
Champion Series™ INDIRECT-FIRED WATER HEATER



All Champion Series™

INSTALLER: LEAVE THIS MANUAL WITH THE OWNER

IMPORTANT GENERAL SAFETY INFORMATION - ADDITIONAL SPECIFIC SAFETY ALERTS APPEAR IN THE FOLLOWING INSTRUCTIONS.

⚠ WARNING READ CAREFULLY THE PRODUCT INSTALLATION, OPERATING AND MAINTENANCE MANUAL. FAILURE TO FOLLOW THE INSTRUCTIONS AND WARNINGS IN THE MANUAL MAY RESULT IN SERIOUS OR FATAL INJURY AND/OR PROPERTY DAMAGE, AND WILL VOID THE PRODUCT WARRANTY. THIS PRODUCT MUST BE INSTALLED BY A QUALIFIED PROFESSIONAL. FOLLOW ALL APPLICABLE LOCAL AND STATE CODES AND REGULATIONS, IN THE ABSENCE OF SUCH CODES, FOLLOW THE CURRENT EDITIONS OF THE NATIONAL PLUMBING CODE AND NATIONAL ELECTRIC CODE, AS APPLICABLE.



THIS IS THE SAFETY ALERT SYMBOL. IT IS USED TO ALERT YOU TO POTENTIAL PERSONAL INJURY AND OTHER HAZARDS. OBEY ALL SAFETY MESSAGES THAT FOLLOW THIS SYMBOL TO REDUCE THE RISK OF PERSONAL INJURY AS WELL AS PROPERTY DAMAGE.

⚠ CAUTION

The heat transfer medium must be water or other nontoxic fluid having a toxicity rating or class of 1, as listed in Clinical Toxicology of Commercial Products, 5th edition. The pressure of the heat transfer medium must be limited to 30 PSIG by an approved safety or relief valve.

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2. PRE-INSTALLATION CHECKLIST

IMPORTANT STEPS AND DECISIONS REQUIRED BEFORE INSTALLATION

- THIS PRODUCT MUST BE INSTALLED AND MAINTAINED BY A LICENSED PROFESSIONAL. IN ADDITION TO THE INSTRUCTIONS IN THIS MANUAL, FOLLOW ALL APPLICABLE LOCAL AND STATE CODES OR IN THE ABSENCE OF SUCH CODES, THE CURRENT EDITIONS OF THE NATIONAL PLUMBING CODE AND THE NATIONAL ELECTRIC CODE.
- DRIP PAN AND DRAIN: This appliance should not be installed in an area where leakage of the tank or connections can result in damage to the area adjacent to the appliance or to lower floors of the structure. When such locations cannot be avoided, a suitable drain pan, adequately drained and kept clear, must be installed under the appliance.
- CAUTION: Determine whether your water is corrosive or acidic, and that there are no suspended solids, toxic or other substances or abnormally high chlorine levels in the water that could damage or affect the BOILERMATE® or the rest of your plumbing system.

⚠ WARNING USE GLYCOL ONLY WITH DOUBLE-WALLED HEAT EXCHANGER MODELS. Glycol is a hazardous substance. To avoid seepage or leakage of glycol to surfaces where humans or animals can ingest it, use glycol only in double-walled units, so that any leaks will most likely be released to the atmosphere. However, a leak to a surface area may still occur, so any use of glycol must be monitored closely and humans and animals should be protected from contact with the unit.

⚠ WARNING Do not connect the BoilerMate® domestic supply with baseboard or other space heating units or elements. Any contaminants in the baseboard units will contaminate the potable water in the BoilerMate® and also adversely affect its performance.

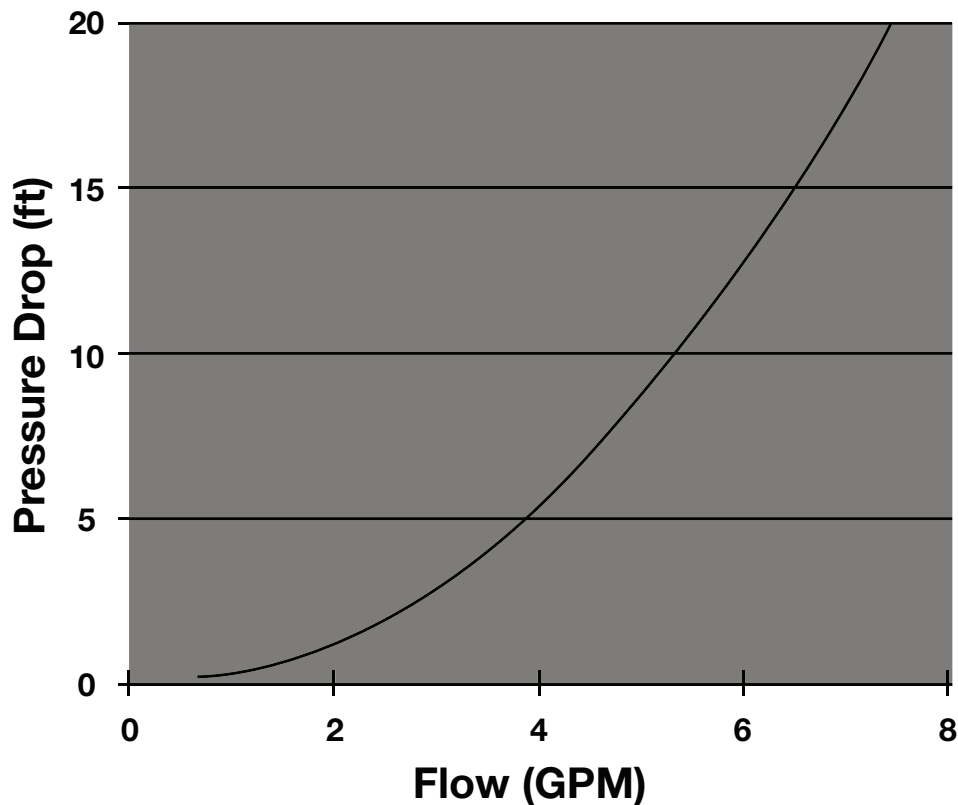
- Select Circulator versus Zone Valve**
The flow of hot boiler water to the BoilerMate® can be controlled with either a motorized zone valve or a circulator.
 - 1. **Separate circulator.** The recommended way to provide adequate flow through the BoilerMate® heat exchanger is to use a separate dedicated circulator with a minimum flow rate of 4 gpm. This option may be used even though the heating system utilizes zone valves.
 - 2. **Zone valve** (system flow of 4-8 gpm). If a zone valve is to be used, a minimum flow rate of 4 gpm with all zones in use is required. A full-port zone valve should be used.
- All installations require a low-water cut-off or automatic fill valve on your boiler system to reduce the risk of boiler water loss.
- In steam boiler installations a low-water cut-off which is also required by most codes.
- Installation of a vacuum breaker is required to prevent damage to the BoilerMate® when drained. There must be no valves installed between the vacuum breaker and BoilerMate®.

3. REQUIRED COMPONENTS AND ACCESSORIES CHECKLIST

MODEL	OPTION	CIRCULATOR	ZONE VALVE*	SHUTOFF VALVE	VACUUM BREAKER	RELIEF VALVE	THERMAL EXPANSION TANK	DRAIN
CH-41 CH-41 CH-80	Z BZ Z	4GPM	*If Circulator not used 3/4" Full Port or 1" STD	4	1	Included	Required (See Therm-X-Trol® Sizing Guide)	Included
ALL INSTALLATIONS REQUIRE TEFLON® SEALING TAPE OR PIPE DOPE FOR THREADED JOINTS. SEE HEAT EXCHANGER PRESSURE DROP CHART TO DETERMINE PUMP HEAD REQUIREMENTS.								

