ASME COMMERCIAL ELECTRIC WATER HEATER

A Spanish language version of these instructions is available by contacting the company listed on the rating plate.
La versión espãnola de estas instructiones se puede obtener al escribible a la fábrica cuyo nombre aparece en la placa de especificaciones.

INSTALLATION & OPERATING INSTRUCTION MANUAL

THE WARRANTY ON THIS WATER HEATER IS IN EFFECT ONLY WHEN THE WATER HEATER IS INSTALLED AND OPERATED IN ACCORDANCE WITH LOCAL CODES AND THESE INSTRUCTIONS. THE MANUFACTURER OF THIS WATER HEATER WILL NOT BE LIABLE FOR ANY DAMAGE RESULTING FROM FAILURE TO COMPLY WITH THESE INSTRUCTIONS. READ THESE INSTRUCTIONS THOROUGHLY BEFORE STARTING.

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

238-45837-00D REV 05/07

TABLE OF CONTENTS

CONGRATULATIONS!

You have just purchased one of the finest water heaters on the market today!

This installation, operation and instruction manual will explain in detail the installation and maintenance of your new ASME Commercial Electric Water Heater. We strongly recommend that you contact a plumbing professional for the installation of this water heater.

We require that you carefully read this manual, as well as the enclosed warranty, and refer to it when questions arise. If you have any specific questions concerning your warranty, please consult the plumbing professional from whom your water heater was purchased. For your records we recommend that you write the model, serial number and installation date of your water heater in the maintenance section in the back of this manual.

This manual should be kept with the water heater.

GENERAL INFORMATION

This electric water heater's design is certified by Underwriters Laboratories (UL) and listed in accordance with UL 1453. C-UL listed in accordance with Canadian National Standard C22.2, No. 110-M90.

This water heater must be installed in accordance with local codes. In the absence of local codes, install this water heater in accordance with the latest edition of the National Electrical Code.

The warranty for this water heater is in effect only when the water heater is installed, adjusted, and operated in accordance with these Installation and Operating Instructions. The manufacturer will not be held liable for damage resulting from alteration and/or failure to comply with these instructions.

This water heater has been designed and certified for the purpose of heating potable water. The installation and use of this water heater for any purpose other than the heating of potable water, may cause damage to the water heater and create a hazardous condition and nullify the warranty.

⚠ CAUTION

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

Do not use this appliance if any part has been submerged in water. The plumbing professional responsible for the installation of this water heater should be contacted to inspect the appliance and to replace any part of the control system, including thermostat(s), which has been submerged in water.

Make sure that the rating plate on the water heater is referenced for certainty that the correct voltage is being supplied to the water heater.

⚠ DANGER

Do not store or use gasoline or other flammable, combustible, or corrosive vapors and liquids in the vicinity of this water heater or any other appliance.

A sacrificial anode(s) is used to extend tank life. Removal of any anode, 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 impurities in the water. If this should happen, an alternative anode(s) 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.

IMPORTANT

Before proceeding, please inspect the water heater and its components for possible damage. DO NOT install any damaged components. If damage is evident, please contact the supplier where the water heater was purchased or the manufacturer listed on the rating plate for replacement parts.

INSTALLATION

Locating The Water Heater

⚠ WARNING

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

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.

The location where this water heater is to be installed is of utmost importance. Before installing this water heater, consult 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 a power supply and water connections. It is recommended that the water heater be located near the center of greatest hot water usage to prevent heat loss through the pipes. **DO NOT locate the water heater where water lines could be subjected to freezing temperatures. Locate the water heater so that access panels, drain valves, and clean-out openings are accessible.**

Locating The Water Heater continued-

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 or sodium chloride, waxes and process chemicals. These materials are corrosive at very low concentration levels with little or no odor to reveal their presence. **NOTE: 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.**

This water heater must be located in an area where leakage from the tank, water line connections, and 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 must have a minimum length and width of at least 4 in. (10.2 cm) greater than the diameter of the water heater. The drain pan, as described above, can be purchased from your plumbing professional. The drain pan must be piped to an adequate drain. The piping must be pitched for proper drainage.

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

To comply with NSF requirements this water heater is to be:

a) Sealed to the floor with sealant, in a smooth and easily cleanable way, or
b) Installed with an optional leg kit that includes legs and/or extensions that provide a minimum clearance of 6” beneath the water heater.

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 California Office of the State Architect, 400 P Street, Sacramento, CA 95814.

Water Connections

Note: Before proceeding with the installation, close the main water supply valve.
After shutting the main water supply valve, open a faucet to relieve the water line pressure in order to prevent 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 line connects to the inlet nipple at the base of the water heater. The hot water outlet line connects to the nipple on top of the water heater. The fittings at the cold water inlet and hot water outlet are dielectric waterway fittings with tapered male threads. Make the proper plumbing connections between the water heater and the plumbing system in the structure. Install a manual 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 top of the water heater. Sweat the tubing to the adapter before fitting the adapter to the water connections. It is imperative that heat is not applied to the nipples containing a plastic liner.

IMPORTANT

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

This water heater may be provided with an optional pressure and temperature gauge. See Figure 1 for proper installation.

If this water heater is installed in a closed water supply system, such as 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 a provision for controlling thermal expansion. Contact your water supplier or local plumbing inspector regarding how thermal expansion can be controlled.

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 the faucets and inspect all water connections for possible leaks. **NEVER OPERATE THE WATER HEATER WITHOUT FIRST BEING CERTAIN IT IS COMPLETELY FILLED WITH WATER.**

⚠ WARNING

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 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 shall 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 shall also have an hourly rated temperature steam BTU discharge capacity not less than the hourly input rating of the water heater.

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

Note: Some models may already be equipped or supplied with a combination temperature and pressure relief valves. Verify that this 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 provided 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 *(15.3 cm)* above, or any distance below the structural floor and at a location where dischargers cannot contact any live electrical part. This discharge line is to be installed complete drainage of both the temperature and pressure relief valve and the discharge line can occur. 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 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.

⚠ WARNING

Hydrogen gas can be produced in the hot water system served by this water heater when there has been no usage for a long period of time (generally two weeks or more). Hydrogen gas is extremely flammable. Therefore, to reduce the risk of injury under these conditions, it is recommended that the hot water faucet be opened for several minutes at the kitchen sink before using any electrical appliance connected to the hot water system. If hydrogen is present, there will probably be an unusual sound, such as air escaping through the pipe, as the water begins to flow. There should be no smoking or open flame near the faucet at the time it is open.

⚠ CAUTION

INCREASING THE THERMOSTAT SETTING ABOVE THE PRESET TEMPERATURE MAY CAUSE SEVERE BURNS AND CONSUME EXCESSIVE ENERGY. HOTTER WATER INCREASES THE RISK OF SCALD INJURY.

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, the potential for scald injury is increased. To protect against injury, install an anti-scald tempering valve in the water system. This valve will reduce the point of discharge water temperature by mixing cold and hot water in branch supply lines. Anti-sealed tempering valves can be obtained from your local plumbing supplier. Please consult a plumbing professional.

Water Connections continued-

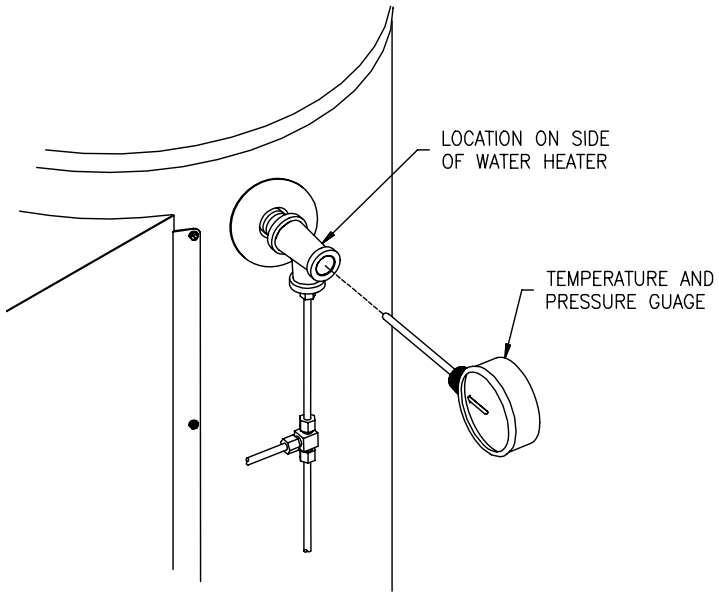


Figure 1

Water Connections continued-

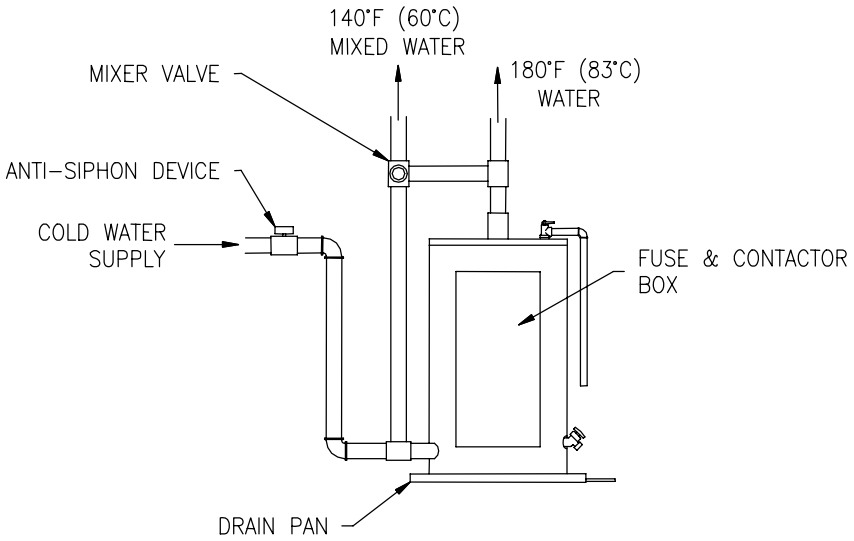


Figure 2A
(Dual Temperature System With Mixing Valve)
50A, 80A, 120A

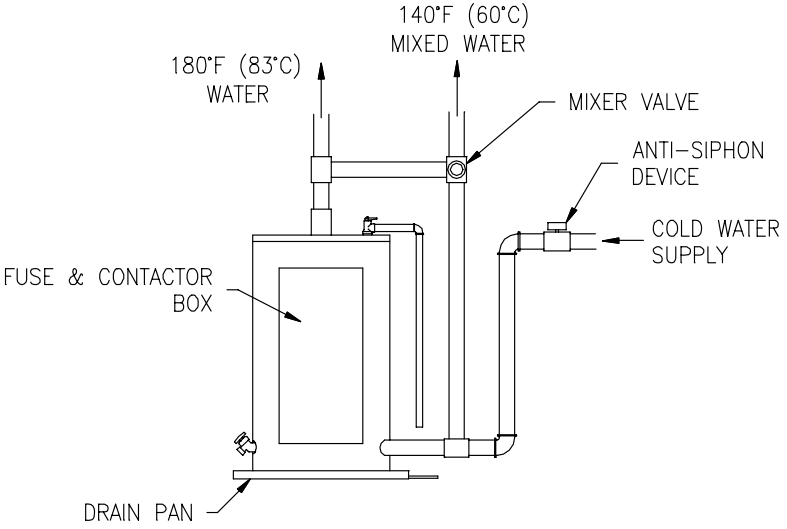


Figure 2B
(Dual Temperature System With Mixing Valve)
6A, 12A, 20A, 30A, 40A

Water Connections continued-

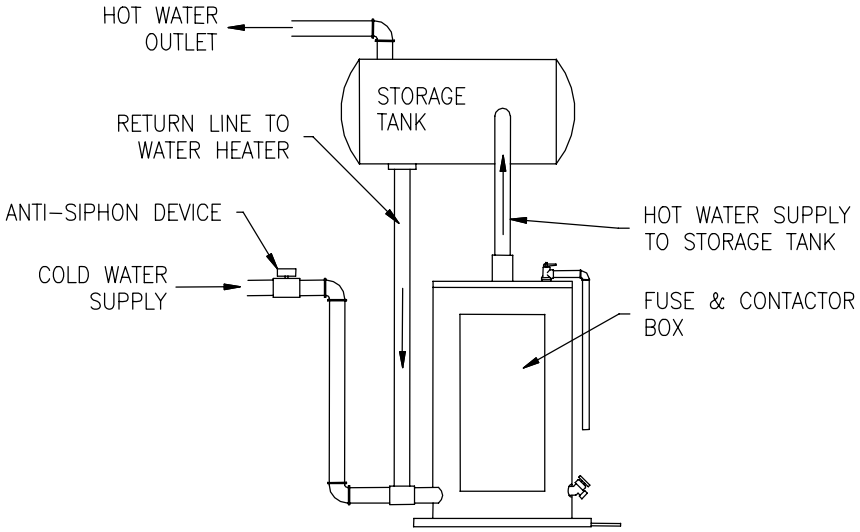


Figure 3A
(Single Installation With Storage Tank Gravity Circulation)
50A, 80A, 120A

