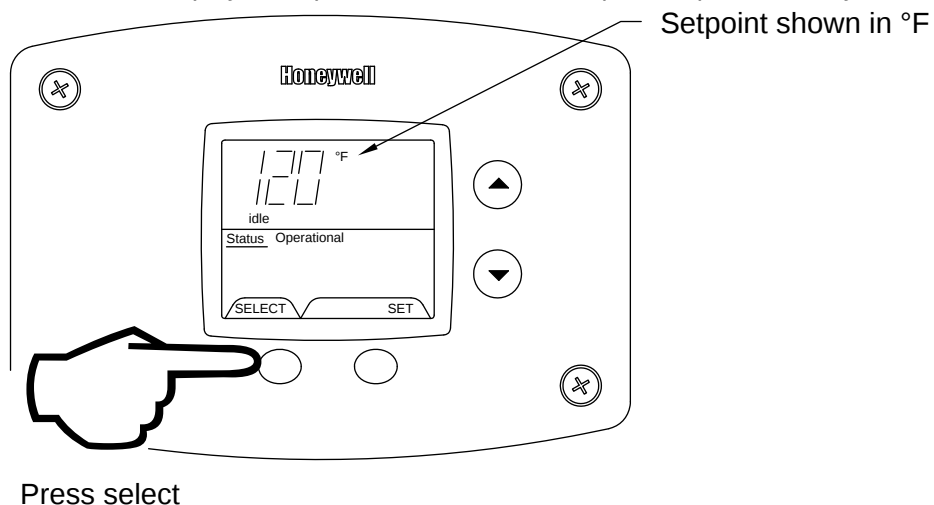
Step 3b

Step 4: Press "SET" button to confirm °F or °C format. "°F/°C" will stop flashing. Setpoint display will appear in the format selected (°F or °C) in 10 seconds.



Step 4

Step 5: Pressing "SELECT" button will return display to setpoint in format selected (°F or °C) immediately.



Step 5

An automatic gas shut-off device (ECO) is incorporated in the sensor and control board which will shut off all gas supply to the burner if the water heater temperature exceeds 200°F (93°C). Should the ECO function (open), the water temperature should be reduced to approximately 120°F (49°C) and follow applicable Lighting Instructions to place the water heater in operation. The water heater must have the problem corrected by a qualified service person before putting the water heater back in operation. It is recommended that all service work be performed by a qualified service agency.

If the water heater is to remain idle for 30 days or more or is subjected to freezing temperatures while shut off, the water heater and piping should be fully drained (See "To Drain the Water Heater") and the drain valve should be left fully open.

WARNING

Hydrogen gas can be produced in an operating water heater that has not had water drawn from the tank for a long period of time (generally two weeks or more). Hydrogen gas is extremely flammable. To prevent the possibility of injury under these conditions, we recommend the hot water faucet to be open for several minutes at the kitchen sink before you use any electrical appliance which is connected to the hot water system. If hydrogen is present, there will be an unusual sound such as air escaping through the pipes as hot water begins to flow. Do not smoke or have open flame near the faucet at the time it is open.

NOTICE

IMPORTANT- In the event of an emergency, turn off the gas and electric to the appliance.

IMPORTANT- The water heater should be inspected at a minimum annually by a qualified service technician for damaged components and/or joints not sealed. DO NOT operate this water heater if any part is found damaged or if any joint is found not sealed

WARNING

Water heaters are heat producing appliances. To avoid damage or injury there must be no materials stored against the water heater or vent system, and proper care must be taken to avoid unnecessary contact (especially by children) with the water heater and vent system. **UNDER NO CIRCUMSTANCES SHALL FLAMMABLE MATERIALS, SUCH AS GASOLINE OR PAINT THINNER BE USED OR STORED IN THE VICINITY OF THIS WATER HEATER, VENT SYSTEM OR IN ANY LOCATION FROM WHICH FUMES COULD REACH THE WATER HEATER OR VENT SYSTEM.**

SECTION X: MAINTENANCE



DANGER

DO NOT ATTEMPT TO REPAIR GAS VALVE.
DO NOT ATTEMPT TO REPAIR IGNITION MODULE.
DO NOT ATTEMPT TO REPAIR VENTURI.
DO NOT ATTEMPT TO REPAIR THERMOSTAT BOARD.
DO NOT ATTEMPT TO REPAIR TRANSFORMER.
DO NOT ATTEMPT TO REPAIR FLOW SWITCH.

GENERAL

KEEP APPLIANCE AREA CLEAR AND FREE FROM COMBUSTIBLE MATERIALS, GASOLINE AND OTHER FLAMMABLE VAPORS AND LIQUIDS.

Water heater maintenance includes periodic tank flushing and cleaning, and removal of lime scale. The unit should be inspected and adjusted to maintain proper combustion. Refer to Table 5, "Suggested Maintenance Schedule". A periodic inspection of the venting system should be made.

BURNER FLAME CHECK

At the time of installation and at monthly intervals, a visual check of the burner flames should be made to determine if they are burning properly. The main burner may be seen through the sight glass window on the side of the combustion insert mounting bracket (Figure 11). The burner flames should be a blue flame near the burner surface in a uniform flame pattern. Occasional yellow or white streaks are normal.

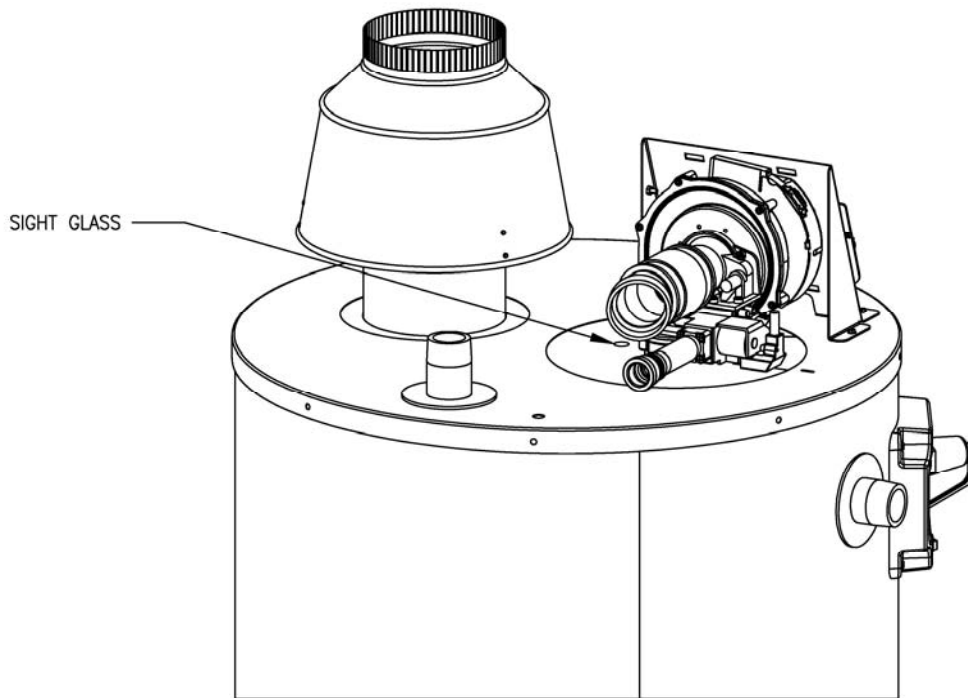


Figure 11. Sight Glass Location

MAINTENANCE SCHEDULE

Following are the instructions for performing some of the recommended maintenance. Unit inspection and adjustment should be performed by a competent technician.

Table 5. Suggested Maintenance Schedule.

COMPONENT	OPERATION	INTERVAL	REQUIRED
Tank	Sediment Removal	Monthly	Flushing
Anode Rods	Inspect	Semi-Annually	Replace as Required
Relief Valve	Check Operation	Semi-Annually	Proper Operation
Blower	Inspect	As Required	Proper Operation
Vent Air Intake System	Clean Inlet Screen	Every 3 Months	Free of Debris
Ignition System	Inspect	Annually	Clean of dust and dirt
Combustion System	Inspect	Monthly	Confirm S-OP

FLUSHING WATER HEATER

1. Turn OFF the water heater electrical disconnect switch.
2. Open the drain valve and allow water to flow until it runs clean.
3. Close the drain valve when finished flushing.
4. Turn ON the water heater electrical disconnect switch.

DRAINING WATER HEATER

The water heater must be drained if it is to be shut down and exposed to freezing temperatures. Maintenance and service procedures may also require draining the water heater.

1. Turn off the water heater electrical disconnect switch.
2. Connect a hose to the drain valve.
3. Locate hose's discharge in an area where hot water will not cause any damage or injury.
4. Close the cold water inlet valve to water heater.
5. Open a nearby hot water faucet to vent the system.
6. Open the heater drain valve.
7. If the water heater is being drained for an extended shutdown, it is suggested the drain valve be left open during this period.

FILLING WATER HEATER

1. Close the water heater drain valve by turning the valve stem clockwise. If alternative water connections are provided but not used, make certain they are plugged (i.e. rear connections).
2. Open the cold water supply shut-off valve.
3. Open several hot water faucets to allow air to escape from the system.
4. When a steady stream of water flows from the faucets, the water heater is filled. Close the faucets and check for water leaks at the water heater drain valve, combination temperature and pressure relief valve and the hot and cold water connections.

SEDIMENT AND LIME SCALE REMOVAL

Waterborne impurities consist of the particles of soil and sand, which settle out and form a layer of sediment on the bottom of the tank.

The amount of calcium carbonate (lime) released from water is in direct proportion to water temperature and usage. The higher the water temperature or water usage, the more lime deposits are dropped out of the water. This is the lime scale, which forms in pipes, water heaters and on cooking utensils.

Lime accumulation not only reduces the life of the equipment but also reduces efficiency of the water heater and increases fuel consumption.

The usage of water softening equipment greatly reduces the hardness of the water. However, this equipment does not always remove all of the hardness (lime). For this reason it is recommended that a regular schedule of deliming be maintained.

The depth of the buildup should be measured periodically. Water heaters will have about 3 inches of lime buildup when the level of lime has reached the bottom of the cleanout opening or about 1 inch of lime buildup if it has reached the drain valve opening. A schedule for deliming should be set up, based on the amount of time it would take for a 1/2 inch buildup of lime.

Example 1: Initial inspection shows ½ an inch of lime accumulation. Therefore, the water heater can be delimed once a year.

To remove sediment and lime scale

1. Drain the heater. Refer to DRAINING THE WATER instructions in this section.
2. Remove outer cover plate from lower side of water heater jacket.
3. Remove cover and gasket from cleanout opening.
4. Remove lime, scale or sediment using care not to damage the glass-lining.
5. Inspect cleanout plate gasket: Replace gasket if necessary (Contact Bradford White Local Distributor for correct part number).
6. Install gasket and cleanout plate. Be sure to draw plate up tight by tightening screws securely.
7. Close the drain valve. Open a hot water fixture to allow air to escape. Open the cold water supply to water heater and allow the tank to fill. Follow the lighting instructions.
8. Check for water leakage.
9. Install outer jacket cover plate.

ANODE INSPECTION AND REPLACEMENT

This water heater is equipped with multiple sacrificial anodes. Anodes protect the glass-lined tank from corrosion by sacrificing themselves through electrolysis. When the anode material is consumed, there is no more protection and corrosion of the tank accelerates.

Inspection of the anode every 6 months allows you to identify the rate of anode degradation. The anode should be replaced when its diameter is 3/8 of an inch, or annually whichever is first. Aggressive, very hot and softened water causes rapid consumption of the anode requiring frequent inspections. The replacement anodes rods are available from your plumbing professional.