Heat Exchanger Pressure Drop

Use this chart to select the proper circulator for your BoilerMate®.



CAUTION

If a steel hydropneumatic tank is in place, AMTROL® recommends replacing it with a properly sized EXTROL® or Radiant EXTROL® expansion tank. Otherwise, significant heat transfer problems can occur by causing air to be trapped in the heat exchanger. If the boiler system has an EXTROL® or Radiant EXTROL® expansion tank and the boiler temperatures are being changed, resize the EXTROL® or Radiant EXTROL® expansion tank.

4. CH-41Z/CH-80Z PIPING INSTALLATION

DOMESTIC WATER PIPING

1. Connect the cold water supply to the pipe labeled COLD WATER

⚠ WARNING Do not apply heat to this fitting when making sweat connections to heater. Sweat tubing to adapter before fitting adapter to cold water inlet of heater. It is imperative that no heat be applied to the cold water inlet, as it contains a nonmetallic dip tube.

2. Connect the HOT WATER piping to the domestic hot water system.

3. When all domestic water piping is complete, open the cold water supply and allow some water to enter the tank. Look and listen for signs of leaks and repair as necessary before continuing.

Note: If installing on a city supply, ensure a dedicated Thermal Expansion tank (Therm-X-Trol® or equivalent) is used.

Note: If a water heater is installed in a closed water supply system, such as one having a back-flow preventer in the cold water supply line, means shall be provided to control thermal expansion. Contact the water supplier or local plumbing inspector on how to control this situation.

4. Install a blowdown tube on the T&P relief valve outlet. Plumb to within 6 inches above a floor drain or as directed by plumbing code.

Note: No valve is to be placed between the T&P relief valve and the tank.

Note: Valves for reducing point of use temperature by mixing cold and hot water are available. Consult a licensed plumber or the local plumbing authority.

BOILER PIPING

1. Plumb the circulator or zone valve onto the BOILER SUPPLY fitting.

2. Pipe the BOILER RETURN connection to the boiler return fitting.

⚠ CAUTION Be sure the return line is NOT plumbed to the suction side of any heating circulators. This may require moving the heating circulator off the boiler tapping on packaged boilers. Failure to do so will result in overheating and tank damage when the heating system is in operation.

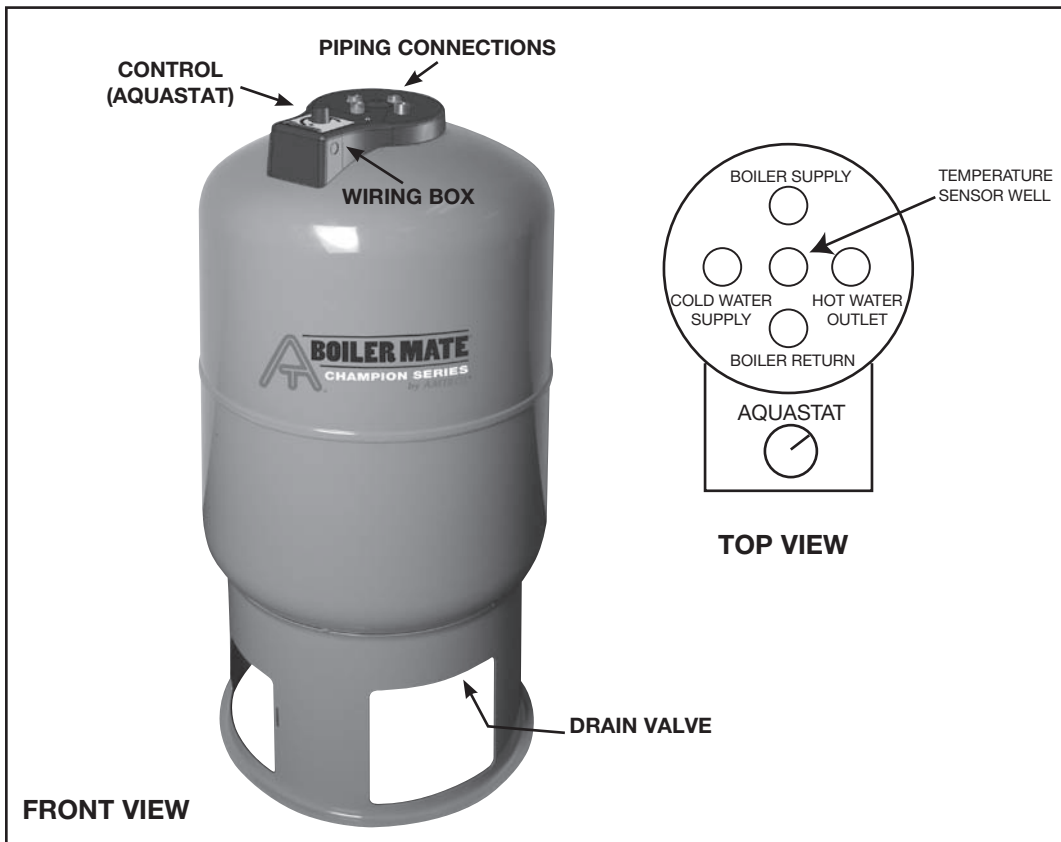
3. Install a weighted flow check on the boiler return line. This is not necessary on systems utilizing a zone valve to control the BoilerMate® temperature.

4. After completing the boiler piping, slowly open the boiler fill valve and pressurize the BoilerMate® loop. Check for leaks and repair as necessary. Proceed to the appropriate wiring section in this manual.

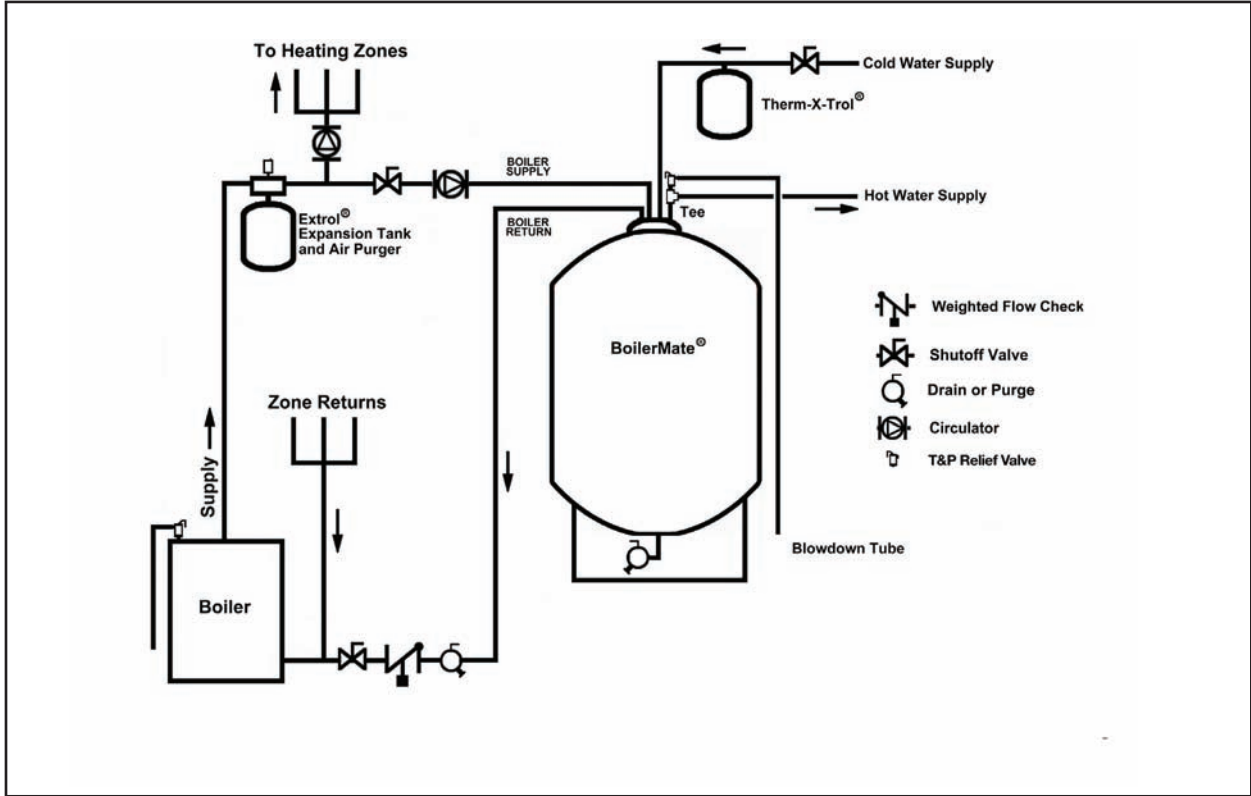
⚠ WARNING If installing on city water supply a properly sized THERM-X-TROL® is required with the BoilerMate® and should be installed as set forth in the THERM-X-TROL® product installation manual.

