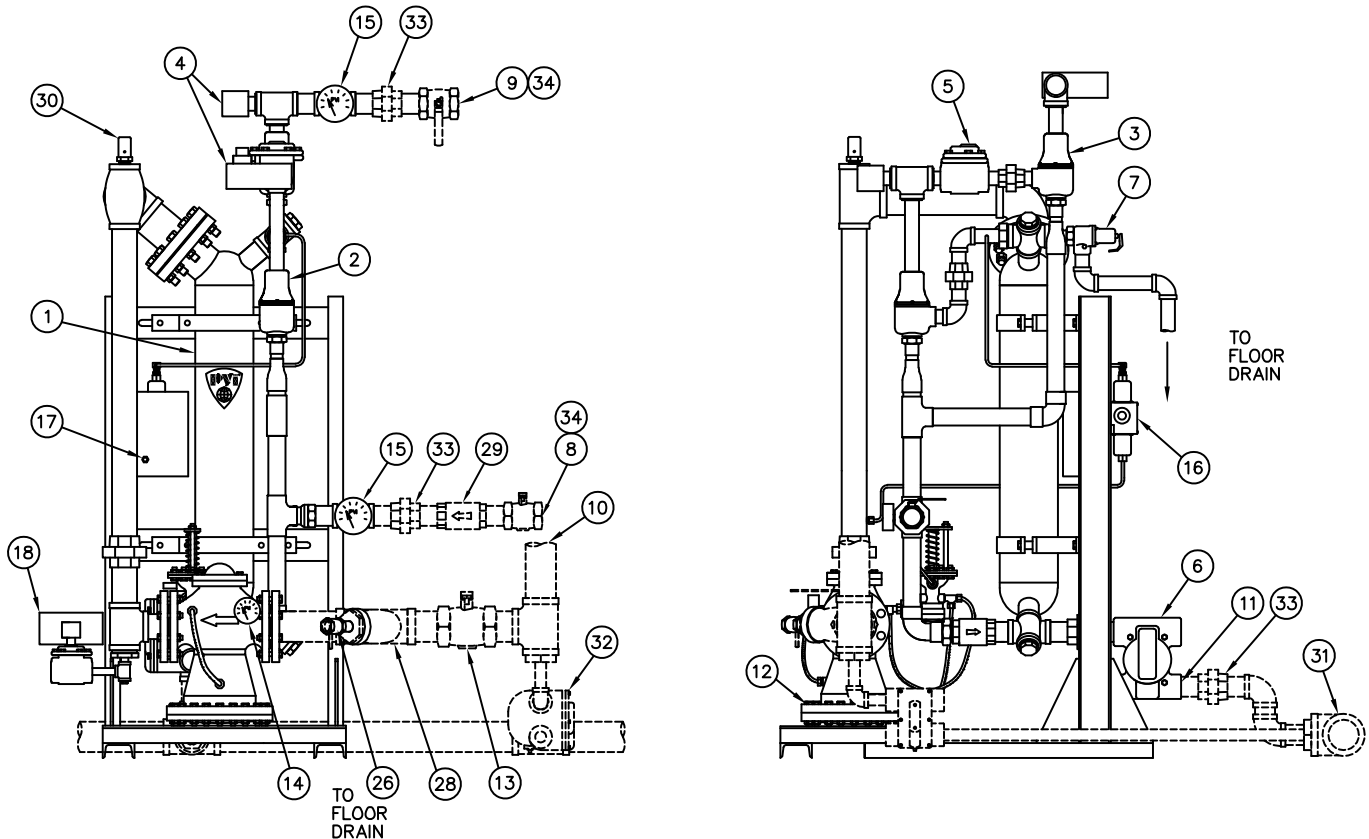


# INSTALLATION & MAINTENANCE MANUAL

## CSX and CSXT INSTANTANEOUS STEAM WATER HEATER

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

**IMPORTANT: THIS MANUAL CONTAINS INFORMATION REQUIRED FOR INSTALLATION, OPERATION AND MAINTENANCE OF THIS EQUIPMENT. READ AND FOLLOW THE INFORMATION IN THIS MANUAL AND ALL OTHER PROVIDED INSTRUCTIONS, LABELS AND MARKINGS BEFORE INSTALLING, OPERATING OR SERVICING THIS UNIT.**



Typical Construction for CSX- Figure 1

- |   |   |  |
|---|---|--|
| 1. Heat exchanger(s)                            | 13. Steam shutoff valve(s) *                        | 25. Condensate y-strainer(s) *           |
| 2. Primary temperature control valve(s)         | 14. Steam pressure gauge *                          | 26. Y-strainer blow-down valve(s) *      |
| 3. Secondary temperature control valve(s)       | 15. Temperature gauges *                            | 27. Circulation return connection *      |
| 4. Temperature limiting device                  | 16. Differential pressure switch (for PGM option) * | 28. Y-strainer **                        |
| 5. Solenoid shutoff valve(s)                    | 17. Reset switch *                                  | 29. Check valve **                       |
| 6. Steam trap(s)                                | 18. Steam purge valve *                             | 30. Vacuum breaker **                    |
| 7. Pressure relief valve (Plumb to floor drain) | 19. Steam header *                                  | 31. Condensate return line **            |
| 8. Potable water inlet                          | 20. Return circulation pump *                       | 32. Steam supply line condensate trap ** |
| 9. Potable water outlet                         | 21. Subcooling heat exchanger *                     | 33. Unions **                            |
| 10. Steam inlet                                 | 22. Subcooler bypass valves *                       | 34. Isolation valves **                  |
| 11. Condensate connection                       | 23. Instrumentation wiring junction box *           |  |
| 12. Steam regulating valve *                    | 24. Pressure transducer *                           |  |
- \* Optional  
\*\* Not supplied by PVI (shown with dashed lines)