To inspect or replace an anode

The anodes on this water heater are easily accessible from the top of the water heater making replacement simple and quick. Use the following procedure to remove and inspect the anodes.

1. Drain the heater. Refer to DRAINING THE WATER HEATER instructions in this section.
2. Flush the heater. Refer to FLUSHING THE WATER HEATER instructions in this section.
3. Remove the plastic plug covering the anode.
4. Remove the anode using a socket of the appropriate size. Sometimes a breaker bar will need to be used. Do not use an impact wrench.
5. Inspect and replace the anode as required. Use pipe tape or sealant when reinstalling the anode.
6. Close the drain valve. Open a hot water fixture to allow air to escape. Open the cold water supply to water heater and allow the tank to fill.
7. Check your anode and drain valve for leaks.
8. Replace the plastic cover that covers the anode.
9. Follow the lighting instructions.

DRAIN VALVE AND TANK ACCESS PANEL

The water heaters are equipped with a ¾ inch drain valve.

An access panel covers the cleanout opening in the tank, which is sealed by a gasket and cover.

RELIEF VALVE

At least twice a year, the temperature and pressure relief valve should be checked to ensure that it is in operating condition. To check the relief valve, lift the lever at the end of the valve several times. The valve should seat properly and operate freely.

If water does not flow, remove and inspect for obstructions or corrosion. Replace with a new valve of the recommended size as necessary. A thorough inspection of the valve should be performed at least every three years by removing the temperature and relief valve from the tank. Do not attempt to repair the valve, as this could result in improper operation and a tank explosion. In areas with poor water conditions, it may be necessary to inspect the T&P valve more often than the recommended maintenance schedule



CAUTION

Before manually operating the valve, make sure that a drain line has been attached to the valve to direct the discharge to an open drain. Failure to take this precaution could mean contact with extremely hot water passing out the valve during this checking operation.

If the temperature and pressure relief valve on the water heater discharges periodically or continuously, it may be due to thermal expansion of water in a closed water supply system, or, it may be due to a faulty relief valve.

Thermal expansion is the normal response of water when it is heated. In a closed system, thermal expansion will cause the system pressure to build until the relief valve actuation pressure is equaled. Then, the relief valve will open, allowing some water to escape, slightly lowering the pressure.

Contact your water supplier or local plumbing inspector on how to control this situation.



WARNING

Above all, do not plug the temperature and pressure relief valve. This is not a solution and can create a hazardous situation.

VENT AND AIR INTAKE SYSTEM

Examine the vent and air intake system every 3 months. Points of inspection are as follows:

1. Check for obstructions and/or deterioration of vent piping and vent terminal. Replace immediately where needed.
2. Vent pipe and vent terminal screen should be cleaned of any foreign material. The screen is located inside the vent terminal outlet and is accessible from the outside of the vent terminal elbow. Do not reach inside the vent terminal when the water heater is in operation.
3. Check all venting system connections for leakage and reseal as required.

COMBUSTION SYSTEM INSPECTION

Inspect the operation of the combustion system monthly. Use the following procedure to inspect the combustion system.

1. Turn off the main power switch of the water heater.
2. Adjust the thermostat to the Min. setting.
3. Remove the top of the combustion surround by unlatching it.
4. While observing the ignition module, turn on the main power switch.
5. Adjust thermostat to the Max. setting.
6. Watch the ignition display as the controller goes through the sequence of operation as previously described.
7. Upon ignition, observe the main burner flame.
8. Readjust thermostat to previous setting.
9. Replace combustion surround top and latch it securely in place.



WARNING

Do not run out of propane gas. Damage to the water heater may occur.

SECTION XI: DIAGNOSTIC AND TROUBLESHOOTING GUIDE

DIRECT SPARK HONEYWELL INTEGRATED CONTROL SYSTEM **SEQUENCE OF OPERATION**

1. When the tank temperature drops below the temperature setpoint on the display, the control sends power to the combustion blower for a 30 second pre-purge period, circulator turns on and damper opens.
2. At the end of the pre-purge period, the control sends high voltage through the spark cable to the spark rod to spark to the burner. The gas valve also opens. When the burner lights, a microamp current is generated through the flame sense rod allowing the control to detect burner flame. The sparking then ceases and the flame is monitored by the flame sense circuit until the tank temperature reaches the thermostat setpoint and turns off the gas valve.
3. If the burner fails to light, the gas valve closes, sparking to the burner stops, and the combustion blower continues to operate for 60 seconds to purge the heat exchanger of unburned gas. The ignition trial is repeated. The control will make 3 attempts to ignite the burner. If the burner fails to light after the third attempt, the control enters "Soft Lockout", which is an idle period for 60 minutes. There will be an error code 62 or 63 shown on the water heater display indicating that the control cycled through the maximum number of ignition retries for ignition. The control will make another 3 ignition attempts after the 1 hour waiting period.
4. If the exhaust vent should become blocked, the exhaust vent temperature switch will open and the gas valve closes. The combustion blower will continue to operate. An error code 26 is shown on the water heater display. Removing the blockage and resetting the switch will resume normal operation.
5. The burner flame is monitored by the flame sense circuit and if the flame should extinguish, the gas valve closes and the combustion blower will operate to purge the heat exchanger before making an attempt to relight the burner. There may be 3 attempts to relight the burner before going into the Soft Lockout period explained previously.
6. The burner will continue to operate during the heating cycle until the tank temperature reaches the setpoint. The gas valve opens and the combustion blower continues to operate for 30 seconds to purge the heat exchanger of flue gases.
7. If for some reason, the tank temperature should exceed 200°F (93°C), then the control closes the gas valve and goes into a "Hard Lockout" state and will not operate until reset by a qualified service person. The display will read error code "65", which indicates the tank high limit temperature has been exceeded. No attempt should be made to reset the control until a service person has corrected the cause of the high limit condition. Refer to the diagnostic service section at the end of this Installation and Operating Instruction Manual.

ACCESSING SERVICE MODE ON THE WATER HEATER DISPLAY (FOR SERVICE PERSONNEL ONLY)

(270,000 BTU/hr and below)

See supplement included with 399,999 BTU/hr models for this information.

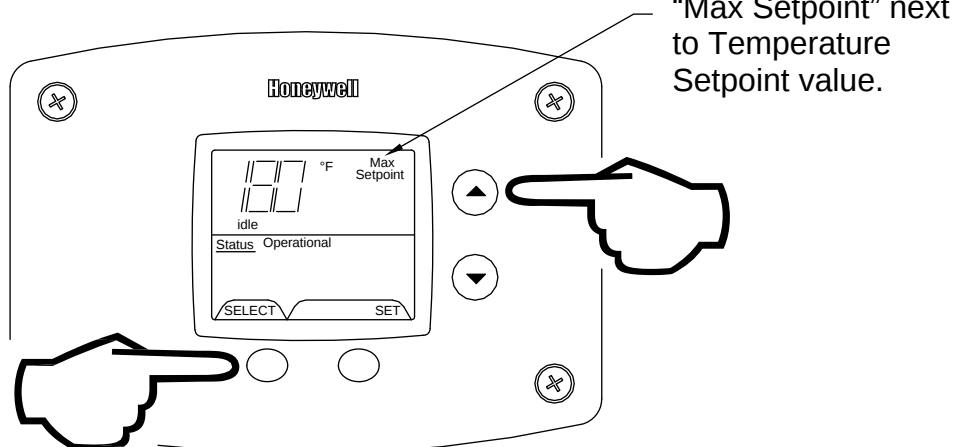
The display has a "Service Mode" for changing the maximum setpoint and accessing information in aiding servicing of the water heater. This procedure is for service and installation personnel only. To enter the Service Mode, follow the steps illustrated below:



WARNING

The following procedure is for service and installation personnel only. Resetting lockout conditions without correcting the malfunction can result in a hazardous condition.

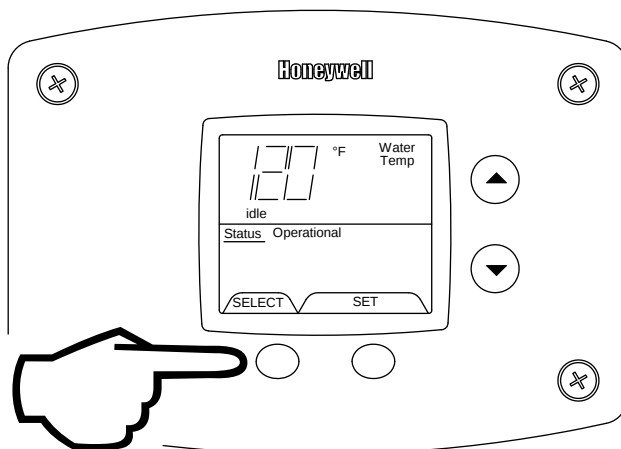
Step 1: Press “Select” and “Temperature Up” buttons together and hold for 3 seconds until “Max Setpoint” is shown in the display.



NOTICE

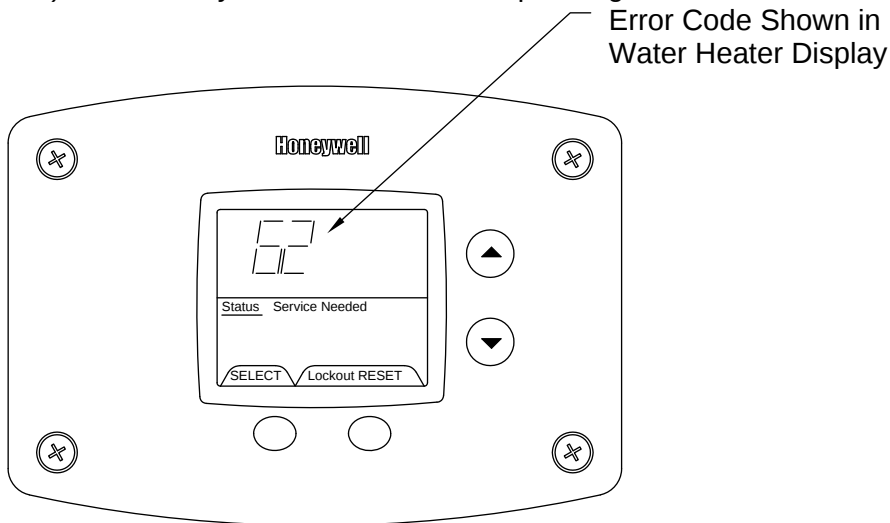
Approximately 12 minutes after the last button press, the display will automatically return to the “User Mode”. Simultaneously pressing the “Select” and “Temperature Up” buttons will switch the display immediately to the “User Mode”.