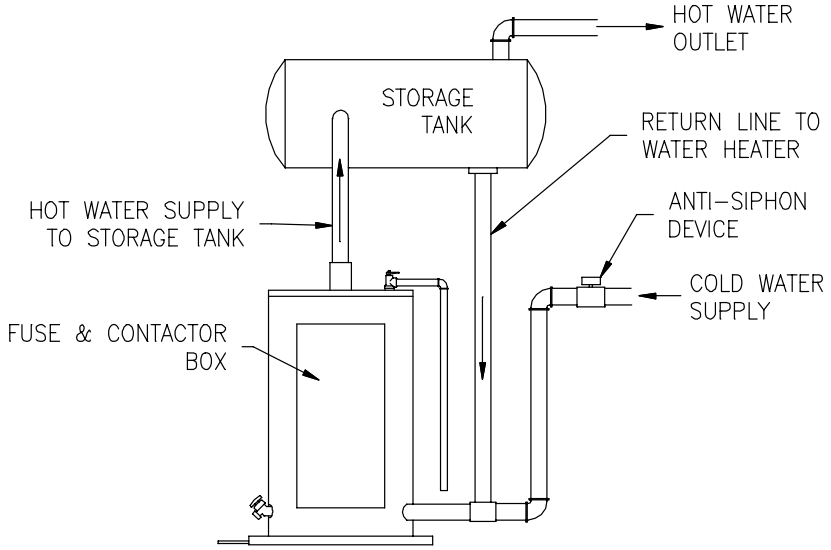


Figure 3B
(Single Installation With Storage Tank Gravity Circulation)
6A, 12A, 20A, 30A, 40A

Water Connections continued-

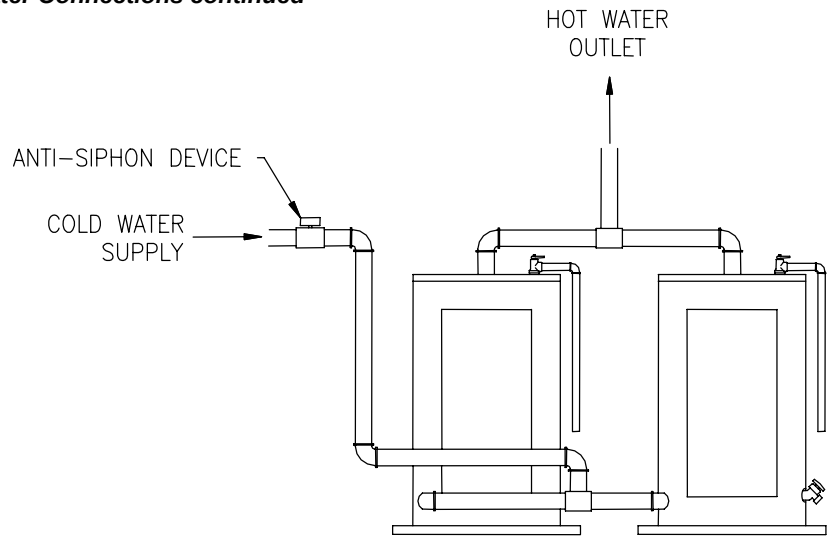


Figure 4A
(Dual Water Heater Installation)
50A, 80A, 120A

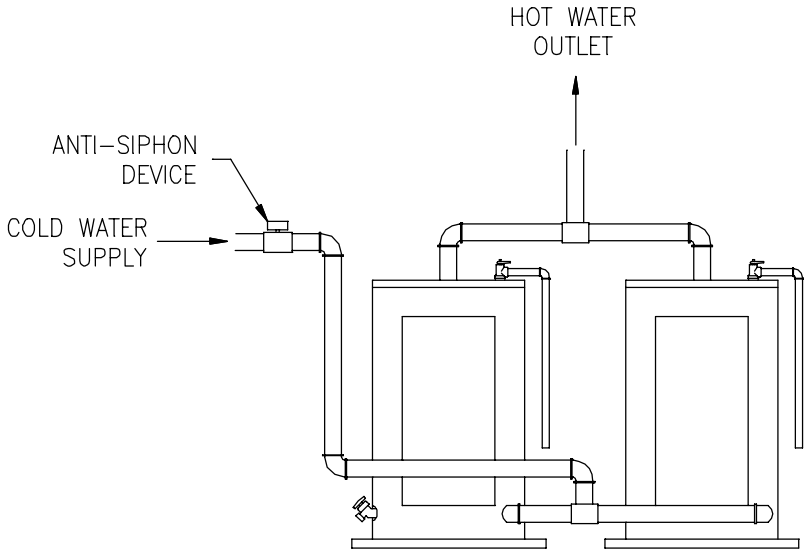


Figure 4B
(Dual Water Heater Installation)
6A, 12A, 20A, 30A, 40A

Electrical Connections

Before any electrical connections are attempted, be sure the water heater is full of water and that the manual shut-off valve in the cold water supply line is open. Heating elements, which have been energized for a very short period of time, can be damaged (burned-out) if they are not completely immersed in water. This warranty does not cover burned-out heating elements. Check the rating plate and wiring diagram before proceeding. This electric water heater was manufactured and wired in accordance with the Underwriters Laboratories testing approvals requirements. The temperature-limiting device is of the manual reset, trip-free type and has been factory installed to interrupt all ungrounded power supply conductors in the event of thermostat failure. The plumbing supplier in your area ordered this water heater wired at the factory to comply with existing area codes, but local utility codes may require or allow other circuitry. Consult your local power company to determine the correct electrical hook-up in order to meet local utility and building codes and in order to obtain the most economical rates. All electrical connections to elements, thermostats, contactors, fuses (certain models), and transformer have been made at the factory. **DO NOT** alter any of the internal wiring. Wiring connections may loosen during shipment. Check all connections for tightness.

To make the wiring connections to a power supply, follow the steps below.

A) Open the cover door of the control box.
B) Bring the power leads from an adequately fused disconnect switch (not furnished with the water heater due to varying state and local codes) and connect to the terminal block. Local ordinances and/or utility company may require an increase in the gage size of the wiring for conditions where long wiring lengths exist.
C) This water heater must be properly grounded. A ground lug is provided within the electrical control box for connection to a properly sized ground. (See wiring diagram for minimum required ground size. The wiring diagram is located on the inside door of the control box)
D) Close the cover door of the control box.

Heating Elements

To replace heating elements, disconnect power to the water heater, drain tank and replace element. To remove a heating element, use a screw type element wrench (1 1/2” or 2 3/8”) available from most supply houses. **Do not** over-tighten the new element, as this will cause distortion in the new element gasket. Once the element has been replaced, follow the instructions “To Fill The Water Heater”. It is imperative that the water heater is full before power is restored to the heating elements.

Amperage Chart

kW	208V		240V		277V	380V	415V	480V		415V
Input	1Ø	3Ø	1Ø	3Ø	1Ø	3Ø	3Ø	1Ø	3Ø	3Ø
3	15	-	13	-	11	-	-	7	-	-
6	29	17	25	14	22	9	8	8	12	8
9	43	25	38	22	32	14	13	13	19	13
12	58	33	50	29	43	19	17	17	25	17
13.5	65	38	56	32	49	21	19	19	28	19
15	72	42	63	36	54	23	21	21	31	21
18	87	50	75	43	65	28	25	25	38	25
24	115	67	100	58	87	37	34	34	50	34
27	130	75	113	65	97	41	38	38	56	38
30	144	83	125	72	108	46	42	42	63	42
36	173	100	150	87	130	55	50	50	75	50
45	216	125	188	108	162	69	63	63	94	63
54	260	150	225	130	195	83	75	75	113	75
81	390	225	338	195	293	123	113	169	98	78

Water heaters with amperage draw of 120 AMPS or more require factory installed internal fusing to comply with Underwriters Laboratories requirements.

GPH Recovery Capacities

kW	Temperature Rise								
Input	40°F	50°F	60°F	70°F	80°F	90°F	100°F	120°F	140°F
3	31	25	21	18	16	14	13	11	9
6	62	50	41	35	31	28	25	21	18
9	93	74	62	53	47	41	37	31	27
12	124	99	83	71	62	55	50	41	35
13.5	140	112	93	80	70	62	56	47	40
15	155	125	103	89	78	69	62	52	44
18	186	149	124	106	93	83	74	62	53
24	248	199	164	142	124	110	99	83	71
27	279	223	186	160	140	124	112	93	80
30	310	248	207	177	155	138	124	103	89
36	372	298	248	213	186	165	149	124	106
45	465	372	310	266	233	207	186	155	133
54	558	447	372	319	279	248	223	186	160
81	837	671	558	479	419	372	335	279	240

Multiply kW input by 3,412 to determine BTU input:
Example: 54kW x 3412 = 184,248 BTU's

Recovery Computation Formula

GPH= (watts x 3.412) / (8.25 x °Temp. Rise)

GENERAL OPERATION

Before closing the switch to allow electric current to flow to the water heater, make certain that the water heater is full of water and that the cold water inlet valve is open. Complete failure of the heating elements will result if they are not totally immersed in water at all times. When the switch is closed, the operation of this electric water heater is automatic. The temperature control knob located on the side on the control box is factory preset to 120°F *(49°C)*. Care must be taken whenever using hot water to avoid scalding injury. Certain appliances require high temperature hot water (such as dishwashers and automatic clothes washers).

TO FILL THE WATER HEATER

⚠ CAUTION

Scalding may occur within five (5) seconds at a temperature setting of 140°F *(60°C)*.

1. Close the water heater drain valve by turning the knob clockwise.
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. Reconnect power supply to 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. Disconnect the power supply to the water heater. Consult the plumbing professional or electric company in your area for service.
2. Close the cold water supply shut-off valve.
3. Open the drain valve on the water heater by turning the knob counter-clockwise. The drain valve has threads on the end that will allow connection of a standard hose coupling.
4. Open a hot water faucet to allow air to enter the system.

To refill the water heater, refer to “TO FILL THE WATER HEATER.”

Thermostat Adjustment

To adjust the water temperature, locate the temperature control dial on the right side of the control box. To increase the water temperature, rotate the temperature control dial clockwise. To decrease the water temperature, rotate the temperature control dial counterclockwise (see Figure 5). The thermostat(s) or temperature control dial has been factory preset to approximately 120°F *(49°C)*.

Thermostat adjustment continued-

⚠ 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 anti-scald tempering valve in the water system. This valve will reduce point of discharge water temperatures by mixing cold and hot water in branch water lines. A licensed plumbing professional or local plumbing authority should be consulted.

Note: This water heater is equipped with an energy cut out device to prevent overheating. Should overheating occur, turn off the electrical supply to the water heater and contact a qualified service technician.

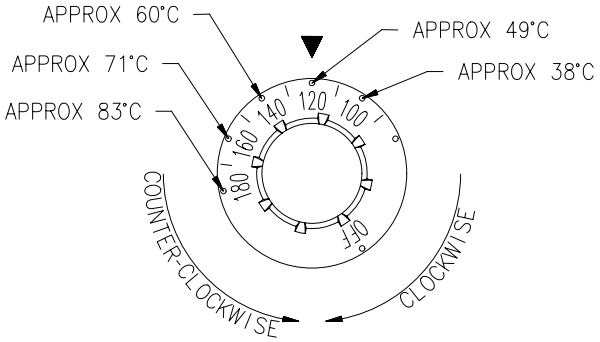


Figure 5

MAINTENANCE

IMPORTANT

The water heater should be inspected at a minimum of annually by a qualified service technician for damaged components. **DO NOT** operate this water heater if any part is found damaged.