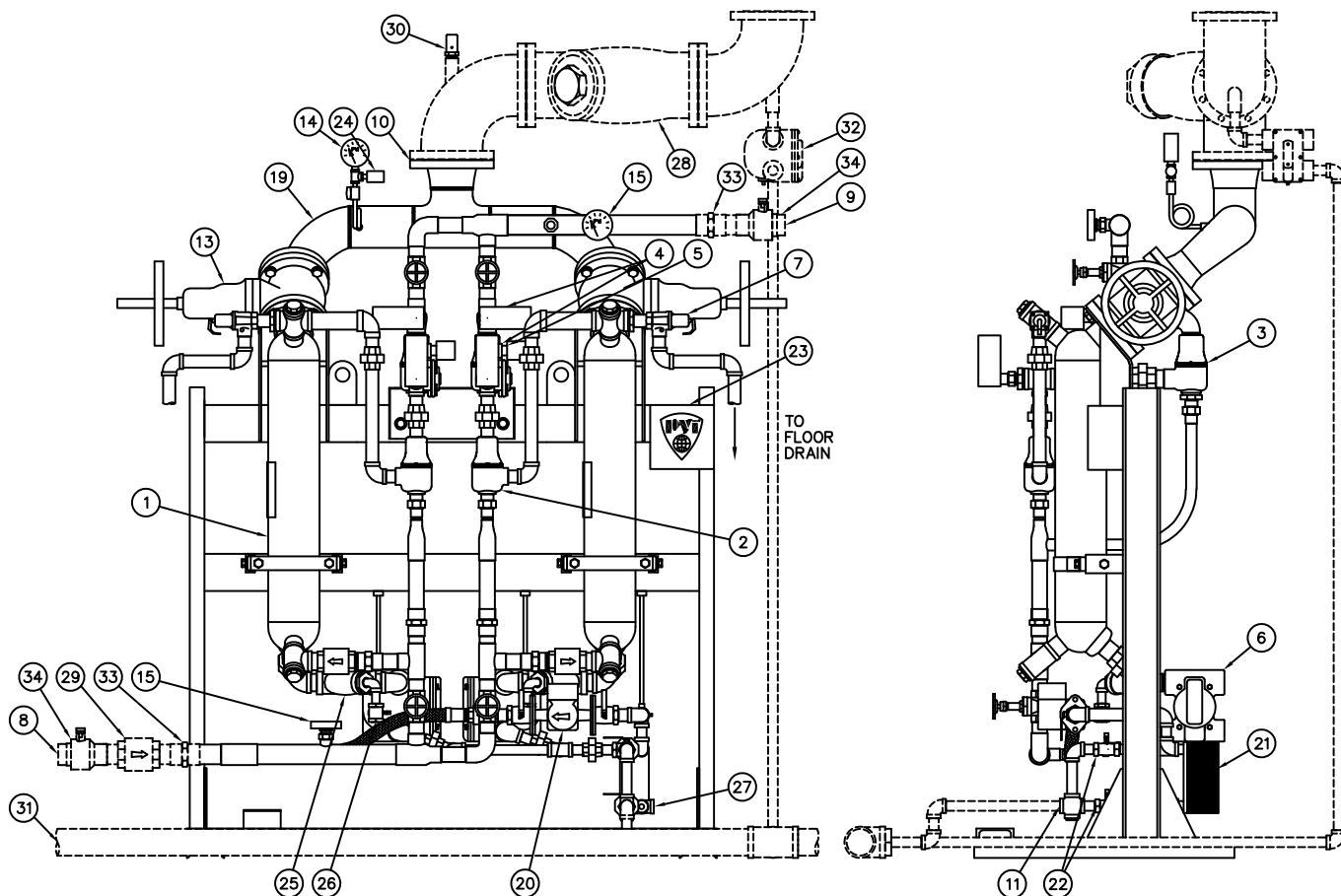
**TO THE INSTALLER:** After installation, these instructions must be given to the equipment user or left near the appliance.

**SPECIAL INSTRUCTIONS TO THE OWNER:** Retain this manual for future reference. These instructions contain important information that will help you in maintaining and operating this appliance.



PVI INDUSTRIES, LLC • P.O. Box 7124 • Fort Worth, Texas 76111 • Tel 1-800-433-5654 • [www.pvi.com](http://www.pvi.com)

# CSX and CSXT SERIES WATER HEATERS



Typical Construction for CSXT - Figure 2

- |   |   |  |
|---|---|--|
| 1. Heat exchanger(s)                            | 13. Steam shutoff valve(s) *                        | 25. Condensate y-strainer(s) *           |
| 2. Primary temperature control valve(s)         | 14. Steam pressure gauge *                          | 26. Y-strainer blow-down valve(s) *      |
| 3. Secondary temperature control valve(s)       | 15. Temperature gauges *                            | 27. Circulation return connection *      |
| 4. Temperature limiting device                  | 16. Differential pressure switch (for PGM option) * | 28. Y-strainer **                        |
| 5. Solenoid shutoff valve(s)                    | 17. Reset switch *                                  | 29. Check valve **                       |
| 6. Steam trap(s)                                | 18. Steam purge valve *                             | 30. Vacuum breaker **                    |
| 7. Pressure relief valve (Plumb to floor drain) | 19. Steam header *                                  | 31. Condensate return line **            |
| 8. Potable water inlet                          | 20. Return circulation pump *                       | 32. Steam supply line condensate trap ** |
| 9. Potable water outlet                         | 21. Subcooling heat exchanger *                     | 33. Unions **                            |
| 10. Steam inlet                                 | 22. Subcooler bypass valves *                       | 34. Isolation valves **                  |
| 11. Condensate connection                       | 23. Instrumentation wiring junction box *           |  |
| 12. Steam regulating valve *                    | 24. Pressure transducer *                           |  |
- \* Optional  
 \*\* Not supplied by PVI (shown with dashed lines)

**Warning: Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury, exposure to hazardous materials or loss of life. Refer to the information contained in this manual for installation, operation and maintenance of this equipment. Installation and service must be performed by a qualified installer or service agency, who must read and follow the information in this manual and all other provided instructions, labels and markings before installing, operating, servicing or removing this appliance.**

**WARNING:** Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the unit and to replace any part of the control system, any gas controls and any other items affecting safe appliance operation and which has been under water. Failure to follow these instructions can cause property damage, personal injury, exposure to hazardous materials or loss of life.

**CHECKING EQUIPMENT BEFORE YOU INSTALL** – Inspect the unit completely upon receipt from the freight carrier before signing the bill of lading. Inspect the appliance and all accompanying parts for signs of impact or mishandling. Verify the total number of pieces shown on packing slips with those actually received. Contact the freight carrier immediately if any damage or shortage is detected.