Step 2: Pressing “Select” button will change display to next mode

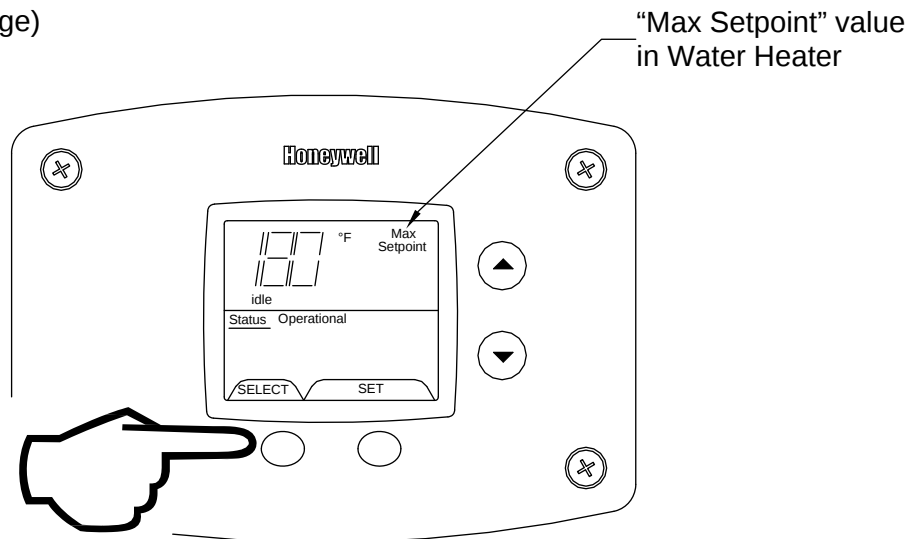


The following is the sequence of modes available in “Service Mode” by pressing the “Select” button:

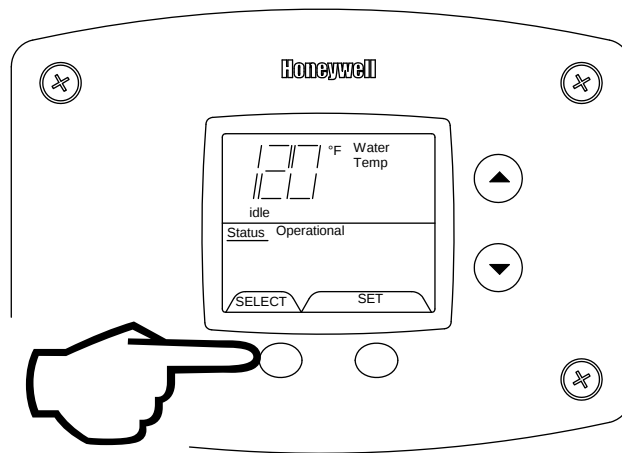
Error Code Number (Display/Reset). This is only shown if there is an operating error in the “User Mode”.



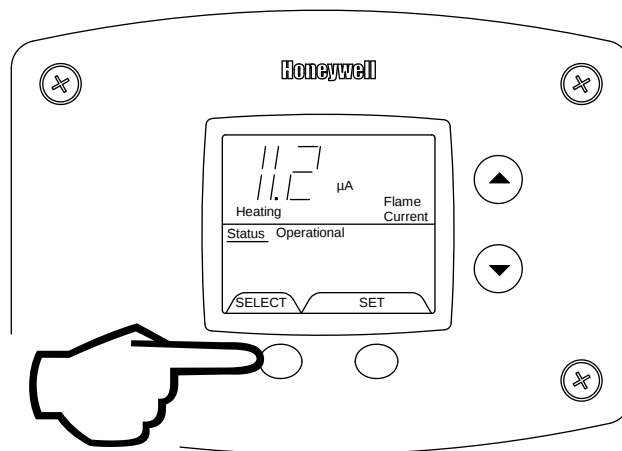
1. Max Setpoint (Display/Change)



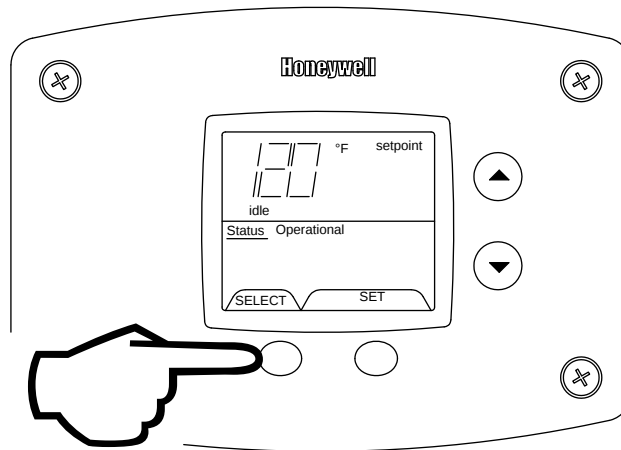
2. Water Temperature Sensor Reading.



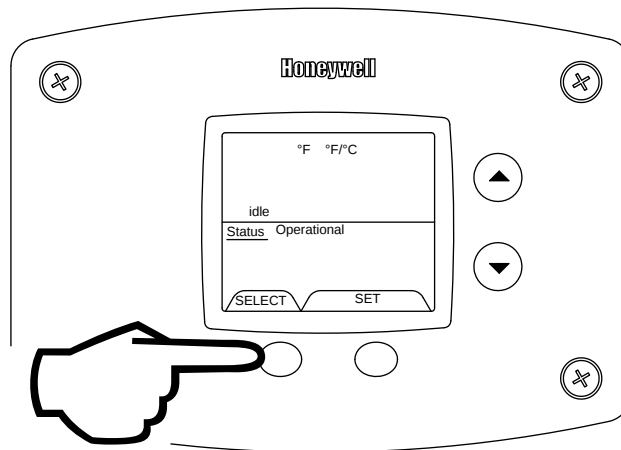
3. Flame Current of Pilot Flame Sensor (Displays only in the Heating Cycle)



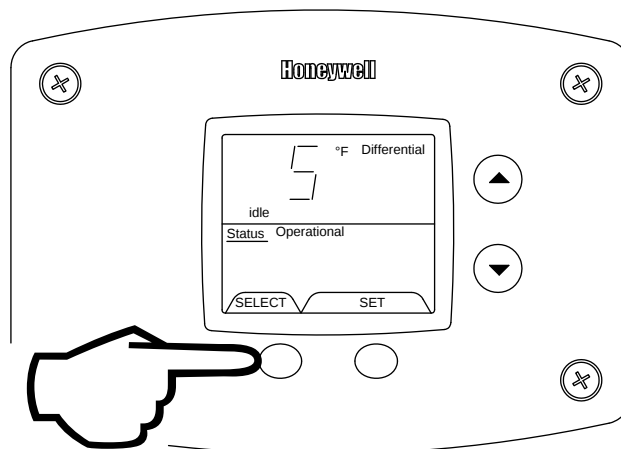
4. Setpoint (Display/Change)



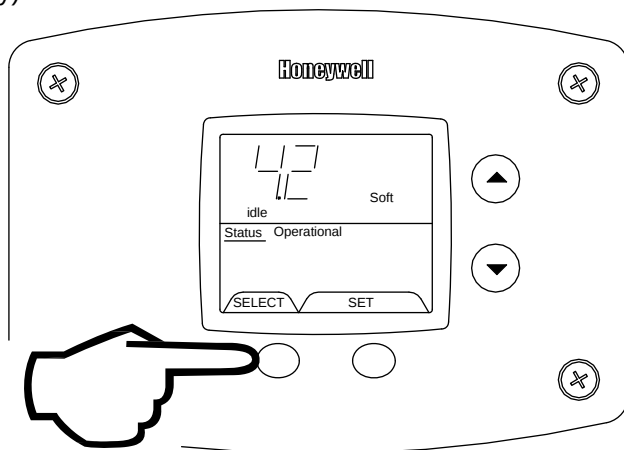
5. °F/°C (Display/Change)



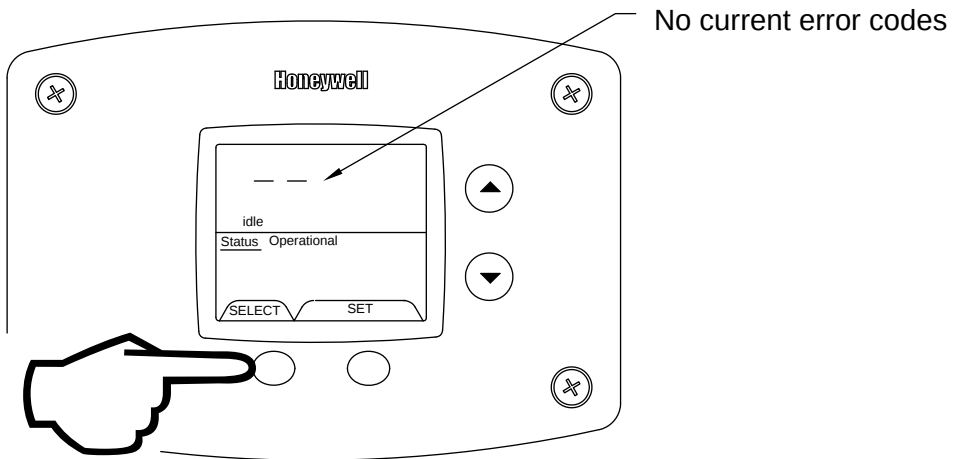
6. Differential (Display only – shows the differential of the thermostat)



7. Software Version (Display only)



8. Error Code History (Displays if there are present error codes or up to 10 previous error codes). Water Heater Display will show -- if there are no error codes.



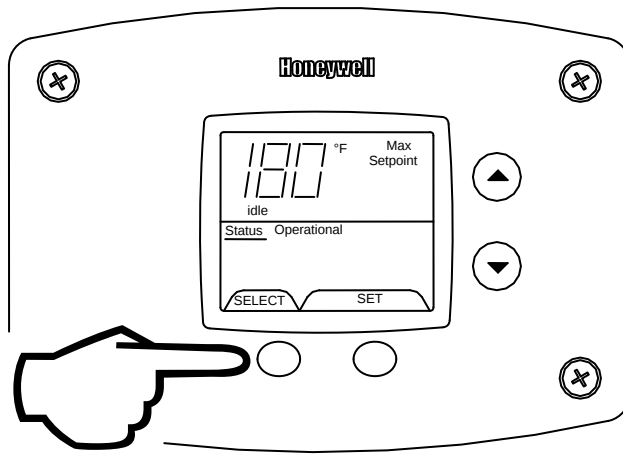
To change the Maximum Setpoint Limit (Max Setpoint) for the temperature setpoint



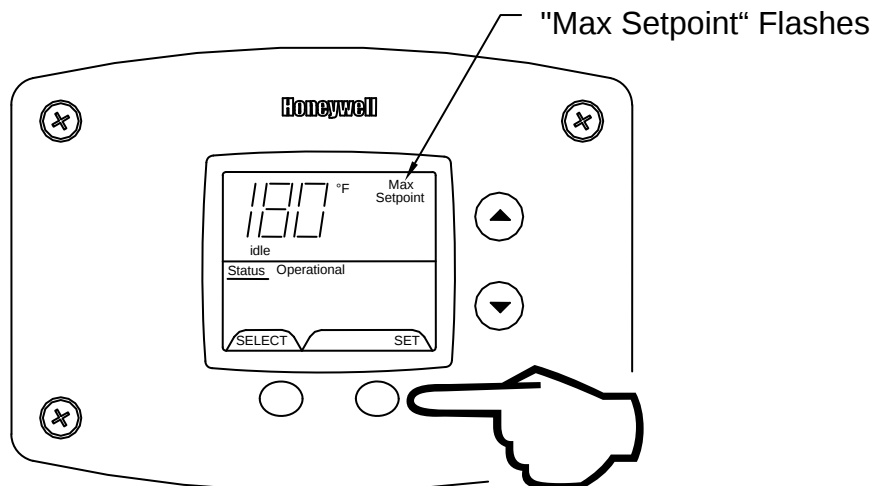
WARNING

Setting the water temperature to the maximum set point can result in scalding hot water delivered to the faucets. It is highly recommended that the maximum setpoint be adjusted to the lowest temperature possible for the needs of the installation. See following section to change the maximum setpoint limit (max setpoint). Make sure the water heater control display is not in a public area that can result in the temperature settings being improperly adjusted. See previous warning on scalds and an ASSE approved mixing valve.