Recommended Clearance For Servicing

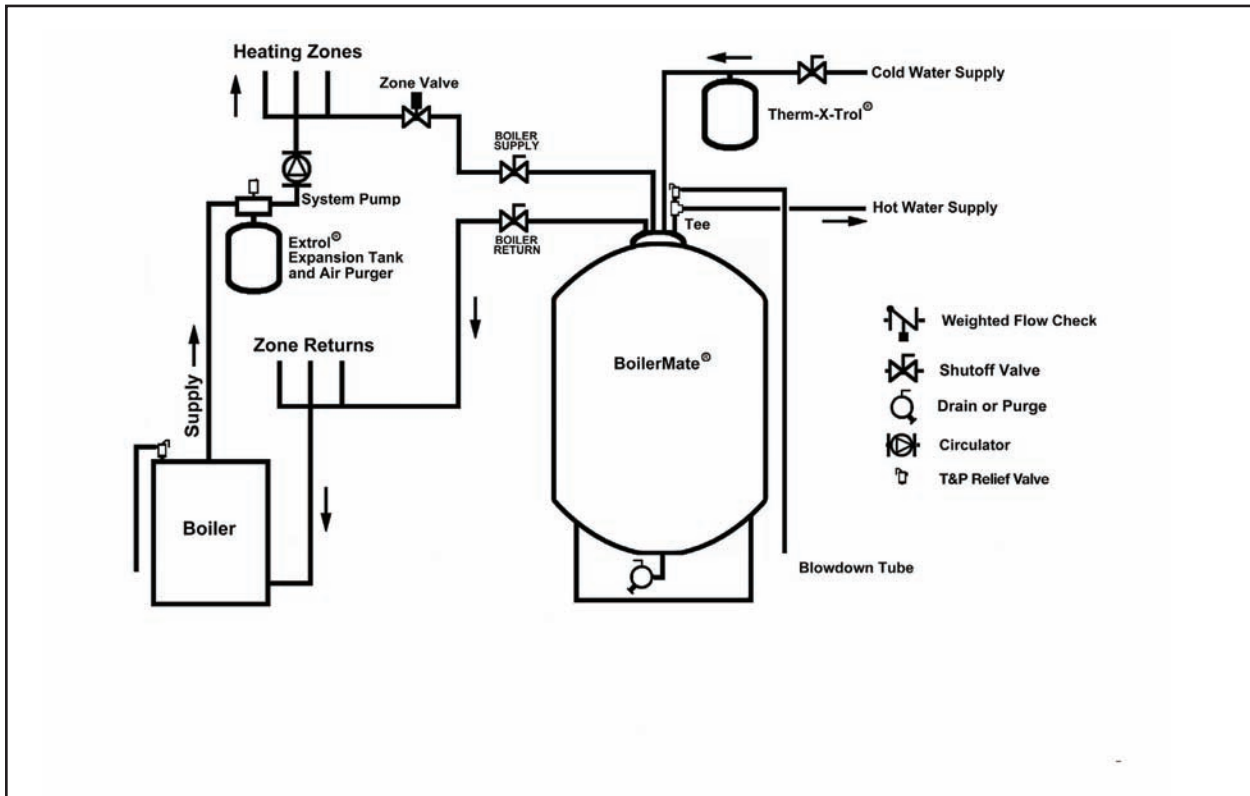
LEFT	1"	HEAD ROOM	48"
RIGHT	1"	REAR	1"
FRONT	30"		



PIPING USING DEDICATED CIRCULATOR PUMP (RECOMMENDED)



PIPING USING ZONE VALVE WITH EXISTING HEATING SYSTEM CIRCULATOR



5. CH-41BZ CHAMPION SERIES PIPING INSTALLATION

DOMESTIC WATER PIPING

1. Thread the included 3/4" brass tee onto the pipe marked COLD WATER.
2. Screw the 3/4" drain valve into the opposite end of the brass tee.
3. Connect the cold water supply to the remaining port on the brass tee.
4. Temporarily attach the top tee fitting (with o-ring face seal) to the union nut on top of the tank. Test fit the piping near the tee before soldering. Remove the tee before soldering connections to avoid damage to the top o-ring seal or plastic liner.

Note: Do not solder piping within 24 inches of the top tee fitting while attached to the tank.

5. Make an 8-inch "heat trap" as shown in the diagram. This will reduce standby losses from heat migrating up the piping. Continue this line to the domestic hot water system.
6. Install the included T&P relief valve on the top port of the top tee connection. Plumb a blowdown tube to within 6 inches of a floor drain or as directed by plumbing code.

Note: No valve is to be placed between the T&P relief valve and the tank.
Note: Valves for reducing point of use temperature by mixing cold and hot water are available. Consult a licensed plumber or the local plumbing authority.

7. When all domestic water piping is complete, open the cold water supply and allow some water to enter the tank. Look and listen for signs of leaks and repair as necessary before continuing.

Note: If a water heater is installed in a closed water supply system, such as one having a back-flow preventer in the cold water supply line, means shall be provided to control thermal expansion. Contact the water supplier or local plumbing inspector on how to control this situation.

BOILER PIPING

1. Plumb the circulator or zone valve on the BOILER SUPPLY line. If using a separate circulator, the pump flange can be mounted directly to the threaded pipe marked BOILER SUPPLY. Alternately, the circulator can be placed anywhere on the boiler supply line.
2. Pipe the BOILER RETURN connection to the boiler return line.

CAUTION Be sure the return line is NOT plumbed to the suction side of any heating circulators. This may require moving the heating circulator off the boiler tapping on packaged boilers. Failure to do so will result in overheating and tank damage when the heating system is in operation.

3. Install a weighted flow check on the boiler return line. This is not necessary on systems utilizing a zone valve to control the BoilerMate® temperature.
4. After completing the boiler piping, slowly open the boiler fill valve and pressurize the BoilerMate® loop. Check for leaks and repair as necessary. Proceed to the appropriate wiring section in this manual.