**WARRANTY** – The Factory Warranty does not apply to the improper installation or operation of the equipment. Experience has shown that improper installation or system design, rather than faulty equipment, is the cause of most operating problems. The warranty also excludes damage to the equipment caused by corrosive chemicals present in the mechanical room, steam or water. (See Warranty for complete details)

### **IMPORTANT SAFETY NOTE**

*It takes only 5 seconds of skin contact with 140 °F water to cause a second degree burn! You must protect against high water temperatures at all lavatories, tubs, showers and other points of hot water contact.*

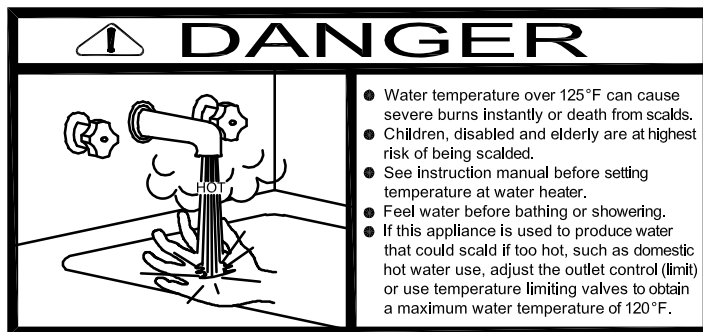
**Accidental scalding from high water temperatures is a greater risk in some types of installations. Some examples are:**

**HOMES FOR THE MENTALLY OR PHYSICALLY HANDICAPPED  
HOSPITALS AND NURSING HOMES**

**ELDER CARE FACILITIES AND REST HOMES**

**ORPHANAGES AND CHILD CARE FACILITIES**

**OTHER INSTALLATIONS - WHERE RESPONSE TO CONTACT WITH HOT WATER MAY BE SLOWER OR WHERE THE DANGER OF HOT WATER CONTACT IS GREATER**



**Thermostatically controlled mixing valves must be used in the design of the potable hot water system. Potable hot water should be tempered to no more than 110°F when used for bathing or other personal uses.**

**Good engineering practice mandates the use of thermostatically controlled mixing valves set at 120°F or less to keep the delivered water temperature below scalding temperatures.**

# CSX and CSXT SERIES WATER HEATERS

## CODES

The equipment must be installed in accordance with the instructions in this manual, appliance markings and supplemental instructions and in compliance with those installation regulations in force in the local area where the installation is to be made. These shall be carefully followed in all cases. Authorities having jurisdiction must be consulted before installation is made. In the absence of such regulations, the installation must be in accordance with the instructions in this manual, appliance marking and supplemental instructions and in compliance with the latest edition of the applicable state mechanical and plumbing code.

## INSTALLATION

1. Confirm that the system utilities are adequate to meet the heater requirements on the decal.
2. These units are suitable for indoor installation only.
3. The appliance must be placed on a level floor.
4. Do not attempt to move or lift heater by the plumbing connections or heat exchanger. Lift only by the skid using industry standard safe rigging methods.
5. Locate the unit so that if water connections should leak, water damage will not occur. When such locations cannot be avoided, it is recommended that a suitable drain pan, adequately drained, be installed under the unit. Water damage is not covered by the manufacturer's warranty.
6. Units and associated electrical components and electrical connections, must be installed so they are protected from water (dripping, spraying, rain, etc.) during appliance operation and service.
7. It is recommended that at least 18" be provided on all sides and above the appliance for service and inspection. Optional equipment may increase the clearance requirements. Allow sufficient space for installing and servicing connections such as water, steam, and condensate, relief valve to drain plumbing, electrical, pump and other auxiliary equipment.
8. In hard water areas, potable water treatment should be used to reduce introduction of minerals into the system. Minerals in the water can collect on the tubes and heat-exchanger surfaces reducing the life of the product. Heat exchanger failure due to scale accumulation is not covered by the product warranty.

**Important:** The CSX is not recommended for use where water chloride levels exceed 70 ppm. Chloride levels above 70 ppm can result in unwarranted heat exchanger damage.

## ELECTRICAL REQUIREMENTS

This appliance is wired for 120-volt service. The appliance, when installed, must be electrically grounded in accordance with the requirements of the authority having jurisdiction or in the absence of such requirements, with the latest edition of the National Electrical Code ANSI/N FPA No. 70. When the unit is installed in Canada, it must conform to the CAE C22.1, Canadian Electrical Code and/or Local Electrical Codes.

1. Supply 15 amp, 120V service to each water heater. The maximum draw is 10.5 amps and the expected draw is 2 amps plus the draw of optional equipment. Separate electrical circuits are recommended for multiple appliance installations.
2. All wiring between the unit and field installed devices must be made with type T copper wire of proper size for the appliance load. Damage resulting from use of aluminum wiring will be unwarranted.
3. On CSXT units, line voltage (120V, single phase) must be connected separately to both solenoid valve junction box connection points and to the recirculation pump (if supplied).
4. Line voltage wire exterior to the appliance must be enclosed in approved conduit or approved metal clad cable.
5. Instrumentation wiring connections (if equipped) are all made in the junction box located on the right side of the appliance. Connect to the labeled terminal blocks according to the instrumentation wiring diagram. Operation of the pressure transducer depends on a 12-30 VDC power supply being connected to the specified terminals. All RTD probes are of the 3-wire type and to achieve optimum accuracy, all three wires must be connected to a RTD meter or transmitter with 3-wire input connections (such as an Omega #TX92A-3).

# CSX and CSXT SERIES WATER HEATERS

## WATER INLET / OUTLET CONNECTIONS

**Important:** Before connecting the CSX, steam, water and condensate lines must be supported so the water heater is not supporting any piping weight. If there is weight put on the heat exchanger connections, it could lead to unwarranted stress-induced corrosion of the heat exchanger or mechanical damage of the system.

1. Connect the water inlet and outlet to the potable system. Use backup wrenches on all screwed pipe connections to prevent damage to the heater plumbing. Piping and components connected to the water heater must be suitable for potable water, for the water temperatures they will experience and for their application.
2. For ease of service, install unions and shutoff valves on inlet and outlet piping to the unit.
3. The CSX heater must be equipped with a recirculation pump (available option) that should be able to pump at least 4 gpm (6 gpm with optional subcooler). Connect the building hot water recirculation return line directly to the inlet of the heater. If the CSX includes a subcooling heat exchanger, then connect the building hot water recirculation return line to the fitting on the subcooling heat exchanger as shown in Figure 2. The pump will draw the recirculation water through the subcooling heat exchanger and introduce it to the inlet of the heater.
4. Fix any system leaks. DO NOT use petroleum based stop-leak products. All system leaks must be repaired.
5. After plumbing the unit and checking for leaks, the heat exchanger and steam and hot water piping should be insulated. Insulation will reduce wasteful heat loss and will help protect operators from contacting hot surfaces

**Warning: Insulate or guard all steam and hot water surfaces. Uninsulated or unguarded steam and hot water surfaces can cause burns instantly.**

## RELIEF VALVE PIPING

CSX water heaters are supplied with pressure relief valves for each heat exchanger sized in accordance with ANSI/ASME Boiler and Pressure Vessel Code, Section IV. The relief valve(s) must be threaded directly into the dedicated relief valve fitting located near the top of the heat exchangers and the relief valve discharge must be plumbed to an appropriate floor drain. The discharge line must allow complete drainage of the valve and line.