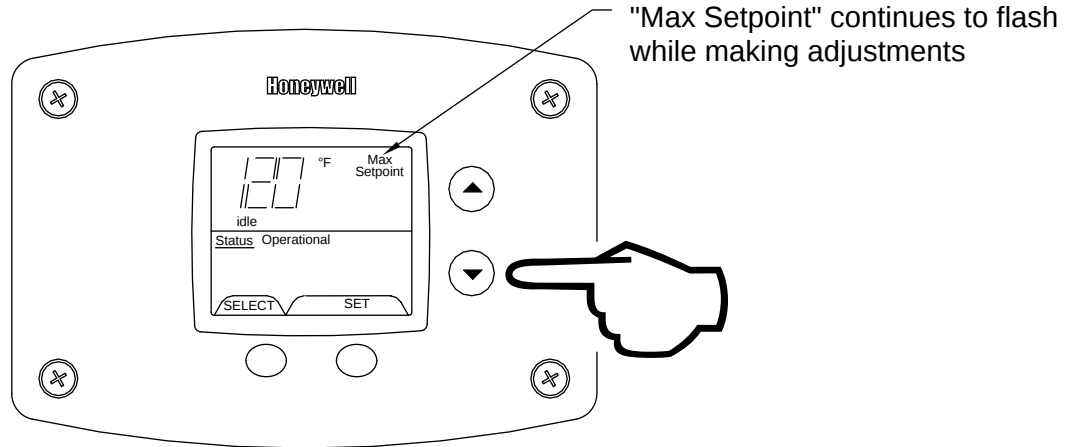
Step 1: In service mode press the “Select” button until “Max Setpoint” is displayed.



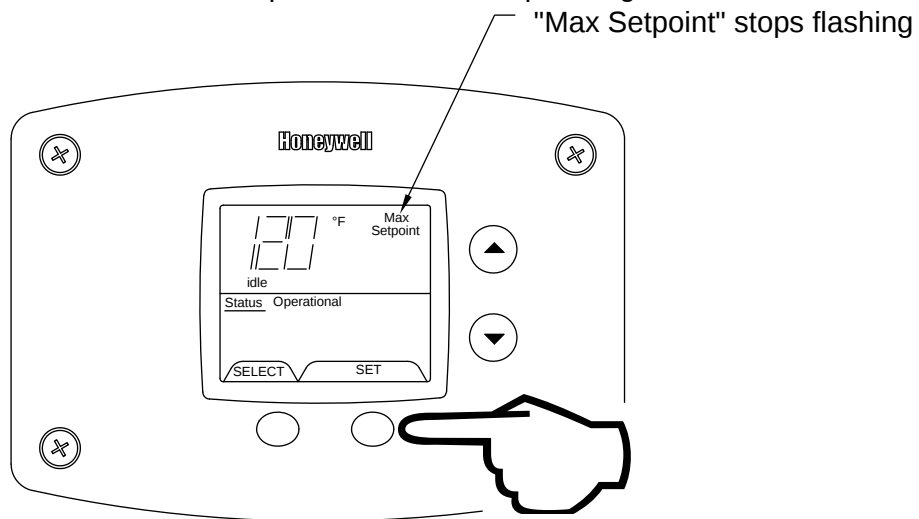
Step 2: Press “Set” button to enter setting mode. “Max Setpoint” will flash to indicate setting mode.



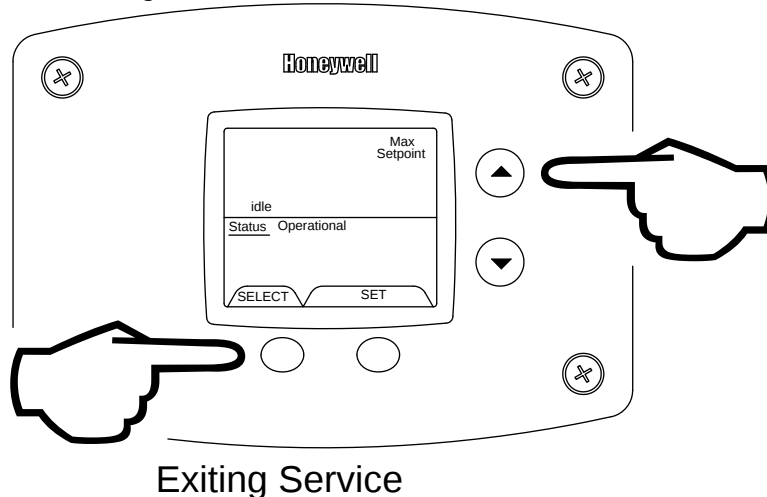
Step 3: Press the “UP” or “DOWN” buttons to change the maximum setpoint value. This will limit the maximum setpoint the user can select. Note: The maximum setpoint is approximately 180°F (82°C).



Step 4: Press “Set” button to confirm new “Max Setpoint” value and stop setting mode.

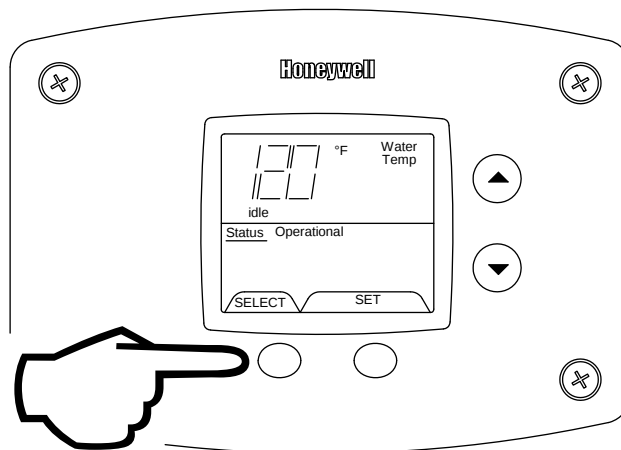


Step 5: Approximately 12 minutes after the last button press, the Water Heater Display will go back to “User Mode”. It will read “Max Setpoint” without showing a temperature value if the temperature setpoint is at the maximum setting. The Water Heater Display can be set back to the “User Mode” immediately by pressing both the “Temperature Up” and “Select” buttons together for 3 seconds.



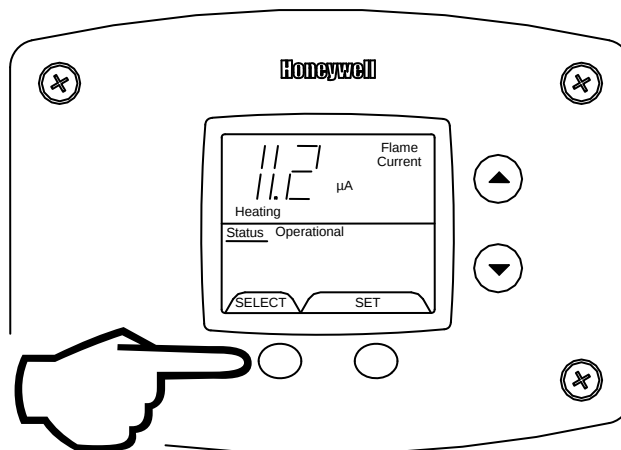
Display of Water Temperature

Step 1: In Service Mode, Press the “Select” button until “Water Temp” is displayed in the upper right section of the water heater display. This is the reading for the tank sensor.



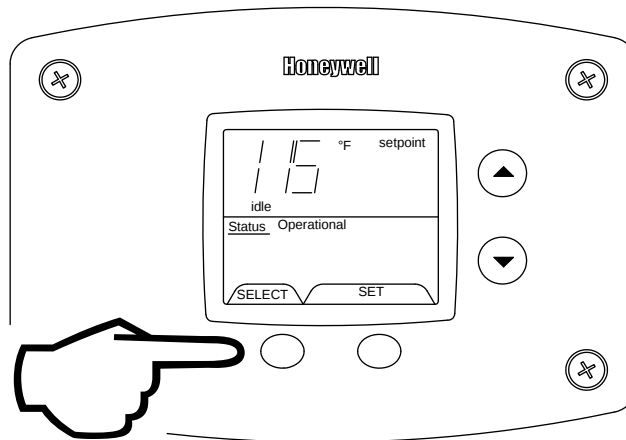
To Display Flame Sense Current of the Pilot Flame Sensor

The pilot flame sense current is available only when the burners are in operation. Step 1: Make sure the status displays “Heating” or draw enough hot water to start the burners. Step 2: Enter the “Service Mode” described previously. Step 3: Press the “Select” button until a number value is displayed with “Flame Current” to the right of the number. The value displayed is in microamps (μA).

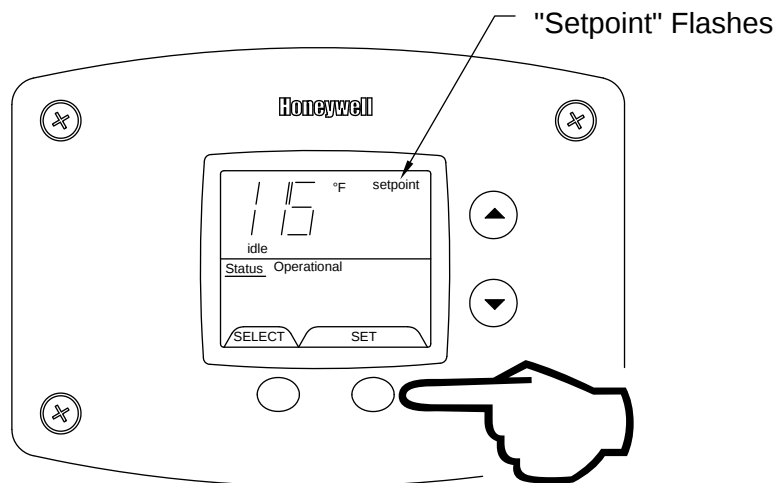


To Display and Change Temperature Setpoint

Step 1: In "Service Mode" press the "Select" button until "Setpoint" is shown in the water heater display.



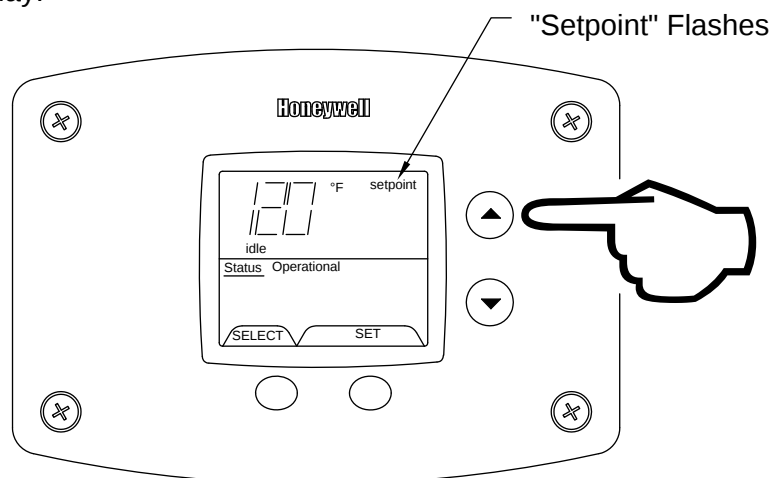
Step 2: Press the "Set" button to enter the setting mode. "Setpoint" will flash in the water heater display.