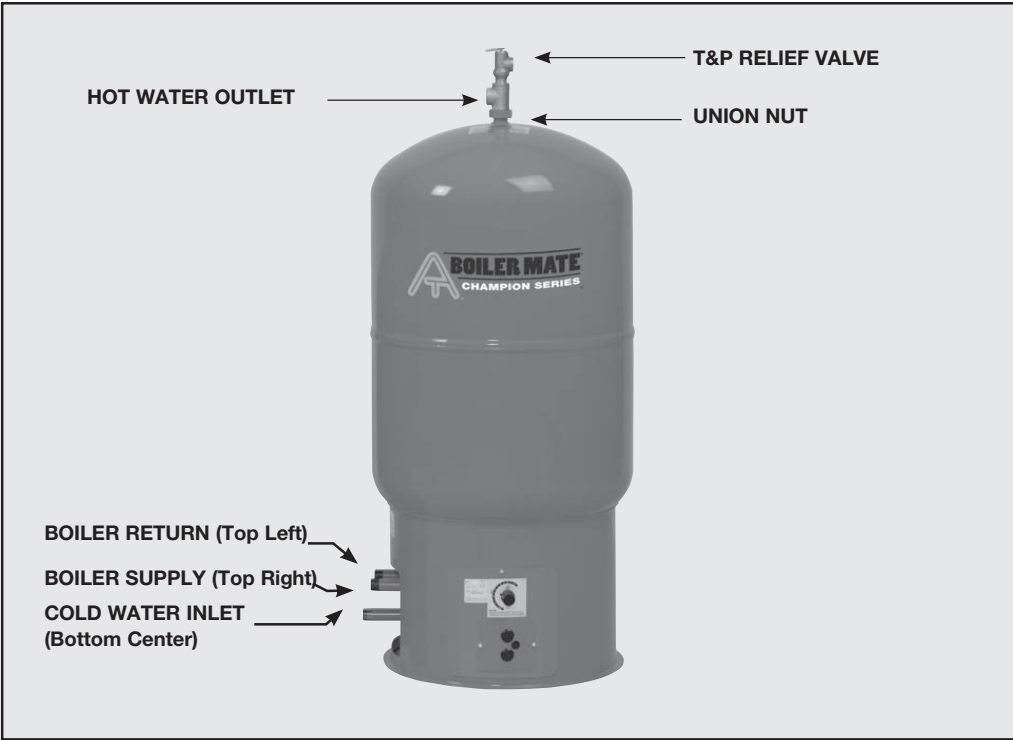
WARNING If installing on city water supply a properly sized THERM-X-TROL® is required with the BoilerMate® and should be installed as set forth in the THERM-X-TROL® product installation manual.

Clearance From Combustible Surfaces

LEFT SIDE1"	REAR1"
RIGHT SIDE1"	FLOOR0"
TOP9"	FRONT1"

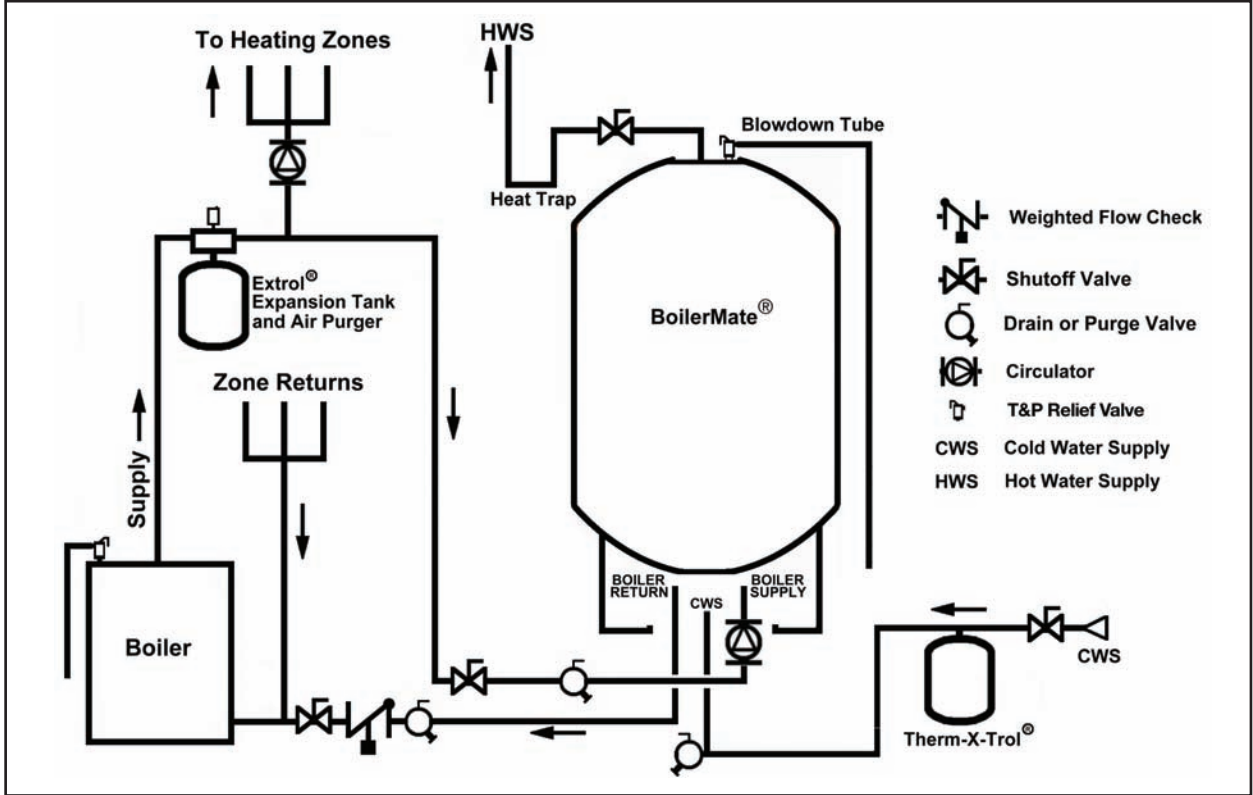
Recommended Clearance For Servicing

LEFT12"	HEAD ROOM9"
RIGHT12"	REAR1"
FRONT30"	