The water heater must not be operated without a correctly installed, properly sized and properly operating relief valve. If a replacement relief valve is required, it must be of the automatic reset type pressure relief valve complying with the ANSI/ASME Boiler and Pressure Vessel Code, Section IV, must not be less than the hourly Btu input rating of the water heater as stated on the information decal located on or adjacent the Heat Exchanger and must not have a relieving pressure exceeding the 150 psi maximum working pressure of the water heater.

A relief valve that discharges periodically may result from the thermal expansion of heated water when restricted by a backflow preventer or check valve installed in the cold water supply. A means to control thermal expansion must be provided by a qualified plumbing professional. Do not plug the relief valve.

**Warning: Do not install a reducing coupling, valve or other restriction between the relief valve discharge and a suitable floor drain. Such restriction could prevent the valve from fully relieving if the pressure settings are exceeded, which could result in property damage, personal injury or death.**

**Warning: The relief valve discharge must be piped to a suitable floor drain to avoid exposure to hot discharge water during relief valve operation. Exposure to hot discharge water can cause water damage and/or burns resulting in property damage, personal injury or death.**

# CSX and CSXT SERIES WATER HEATERS

## STEAM CONNECTIONS

**Important:** Before connecting the CSX, steam, water and condensate lines must be supported so the water heater is not supporting any piping weight. If there is weight put on the heat exchanger connections, it could lead to unwarranted stress-induced corrosion of the heat exchanger or mechanical damage of the system.

1. All steam and water supply lines should be flushed before connecting the unit. Failure to flush lines could cause components of unit to malfunction
2. Steam supplied to the CSX heater must not exceed 15 psi. If the steam supply pressure exceeds 15 psi or is not regulated, a steam regulating valve must be used to limit steam supply pressure to 15 psi.
3. In order to achieve rated hot water output, the capacity of the steam supply system must exceed the heater requirements as stated on the heater decal.
4. A vacuum breaker should be installed near the appliance inlet from the steam supply piping.
5. Install the supplied steam header using the supplied gaskets, grade 5 bolts, nuts and washers. Orient the steam gauge vertically and connect the pressure transducer connector to the pressure transducer on the steam header.
6. A blow-down valve on the y-strainer with piping to a suitable drain is recommended for use during startup and maintenance cleaning.
7. A steam trap upstream of the steam header with piping to a suitable drain or the condensate receiver plumbing is recommended to drain condensate that collects in the supply piping.

**Warning: Steam supply to the heat exchanger must be constant and less than or equal to 15 psi. An unregulated steam supply or steam supply in excess of 15 psi could cause loss of temperature control and failure of heater components that may result in property damage, personal injury or loss of life.**

**Warning! Insulate or guard all steam and hot water surfaces. Uninsulated or unguarded steam and hot water surfaces can cause burns instantly.**

8. Connect the main steam trap(s) to the condensate return line or, if equipped with a subcooler, connect the return line to the subcooler outlet. The trap(s) must be located below the elevation of the condensate drain connection on the heat exchanger.
9. Connect steam and condensate connections to the building system plumbing. The recommended methods of condensate distribution are:
  - a. Plumb to a condensate receiver and pump or vacuum return to the condensate return header.
  - b. Plumb to a pneumatic/electric actuated condensate pump trap for return to the condensate return header.
  - c. Plumb to drain – (Requires additional make-up water at steam supply boiler).

**Important:** Inadequate drainage of condensate from the CSX water heater will adversely affect heat transfer, will limit water heater performance and may cause unwarranted damage to the water heater. After all the connections are made it is a good practice to tighten all unions and check the electrical connections.

## CSX and CSXT SERIES WATER HEATERS

### OPTIONAL PRESSURE GRADIENT MONITORING SYSTEM (PGM)

CSX instantaneous steam-to-water heater may be equipped with an optional Pressure Gradient Monitoring system. The PGM system is a series of components used to turn off steam to the heat exchanger and vent residual steam pressure from the heat exchanger when a water or steam pressure condition occurs that could result in steam entering the potable water system if there is a heat exchanger tube leak. This PGM action occurs when the potable water pressure is less than approximately 10 psi higher than the steam inlet pressure.

The components included in the PGM system are:

- a. Steam isolation valve – to close steam flow to unit upon shutdown signal
- b. Steam solenoid purge valve – to open and drain steam side upon shutdown signal
- c. Differential pressure switch – to monitor steam side and water side pressure
- d. Time Delay relay – to initiate sequence of valve shutdown activity when differential pressure is realized beyond the set point of the relay timer. This is included to avoid nuisance trips associated to momentary spikes in water pressure.
- e. Reset switch – requires manual reset to allow for observation of conditions that created shutdown condition

The sequence of events to actuate the PGM system is:

1. During normal operation water pressure in the heat exchanger shell is substantially higher (for example 55 psi) than the steam pressure in the tubes of the heat exchanger (for example 15 psi).
2. If a leak occurs in a heat exchanger tube, the higher-pressure potable water will begin to leak into the lower pressure steam side of the heat exchanger.
3. Since water is flowing through the leak from the potable water side into the steam side of the heat exchanger, contaminants that may exist on the steam side do not enter the potable water side of the heat exchanger.
4. If the differential pressure between the steam side and water side drops below 10 psi, (i.e. the potable system pressure is 10 psi or less above that of the steam system pressure) the pressure switch closes, energizing a time delay relay. If this low differential pressure condition occurs continuously for more than a few seconds, the time delay relay energizes the main relay coil through a reset switch. The time delay reduces switching caused by momentary pressure fluctuations.
5. Energizing the main relay coil simultaneously closes a solenoid valve on the steam inlet side (pilot interruption to close steam valve or shut inlet valve directly) and opens a condensate line solenoid valve to evacuate the steam side of the heat exchanger. Cold water or recirculation temperature flow on the water side will occur until the system is reset or repaired.
6. To investigate the cause of the shutdown, observe the condensate drain line for flow. If a continuous flow of cold water is evident, a heat exchanger tube is leaking and the heat exchanger must be replaced. If no water flow is present, a loss of water pressure, increase in steam pressure or combination of the two occurred for longer than 10 seconds. To reset the CSX system, press the reset switch. The solenoid valves will reset and steam will begin to fill the tube section of the heat exchanger.

**Important:** The steam purge valve must be plumbed to a suitable drain or the condensate return system.

## DESCRIPTION OF OPERATION

When there is no hot water demand, the steam and water sides of the heat exchangers in this water heating system reach thermal equilibrium, so it is constantly ready to provide hot water. If the available supply steam pressure is more than 15 psi, a steam regulating valve (available option) must be used to reduce the steam pressure. A pressure-sensing pilot on this steam regulating valve forces the steam valve closed as pressure reaches and is maintained at 15 psi. As hot water demand is placed on the appliance, cold water entering the heat exchanger condenses steam causing pressure in the steam inlet piping to drop. This lower pressure causes additional steam to enter the heat exchanger to meet the heating load. When hot water demand diminishes, steam pressure in the heat exchanger again increases to match the supply steam pressure.