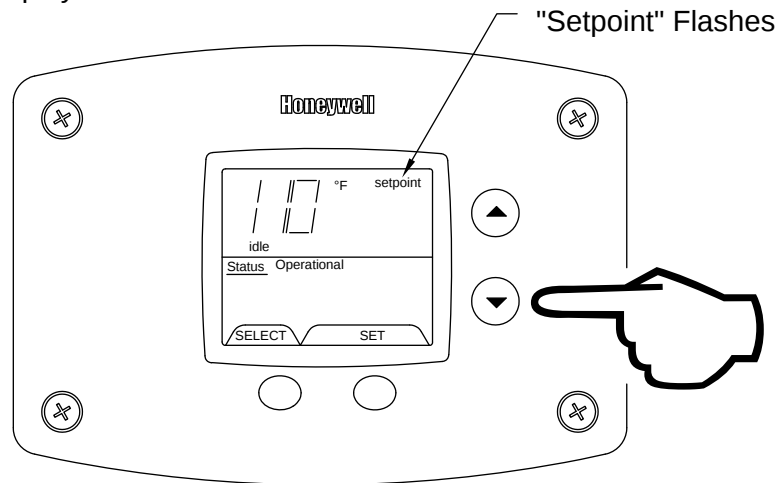
NOTICE

Note: The maximum temperature that can be set in the Water Heater Display is limited to the "Max Setpoint" described previously. To change the "Max Setpoint", refer to the procedure "To Change the Maximum Setpoint Limit..." described previously under "Accessing the Service Mode on the Water Heater Display".

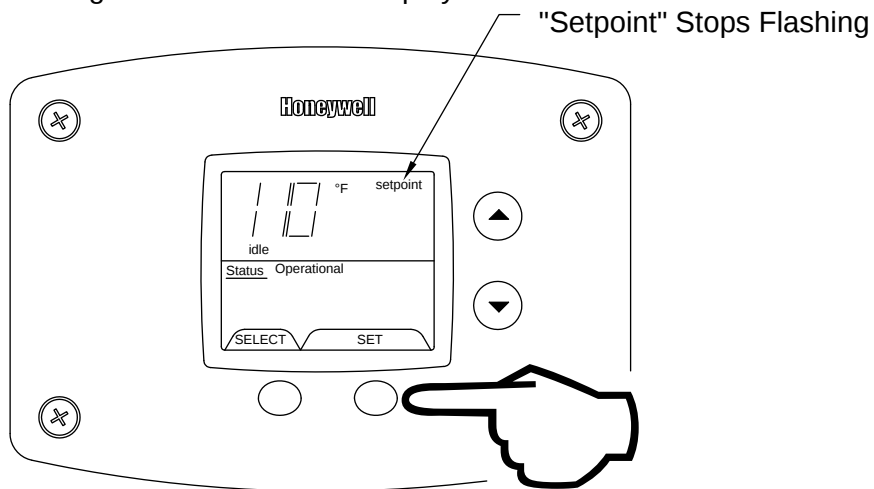
Step 3: To raise the temperature setpoint, press the "Temperature Up" button until the desired temperature is shown on the water heater display.



Step 4: To lower the temperature setpoint, press the “Temperature Down” button until the desired temperature is shown on the water heater display.

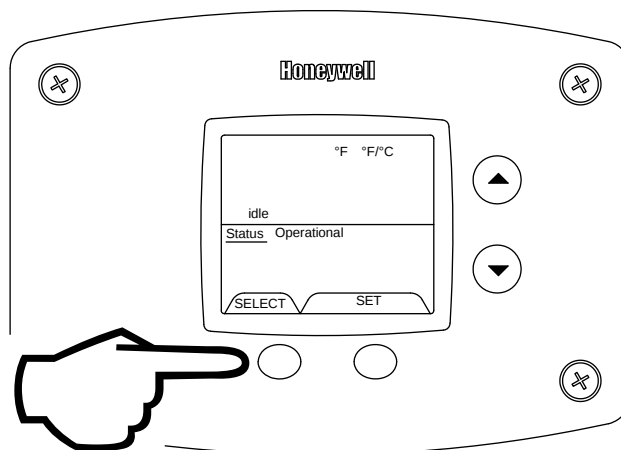


Step 5: When the desired setpoint is reached on the water heater display, press the “Set” button to confirm the new setpoint. “Setpoint” stops flashing in the water heater display.

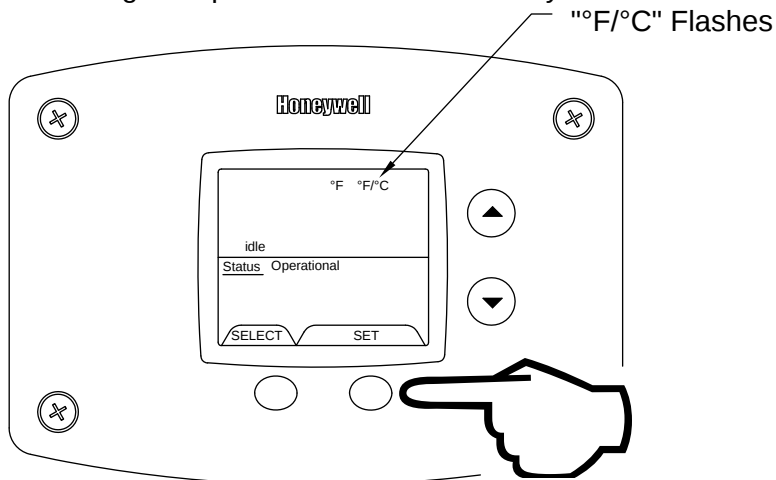


To Change Temperature Format in Display from °F to °C or °C to °F:

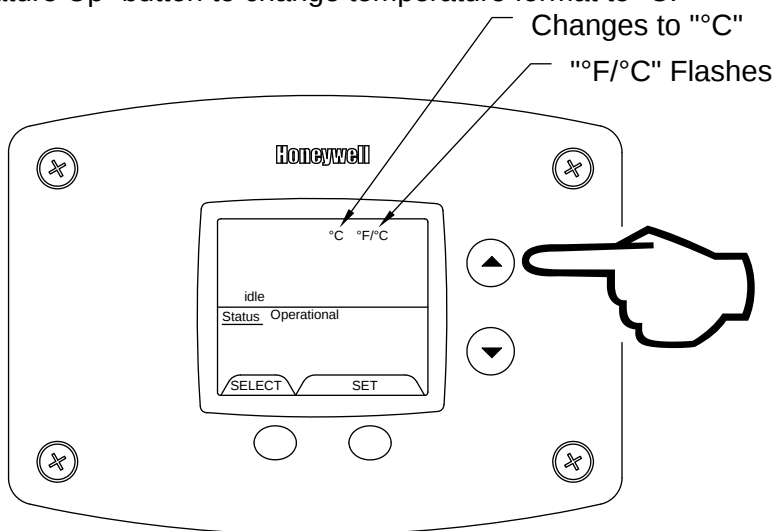
Step 1: While in “Service Mode”, press “Select” button until “°F/°C” is shown in the upper right portion of the water heater display.



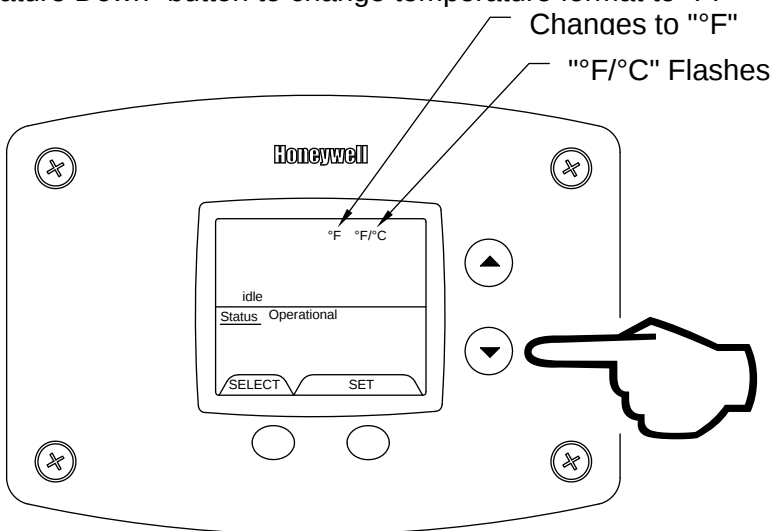
Step 2: Press "Set" button to change temperature format. "°F/°C" symbol will flash in the water heater display.



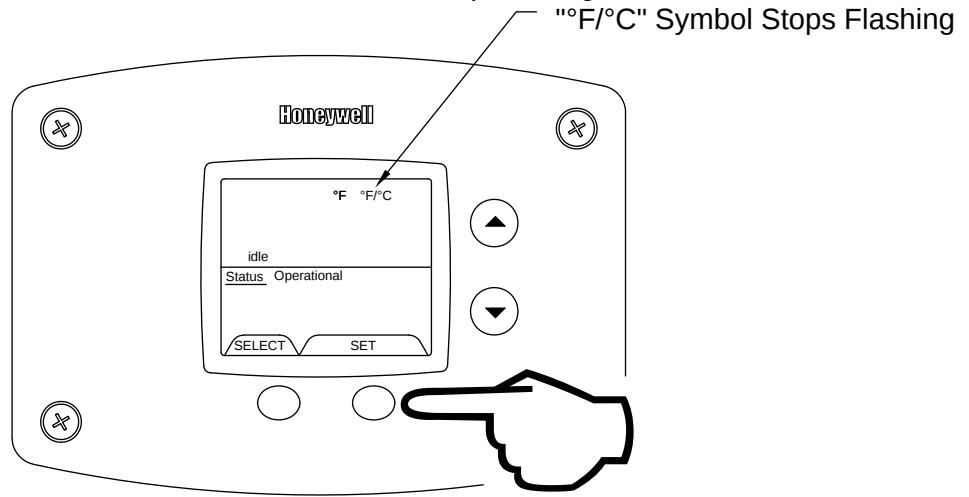
Step 3a: Press "Temperature Up" button to change temperature format to °C.



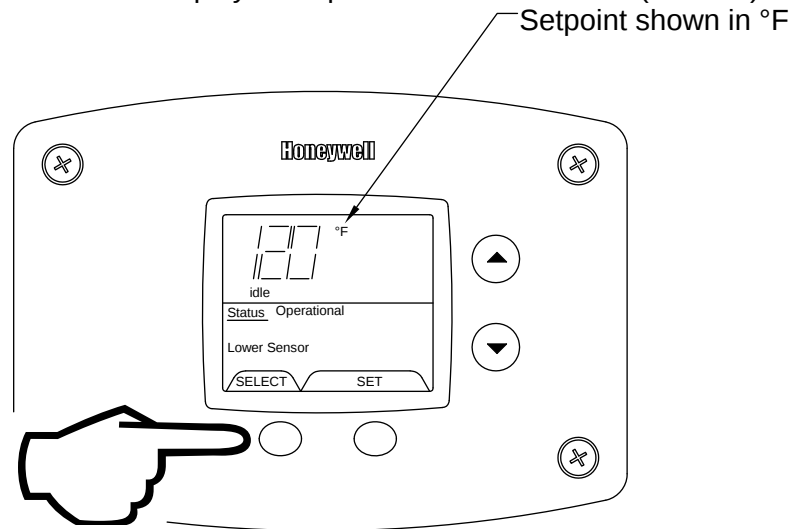
Step 3b: Press "Temperature Down" button to change temperature format to °F.



Step 4: Press "Set" button to confirm °F or °C format. °F/°C will stop flashing.



Step 5: Pressing "Select" button will return display to setpoint in format selected (°F or °C) immediately.