Shut off the electric power whenever the water supply to the water heater is off. Shut off the electric power and water supply, drain the water heater completely to prevent freezing whenever the building is left unoccupied during the cold weather months. In order to insure efficient operation and long tank life, drain the water heater at least once a month through the drain valve until the water runs clear. Failure to do this may result in noisy operation and lime and sediment buildup in the bottom of the tank. Check the temperature-pressure relief valve to insure that the valve has not become encrusted with lime. Lift the lever at the top of the valve several times until the valve seats properly

Maintenance continued-

without leaking and operates freely. The following maintenance should be performed by a qualified service technician at the minimum periodic intervals suggested below. In some installations, the maintenance interval may be more frequent depending on the amount of use and the operating conditions of the water heater. Regular inspection and maintenance of the water heater will help to insure safe and reliable operation.

1. Annually, check the operation of the thermostat(s).
2. Bi-annually, check the seal around the heating elements for leaks. If there is any sign of leaking, disconnect the power supply to the water heater and contact the plumbing professional that installed this water heater or a qualified service technician.
3. At least once a year, check the combination temperature and pressure relief valve to insure that the valve has not become encrusted with lime. Lift the lever at the top of the temperature-pressure relief valve several times until the valve seats properly without leaking and operates freely.
4. If the combination temperature and pressure relief valve on the appliance

⚠ WARNING

When lifting lever of temperature-pressure relief valve, hot water will be released under pressure. Be certain that any released water does not result in bodily injury or property damage.

discharges periodically, this may be due to thermal expansion in a closed water supply system. Contact the water supplier or local plumbing inspector on how to correct this situation. **Do not plug the combination temperature and pressure relief valve outlet for any reason.**

5. Monthly, drain the water heater through the drain valve until the water runs clear to remove silt and sediment.

⚠ WARNING! THIS WATER MAY BE HOT.

6. A sacrificial anode rod has been installed to extend tank life. The anode rod should be inspected periodically (every 2 years) 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 rod. Contact the plumbing professional who installed the water heater or the manufacturer listed on the rating plate for anode replacement information. The use of a water softener may increase the speed of anode consumption. More frequent inspection of the anode is needed when using softened (or phosphate treated) water.

Maintenance continued-

7. If this water heater is equipped with fuses, before removing any fuse, disconnect the all power to the water heater. Open the control box door and replace fuses according to the size indicated on the wiring diagram affixed to the inside of the control box door.

⚠ CAUTION

FOR YOUR SAFETY, **DO NOT** ATTEMPT TO REPAIR THERMOSTAT(S), HEATING ELEMENTS, OR ELECTRICAL WIRING. REFER SUCH REPAIRS TO A QUALIFIED SERVICE TECHNICIAN.

Contact your local plumbing supplier or plumbing professional for replacement parts or contact the company at the address displayed on the rating plate of the water heater.

For faster and better service, please provide the part name, model, and serial number(s) of the water heater(s) when ordering parts.

READ THE WARRANTY FOR A FULL EXPLANATION OF THE LENGTH OF TIME THAT PARTS AND THE WATER HEATER ARE WARRANTED.

Manufactured under one or more of the following U.S. Patents: RE.34,534; B1 5,341,770; 4,416,222; 4,628,184; 4,669,448; 4,672,919; 4,808,356; 4,829,983; 4,861,968; 4,904,428; 5,000,893; 5,023,031; 5,052,346; 5,081,696; 5,092,519; 5,115,767; 5,199,385; 5,277,171; 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; 6,142,216; 6,684,821; 7,063,132;
Other U.S. and Foreign patent applications pending. Current Canadian Patents: 1,272,914; 1,280,043; 1,289,832; 2,045,862; 2,092,105; 2,107,012; 2,108,186; 2,112,515

Complete the following information and retain for future reference:

Model No:_____

Serial No:_____

Service Phone
Days:_____ Nights:_____

Address:_____

Supplier:_____

Supplier Phone No:_____

SERVICING GUIDE

This “Servicing Guide“ section of this Installation and Operation Installation manual is provided for the purpose of improving the effectiveness and the efficiency of servicing this water heater. This information is intended to assist qualified service personnel. Servicing of this water heater may require knowledge of electrical testing instruments. If you are unfamiliar or unsure of the electrical circuits or the testing instruments, consult a qualified electrician.

This section of these Installation and Operation Instructions is not intended for use as a troubleshooting guide. For troubleshooting instructions please contact the supplier from whom this water heater was purchased or the manufacturer listed on the rating plate.

This water heater has two distinct electrical systems. One system connects the electrical power to the heating elements, while the other system controls the water heater operation. The electrical contactors interconnect these two systems. In order to clearly illustrate the electrical circuits, two wiring diagrams are provided. These diagrams are labeled as the “Power Circuit Wiring Diagram” and the “Control Circuit Wiring Diagram” and they are attached to the surface of the panels inside the water heater control cabinet.

Control Circuit Description:

This description will explain certain aspects of the Control Circuit. The control circuit operates with 120VAC electrical service. This voltage is provide by the multi-tap transformer which has the primary coil connected to the field wiring that is serving the water heater. The Transformer, the Water Heater Thermostat, the Hi-Limit Temperature Control, and the Contactor Coil are always included in the Control Circuit.

Referring to the ”Control Circuit Wiring Diagram“, the contactor coil is energized when the Thermostat senses a need for heating. Electrical current to the contactor coil will be interrupted when the water temperature is sufficient to satisfy the temperature limits of the either the Thermostat or the Hi-Limit Control. The Hi-Limit Control is provided with manual reset buttons.

Certain other control components are available as “Optional“. When these optional components are installed with the water heater, the control circuit wiring diagram accordingly will include these components. The optional equipment available from the manufacturer includes the following:

- High Water Pressure Switch
- Low Water Pressure Switch
- Low Water Level Switch
- Alarm Horn
- Heating Element Sequencers
- Electrical Door Lock

Optional Components

High and Low Water Pressure Controls

These controls interrupt the electrical current to the contactor coil when the pressure settings are exceeded. The operation and setting of these controls are described in the manual provided by the control manufacturer. This manual is included with the water heater Installation and Operating Instruction manual provided by Bradford White Corporation.

The pressure settings for these controls are adjustable. These controls are specified for use when the installation has unique pressure requirements that must be safeguarded. Therefore, before adjusting the pressure values, it is recommended that you consult the person responsible for the facility that the water heater is servicing.

The electrical connections are referenced in the Control Circuit Wiring Diagram and in the pressure control manual provided by the control manufacturer. Refer to these instructions when servicing the controls.

The following unusual situations will give reason for the pressure controls to interrupt the electrical current to the coil of the contactor:

- Upon installation or occasions of re-starting heater operation, if the inlet supply line is closed (i.e. a shut-off valve), the high pressure limit may be exceeded due to reasons of thermal expansion of the water.

- If during the operation of the water heater the inlet line is closed (i.e. a shut-off valve), a low pressure condition can develop when water is allowed to exit through the outlet connection.

- If during the operation of the water heater the inlet line is closed (i.e. a shut-off valve), a low pressure condition can develop when water is removed through the water heater drain valve.

Low Water Level Control

This control will interrupt the electrical current to the contactor coil when a low water level condition is sensed inside the water heater tank. When the low water level condition is corrected the control will automatically sense the new situation and electrical current will again energize the contactor coil. Normal water heater operation will be resumed.

To remove the low water level control from the tank you must first loosen the control by un-threading it from the tank fitting and then rotating the control until the arrow printed on the side of the hex fitting is pointing downward. Refer to figure 6 for clarification. This will enable the float orientation to align itself with the opening in the tank-fitting.

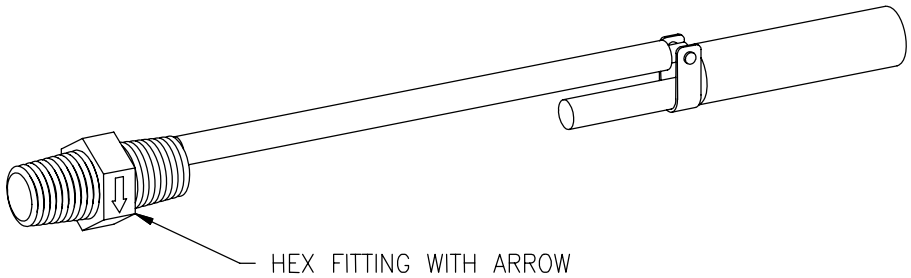


Figure 6

When installing the control refer to the direction of the arrow on the hex and insure that it is pointing upwards. If it is not pointing upward, the control switch will not activate when the tank is refilled with water. Refer to Figure 7 for clarification.

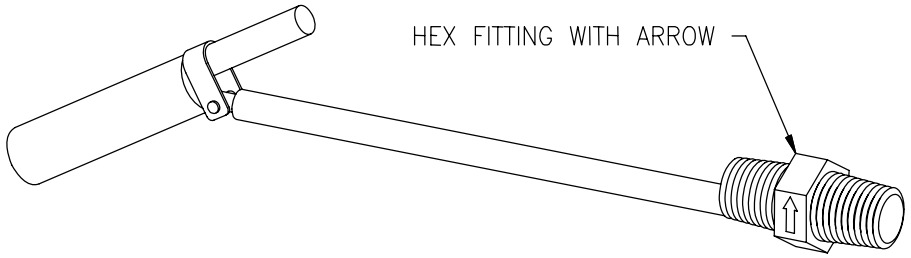


Figure 7

Alarm Horn

The Alarm Horn is an option specified when the installation desires an audible signal to immediately sound an alert when the water heater operation is interrupted for certain faults. Referring to the control circuit wiring diagram, the alarm will activate when any one of the following events occur:

- The Hi-Limit control has been tripped
- The High Water Pressure Control senses excessive pressure
- The Low Water Pressure Control senses insufficient pressure
- The Low Water Level Control senses an insufficient quantity of water

The alarm will sound only for the options specified (i.e. if a low water level control is not specified then the alarm will not recognize a low water level condition). Referring to the Control Circuit Wiring Diagram, observe the horn relay that is employed to correctly apply the horn to the control circuit.

The following unusual situations will give reason for the alarm to sound:

- If a High Pressure Control is installed, upon installation of the water heater or occasions of re-starting water heater operation, if the inlet supply line is closed (i.e. a shut-off valve), the high pressure may be exceeded due to reasons of thermal expansion of the water.

- If a Low Pressure Control is installed and if during the operation of the water heater the inlet line is closed (i.e. a shut-off valve), a low pressure condition can develop when water is allowed to exit through the outlet connection.

- If a Low Pressure Control is installed and if during the operation of the water heater the inlet line is closed (i.e. a shut-off valve), a low pressure condition can develop when water is removed through the water heater drain valve.

Heating Element Sequencers:

Heating element sequencers are available in order to stage the activation of the heating elements thereby, reducing the inrush current to the water heater. The sequencers will control one or two contactor coils depending upon the water heater voltage, phase, and KW.

One contactor will be energized immediately when there is heating demand, the second contactor, controlled with a sequencer, will be activated approximately 20 seconds later, and the third contactor will be activated in another 20 seconds thereby, staging the three contactors over the 40 second time period. The staging occurs in a similar manner for applications having more than three contactors.

Refer to the Control Circuit Wiring Diagram for the specific application being serviced.

Note: On the occasion of servicing the water heater where frequent restarts in a short time interval are encountered (i.e. on, off, on, etc.), the timing sequences will not begin until the sequencers have experienced a time interval to reset.

Electrical Door Lock:

An electrical door lock is offered in order to secure the access to the water heater control cabinet. This device will lock the control cabinet door when the 120VAC control circuit voltage is applied to it.

Note: Once the door is opened, the water heater can be re-energized, if necessary, for service diagnosis.

Power Circuit Description:

The Power Circuit Wiring Diagram illustrates the electrical connections from the incoming power supply through the circuit to the electrical elements. The power circuits are available with internal circuit fusing and without internal circuit fusing.