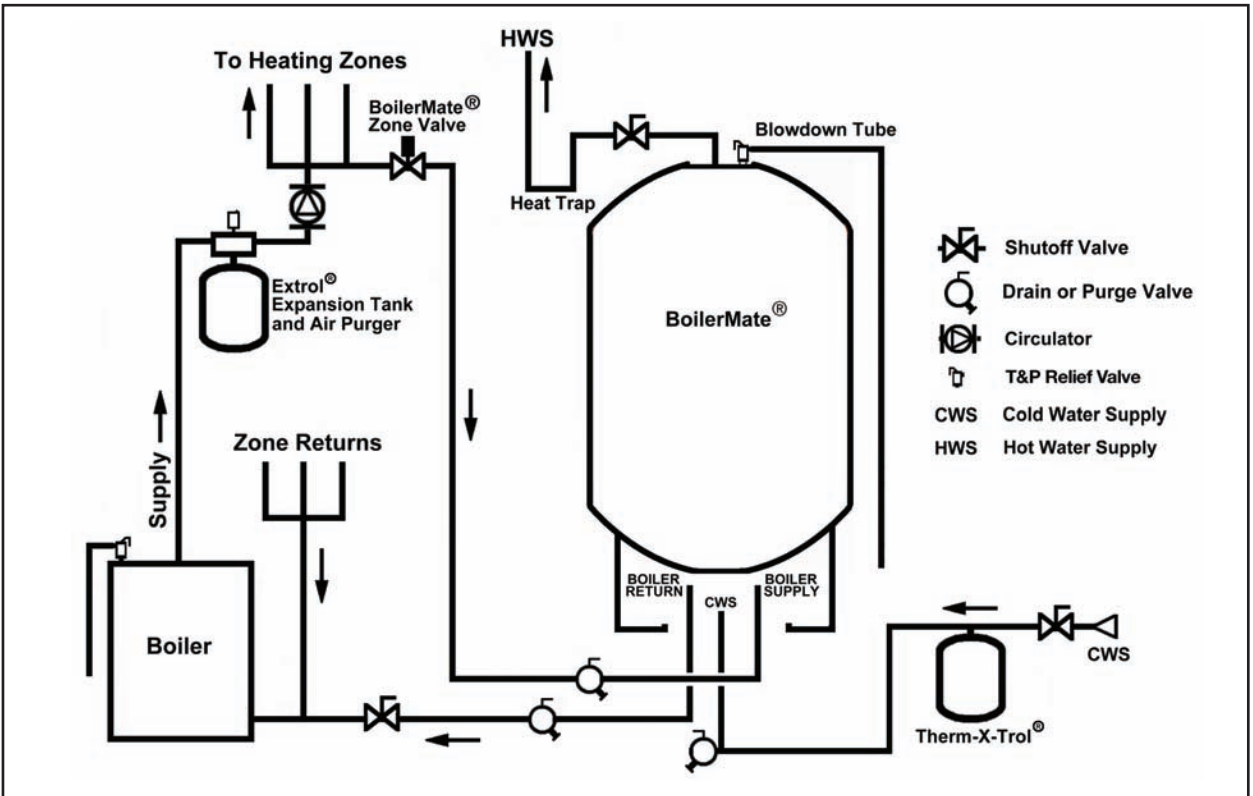


CH-41BZ

PIPING USING SEPARATE CIRCULATOR PUMP (RECOMMENDED)



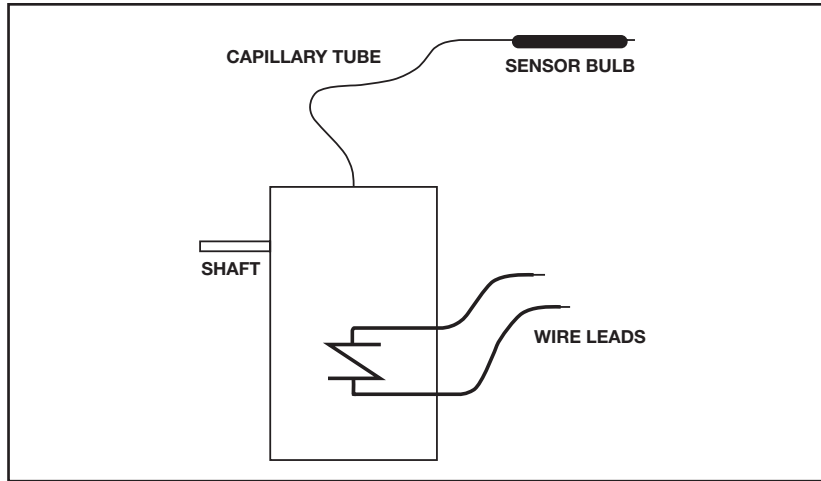
PIPING USING ZONE VALVE WITH EXISTING HEATING SYSTEM CIRCULATOR



6. WIRING

CH-41Z and CH-80Z options utilize a standard dry-contact aquastat with capillary temperature sensor. The dial control contains a make-and-break switch and is suitable for 24V.

CH-41BZ options utilize a standard dry-contact aquastat with capillary temperature sensor. The dial control contains a make-and-break switch and is suitable for 24V or 120V, 25A Max.



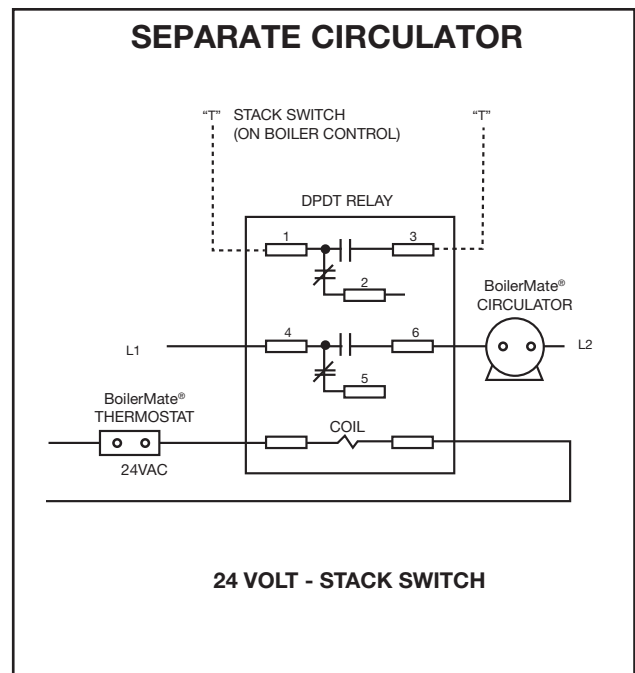
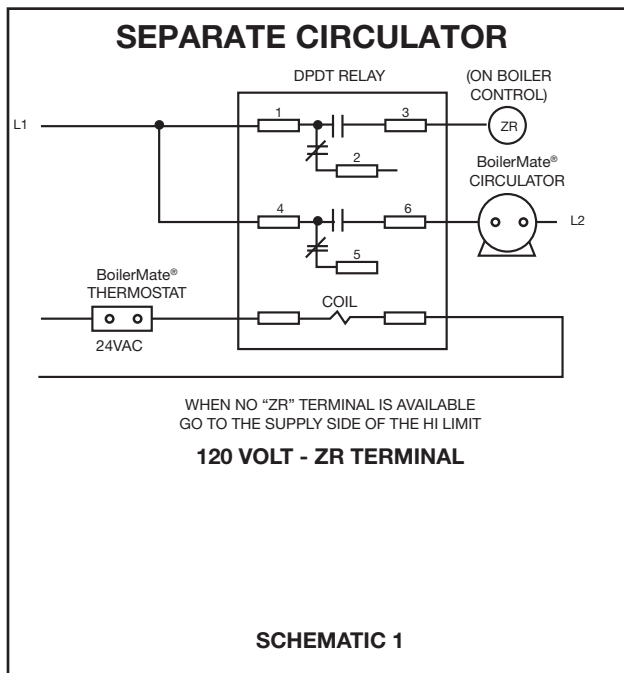
To wire Dial Control models, select the appropriate diagram from the following pages. If a suitable diagram is not available for your application, please contact AMTROL Tech Support at (401)535-1216. Always disconnect power before wiring the control. Ensure that the proper conduit and connectors are used per your local code. In lieu of local code, the National Electric Code (NEC) should be followed. If power is supplied to the control, minimum 18-gauge wire should be used in conjunction with an NEC Class II transformer.

Note: Line-voltage and safety-circuit wiring which is external to the water heater jacket when all panels are in place, and which is part of the appliance, shall be protected by metal conduit, metal-clad cable or raceways. "Power Limited Circuit Cable" need not be provided with the protection specified above if it is securely fastened to the appliance jacket and follows the contour of the appliance jacket. Thermoelectric circuit wiring shall be exempt from this provision.