How to reset the control from Lockout Conditions:

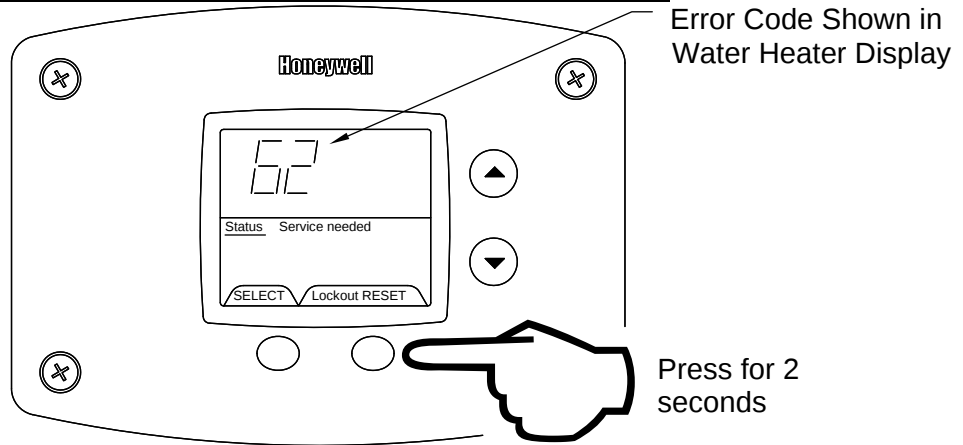


WARNING

The following procedure is for service and installation personnel only. Resetting lockout conditions without correcting the malfunction can result in a hazardous condition.

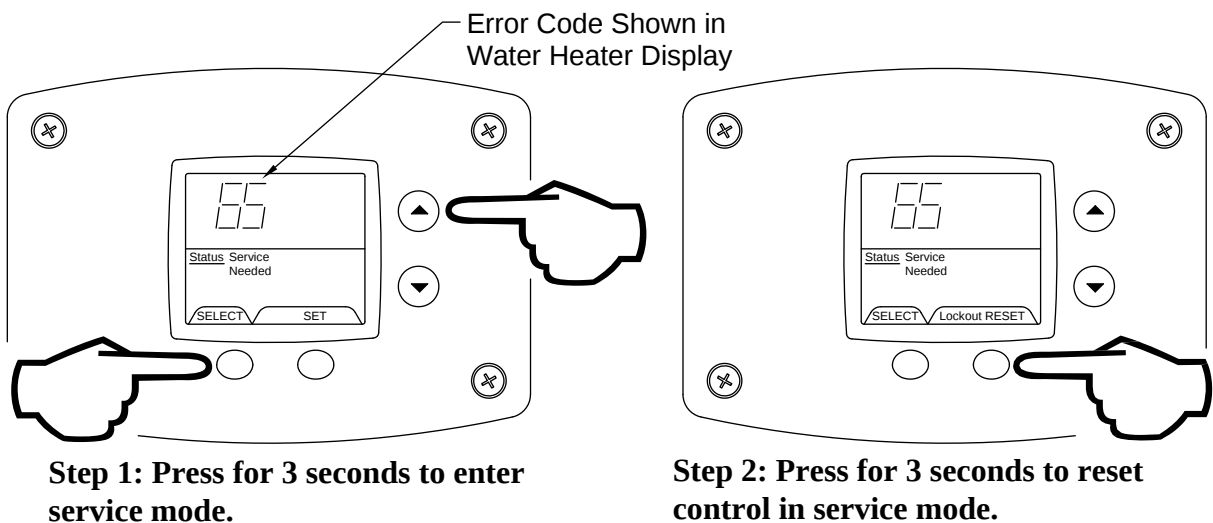
If an error code is displayed (except for #4, low flame sense current), the water heater will be in a “lockout condition” with the water heater display showing the error code number and “Service Needed” in the status section of the display window. Error codes 62 (maximum number of retries detected) and 63 (maximum number of ignition recycles detected) are “Soft Lockouts” in which the control can be reset in the “User Mode” by pressing the lower right button under “Lockout Reset” shown in the lower right portion of the display. The control will also go through 3 attempts to relight the burners every hour in the soft lockout condition.

Resetting Error Codes in Soft Lockout Condition



All other error codes will put the water heater into a “Hard Lockout” condition, in which the water heater will not operate and cannot be reset in the “User Mode”. To reset a hard lockout, first enter the “Service Mode” described earlier by pressing both the “Temperature Up” and “Select Buttons” at the same time for 3 seconds. Then press the lower right button under “Lockout Reset” in the water heater display and hold for 3 seconds.

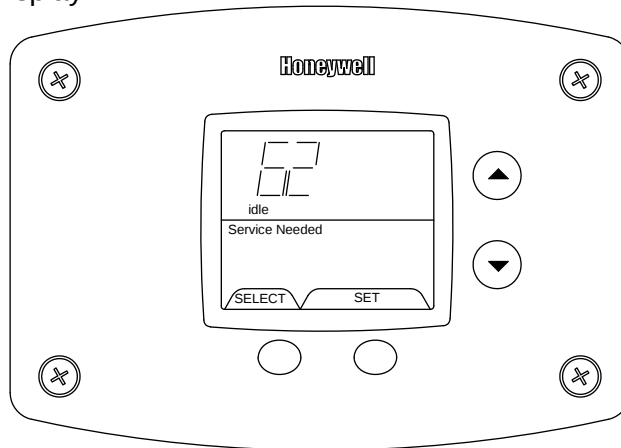
Resetting Error Codes in Hard Lockout Condition



Error Codes and Error History Display:

If there is an operating problem with the water heater, an error code number will appear on the water heater display with “Service Needed” to the right of the “Status” indicator. The error code label is located below the water heater display and the following section in this Installation and Operating Instruction Manual explains the error codes with corrective actions to repair the water heater.

Example of Error Code in the Display:



Error Code History

In “Service Mode” pressing the “Select” button after the “Software Version” (item 8 in the previously described sequence of service modes) will show an error code history, if there have been any previous operating problems with the water heater. If the display shows --, there is not a current error code.

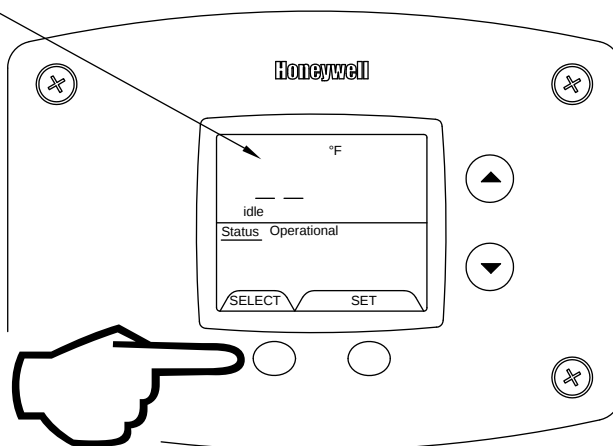
The Water Heater Display will provide up to 10 previous error codes. The oldest error code will be stored in code index #1 and the most recent in code index #10 (if there are 10 error codes).

To view previous error codes

Step 1:

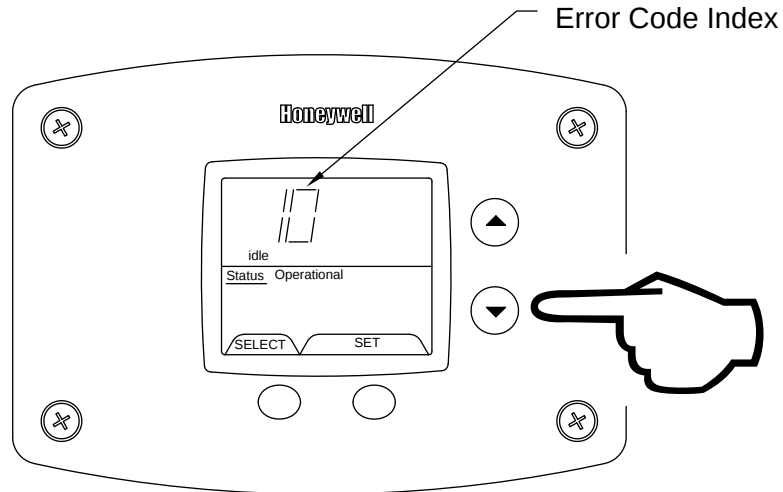
In “Service Mode” press the “Select” button until the next display after the “Software Version”. If there are no current error codes, the display will show -- .

No Current Error Code



Step 2:

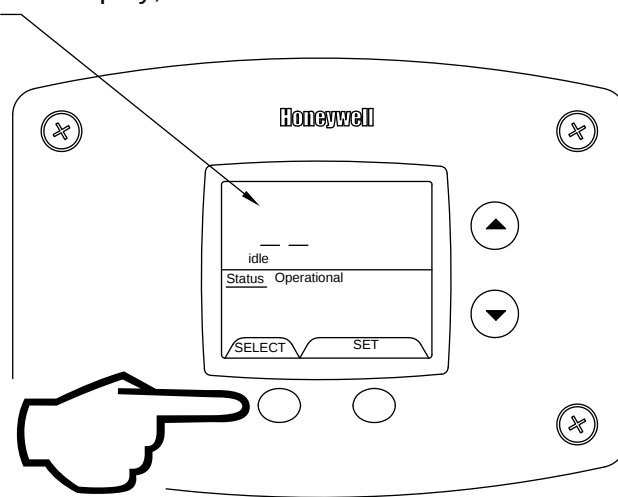
Press the “Temperature Down” button to select the error code index, starting with the most recent error code “10”.



Step 3:

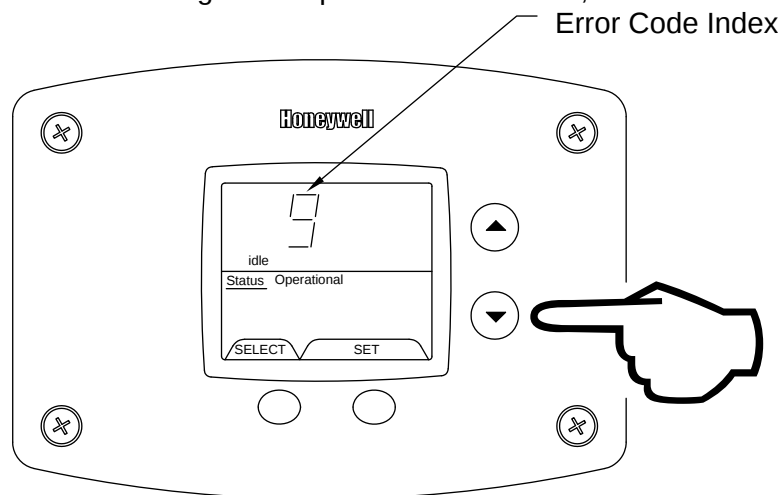
Press the “Select” button to view the error code for “code 10”. If there is a number displayed, note what the number is. The label next to the water heater display will identify the code number. If no number is displayed with only a “--” in the water heater display, then there has not been an error code for error code index 10.

No Error Code Shown for
Code Index 10



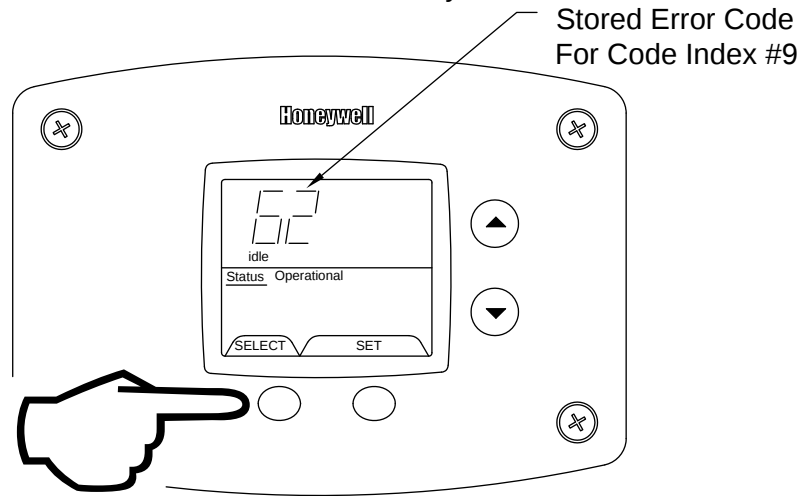
Step 4:

Press the “Temperature Down” button to change to the previous code index, code #9.