Refer to the water heater power circuit wiring diagram attached to the inside panel of the control cabinet for the specific connections of the water heater being serviced. The power circuit components and supporting information that appear on the wiring diagram include the following:

- Field wiring connection via terminal block or other connection point
- Fuse block with amperage ratings displayed (when provided)
- Contactors with amperage ratings displayed
- Electrical elements with voltage and wattage ratings displayed
- Water heater total amperage draw is displayed

BRADFORD WHITE®
CORPORATION

COMMERCIAL ELECTRIC ENERGY SAVER WATER HEATER

ASME SERIES IMMERSION THERMOSTAT WITH CONTACTORS

SERVICE MANUAL

Troubleshooting Guide
and Instructions for Service

(To be performed ONLY by
qualified service providers)

Models Covered by This Manual:

6A, 12A, 20A, 30A, 40A, 50A, 80A, 120A

Table of Contents

Introduction

This service manual is designed to aid service and maintenance professionals on the function, proper diagnosis and repair of Bradford White Commercial Electric Water Heaters.

The text and illustrations in this manual provide step by step instructions to facilitate proper operation and troubleshooting procedures. Contact the Bradford White Technical Support Group immediately if diagnosis can not be made using the methods described in this service manual.

Tools

- Multi Meter.
- 2-1/8" Deep Well Socket.
- 1-1/16" Deep Well Socket.
- ¼" Nut Driver.
- Phillips Head Screw Driver.
- Common Screw driver.
- Thermometer.
- Drain Hose.

- Other Hand Tools: Pipe Wrench, Channel Locks, Pliers (common & needle nose), Wire cutters, Wire Strippers, Allen Wrench Set, Flash Light.

Model Number Breakdown

120A - 24 - 3 - 108B - BBG

Pressure Gage Option.

Control Circuit Option Code.
Any combination of the following optional controls:
- Heating Element Time Delay Sequencing.
- Low Water Power Interrupt.
- Panel Door Interlock
- High Pressure Power Interrupt
- Low Pressure Power Interrupt
- Alarm Horn

NOTE: Code "AA" denotes no optional controls used.

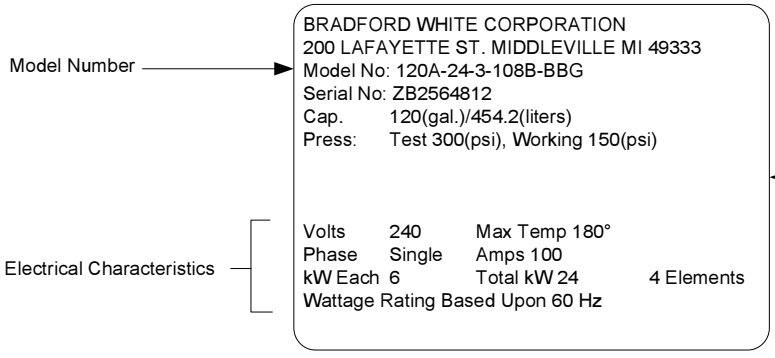
Power Circuit Code.
- Voltage
- kW Rating
- Phase
- Amp Rating

Warranty

kW Rating

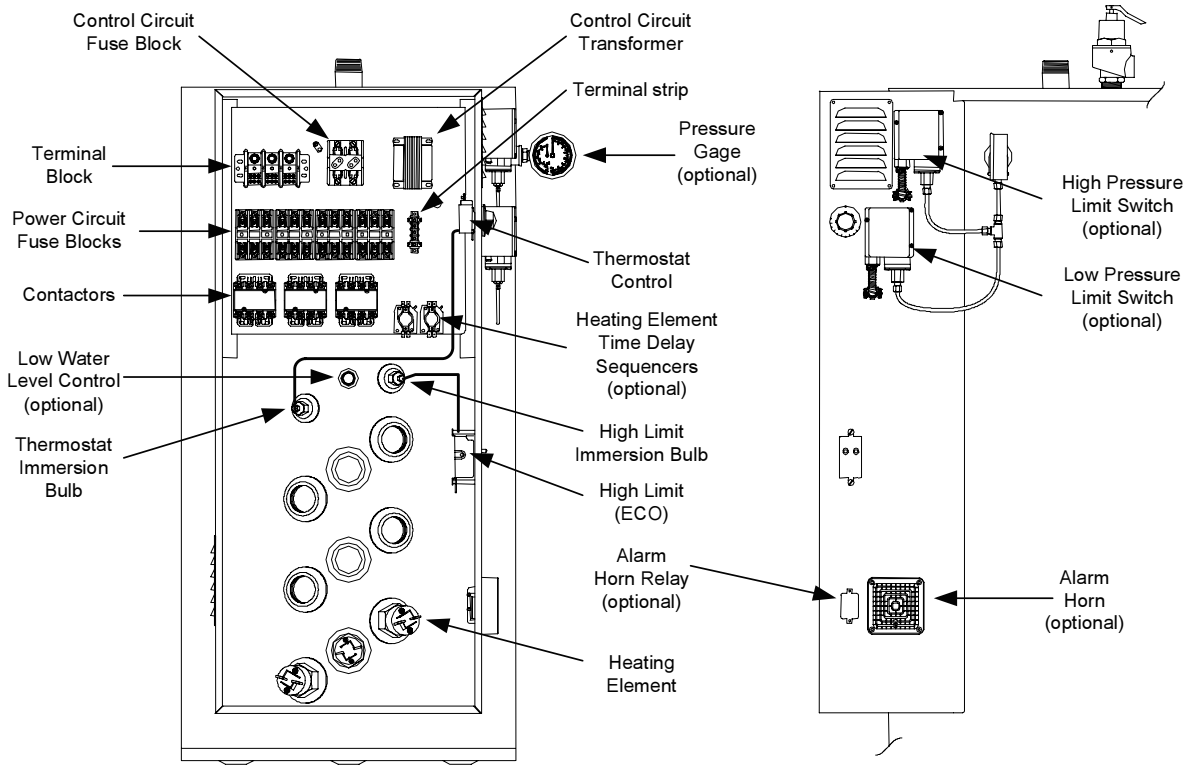
Tank

In the Field, this information is obtained from the heaters rating plate



Typical Rating Plate
Located On Front Of Water Heater

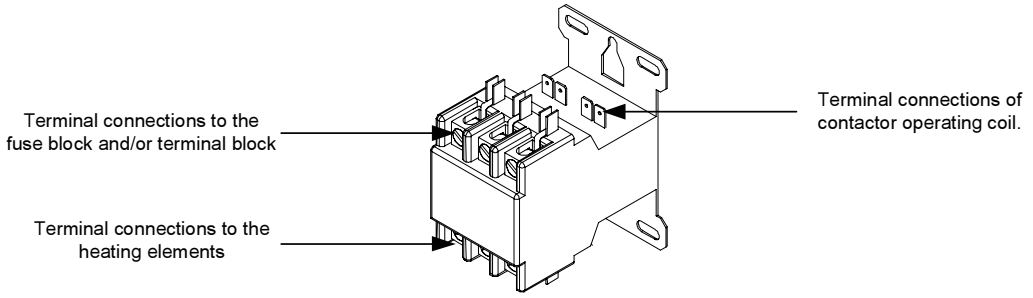
General Controls Layout



Standard Controls

Contactor

Contactor operation is achieved by energizing a 120 volt operating coil located within the contactor in response to a call for heat from the immersion thermostat. Upon a call for heat, one or more contactors will energize all heating elements simultaneously. Optionally, time delay sequencers may be used to stage contactor activation thereby reducing the inrush of current to the water heater.

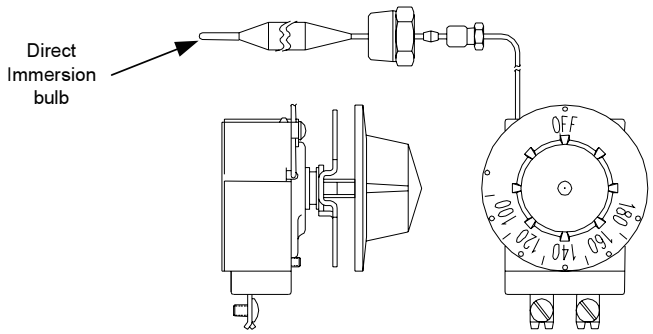


Standard Controls (continued)

Immersion Style Thermostat Control

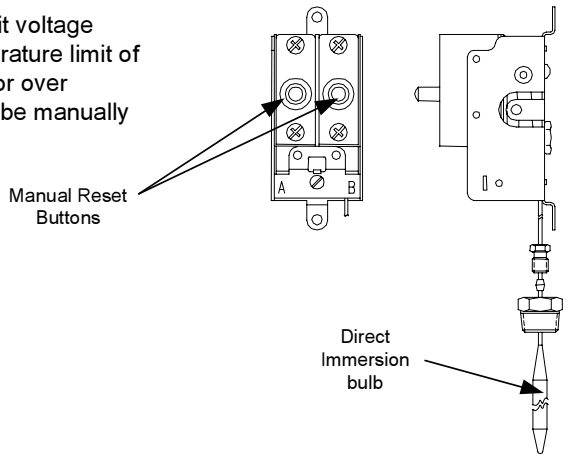
The thermostat will complete control circuit voltage upon a call for heat. Likewise, the control will interrupt control circuit voltage when the water temperature is sufficient to satisfy the adjustable temperature limit of control.

Immersion Thermostat Control



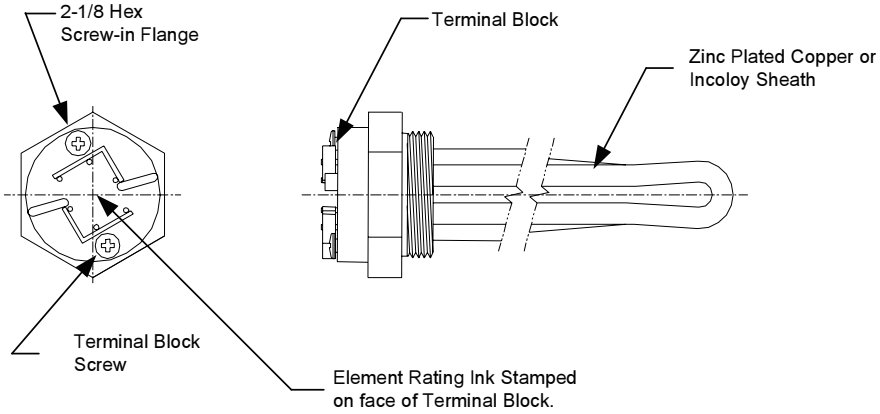
Immersion Style High Limit (ECO) Control for Contactor Models

The high limit (ECO) control will interrupt control circuit voltage causing the heater to shut down when the high temperature limit of the control is reached (196°F±4°F). Once the cause for over heated water has been determined, The control must be manually reset to restore normal operation.



Standard Controls (continued)

Direct Immersion "Screw-in" Type Heating Element



Optional Controls

Certain control components are available as "Optional". When these optional components are installed with the water heater, the control circuit wiring diagram accordingly will include these components. The optional equipment available from the manufacturer includes the following:

-High Water Pressure Switch

-Low Water Pressure Switch

-Low Water Level Switch

-Heating Element Time Delay Sequencers

-Electrical Door Lock

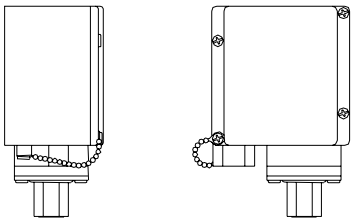
-Alarm Horn

High and Low Water Pressure Controls-

These controls interrupt the electrical current to the contactor coil when the pressure settings are exceeded. The operation and setting of these controls are described in the manual provided by the control manufacturer. This manual is included with the water heater Installation and Operating Instruction manual provided with the water heater.

The pressure settings for these controls are adjustable. These controls are specified for use when the installation has unique pressure requirements that must be safeguarded. Therefore, before adjusting the pressure values, it is recommended that you consult the person responsible for the facility that the water heater is servicing.

The electrical connections are referenced in the Control Circuit Wiring Diagram and in the pressure control manual provided by the control manufacturer. Refer to these instructions when servicing the controls.

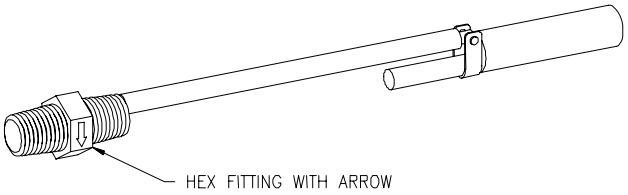


Optional Controls (continued)

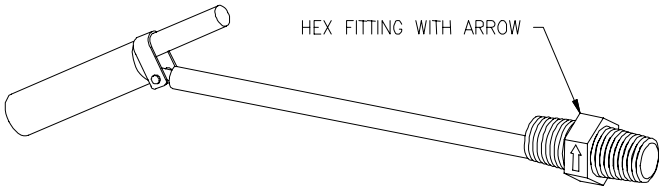
Low Water Level Control-

This control will interrupt the electrical current to the contactor coil when a low water level condition is sensed inside the water heater tank. When the low water level condition is corrected the control will automatically sense the new situation and electrical current will again energize the contactor coil. Normal water heater operation will be resumed.