When hot water demand is initiated, cold water enters the cold inlet port of the temperature control valve(s). Cold water flows into the valve body, where it is blended with hot water from the heat exchanger. If the blended water temperature at the valve outlet increases or decreases from the specified temperature, the internal ports reposition to change the amount of cold and hot water blended to again reach the specified blended water temperature. When demand ceases, the temperature control valve moves to seal the hot port. The CSX water heater utilizes a two valve step reduction system to improve temperature control and response to changes in demand. In order for these valves to properly respond to changing hot water demand, a constant flow of at least 4 gallon per minute is required. This flow is usually provided by connecting the pumped building hot water circulating return to the cold makeup water inlet, either directly or through an optional condensate subcooling heat exchanger.

Two temperature limiting devices monitor the temperature downstream of each temperature control valve. If the valve does not hold the temperature close to its setpoint, the limiting devices will shut the solenoid valve blocking flow of heated water to the outlet.

If the CSX is installed with an optional condensate subcooling heat exchanger, this small heat exchanger reduces the 200°F plus temperature of condensate exiting the traps. This reduces energy lost in the condensate lines and enables the heater to be installed into a vacuum condensate return system where condensate must be below a certain design temperature. The subcooling heat exchanger frequently uses building hot water circulating return water as the cooling medium.

## STARTUP PROCEDURE

Pre-startup Inspection:

- Confirm the water supply pressure does not exceed the psi rating of the relief valve and heat exchanger.
- Confirm the main steam stop valve upstream of the water heater is closed. If the heater is installed without a steam regulating valve, steam supply pressure must never exceed 15 psi.
- Water supply pressure must be more than 30 psi flow pressure at all times. Water pressure below steam pressure will result in flashing inside the heat exchanger and, in the event of a heat exchanger tube leak, could allow contaminated steam to enter the potable water.

**Warning: To avoid possible contamination of potable water in the event of a heat exchanger tube leak, water pressure in the heat exchanger must always be maintained above the supply steam pressure. Potable water contamination resulting from failure to maintain water pressure in the heat exchanger above the supply steam pressure can cause personal injury, exposure to hazardous materials or loss of life.**

- Contact factory if water pressure may occur lower than the steam supply pressure.
- The hot water system must have a recirculation line. The recirculation flow should be able to pump at least 4 gpm (6 gpm with optional subcooler).
- Check all pipe fittings.
- Unless supplied as an option, fit a steam pressure gauge to a downstream tap on the steam regulating valve or steam plumbing.

## CSX and CSXT SERIES WATER HEATERS

With All Product Valves Closed, Proceed As Follows:

1. Switch on power to unit to activate the solenoid valves and thermostats. The solenoid valve(s) should open.
2. Crack open the steam strainer blow-down valve.
3. Fully open the gate valve(s) below the secondary temperature control valve(s), if supplied.
4. On CSXT units, fully open all four isolation gate valves.
5. Check that the pump isolation valves are open.
6. Check the setpoints of the temperature limiting devices. They should be set relative to the temperature control valve according to the decal on the device.
7. Slowly open the water supply valve. Check for water leaks on waterside piping. Crack open the potable water outlet valve to vent air from exchanger and piping. It may be necessary to open a hot water faucet downstream in the system.
8. Close water discharge valve after venting air.
9. Open the water inlet valve fully and open the water discharge valve to about 50% for water heater flow volume.
10. Record water temperature at cold water inlet and hot water outlet.

**Caution:** Do not supply steam to a heater until a consistent flow of water is demonstrated.

11. Crack open the steam supply to the heater and allow condensate and air to be vented through the steam inlet strainer blow-down and steam supply valves.
12. Slowly and fully open the main steam shutoff valve(s).
13. Adjust pressure pilot (if supplied) so that the pressure downstream of the valve is 15 psi or less. (Refer to the steam valve literature for adjustment instructions)
14. Observe steam traps for operation. Traps are self-priming and should require no further adjustment.
15. Check the pressure in the condensate return line. The ability to lift condensate via steam pressure cannot always be assured. Generally  $\frac{1}{2}$  psi steam pressure is required for every foot in height that the condensate is to be lifted. Lifting condensate is not recommended, but if lifted, a check valve must be installed immediately after the heater condensate outlet in condensate return line.
16. Check operation of the subcooling heat exchanger (if equipped). Record the condensate outlet temperature and the return water temperature. If return water is flowing and the pump is operating properly, condensate should be cooled to 170°F or less.
17. If the outlet temperature is more than 5°F under the design temperature, slowly close the gate valve below secondary temperature control valve until the temperature reaches the design temperature.
18. Record the cold water inlet and hot water outlet temperature again. With units that have a subcooling heat exchanger, the cold water inlet temperature should be slightly higher due to the mixing of heated return water.

**Important:** Special attention should be paid to noise and leaks. Non-destructive water hammer (noise) as well as noise generated from the expansion of steam is expected during startup. Extraordinary noise generation or leaking piping is reason to shut down the steam supply to the unit.

# CSX and CSXT SERIES WATER HEATERS

## Operating Reminders

In order to achieve maximum performance from the heat exchanger, the following must be strictly followed:

- Pressures and temperatures must not exceed limits on product decal.
- Heat exchangers should be free of any debris existing in the water.
- Prevent evaporation of fluid on the shell side. Steam or vapor should only flow through the tubes.
- The system should be designed to prevent the heat exchanger from encountering pressure shocks.
- Prevent rapid temperature increases in the heat exchangers. This would include installation of expansion tanks and safety valves into the system.
- Prevent water in heat exchanger and piping from dropping below their freezing point.
- System should have 4 gpm (6 gpm with optional subcooler) minimum recirculation at all times.

## Shut Down

1. Valve off the supply of steam to the heater.
2. Allow a flow of potable water until it runs cold. Then shut off isolation valve at inlet of heater and then outlet.
3. Then disconnect electrical power.

## MAINTENANCE

A preventative maintenance program should be established to assure a long, trouble-free life for the water heater.