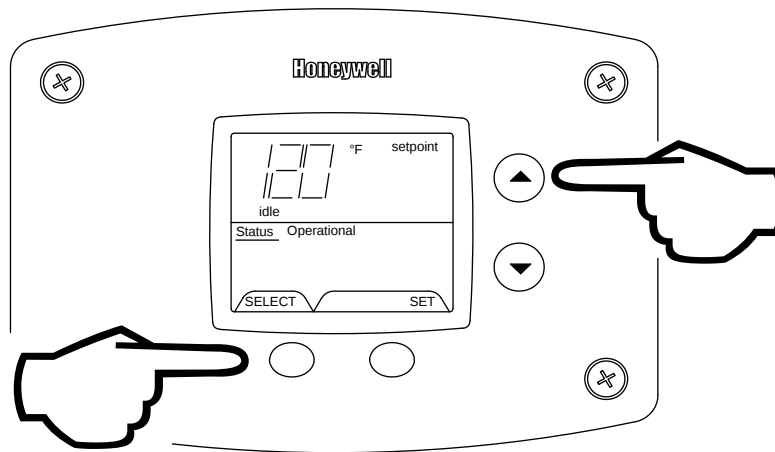


Step 5:

Press the “Select” button for code index #9 to view if there are any code numbers.



Step 6: Continue pressing the “Temperature Down” button to change to the next error code index and press “Select” to view the error code number, if any, for that index number. Continue on to index #1, the oldest error code index. The water heater display will store up to 10 error codes with the oldest code starting in code index #1 with the most recent code in code index #10.



Exiting Service Mode

Step 7: 10 seconds after the last button press, the Water Heater Display will revert back to the current error code display. To exit Service Mode, press Temperature Up button and Select Button for 3 seconds.

DIAGNOSTIC ERROR CODES AND TROUBLESHOOTING PROCEDURES FOR EF MODELS WITH HONEYWELL INTEGRATED DIRECT SPARK IGNITION CONTROL SYSTEM

Error Code	Definition of Code	Cause of Problem and Actions Taken to Correct
No code – blank display		• Check power supply to the water heater. • Make sure water heater is plugged in and the breaker is on. • Check if there is 120 volts power supply to the LINE connections on the control board. • If 120 volts is present, check for 24 volts output to SECONDARY terminals on the Control Board. • Check for loose wires, defective transformer. • Check wire harness connections from display to the control board.
4	Low Flame Sense Current	• Determine flame sense current in the Service Mode with the water heater operating. • If less than 4.0 microamps, check burner flame sense rod and wire. • Clean flame sense rod with emery cloth. • If problem is not solved, check for debris clogging burner or replace flame sense rod.
6	Flame Sensed Out of Normal Sequence (Before Opening Gas Valve or After Closing Gas Valve)	• Check to make sure gas valve has closed. • No voltage should be present at the gas valve before or after ignition cycle. • Make sure wire positions on the wire harness are correct. • If gas valve is stuck open, replace.
23	Flame Detected Before Ignition	• Check to make sure gas valve has closed. • No voltage should be present at the gas valve before the ignition cycle. • Make sure wire positions on the wire harness are correct. • If gas valve is stuck open, replace.
24	Flame Detected After Heating Cycle Completes	• Check to make sure gas valve has closed. • No voltage should be present at the gas valve before the ignition cycle. • Make sure wire positions on the wire harness are correct. • If gas valve is stuck open, replace.
26	Exhaust Vent Limit Switch Open	• Check to see if the exhaust vent high limit switch, located on the draft hood has opened. • Depress the red manual reset button on the high limit switch. • If it resets with a “click”, the switch has opened. • Check for evidence of blockage in the exhaust vent. • If there is evidence of blockage in the exhaust, call your Plumbing Professional to the clear blockage. • Do not continue to operate the water heater with the blockage in the exhaust vent.
32	Sensor Reading Faulty	• Resistance of sensor out of operating range. • Check continuity of wire harness to sensor, and if O.K., replace sensor.
57	Flame Rod Shorted to Ground	• Pilot flame sensor rod is shorted to ground. • Check to see if flame sensor wire has bare spots touching metal parts of if flame sensor rod is touching the burner or other metal parts. • Replace if flame sense wire is damaged or flame rod is bent.
58	AC Line Frequency Error – Signal Too Noisy or Frequency Incorrect	• Check line voltage frequency to the water heater. • Determine if there are wide fluctuations. • Call an electrician if the problem persists. • The water heater should be on a separate line.
59	Line Voltage Too Low or High	• Check line voltage to the water heater. • Determine cause of low or high voltage. • Call an electrician or your utility. • The water heater should be on a separate line.
61	DC Output Voltage Unstable	• Check line voltage to the water heater for erratic readings. • Also check wiring to make sure there are no shorts. • If power supply and wiring are O.K., replace control board.

Error Code	Definition of Code	Cause of Problem and Actions Taken to Correct
62	Maximum Number of Retries Detected	• Burner is either not lighting or not staying lit during ignition cycle. • Check inlet gas pressure for minimum pressure on rating label. • Can you hear sparking to the burner? • Check high voltage cable connections. • Check inlet gas pressure to the gas valve making sure the pressure is within the limits specified on the rating label. • Check gas valve wire harness for broken wires or shorts. • Check outlet gas pressure. • If 24 volts is present to the terminals at the gas valve, replace gas valve. • Check for voltage output to the blue gas valve wires on the control board pins. • If during the ignition trial period, there is no voltage present at the control board pin terminals for the blue wires leading to the gas valve, then replace the control board. • Replace spark rod if insulator is damaged or rod is loose. • Check to make sure combustion blower is operating when thermostat calls for heat. • If blower is not running check for 120 volts to blower harness and then at blower pin connections. • Replace control, wire harness, or blower if defective. • Check to make sure vent terminals are clear of debris or snow and ice. • Make sure the condensate drain flows freely.
63	Maximum Number of Ignition Recycles Detected	• Burner flame is lost during run cycle, and then re-established on ignition cycle. Check inlet gas pressure. • Is gas pressure dropping below the minimum operating pressure on the rating label after the gas valve opens? • Is the gas pipe size to the water heater adequate? • Check the condition of the burner. • Clean or replace as needed. • Check the burner flame and observe the microamp output on the run cycle. • Replace burner if clogged with dirt and debris. • Replace spark rod or flame sensor if damaged. • Check to make sure vent terminals are clear of debris or snow and ice. • Make sure the condensate drain flows freely.
64	Electronics Failure	• Replace control board.
65	High Water Temperature (Over 200°F (93°C))	• Water temperature in tank has exceeded 200°F (93°C). • Check tank sensor. • Make sure sensor is fully inserted into the well (clip on sensor wire secures sensor in place). • Check sensor reading. • If not within specifications, replace sensor. • If sensor and wire harnesses check O.K., replace control board.

Procedure for Checking Thermostat Sensors

Set the thermostat above water temperature (See temperature adjustment section) and observe system through one (1) complete cycle. Make sure system operates as desired.

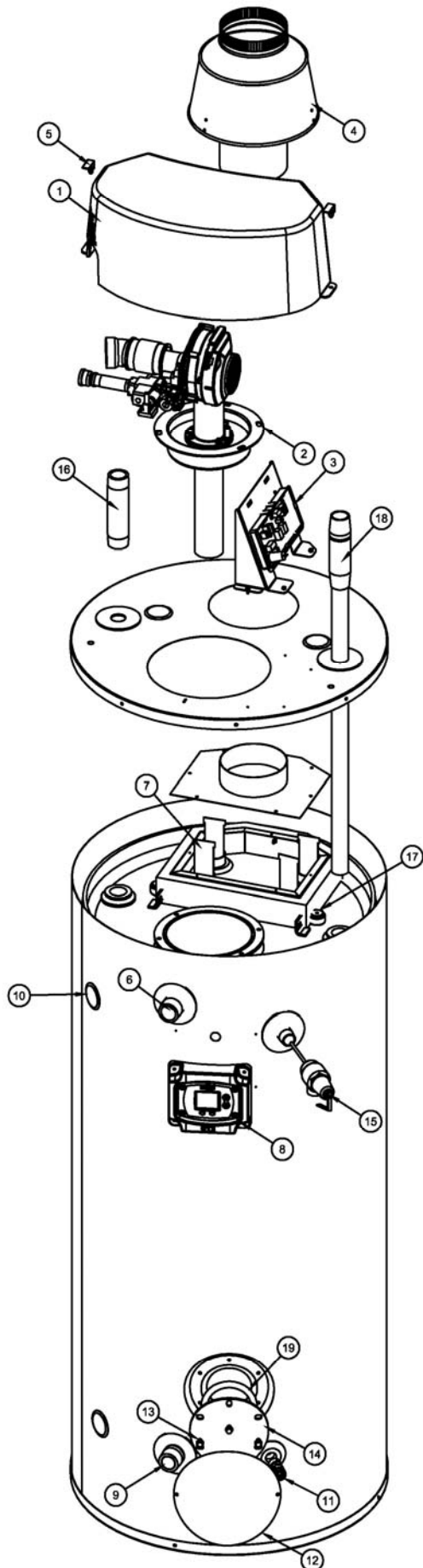
To check the upper sensor assembly, compare the resistance of the sensor terminals (yellow and black lead for upper sensor) as measured by an ohmmeter to the water temperature as measured by an accurate thermometer. Thermistor resistance increases as the temperature decreases. The tables below show the correct sensor resistance at various temperatures. Replace the sensor if the ohm reading in the chart does not approximate the reading from the sensor at the temperature measured in the tank.