To remove the low water level control from the tank you must first loosen the control by un-threading it from the tank fitting and then rotating the control until the arrow printed on the side of the hex fitting is pointing downward. This will enable the float orientation to align itself with the opening in the tank-fitting.



When installed, refer to the direction of the arrow on the hex and insure that it is pointing upwards. If it is not pointing upward, the control switch will not activate when the tank is refilled with water. Refer to illustration below for clarification.



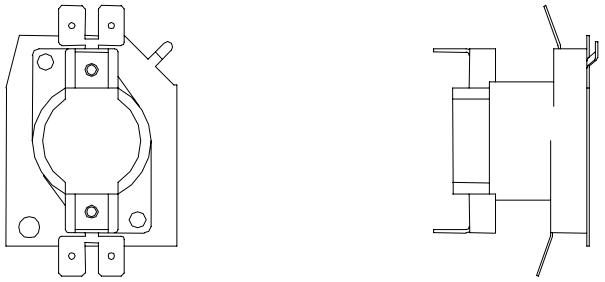
Heating Element Time Delay Sequencers-

Heating element sequencers are available in order to stage the activation of the heating elements thereby, reducing the inrush of electrical current to the water heater. The sequencers will control one or more contactor coils depending upon the water heater voltage, phase, and KW.

One contactor will be energized immediately when there is heating demand, the second contactor, controlled with a sequencer, will be activated approximately 20 seconds later, and the third contactor will be activated in another 20 seconds thereby, staging the three contactors over the 40 second time period. The staging occurs in a similar manner for applications having more than three contactors.

Refer to the Control Circuit Wiring Diagram for the specific application being serviced.

Note: On the occasion of servicing the water heater where frequent restarts in a short time interval are encountered (i.e. on, off, on, etc.), the timing sequences will not begin until the sequencers have experienced a time interval to reset.

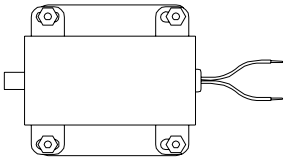


Optional Controls (continued)

Electrical Door lock-

An electrical door lock is offered in order to secure the access to the water heater control cabinet. This device will lock the control cabinet door when the 120VAC control circuit voltage is applied to it.

Note: Once the door is opened, the water heater can be re-energized, if necessary, for service diagnosis.

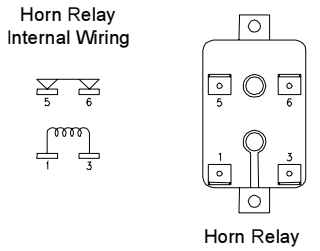


Alarm Horn-

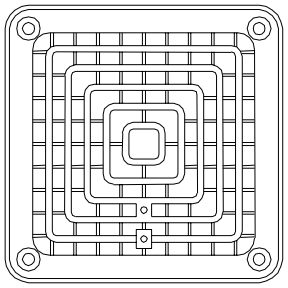
The Alarm Horn is an option specified when the installation desires an audible signal to immediately sound an alert when the water heater operation is interrupted for certain faults. Referring to the control circuit wiring diagram, the alarm will activate when any one of the following events occur:

- The Hi-Limit control has been tripped
- The High Water Pressure Control senses excessive pressure
- The Low Water Pressure Control senses insufficient pressure
- The Low Water Level Control senses an insufficient quantity of water

The alarm will sound only for the options specified (i.e. if a low water level control is not specified then the alarm will not recognize a low water level condition).

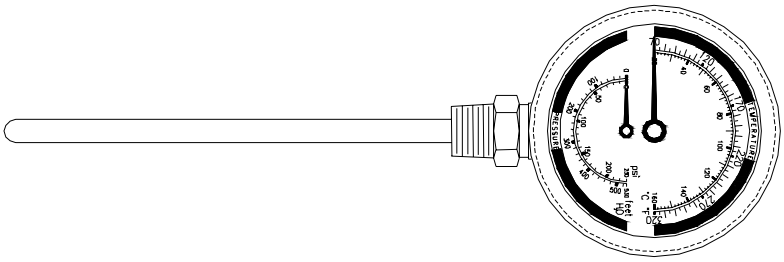


Horn Relay



Combination Temperature and Pressure Gage-

A non-electrical device to visually reference water temperature and internal tank pressure.



BRADFORD WHITE CORPORATION

Commonly Used Formulas

(Single phase)

$$\text{Amps} = \frac{\text{Watts}}{\text{Volts}}$$

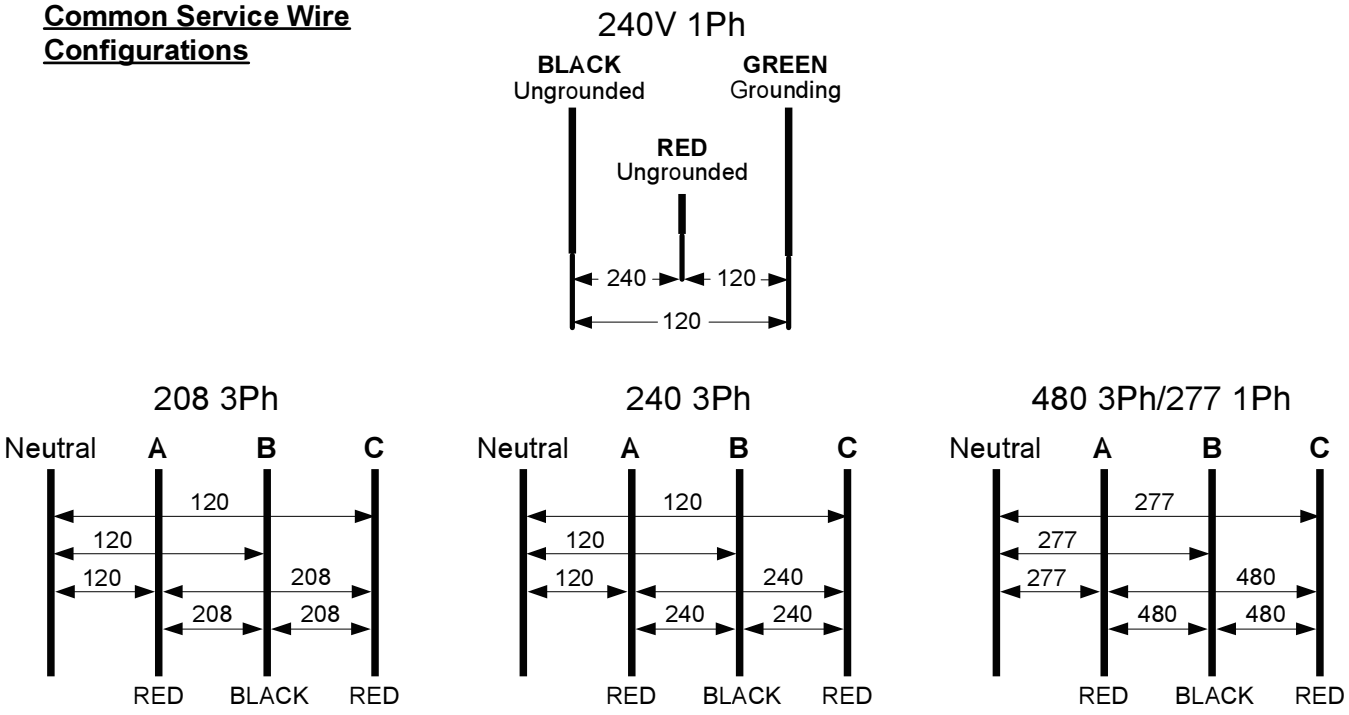
(balanced 3 phase)

$$\text{Amps} = \frac{\text{Watts}}{\text{Volts} \times 1.732}$$

$$\text{Watts} = \text{Amps} \times \text{Volts}$$

$$\text{Ohms} = \frac{\text{Volts}^2}{\text{Watts}}$$

Common Service Wire Configurations



Full Load Current Amps

	208 Volt		240 Volt		277 Volt	380 Volt	415 Volt	480 Volt		600 Volt
kW	1 Ph	3 Ph	1 Ph	3 Ph	1 Ph	3 Ph	3 Ph	1 Ph	3 Ph	3 Ph
3	14.4	-	12.5	-	10.8	-	-	6.3	-	-
6	28.8	16.6	25.0	14.4	21.6	9.1	8.3	12.5	7.2	5.7
9	43.2	25.0	37.2	21.6	32.4	13.6	12.5	18.7	10.8	8.66
12	57.6	33.3	50.0	28.9	43.3	18.2	16.7	25.0	14.4	11.5
13.5	64.9	37.5	56.2	32.5	48.7	20.5	18.8	28.1	16.2	13.0
15	72.1	41.6	62.5	36.1	54.1	22.7	20.9	31.2	18.0	14.4
18	86.5	50.0	75.0	43.4	64.9	27.3	25.0	37.5	21.6	17.3
24	115.4	66.7	100.0	57.8	86.6	36.4	33.4	50.0	28.9	23.1
27	129.8	75.0	112.5	65.0	97.4	41.0	37.5	56.2	32.5	26.0
30	144.2	83.3	125.0	72.2	108.3	45.6	41.7	62.5	36.1	28.8
36	173.0	100.0	150.0	86.7	129.9	54.7	50.1	75.0	43.3	34.6
45	216.3	125.0	187.5	108.3	162.4	68.4	62.6	93.7	54.1	43.3
54	259.6	150.0	225.0	130.0	194.9	82.0	75.1	112.5	65.0	52.0
81	389.4	224.8	337.5	194.8	292.4	123.1	112.6	168.7	97.4	78.0

This water heater has two distinct electrical systems. One system, referred to as the ***"Control Circuit"***, controls the water heater operation, while the other system referred to as the ***"Power Circuit"***, connects the electrical power to the heating elements, The electrical contactors interconnect these two systems. In order to clearly illustrate the electrical circuits, two wiring diagrams are provided. These diagrams are labeled as the "Control Circuit Wiring Diagram" and the "Power Circuit Wiring Diagram" and they are attached to the surface of the panels inside the water heater control cabinet.

Control Circuit Description-

The control circuit operates with 120VAC electrical service. This voltage is provide by the multi-tap transformer which has the primary coil connected to the field wiring that is serving the water heater. The Transformer, Thermostat, Hi-Limit control, and the Contactor Coil are always included in the Control Circuit.

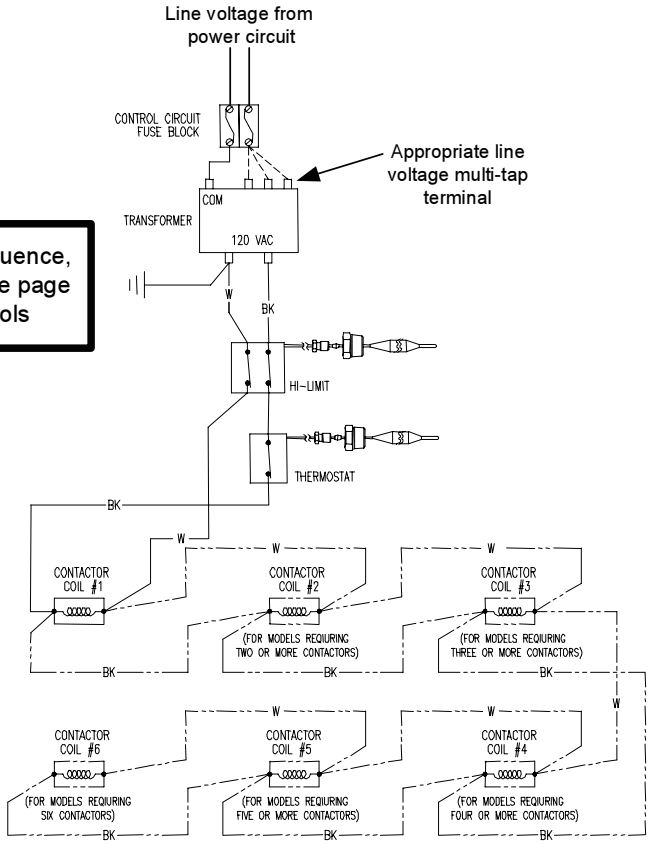
Certain other control components are available as "Optional". When these optional components are installed with the water heater, the control circuit wiring diagram accordingly will include these components. The optional equipment available from the manufacturer includes the following:

- High Water Pressure Switch
- Low Water Pressure Switch
- Low Water Level Switch
- Alarm Horn
- Heating Element Sequencers
- Electrical Door Lock

Control Circuit Sequence of Operation-

NOTE: To help understand the concept of the operating sequence, the control circuit shown is without any optional controls. See page 11 For control circuit showing all available optional controls

1. Line voltage is applied to control circuit fuse block.
2. Line voltage continues to transformer with one leg of voltage connecting to the common terminal and the other leg connecting to the appropriate line voltage multi-tap terminal. Transformer output (always 120 volts) continues to high limit (ECO) control.
3. Hi limit (ECO) control is closed so one leg of 120 volts continues to one side of the contactor coil. The other leg is connected to the thermostat.
4. When the thermostat calls for heat, contacts close inside the thermostat completing the circuit and energizing the contactor coil.
5. The energized contactor coil causes the contactor to close energizing the heating elements.
6. When the temperature setting of the thermostat is reached, the contacts in the thermostat open. This interrupts current flow through the control circuit de-energizing the contactor coil.