**Warning: High Voltage Shock Potential - Turn off all electrical service to the appliance prior to opening water or steam piping and when accessing limit controls, high limit controls, solenoid valves or other high voltage components and wiring. After access, check all connections, close all covers and otherwise secure all electrical wiring and components before restoring electrical service to the appliance. Wires and terminals carry High Voltage (120V). If the electrical service is not turned off and terminals, exposed wires or conducting metals are exposed, a dangerous shock causing personal injury or loss of life could occur.**

## Cleaning the Heat Exchanger

The heat exchanger has inspection plugs (at the hot water outlet and cold water inlet of the heat exchanger) suitable for inspection and cleaning use. The heat exchanger should be isolated from steam and water pressure, allowed to cool and inspected for scale buildup through these openings.

A scale of lime will normally form during operation and will accumulate inside the heat exchanger shell. Lime is formed from naturally occurring mineral compounds in the water, which precipitate out during heating cycles. Some water supplies contain more of these compounds than others and scale buildup will occur more rapidly. Other factors affecting the rate of scale buildup are the amount of hot water used and the temperature of the water. The more hot water used, the more fresh water containing scale-forming compounds is brought into the tank. As the temperature of water increases, the rate of scale deposition will increase.

The frequency of inspections will be determined by the rate of scale buildup. Until the appropriate inspection and cleaning interval is established, it is recommended that the heat exchanger be inspected and internally cleaned every six months or more frequently if higher scaling conditions are inspected.

Debris deposited in the heat exchanger will result in an increase in pressure drop, lower temperature difference on the waterside or a high exit temperature on the steam side. Flushing can be done without removal of the heat exchanger from the system.

The heat exchanger is cleaned by flushing the units with fluids that do not react with stainless steel. A food grade acid detergent or descaler is recommended. The following fluids are prohibited for use as a flushing agent:

- Hydrochloric acid up to 0.1% concentration
- Solutions which contain metallic chloride
- Chlorides (MgCl<sub>2</sub>, NaCl between 0.01 – 1%, CuCl up to 1%, CaCl<sub>2</sub> from 5% to saturation, KCl)
- Any fluid which would deposit alkaline residue or phosphorous

## CSX and CSXT SERIES WATER HEATERS

The cleaning solutions are available at businesses carrying chemical cleaning agents for heat exchangers or tubing and piping applications. As a guideline to purchasing cleaning solutions, check for the following product properties:

- Compatibility with 316L stainless steel
- Compatibility with brass and copper.
- Accepted for use in food processing industries
- Removes scale, slag, tarnishes, and hard water deposits
- Easily rinsed out of the systems
- No objectionable or corrosive fumes

When cleaning the heat exchanger, also inspect the plumbing to the temperature control valve for scale build-up. If necessary, de-scale those hot water surfaces.

### Temperature Control Valve

The temperature control valves are factory set and are not adjustable. They should be inspected and internally cleaned every six months or more frequently if needed. Replacement of the o-ring seals is recommended when the valve body is opened to access the thermostatic element for inspection or replacement. The thermostatic element should be replaced if variation in controlled temperature occurs. The frequency of element replacement will depend on operating conditions.

The thermostatic elements utilize wax activated diaphragm and plug construction. A thermostatic element can be checked by immersing it in an agitated bath of water. Never use oil for checking the element. At 10°F to 13°F above the nominal setting, the bypass port B should be closed.

Replacement elements may be ordered from PVI. The element part number and nominal temperature setting are stamped on the flange of the element. If these are not known, provide PVI the complete model number and serial number on the valve nameplate. O-ring seals should be replaced whenever replacing elements. When installing or reinstalling seals, always lubricate them with light food grade plumbing grease to make installing of the element easier, and to prevent leakage from the housing.

### Relief Valves

Relief valves should be manually operated at least once a year and if it fails to freely discharge water or fails to reseal following testing, it must be replaced with a like relief valve (see installation section for description).

### Condensate Y-strainers (if installed)

Periodically blow-down the valves on the condensate y-strainers. If necessary, shutdown heater, remove and clean the mesh inside the strainer.

**Warning: Discharge from the blow-down valves on the condensate y-strainers is extremely hot and can flash to steam. Use caution and proper personal protection when opening blow-down valves. Failure to do so can result in instant scalding.**

### Steam Purge Valve (if installed)

Check the purge valve for proper operation. With steam pressure on unit, slowly close the isolation valve on the cold water inlet to the unit. This should reduce the water pressure in the heater. When the pressure drops less than 10 psi over your steam pressure, the PGM system will trip. Steam should flow through the purge valve releasing the pressure in the heat exchanger. Open the isolation valve and the PGM system should reset. Then the purge valve should seal completely.

**Warning: Discharge from the steam purge valve is extremely hot and may contain a combination of hot water and steam. Use caution and proper personal protection when opening the steam purge valve. Failure to do so can result in instant scalding.**

## TROUBLESHOOTING SUGGESTIONS

### Problem:

1. Steam delivery pressure to heat exchanger is low or drops off:
  - a. **Cause:** Low inlet pressure.  
**Solution:** Fully open valve. Unclog strainer. Check for low boiler output or upstream blockage and make necessary corrections.
  - b. **Cause:** Steam regulating valve pilot adjustment altered.  
**Solution:** Readjust to desired operating condition.
  - c. **Cause:** Steam regulating valve pilot range incorrect.  
**Solution:** Check nameplate for operating range of pilot. Change pilots if desired operating range is beyond that on existing pilot.
  - d. **Cause:** Steam regulating valve undersized.  
**Solution:** Check valve capacity against the load. If insufficient, increase trim or valve size. Refer to the valve manual for instructions.
  - e. **Cause:** Piping flow restricted.  
**Solution:** Calculate the flow velocity and expected friction loss. If excessive, larger inlet and outlet piping are necessary.
  - f. **Cause:** Bleed orifice missing from steam regulating valve.  
**Solution:** Bleed orifice should be in the downstream fitting of the steam valve. Install a new bleed orifice. If a straight fitting was installed in place of the bleed orifice or it is worn, the pilot signal may not fully open the main valve.
  - g. **Cause:** Steam regulating valve pilot lines blocked.  
**Solution:** Remove the line to the main valve and the downstream feedback line. If they are not clear, replace.
  - h. **Cause:** Steam regulating valve pilot malfunction.  
**Solution:** Refer to the valve manual for instructions on pilot valve repair.
  - i. **Cause:** Steam regulating valve malfunction.  
**Solution:** Refer to the valve manual for instructions on main valve repair.
  - j. **Cause:** Steam solenoid isolation pilot valve closed (on PGM systems).  
**Solution:** The pressure gradient monitoring system is tripped as indicated by the red light. Determine if there has been a tube breach. If not, reset switch to open the pilot valve.
  - k. **Cause:** Steam purge valve is open and blowing steam (on PGM systems).  
**Solution:** If the purge valve is blowing steam continuously, then it is faulty or has debris in it. Disassemble and clean, or replace.