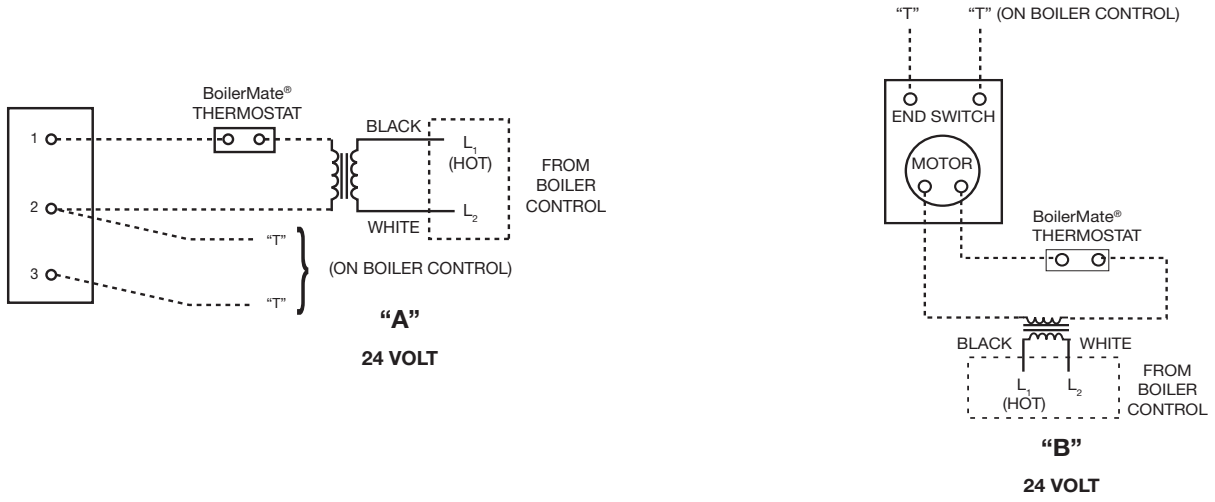
Note: Strain relief shall be provided for all conductors leaving an enclosure. For low-voltage wiring, strain relief at the point of exit from an enclosure is not necessary if, by wire location or support, protection is provided against accidental strain.

Note: If an external electrical source is utilized, the appliance, when installed, must be electrically grounded in accordance with local codes or, in the absence of local codes, with the National Electrical Code, ANSI/NFPA 70.

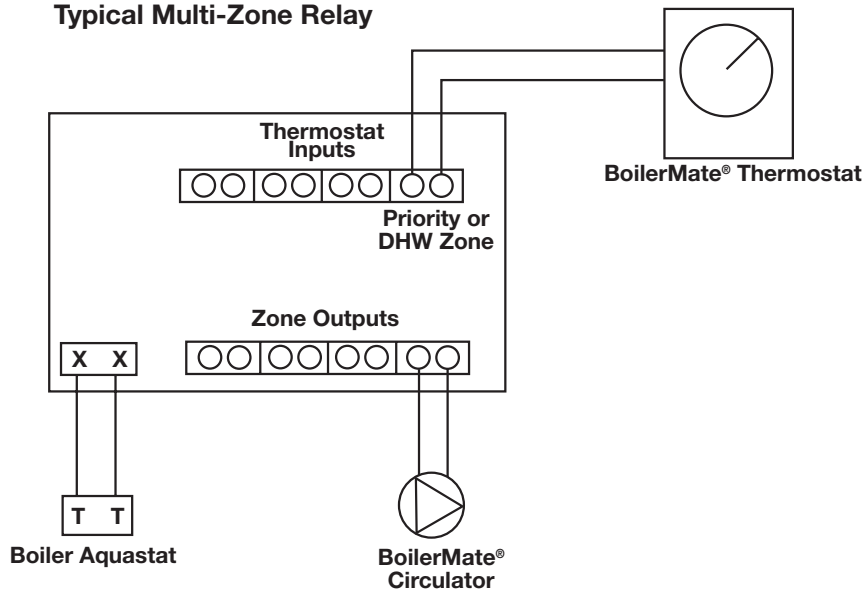
Note: The thermostat is adjusted to 120°F. when shipped from the factory.



ZONE VALVES - SCHEMATIC 3



Typical Multi-Zone Relay

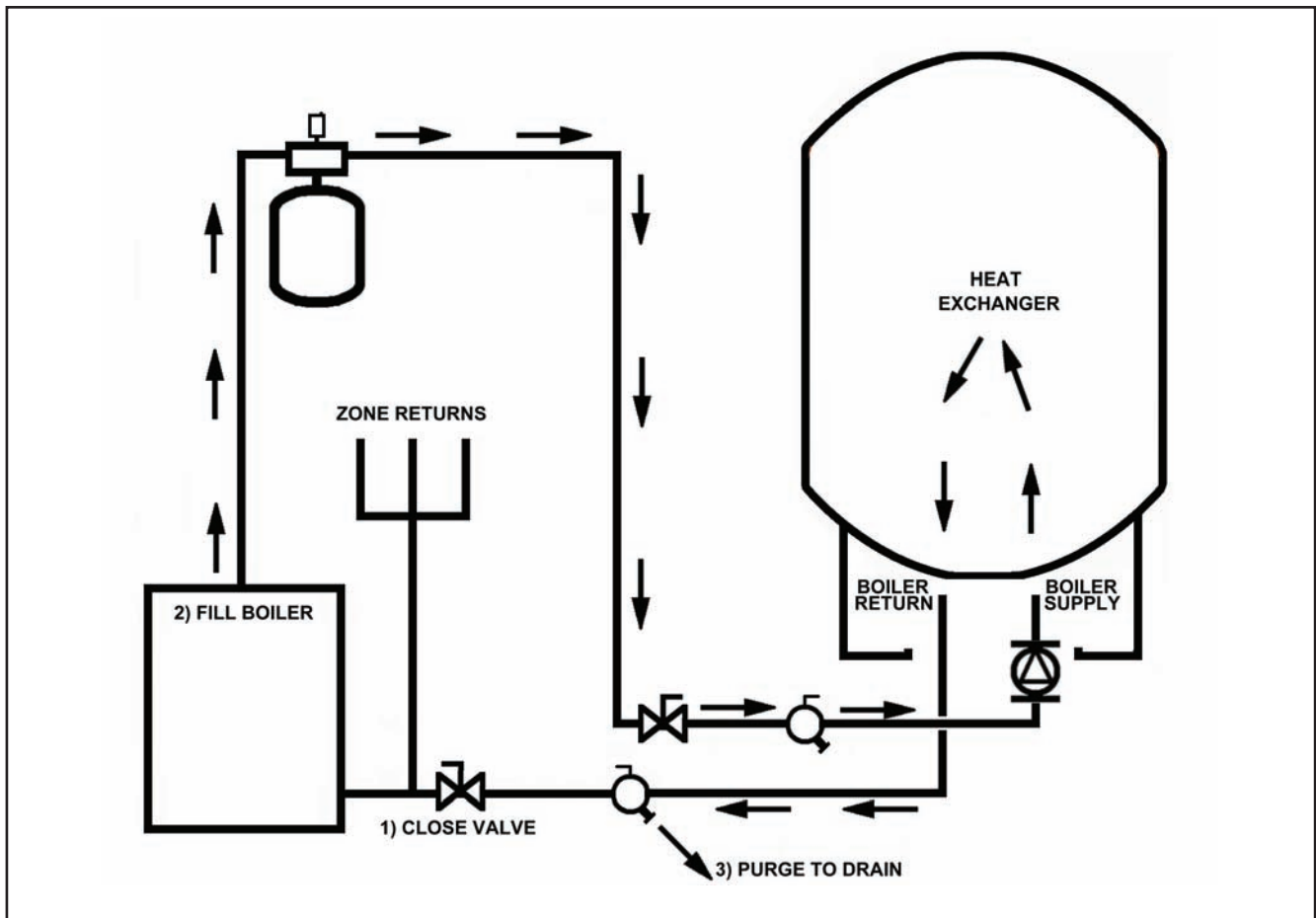


7. STARTUP PROCEDURE FOR ALL MODELS

- 1. PURGE HEAT EXCHANGER:** The heat exchanger should be free of large air pockets to allow the circulator to operate properly. Using the diagram below as a guide, isolate the boiler return line and flush the loop until large air pockets are purged. After this, the air elimination equipment will collect smaller air bubbles to maximize efficiency.
- 2. FILL TANK:** Open the hot water fixture furthest from the heater. Open the cold water supply and allow the water to run until air stops emerging. Until all air is purged from the hot water system, air pockets may appear at any hot water fixture. This is considered normal and will clear as hot water is used.
- 3. START HEATER:** Turn power on to the unit. Dial should have the knob rotated to the 120°F mark for safety. The circulator and boiler should start momentarily. If not, check wiring and consult the troubleshooting section in this manual.