Control Circuit Wire Diagram

7. The de-energized contactor coil causes the contactor to open, interrupting current flow through the Heating elements.

BRADFORD WHITE CORPORATION

Control Circuit Sequence (Continued)-

Certain other control components are available as “Optional“. These controls are specified when the installation has unique requirements that must be safeguarded. When these optional components are installed the control circuit wiring diagram accordingly will include these components. The optional equipment available from the manufacturer includes the following:

- High Water Pressure Switch
- Low Water Pressure Switch
- Low Water Level Switch
- Alarm Horn
- Heating Element Sequencers
- Electrical Door Lock

Control Circuit Sequence of Operation with Optional Controls-

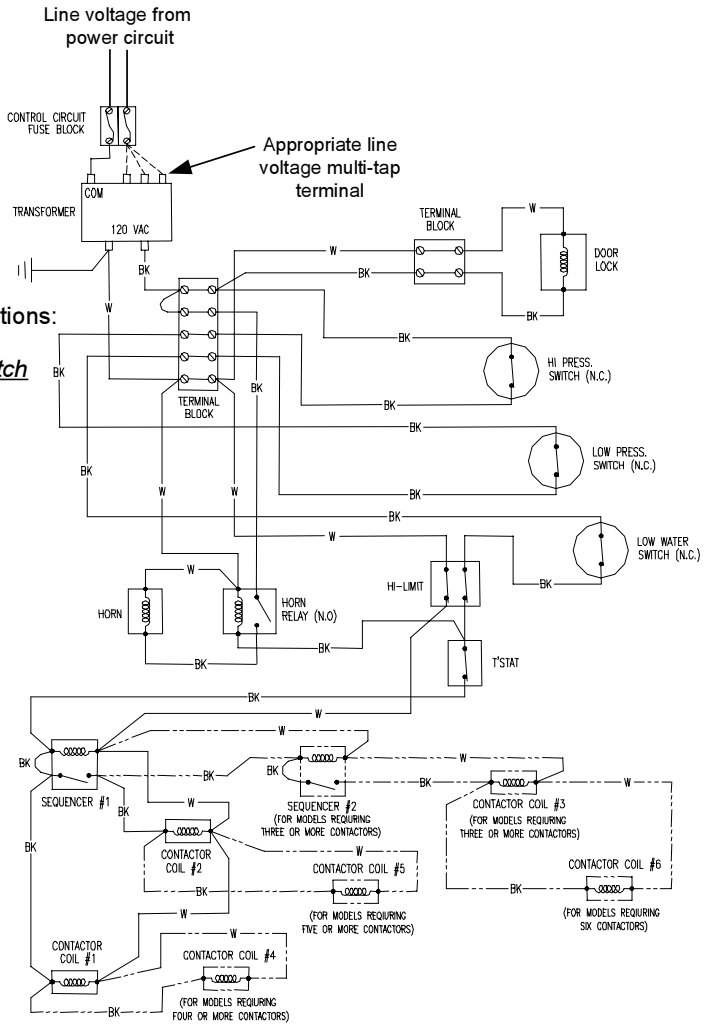
Same as explained on page 10 with the following exceptions:

-*Hi and Low Pressure Switch* and *Low Water Level Switch* when specified are always wired in series ahead of the Hi-limit control.

-*Heating Element Sequencers* are wired in series with contactor coils staging contactor activation at intervals of approximately 20 seconds.

-*Alarm Horn* is wired in series ahead of the thermostat. It monitors only the Hi and Low pressure switch, Low water level Switch and the hi-limit (ECO). If either of these switches open, power to the horn relay is interrupted causing the relay to close sounding the alarm horn.

-*Electrical Door Lock* is wired in parallel to secure the access to the water heater control cabinet. This device will lock the control cabinet door when the 120VAC control circuit voltage is applied. Once the door is opened, the water heater can be re-energized, if necessary, for service diagnosis.



Control Circuit Wire Diagram Showing Optional Controls

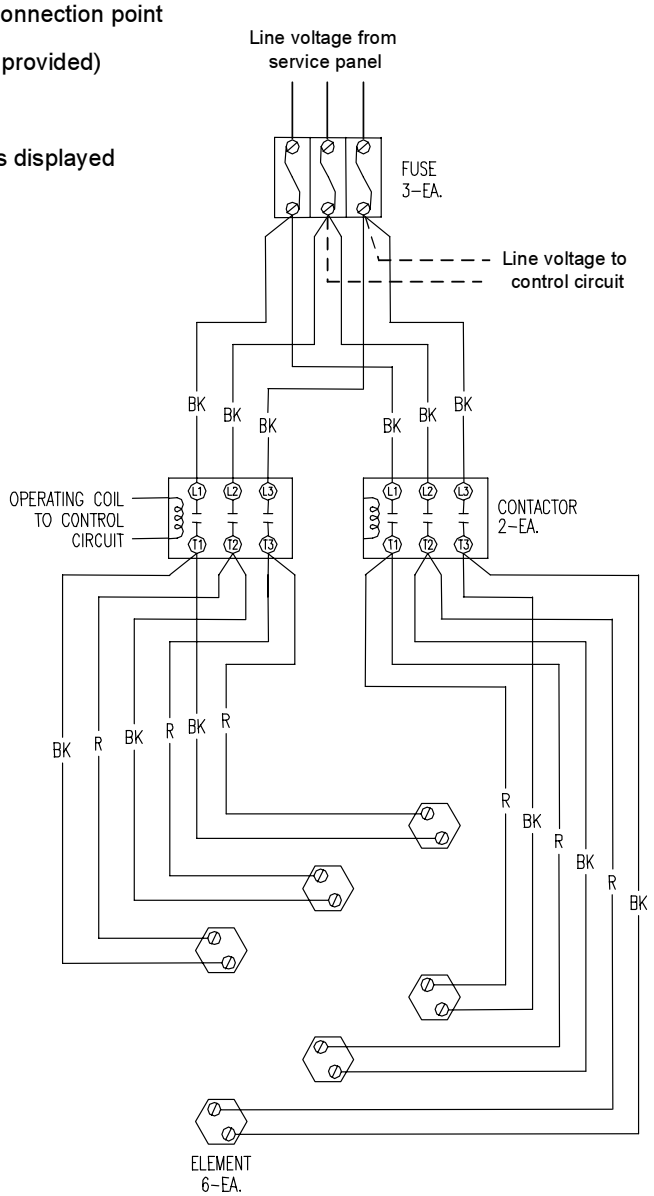
Power Circuit Description-

The Power Circuit Wiring Diagram illustrates the electrical connections from the incoming power supply through the contactors to the heating elements. The power circuits are available with internal circuit fusing and without internal circuit fusing.

As it would be impractical to show all wired configurations in this service manual, a reference wiring diagram is illustrated below to aid in the understanding of the power circuit operating sequence. Service providers must refer to the water heaters power circuit wiring diagram attached to the inside panel of the control cabinet for the specific connections of the water heater being serviced.

The power circuit components and supporting information that appear on the wiring diagram include the following:

- Field wiring connection via terminal block or other connection point
- Fuse block with amperage ratings displayed (when provided)
- Contactors with amperage ratings displayed
- Electrical elements with voltage and wattage ratings displayed
- Water heaters total amperage draw is displayed



Power Circuit Sequence-

1. Line voltage is applied across terminals of fuse block or a terminal block. Line voltage continues down and connects to terminals L1, L2 & L3 of one or more contactors.

   A) Contactor is open (no call for heat), so there is no voltage across terminal T1, T2 & T3 of contactor.

   B) The contactor is controlled by the control circuit as explained on pages 10 & 11.

2. The control circuit senses a call for heat and energizes the operating coil within the contactor.

3. The energized contactor coil causes the contactor to close energizing the elements from terminals T1, T2 & T3 of the contactor.

4. When the temperature setting of the thermostat is reached, the contacts in the thermostat open. This interrupts current flow through the control circuit de-energizing the contactor coil.

5. The de-energized contactor coil causes the contactor to open, interrupting current flow through the elements.

Most common cause for improper electric water heater operation can be linked to heating element failure.

When troubleshooting an electric water heater with the incidence of “No Hot Water” or “Insufficient Amount of Hot Water” It is always a good idea to check the heating elements first following the procedure on page 15.

Common Heating Element Failures Are:

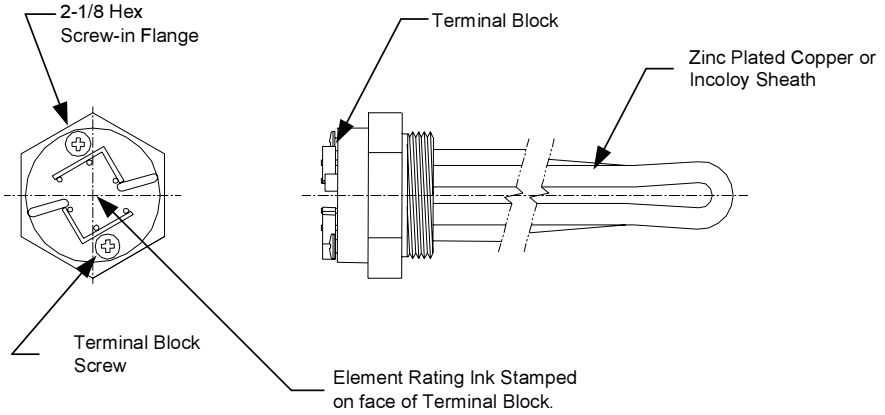
1. **Dry Firing.** Elements may be partially submerged in water or most likely, completely exposed with no water in the tank at all. In open air, an energized element *(Dry Fired)* will become completely inoperable within seconds. In some cases sediment or lime build up around an element can eventually cause an air pocket, resulting in a dry fired element. When element replacement is required, be sure tank is full of water prior to energizing the water heater.

2. **Grounded Element.** In most cases, an element with a short circuit to ground will cause the circuit breaker in the service panel to open or shut off. In some cases there may not be enough current draw for the circuit breaker to open. This will allow the heating element to be in continuous operation resulting in over heated water, limited only by the hi-limit (ECO) located in the control circuit. Repeated actuation of the hi-limit usually is the result of a grounded heating element.

3. **Sediment build up.** Slow hot water recovery can usually be traced back to sediment or lime build up around heating element. Sediment build up can also over time cause a dry fired element.

If an heating element is found to be inoperative, it must be replaced. Follow service procedure ACE-IX on page 23.

The illustration below shows a common “Screw-In” type heating element identifying certain features commonly referred to throughout this manual.



Typical Direct Immersion “Screw-In” Type Heating Element

Quick Step Plan to Hot Water

⚠ WARNING
High voltage exposure. Use caution when making voltage checks to avoid hazard to life or property.