In Degrees F										
°F	0	1	2	3	4	5	6	7	8	9
40	26109	25400	24712	24045	23399	22771	22163	21573	21000	20445
50	19906	19383	18876	18383	17905	17440	16990	16553	16128	15715
60	15314	14925	14548	14180	13823	13477	13140	12812	12494	12185
70	11884	11592	11308	11032	10763	10502	10248	10000	9760	9526
80	9299	9078	8862	8653	8449	8250	8057	7869	7685	7507
90	7333	7165	7000	6839	6683	6531	6383	6238	6098	5961
100	5827	5697	5570	5446	5326	5208	5094	4982	4873	4767
110	4663	4562	4464	4368	4274	4183	4094	4006	3922	3839
120	3758	3679	3602	3527	3453	3382	3312	3244	3177	3112
130	3048	2986	2925	2866	2808	2752	3697	3643	2590	2538
140	2488	2439	2391	2344	2298	2253	2209	2166	2124	2083
150	2043	2004	1966	1928	1891	1856	1820	1786	1753	1720
160	1688	1656	1625	1595	1566	1567	1509	1481	1454	1427
170	1402	1376	1351	1327	1303	1280	1257	1235	1213	1191
180	1170	1150	1129	1110	1090	1071	1053	1035	1017	999
190	982	965	949	933	917	901	886	871	857	842
200	828	814	801	788	775	762	749	737	725	713

In Degrees C										
°C	0	1	2	3	4	5	6	7	8	9
0	32648	31026	29495	28049	26682	25389	24166	23010	21915	20879
10	19898	18968	18088	17253	16461	15710	14998	14322	13680	13071
20	12492	11942	11419	10922	10450	10000	9572	9165	8778	8409
30	8057	7722	7403	7099	6808	6532	6268	6016	5775	5546
40	5327	5117	4917	4726	4543	4368	4201	4042	3889	3742
50	3602	3468	3340	3217	3099	2986	2878	2774	2675	2579
60	2488	2400	2316	2235	2157	2083	2011	1942	1876	1813
70	1752	1693	1637	1582	1530	1480	1432	1385	1340	1297
80	1256	1216	1177	1140	1105	1070	1037	1005	974	944
90	916	888	861	835	810	786	763	741	719	698

SECTION XII: PARTS LIST

Water Heater Full Assembly (270,000 BTU/h and Below)



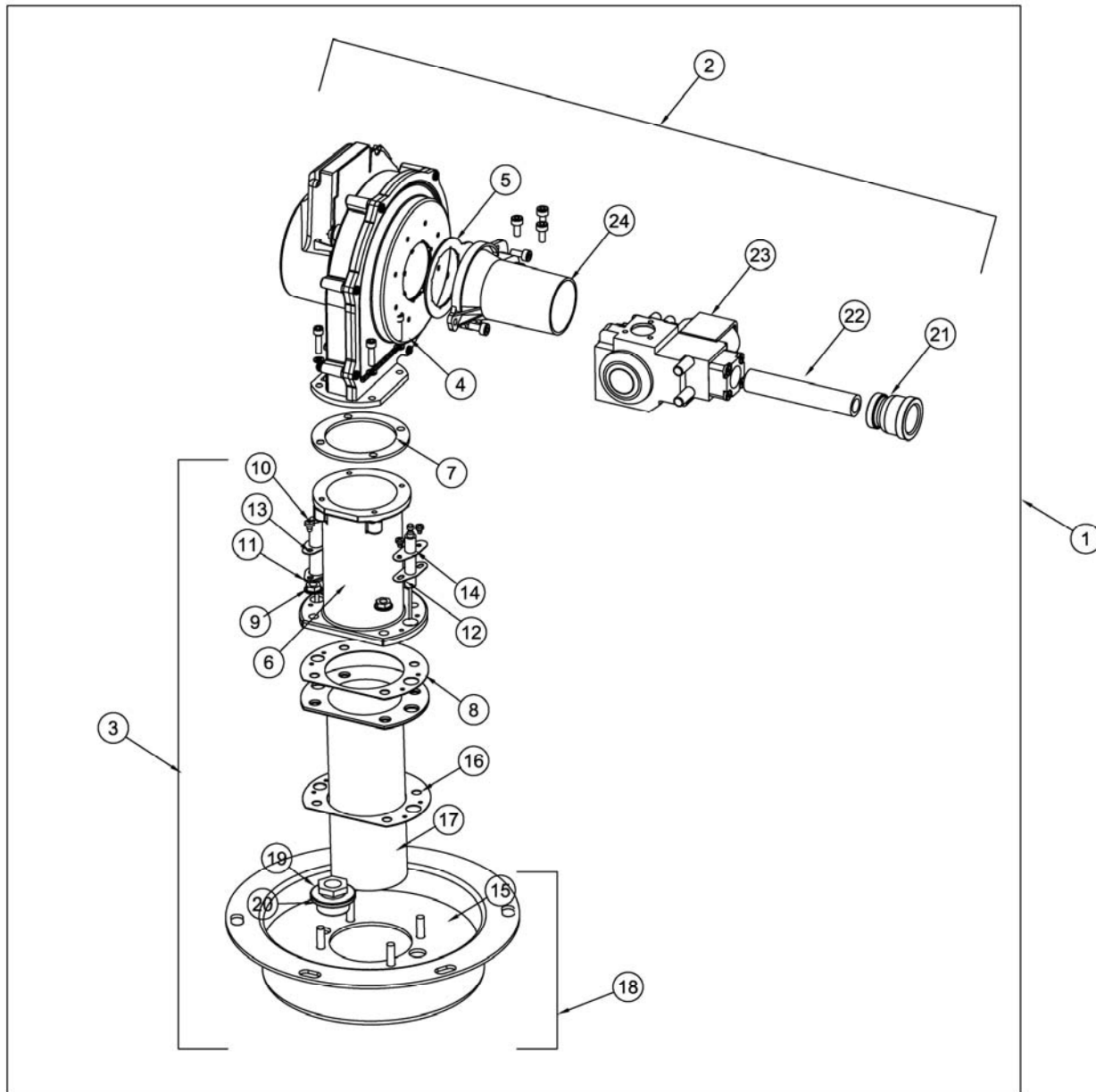
1	Surround Assembly
	Combustion Assembly
2	(Specify model)
3	Ignition Control Assembly
4	Draft Hood (Specify model)
5	Swell Latch
6	Front Hot Water Outlet
7	Baffle 2" Flue (Specify Model)
8	Control Display
9	Front Cold Water Inlet
10	Plastic Hole Closure
11	No Handle Brass Drain Valve
12	Cleanout Access Cover
13	Screw 5/16-18 x 3/4" HH Grade 5
14	Cleanout Cover
15	T&P (Specify Model)
16	Hot Water Outlet Plasticsert Nipple
17	Anode
18	Cold Water Inlet (Hydrojet) Assembly
19	Cleanout Gasket (Specify Model)

Customer must specify complete model number and serial number when ordering service parts.

**SEE SUPPLEMENT INCLUDED WITH
UCG100H399 UNITS FOR PARTS LIST.**

2 Combustion Assembly

1	Combustion Assembly (Specify model)	13	Sensor – Flame Sense
2	Blower/Gas Valve Assembly (Specify model)	14	Igniter – Direct Spark Ignition
3	Burner Assembly (Specify model)	15	Blower / Burner Mounting Plate
4	Blower – (Specify model)	16	Gasket Burner (Specify Model)
5	Gasket & Screw	17	Burner (Specify Model)
6	Transition Tube	18	Burner Mount Assembly
7	Gasket Blower Transition	19	Sight Glass Assembly
8	Gasket Transition Tube	20	Gasket Sight Glass
9	1/4 – 20 Nut	21	Reducer 3/4 x 1/2 NPT
10	Screw 8-32 x 1/4" RHCR	22	Nipple 1/2 NPT x 3"
11	Gasket Flame Sense	23	Gas Valve
12	Gasket Igniter	24	Venturi

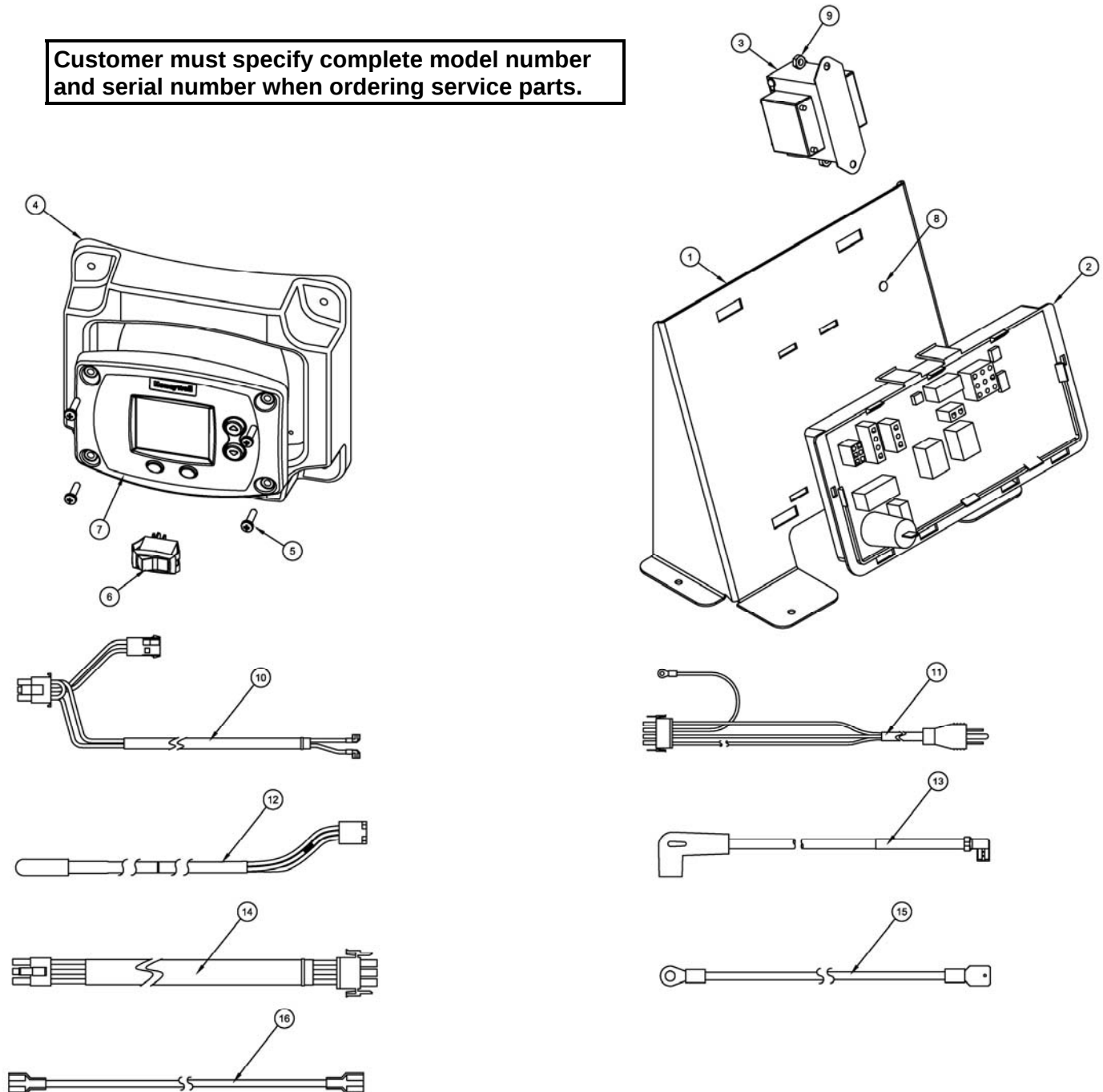


Customer must specify complete model number and serial number when ordering service parts.

3 Ignition Control Assembly and Harnesses

1	Control Panel	9	Hex Nut
2	Control	10	Ignition Control Harness
3	Transformer	11	Power Cord Harness
4	Display Panel	12	T-Stat Sensor Harness
5	Screw	13	High Voltage Spark Cable
6	Switch Main Power	14	Blower/Circ/Damper Harness
7	Control Display	15	Ground Wire
8	Weld Stud	16	Flame Sense Harness

Customer must specify complete model number and serial number when ordering service parts.



Manufactured under one or more of the following U.S. Patents: 5,277,171; 5,341,770; 5,372,185; 5,485,879; 5,574,822; 5,596,952; 5,660,165; 5,682,666; 5,761,379; 5,943,984; 5,954,492; 5,988,117; 6,056,542; 6,142,216; 6,442,178; 6,684,821; 6,935,280; 7,063,132; 7,063,133; 7,007,748; 7,270,087; 7,334,419; 7,337,517; 7,409,925; 7,458,341; 7,559,293; 7,621,238; 7,634,976; 7,650,859; 7,665,210; 7,665,211; 7,699,026; 7,866,168; 7,900,589; 7,971,560; 7,992,526; 8,082,888; 8,146,772; Other U.S. and Foreign patent applications pending. Current Canadian Patents: 2,092,105; 2,107,012; 2,108,186; 2,112,515; 2,143,031; 2,239,007; 2,262,174; 2,314,845; 2,409,271; 2,476,685; 2,504,824; 2,548,958