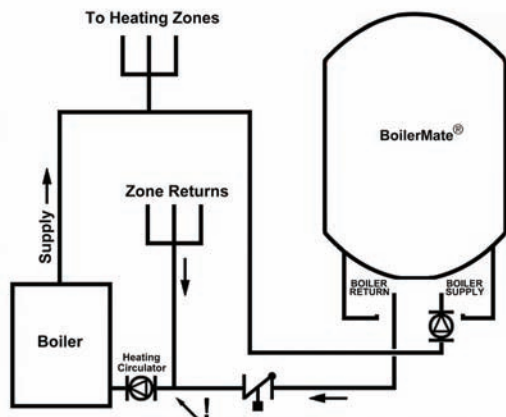
4. CHECK OPERATION: The BoilerMate® will begin to heat. Depending upon the size of the BoilerMate®, output of the boiler and the space heating load, the unit should typically reach set temperature within 15 to 60 minutes. If heating does not occur, consult the troubleshooting section in this manual. **Note:** Large heaters coupled with small boilers may exceed this time period upon initial startup.

5. SET TEMPERATURE: The BoilerMate® control should be set to the minimum temperature consistent with the user's needs. This maximizes efficiency and reduces scald potential.



7. TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	SOLUTION
No hot water	<ol style="list-style-type: none"> 1. No power to unit 2. Air in heat exchanger loop 3. Faulty circulator or zone valve 4. Faulty BoilerMate® thermostat 5. Boiler inoperable 	<ol style="list-style-type: none"> 1. Check circuit breaker, boiler emergency switch and boiler reset switch. 2. Purge air. Ensure circulator is on Boiler Supply. Check air vents. 3. Check circulator and zone valve. Repair or replace if necessary. 4. Check continuity while rotating knob. Circuit should open and close. 5. Check boiler system. Boiler must operate to generate hot water.
Insufficient hot water	<ol style="list-style-type: none"> 1. Demand exceeds capacity 2. Temperature too low 3. Boiler lacks sufficient output 4. Fouled heat exchanger 5. Insufficient heat exchanger flow 6. Loose, missing or damaged dip tube 	<ol style="list-style-type: none"> 1. Check sizing based on household size and boiler output. 2. Increase temperature setpoint. 3. Wire for domestic hot water priority. If problem persists add storage or increase tank size. 4. Check Boiler Supply/Boiler Return during cold startup. If difference is less than 20F, clean heat exchanger. Install water treatment equipment to prevent recurrence. 5. Check for undersized or faulty circulator, stuck or undersized zone valve. Ensure all shutoff valves are open. Check for stuck flow check valve. Purge boiler loop to remove air. 6. Install or replace dip tube.
Water too hot	<ol style="list-style-type: none"> 1. Temperature set too high 2. Improper plumbing 3. Temperature sensor not fully inserted 4. Stuck zone valve 5. Flow check valve stuck open 	<ol style="list-style-type: none"> 1. Reduce temperature setpoint 2. If Boiler Return is plumbed to the suction-side of a heating circulator, overheating will occur when the home's heat is on. Fix plumbing. 3. Fully insert temperature sensor bulb. 4. Repair or replace 5. Clean, repair or replace
Noise from BoilerMate®	<ol style="list-style-type: none"> 1. Air in boiler loop 2. Faulty circulator pump 3. Thermal expansion 4. Normal noise during initial fill 	<ol style="list-style-type: none"> 1. Purge boiler loop. Check air elimination equipment. 2. Repair or replace pump. 3. Ensure the proper Therm-X-Trol® or equivalent thermal expansion tank is installed and the air charge is adjusted properly. 4. When first pressurized, a creaking or hissing sound is normal. After pressurizing, the noise should stop. Always check for leaks.
Relief valve dripping or opening	<ol style="list-style-type: none"> 1. No thermal expansion tank 2. Thermal expansion tank set improperly 3. City pressure too high 4. System over temperature 5. Faulty relief valve 	<ol style="list-style-type: none"> 1. Install the proper Therm-X-Trol® or equivalent thermal expansion tank. 2. Ensure precharge air pressure matches static water pressure. 3. Install a Pressure Reducing Valve (PRV) if city pressure is over 80psi. 4. Determine cause of over temperature condition and correct problem. 5. Replace relief valve.
Discolored water at faucet	<ol style="list-style-type: none"> 1. Poor water quality 2. Sediment or suspended particles 	<ol style="list-style-type: none"> 1. Have water tested for contaminants. Typical problems are: Blue/green color = copper discoloration due to low pH Black staining/sulfur odor = hydrogen sulfide White deposits = hard water Red staining = high iron levels 2. Install sediment filter, purge unit more often to avoid future problems.
Boiler will not operate when calling for hot water	<ol style="list-style-type: none"> 1. Improper or loose wiring 2. Boiler high limit has been reached 3. Problem with boiler system 	<ol style="list-style-type: none"> 1. Check connections using wiring diagrams in this manual. 2. Boiler will periodically cycle on and off during operation. 3. Have boiler repaired to restore proper operation.
Circulator or zone valve will not operate when calling for hot water	<ol style="list-style-type: none"> 1. Improper or loose wiring 2. Faulty circulator pump or zone valve 	<ol style="list-style-type: none"> 1. Check connections using wiring diagrams in this manual. 2. Repair or replace pump or zone valve.



If boiler is a packaged-type with a pre-installed circulator, DO NOT install the BoilerMate® return line on the suction-side of the heating pump. Doing so will cause overheating when the home's heating system is in operation.