1. **STOP, DANGER! Turn power "OFF" to water heater.**
2. Check all wire connections to insure they are snug and corrosion free.
3. Reset high limit (ECO) (page 18).
4. Check for inoperative heating element (page 15).
5. Check line voltage (pg 16), and internal fuses (page 17).
6. Refer to table below if items 1 through 5 above do not correct problem.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION	SERVICE PROCEDURE
No Hot Water	1. No power to heater. 2. Blown water heater fuses. 3. Loose wire connections. 4. Inoperative heating element(s). 5. Inoperative thermostat. 6. Open ECO. 7. Inoperative contactor(s).	1. Check circuit breakers at service panel. 2. Check water heater fuses. 3. Check all wire connections. 4. Check heating element(s). 5. Check thermostat operation. 6. Reset (check) ECO. 7. Check contactor operation.	2. ACE-III, Page 17 4. ACE-I, Page 15. 5. ACE-V, Page 19. 6. ACE-IV, Page 18 7. ACE-VI, Page 20
Not Enough Hot Water	1. Inoperative heating element(s). 2. Thermostat set to low. 3. Inoperative thermostat. 4. Inoperative contactor(s). 5. Loose wire connection. 6. High demand period. 7. Undersized heater. 8. Very cold inlet water to heater. 9. Plumbing connections reversed.	1. Check heating element(s). 2. Increase thermostat setting. 3. Check thermostat. 4. Check contactor operation. 5. Check all wire connection. 6. Reduce demand. 7. Replace with larger heater. 8. Temper water to heater. 9. Correct plumbing connections.	1. ACE-I, Page 15. 3. ACE-V, Page 19. 4. ACE-VI, Page 20.
Slow Hot Water Recovery	1. Sediment or lime build up on element(s). 2. Loose wire connections. 3. Inoperative contactor(s). 4. Derated heating element installed.	1. Clean or replace heating elements. 2. Check all wire connections. 3. Check contactor operation. 4. Verify element voltage and wattage rating.	1. ACE-IX, Page 23. 3. ACE-VI, Page 20. 4. See page 6.
Over Heated Water	1. Grounded heating element(s). 2. Thermostat set to high. 3. Inoperative thermostat. 4. Inoperative ECO.	1. Check heating element(s). 2. Adjust thermostat to desired setting. 3. Check thermostat. 4. Check ECO.	1. ACE-I, Page 15. 3. ACE-V, Page 19. 4. ACE-IV, Page 18.
Noisy (singing or hissing) Elements	1. Lime formation on elements. 2. High or low line voltage.	1. Clean or replace heating elements. 2. Verify line voltage to heater.	1. ACE-IX, Page 23. 2. ACE-II, Page 16.
Noisy Contactor	1. Low line voltage. 2. Debris between contactor plates. 3. Incorrect or defective operating coil. 4. Loose wire connections.	1. Verify line voltage to heater 2. Replace contactor. 3. Replace contactor. 4. Check wire connections.	1. ACE-II, Page 16

Test for Open or Burned Out Element.

⚠ DANGER
High voltage exposure. To avoid hazard to Life or property, be sure power is turned OFF to water heater while performing this procedure.

1. **STOP, DANGER! Turn power "OFF" to water heater.**
2. Open control panel access door.
3. Disconnect wires from heating element.
4. Set multi-meter to "ohms" setting.
5. Touch probes of multi-meter to screw terminals of heating element (see illustration 1).
6. Reading should be 12.8 ohms (±6%) for a 240 volt, 4500 watt element, see table below for other elements.

$$\text{Ohms} = \frac{\text{Volts}^2}{\text{Watts}}$$

A reading outside the range using the formula above (±6%), indicates a bad element and the element must be replaced.

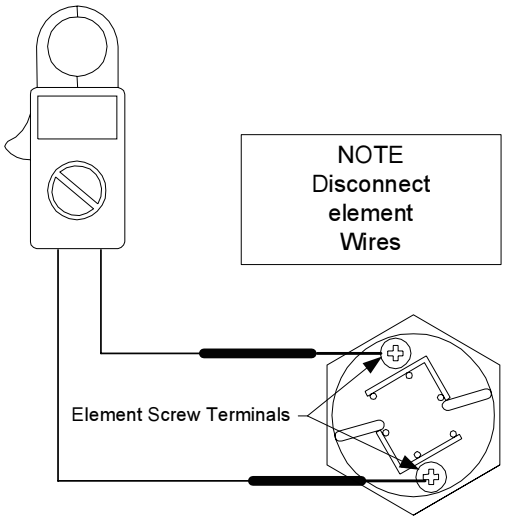


Illustration 1

Ohms of electrical Resistance For commonly Used Elements

Element Wattage	Voltage Rating of Element 208	240	480	600
2000	21.6	28.8	115.2	180
3000	14.4	19.2	76.8	120
4000	10.8	14.4	57.6	90
4500	9.6	12.8	51.2	80
5000	8.7	11.5	46.1	72
6000	7.2	9.6	38.4	60
9000	4.8	6.4	25.6	40

Test For Grounded Heating Element (damaged heating element with short circuit to ground).

1. **STOP, DANGER! Turn power "OFF" to water heater.**
2. Open control panel access door.
3. Disconnect wires from heating element.
4. Set multi-meter to "ohms" setting.
5. Touch one probe of multi-meter to either screw terminal of heating element and the other on the element flange (see illustration 2). There should be no reading on the ohm meter. Any reading indicates a grounded element and the element must be replaced. Repeat this step for the other screw terminal.

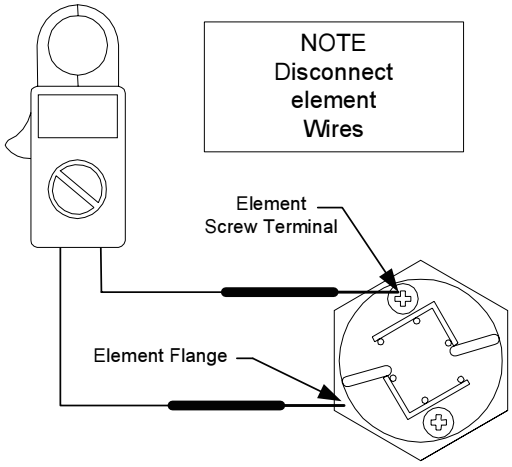


Illustration 2

Line Voltage Testing

⚠ DANGER
High voltage exposure. To avoid hazard to life or property use extreme caution when making voltage checks .

Line voltage (single phase or three phase) will connect to a terminal block or directly to a fuse block located inside control panel.

Determine heaters voltage and phase by referring to the rating plate located on the front of the heater. Apply the appropriate phase procedure below to determine if proper line voltage is present.

Single Phase Line Voltage Testing

1. **STOP, DANGER! Turn power "OFF" to water heater.**
2. Open control panel door.
3. Determine connection point for line voltage from service panel, ***terminal block*** or ***fuse block***
4. Set multi-meter to volts AC. Be sure to scale meter for appropriate voltage.
5. Use caution and turn power "ON" to water heater.
6. Use caution and check voltage across top terminals where service voltage connects to water heater. (see illustration 3).
   - A) Rated voltage IS present, power to the water heater is okay.
   - B) Rated voltage NOT present, Check service panel.

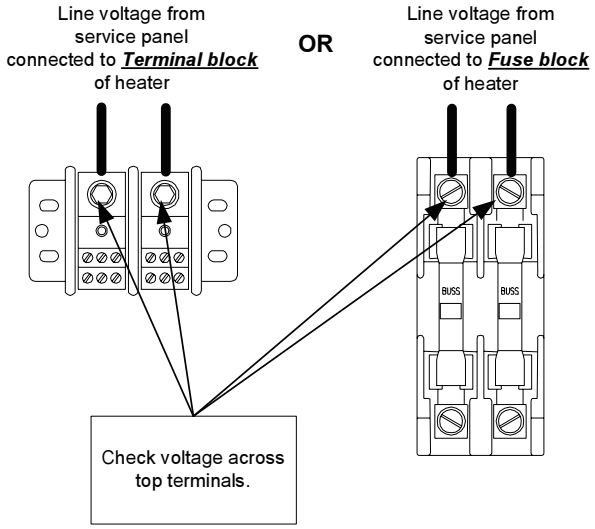


Illustration 3

Three Phase Line Voltage Testing

1. **STOP, DANGER! Turn power "OFF" to water heater.**
2. Open control panel door.
3. Determine connection point for line voltage from service panel, ***terminal block*** or ***fuse block***
4. Set multi-meter to volts AC. Be sure to scale meter for appropriate voltage.
5. Use caution and turn power "ON" to water heater.
6. Use caution and check voltage across top terminals where service voltage connects to water heater. (see illustration 4).
   - A) Rated voltage IS present, power to the water heater is okay.
   - B) Rated voltage NOT present, Check service panel.

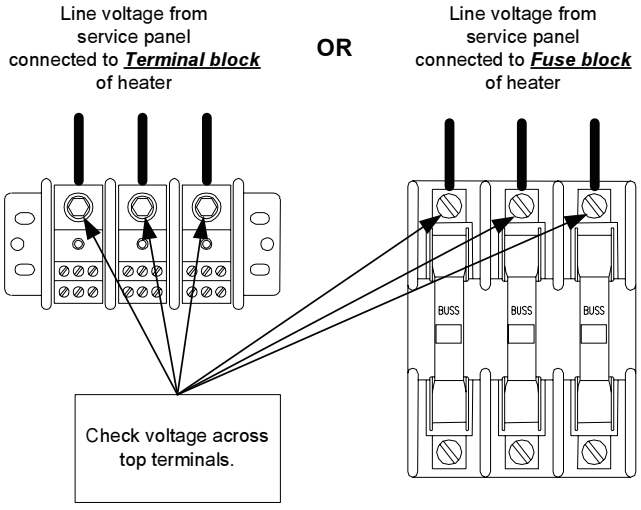


Illustration 4

Fuse Testing

⚠ DANGER
High voltage exposure. To avoid hazard to Life or property, be sure power is turned OFF to water heater while performing this procedure.

1. **STOP, DANGER! Turn power "OFF" to water heater.**
2. Open control panel door to allow access to fuse block.
3. Locate fuse block and remove fuses.
4. Set multi-meter to the "Ohms" setting.
5. Check continuity across fuse (see illustration 5).

   A) Continuity IS present, fuse is okay.

   B) Continuity NOT present, Replace with new fuse

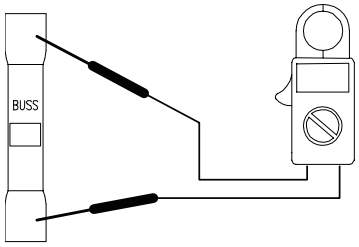


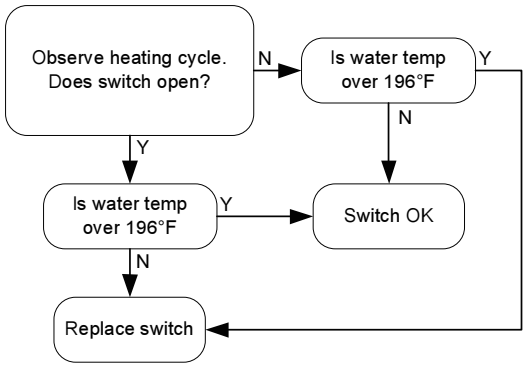
Illustration 5

High Limit Control (ECO) Operation

Switch Contacts:
Normally closed.
Open on rise @ 196°F ±4°F
Manual Reset.

1. Determine if Hi-Limit has actuated. This can be done by simply depressing the reset buttons. If you hear and/or feel a small click, the switch has actuated.

2. Use caution and turn power on to water heater and observe heating cycle following the Hi-Limit Heating Cycle flow chart.



High Limit Heating Cycle Flow Chart

High Limit Control Continuity Testing

DANGER
High voltage exposure. To avoid hazard to Life or property, be sure power is turned OFF to water heater while performing this procedure.

1. **STOP, DANGER! Turn power "OFF" to water heater.**

2. Water temperature must be below 196°F ±4°F

3. Remove Hi-Limit switch from control panel. It is not necessary to remove immersion bulb from tank at this time. See general controls layout on page 4 for location.