### Problem:

2. Steam delivery pressure is high or overrides:
  - a. **Cause:** Open valve on steam regulating valve by-pass line.  
**Solution:** Close the valve
  - b. **Cause:** Steam regulating valve pilot adjustment altered.  
**Solution:** Readjust to desired operating condition.
  - c. **Cause:** Steam regulating valve pilot lines or bleed orifice blocked.  
**Solution:** Remove, check and replace as required.

## CSX and CSXT SERIES WATER HEATERS

- d. **Cause:** Steam regulating valve feedback control line plugged.  
**Solution:** Remove and clean.
- e. **Cause:** Steam regulating valve oversized.  
**Solution:** Check valve capacity against the load. If excessive, install smaller trim or valve. Refer to the valve manual for instructions.
- f. **Cause:** Steam regulating valve pilot malfunction.  
**Solution:** Refer to the valve manual for instructions on pilot valve repair.
- g. **Cause:** Steam regulating valve malfunction.  
**Solution:** Refer to the valve manual for instructions on main valve repair.

### Problem:

#### 3. Steam delivery pressure erratic:

- a. **Cause:** Pressure drop limits exceeded. Recommended maximum single stage reduction is 100 psi (6.9 bar).  
**Solution:** Reduce the pressure drop. If drop remains above 100 psi (6.9 bar), consult representative or factory.
- b. **Cause:** Strainer clogged.  
**Solution:** Clean strainer.
- c. **Cause:** Steam regulating valve oversized.  
**Solution:** Check valve capacity against load. If excessive, install smaller trim or valve. Refer to the valve manual for instructions.
- d. **Cause:** Steam regulating valve pilot lines or bleed orifice blocked.  
**Solution:** Remove, check and replace as required.
- e. **Cause:** Sensing line poorly located. The feedback signal will be inconsistent if line is in a turbulent area.  
**Solution:** Relocate line to a non-turbulent area.
- f. **Cause:** Steam regulating valve pilot malfunction.  
**Solution:** Refer to the valve manual for instructions on pilot valve repair.
- g. **Cause:** Steam regulating valve malfunction.  
**Solution:** Refer to the valve manual for instructions on main valve repair.

### Problem:

#### 4. Outlet water temperature not constant.

- a. **Cause:** Failed temperature control valve.  
**Solution:** Disassemble valve and replace temperature element and gaskets per valve manufacturer's recommendations.
- b. **Cause:** Recirculation inadequate.  
**Solution:** In certain conditions (very low flow), the lack of, or inadequate system recirculation can lead to unstable outlet water temperature. Confirm the recirculation pump is operating properly.

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### Problem:

#### 5. Outlet water temperature below setpoint.

- a. **Cause:** Excessive flow rate.  
**Solution:** Water flow rate through heat exchanger surpasses its capacity. Check flow rate and compare with heater decal.
- b. **Cause:** Excessive scale in heat exchanger.  
**Solution:** Scale on heating surfaces impedes heat transfer. Inspect heat exchanger coil and schedule cleaning.
- c. **Cause:** Failed temperature control valve.  
**Solution:** Disassemble valve and replace temperature element and gaskets.
- d. **Cause:** Solenoid valve closed.  
**Solution:** Indicated by low water temperature and lowered flow rate. Check if thermostats are open. If so, then an over temperature condition occurred. Shutdown unit and disassemble and inspect temperature control valves. If not, then solenoid valve has failed. Replace.
- e. **Cause:** Power failure.  
**Solution:** This closes the solenoid valve also causing loss of hot water pressure. Correct source of power loss.
- f. **Cause:** Low steam delivery pressure  
**Solution:** See steam valve section above.
- g. **Cause:** Steam trap not operating properly.  
**Solution:** Confirm that trap is backing up condensate in heat exchanger. The CSX will sub cool at high flow rates, but at low flow rates the condensate temperature should be over 200°F.
- h. **Cause:** Failed heat exchanger.  
**Solution:** A crack in the heat exchanger would allow potable water into the steam system, flooding the heat exchanger and trap and impeding heat transfer.
- i. **Cause:** PGM (Pressure gradient monitor) system has tripped.  
**Solution:** Red light on control enclosure will be on. Determine if there has been a tube breach. If not, reset switch to open the pilot valve.
- j. **Cause:** Gate valve needs to be adjusted.  
**Solution:** Slowly close gate valve under the secondary temperature control valve to increase the temperature.
- k. **Cause:** One of the limits is tripped.  
**Solution:** Check that both solenoid valves are energized and open. Open by adjusting limit up. Should be set to values shown on wiring diagram.
- l. **Cause:** Condensate flow restricted.  
**Solution:** Check that bypass valves are in the right position. Check the condensate strainers for clogged condition. Check that the condensate return line pressure is what is expected.
- m. **Cause:** Only one heat exchanger in operation.  
**Solution:** Check that all isolation valves are fully open. Check that both solenoid valves are open. Close one side at a time to check individual operation of temperature control valves.

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### Problem:

#### 6. Condensate Outlet Temperature Too High

- a. **Cause:** Insufficient circulation return flow.  
**Solution:** Check that pump is on and isolation valves fully open. Check return line pressure (should not be more than 6 psi less than potable inlet pressure).
- b. **Cause:** By-pass valves in wrong position.  
**Solution:** Open by-pass valves to divert condensate through the subcooling heat exchanger.
- c. **Cause:** Circulation pump is air-locked.  
**Solution:** With pump on, crack pump flange downstream to release air.

### Problem:

#### 7. Low Outlet Water Pressure

- a. **Cause:** Scale build-up in heat exchanger  
**Solution:** Schedule cleaning of heat exchanger.
- b. **Cause:** Solenoid valve closed.  
**Solution:** Check if thermostats are open. If so, then an over temperature condition occurred. Shutdown unit and disassemble and inspect temperature control valves. Check if optional PGM system has tripped. If neither, then solenoid valve has failed. Replace.
- c. **Cause:** Power loss.  
**Solution:** When there is no power to the unit, the solenoid valve is closed.