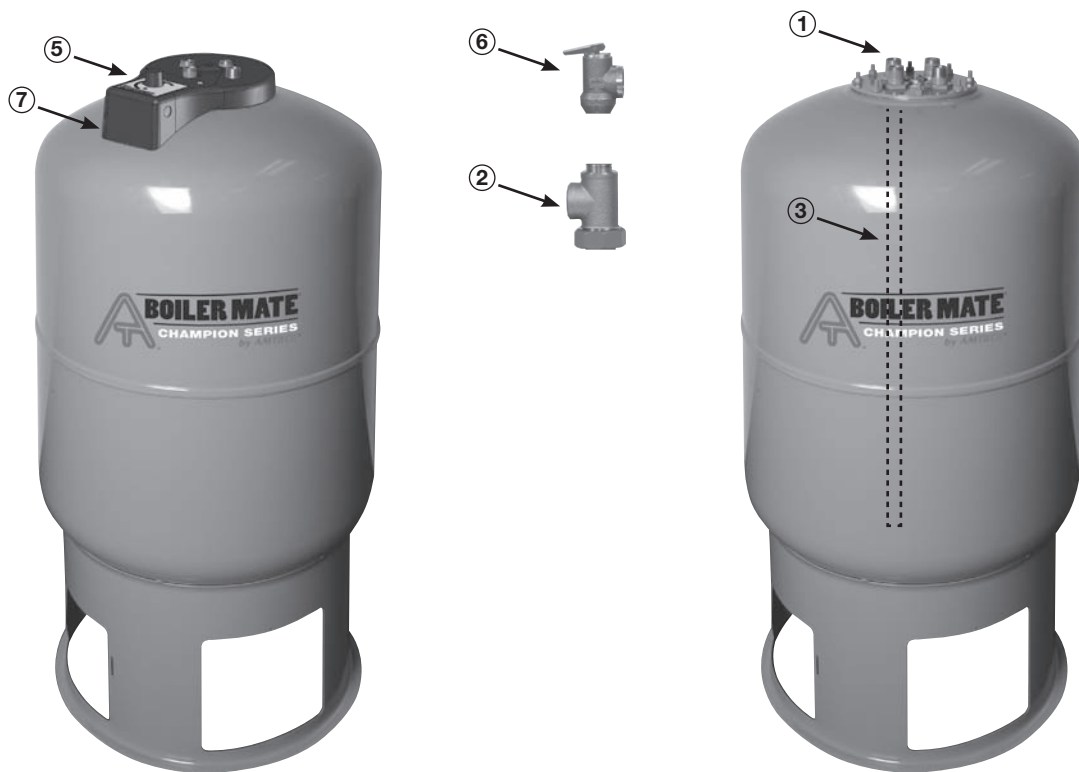
OVERHEATING

If BoilerMate® overheats during space heating months, the installation may have a problem with the piping configuration. The water heater uses the boiler system as its source of energy. As such, the potential exists for the BoilerMate® to be connected in a manner that forces heating water through the exchanger even when the unit is off. **This overheating can present a scald hazard and may damage the unit.** Follow this diagram to determine the source of an overheating condition.

9. REPLACEMENT PARTS

Number	Description	Part Number
1*	Heat Exchanger w/Gasket (CH41Z)	2703R003
2	Hot Water Outlet Tee	9403R123
3	Dip Tube (CH-41Z only)	2703R001
	Dip Tube (CH-80Z only)	2702R001
4	Bottom Drain	9340R160
5	Dial Aquastat	2704-093
6	Safety Relief Valve	2700R116
7	Top Cap Assembly (CH-41Z & CH-80Z)	2704R007
8*	CH-41BZ Coil	2708R003
9*	CH-80Z Coil	2702R002

* Not shown.



To obtain replacement parts, contact the installer or place of purchase.
 Technical support is available by calling AMTROL at **(401) 535-1216**.

10. GENERAL SAFETY INFORMATION

⚠ DANGER SCALDING HAZARD. If the water temperature is over 120°F, household members can suffer serious or fatal scalding and painful and permanent injury. • The Consumer Products Safety Commission recommends an initial setting of 120°F, but notes a slower response time of infants, aged, disabled and other persons increases the scalding hazard and may require lower settings. • Always check the water temperature before use, including washing, bathing or showering. • Temperature limiting valves are available from your plumbing supplier. A check valve must be installed in the boiler return line to prevent gravity flow through the heat exchanger. This can cause overheating and result in serious or fatal scalding.

⚠ DANGER SCALDING HAZARD. If the thermostat is not working properly or if this product is not installed in accordance with the manual, water temperature can reach excessive levels that may cause serious or fatal scalding. After installation and any servicing of the unit, verify that the thermostat is working and firmly inserted in the thermostat well by following the thermostat testing instructions in the manual.

⚠ WARNING Failure to use the correct replacement parts may make your product unsafe.

⚠ WARNING CALIFORNIA PROPOSITION 65
WARNING! WARNING: This product contains a chemical known by the State of California to cause cancer and birth defects or other reproductive harm. (California Installer/Contractor - California law requires that this notice be given to consumer/end user of this product.) **For more information:** www.amtrol.com/prop65

⚠ WARNING In limited circumstances, space heating can be lost in the home with unit utilizing priority mode. Any demand for space heating is postponed until the Boiler Mate® has reached its set temperature. This delay in supplying the space heating zones is usually not noticed by the inhabitants of the living spaces. However, in the event of certain malfunctions such as circulator or thermostat failure, space heating could be delayed indefinitely. If undetected and uncorrected, freezing damage to piping could result.

⚠ CAUTION If a steel hydropneumatic tank is in place, AMTROL® recommends replacing it with a properly sized EXTROL® expansion tank. Otherwise, significant heat transfer problems can occur by causing air to be trapped in the heat exchanger. If the boiler system has an EXTROL® or Radiant EXTROL® expansion tank and the boiler temperatures are being changed, resize the EXTROL® or Radiant EXTROL® expansion tank.

⚠ WARNING If installing on city water supply a properly sized THERM-X-TROL® is required with the BoilerMate® and should be installed as set forth in the THERM-X-TROL® product installation manual. Contact your water supplier or local plumbing inspector for additional information.

⚠ DANGER Prevent pressure build-up in any existing internal tankless coil. Do not plug incoming or outgoing tapings in the internal tankless coil plate. Leave the coil in the boiler and leave system connections open, to prevent pressure build-up.

⚠ DANGER **Electrocution Hazard.** The BoilerMate® must be electrically grounded. Electrical supply must come from the boiler side of boiler's emergency shut-off switch in order to prevent unsafe operation.

⚠ WARNING **Chlorine Aggressive Water:** The water quality can significantly influence the life of this Product. You should test for corrosive elements, acidity, total solids and other relevant contaminants, including chlorine and treat your water appropriately to insure satisfactory performance and prevent premature failure.

Note: Inspect for shipping damage and notify freight carrier or store where purchased immediately if damage present. To avoid risk of personal injury and property damage, if the product appears to be malfunctioning or shows signs of corrosion, call a qualified professional immediately. Current copies of the Product manual can be viewed at www.amtrol.com. Use proper safety equipment when installing.

⚠ DANGER EXPLOSION HAZARD. The pressure of the heat transfer medium must be limited to a maximum of 30 psig by an approved safety or relief valve on your boiler. The BoilerMate® pressure must be limited to 150 psig maximum by the installation of a temperature and pressure relief valve (included). The relief tube must be plumbed to a suitable drain per code. No reducing coupling or other restriction may be placed in this line.

⚠ WARNING This Product, like most Products under pressure, may over time corrode, weaken and burst or explode, causing serious or fatal injury, leaking or flooding and/or property damage. To minimize risk, a licensed professional must install and periodically inspect and service the Product. A drip pan connected to an adequate drain must be installed if leaking or flooding could cause property damage. Do not locate in an area where leaking could cause property damage.

⚠ WARNING **EXPLOSION OR RUPTURE HAZARD.** A relief valve must be installed to prevent pressure in excess of local code requirement or maximum working pressure designated in the Product Manual, whichever is less. Do not expose Product to freezing temperatures or temperatures in excess of the maximum rated operating temperature.

⚠ DANGER If not installed by the boiler manufacturer, install a low water cut-off or pressure reducing valve on your boiler so that leaking will not result in a dry boiler which if the boiler continues to fire, will cause an explosion hazard.

⚠ DANGER This unit must be installed as a separate heating zone. Do not connect this unit to an existing heating zone or dangerous over-heating will result.

⚠ CAUTION Do not drain this appliance before shutting off the supply valve and opening the relief valve or another downstream fixture, as it will damage this unit. A vacuum breaker should be installed to avoid damaging the liner. Damage to the unit and leakage can occur if a vacuum breaker is not installed.

⚠ WARNING **USE GLYCOL ONLY WITH DOUBLE-WALLED HEAT EXCHANGER MODELS.** Avoid risk of ingesting a toxic glycol fluid. The heat transfer medium should be water. If glycol must be used, it should only be used with double-walled heat exchangers and closely monitored for leakage.