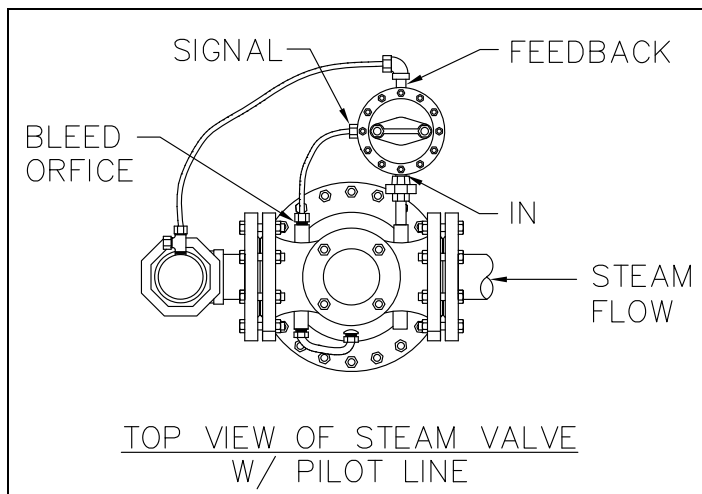
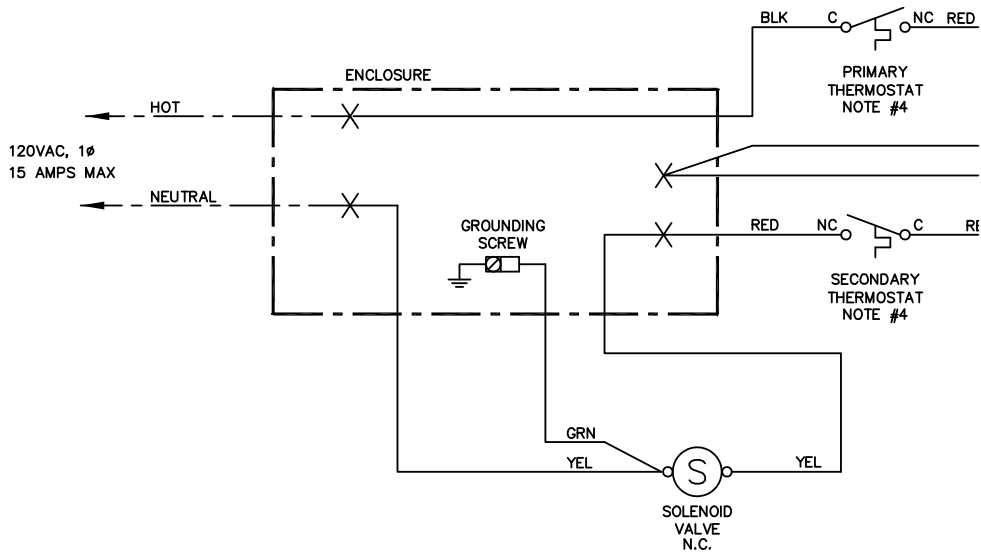


Figure 3

# CSX and CSXT SERIES WATER HEATERS

## Standard CSX

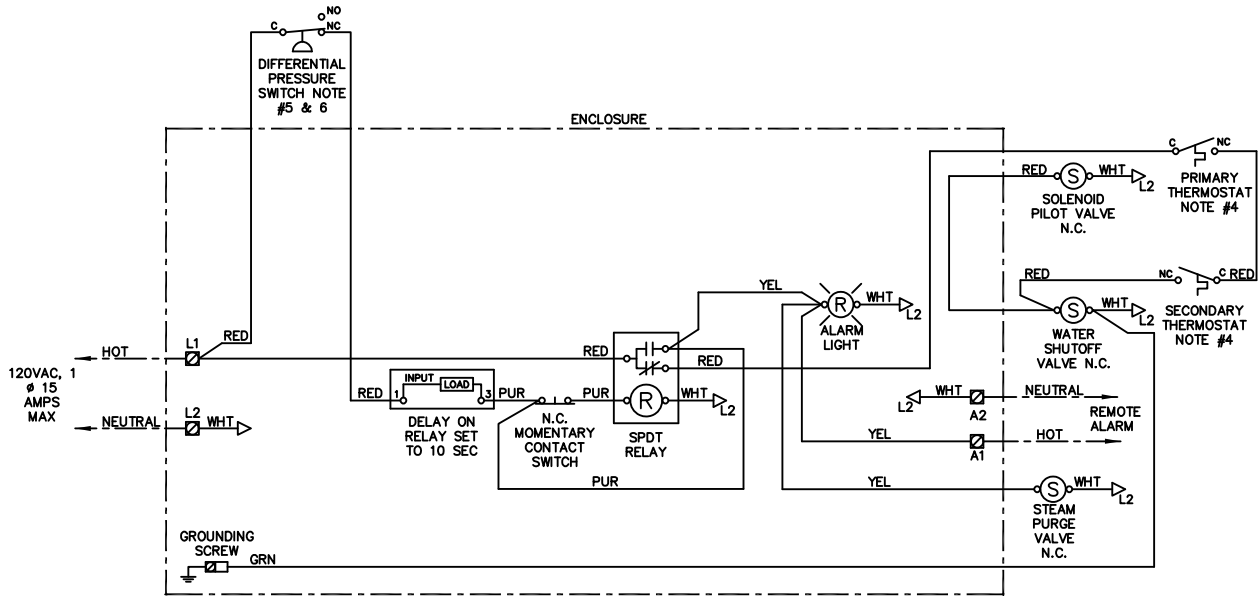


FIELD   
 STANDARD

**NOTES:**

1. ALL WIRING MUST BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE LOCAL CODES AND THE NATIONAL ELECTRICAL CODE, NFPA NO. 70, LATEST EDITION.
2. CONNECT TO 15 AMPERE MAXIMUM BRANCH CIRCUIT.
3. ALL WIRING IS 16 AWG CSA EXCEPT AS NOTED.
4. SET PRIMARY THERMOSTAT 20°F ABOVE SETPOINT OF PRIMARY TEMPERATURE CONTROL VALVE, AND SET SECONDARY THERMOSTAT 10°F ABOVE SETPOINT OF SECONDARY TEMPERATURE CONTROL VALVE.

## CSX w/ PGM option



STANDARD   
 FIELD

**NOTES:**

1. ALL WIRING MUST BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE LOCAL CODES AND THE NATIONAL ELECTRICAL CODE, NFPA NO. 70, LATEST EDITION.
2. CONNECT TO 15 AMPERE MAXIMUM BRANCH CIRCUIT.
3. ALL WIRING IS 16 AWG CSA EXCEPT AS NOTED.
4. SET PRIMARY THERMOSTAT 20°F ABOVE SETPOINT OF PRIMARY TEMPERATURE CONTROL VALVE, AND SET SECONDARY THERMOSTAT 10°F ABOVE SETPOINT OF SECONDARY TEMPERATURE CONTROL VALVE.
5. ADJUST DIFFERENTIAL PRESSURE SWITCH TO 10 PSI BY ADJUSTING SET SCREW.
6. HIGH SIDE OF DIFFERENTIAL PRESSURE SWITCH GOES TO WATERSIDE, AND LOW SIDE GOES TO STEAM.

# CSX and CSXT SERIES WATER HEATERS

## CSXT