4. Disconnect wire leads to Hi-Limit Control.

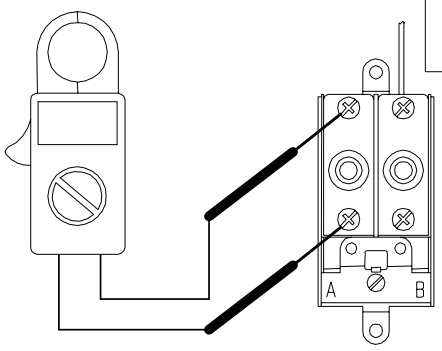
5. Depress reset buttons to insure switch contacts are closed.

6. Set multi-meter to Ohms setting, Check continuity Thru circuit A & B as shown in the illustrations below.

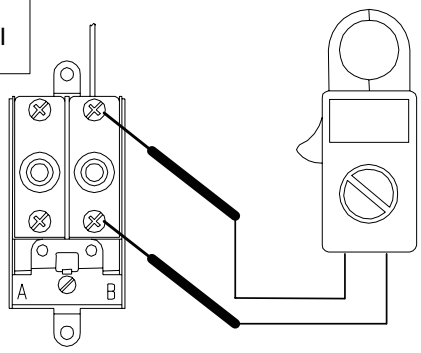
   - Continuity **IS** present, Switch is okay.

   - Continuity **NOT** present, Replace switch.

NOTE
Disconnect
Wire Leads to Control



Circuit "A" Continuity Testing



Circuit "B" Continuity Testing

Immersion Thermostat Operation Testing

Thermostat Specification:
Calibration: 184°F/176°F
Max Differential: 6°F
Operating Range 80 to 180°F

⚠ DANGER
High voltage exposure. To avoid hazard to life or property use extreme caution when making voltage checks .

Providing the water temperature in tank is within the operating range of the thermostat, checking thermostat operation can be as simple as rotating the thermostat dial and listening to the contactor(s) to see if they respond to a call for heat.

Use caution and turn Power "ON" and rotate the thermostat dial to call for heat. With water temperature below the thermostat setting, the contactor(s) close. With the contacts closed, use caution and check for rated voltage across lower terminals of contactor(s) (see illustration 10), If rated voltage is present, the thermostat is calling for heat.

Rotate thermostat dial to the minimum setting. With water temperature above the thermostat setting the contactor(s) will open. With the contacts open, voltage should not be present at lower terminals of contactor(s).

Follow the procedure below If preliminary testing above does not verify thermostat operation.

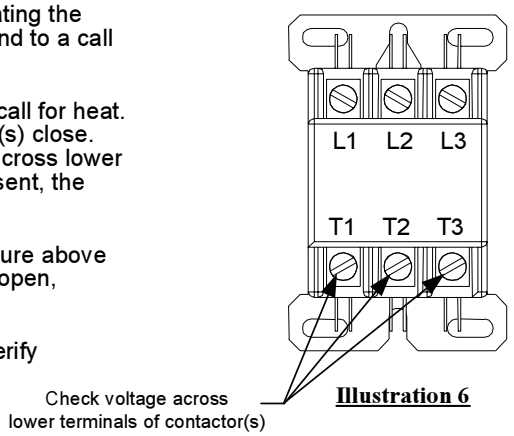


Illustration 6

Thermostat Control Continuity Testing.

1. This procedure assumes line voltage, ECO and contactor(s) are in working order.
2. **STOP, DANGER! Turn power "OFF" to water heater.**
3. Open control panel door.
4. Locate thermostat control (see general controls layout on page 4) and remove wire leads to control screw terminals.
5. Water temperature in tank must be within operating range of thermostat for this test. If above or below, it will be necessary to drain tank and remove thermostat immersion bulb from tank to warm or cool the bulb to be within operating range of thermostat.
6. Set multi-meter to the "Ohms" setting.
7. Rotate thermostat dial to highest setting.
8. Check across screw terminals of control (see illustration 7).
   - A) Continuity IS present, okay, Go to step 9.
   - B) Continuity NOT present, replace thermostat.
9. Rotate thermostat dial to lowest setting.
10. Check across screw terminals of control (see illustration 7).
    - A) Continuity NOT present, thermostat is okay,
    - B) Continuity IS present, replace thermostat.

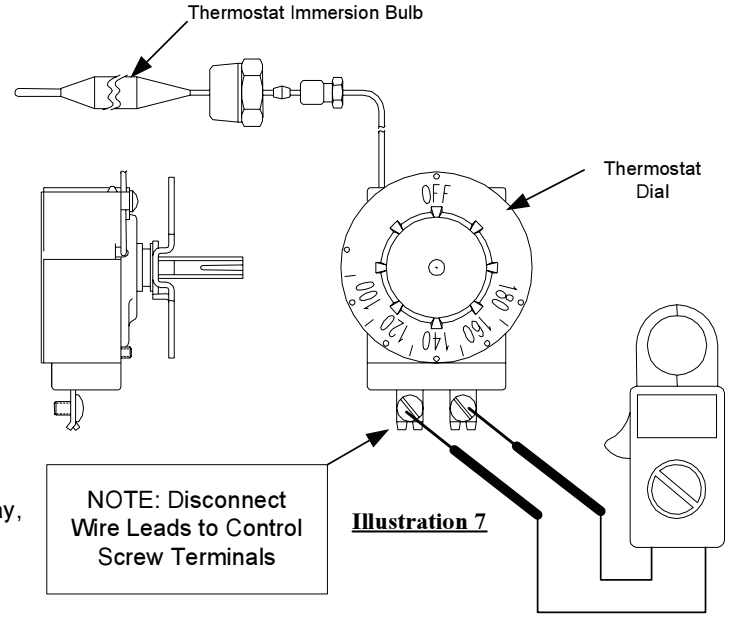


Illustration 7

Contactor Operating Coil

Contactor operation is achieved by energizing an operating coil located within the contactor. The contactor coil is considered part of the control circuit operating at 120 volts as described on page 10.

⚠ DANGER
High voltage exposure. To avoid hazard to life or property, use extreme caution when making voltage checks .

Noisy Contactor

Noisy or chattering contactor operation in most cases is due to voltage variations being supplied to the water heater. Extended periods of voltage variations will cause damage to the operating coil of the contactor causing noisy operation. Determine that service voltage to the unit meets the electrical requirements per the rating plate located on the front of the water heater, see page 16

In addition, debris between the contact plates will cause noisy operation.

Contactor Operation Testing

This procedure assumes control circuit is operating correctly.

Providing the water temperature in tank is within the operating range of the thermostat, checking contactor operation can be as simple as rotating the thermostat dial and listening to the contactor(s) to see if they respond to a call for heat.

1. Turn Power "ON" and rotate thermostat dial to the maximum setting, with water temperature in tank below the thermostat setting, the contactor(s) will close. With the contacts closed, check for 120 volts across operating coil terminals (see illustration 8).

   A) 120 volts IS present, okay, go to step 2.

   B) 120 volts NOT present, verify control circuit operation.

2. Check for rated voltage across lower terminals of contactor(s) (see illustration 9).

   A) Rated voltage IS present, okay, go to step 3.

   B) Rated voltage NOT present, replace contactor.

3. Rotate thermostat dial to the minimum setting. With water temperature in tank above thermostat setting, the contactor(s) will open. With the contacts open, voltage should not be present at lower terminals of contactor(s).

4. Check for 120 volts across operating coil terminals (see illustration 8).

   A) 120 volts IS present, verify control circuit operation.

   B) 120 volts NOT present, okay go to step 5.

5. Check for rated voltage across lower terminals of contactor(s) (see illustration 9).

   A) Rated voltage IS present, replace contactor.

   B) Rated voltage NOT present, contactor is okay.

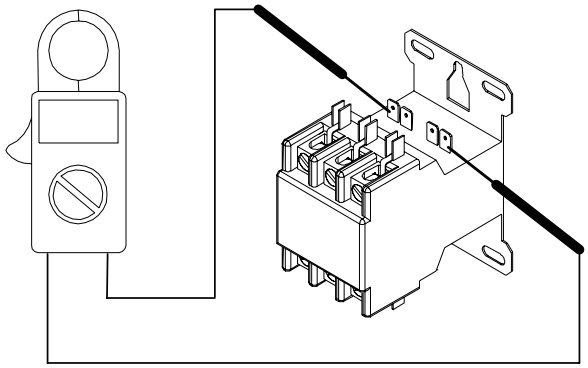


Illustration 8

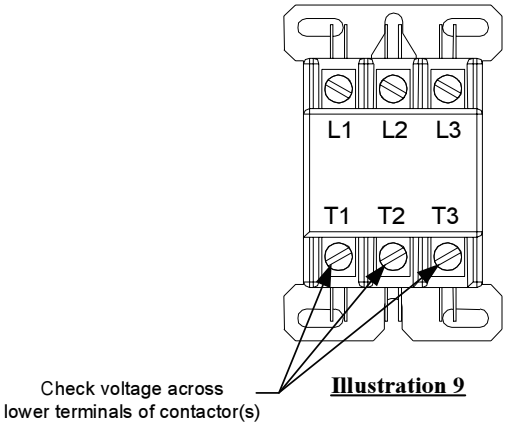


Illustration 9

DANGER
High voltage exposure. To avoid hazard to Life or property, be sure power is turned OFF to water heater while performing this procedure.

Immersion Thermostat Removal

1. **STOP, DANGER! Turn power "OFF" to water heater.**
2. Open control box door.
3. Turn off cold water supply to heater. Connect hose to drain spigot of water heater and route to an open drain. Open a nearby hot water faucet to vent heater for draining. Open drain spigot of water heater and allow heater to drain to a point below the Immersion bulb location (see illustration 10 for location).
4. Close drain spigot and remove hose.
5. Locate thermostat control inside lower control box mounted to the right inside surface of the control box. (see illustration 10).
6. Follow copper capillary tube from thermostat control to the immersion bulb location and remove immersion bulb from tank, 11/16" wrench.
7. Remove (pull) thermostat dial from stem of thermostat control.
8. Remove the two control mounting screws and remove thermostat control from control panel.
9. Disconnect wire leads to the thermostat control. NOTE: It may be necessary to identify wires for proper reconnection to new thermostat.

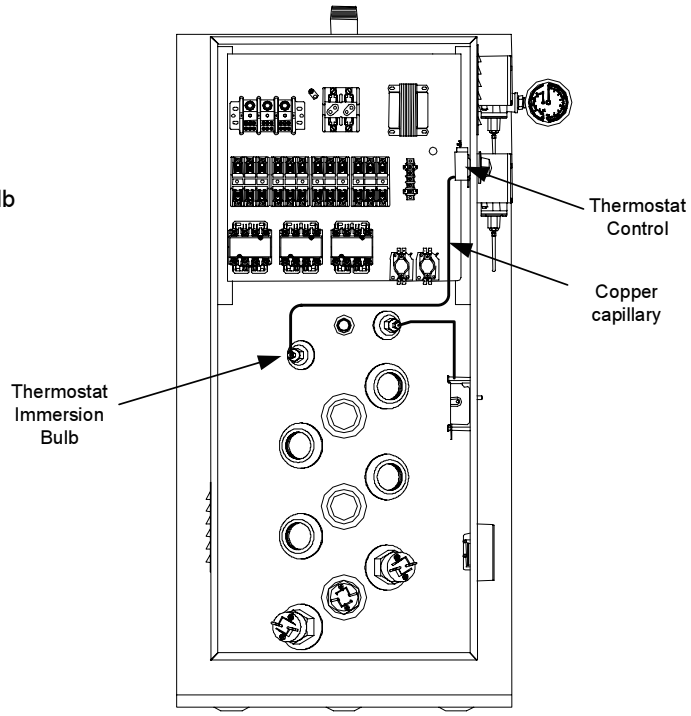


Illustration 10

Immersion Thermostat Replacement

10. Refer to control circuit wire diagram and properly reconnect wire leads to new thermostat control and install new control inside control box using screws from step 8.
11. Replace control dial to stem of thermostat.
12. Loosen ferrule nut of immersion bulb. (see illustration 11)

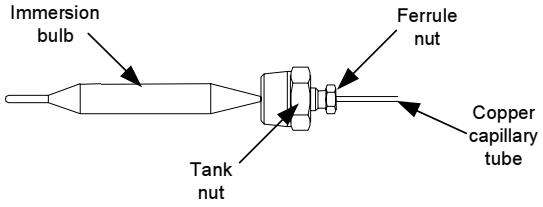


Illustration 11

13. Position tank nut at end of immersion bulb as shown in illustration 11. Insert immersion bulb into tank and tighten tank nut.
14. Gently pull copper capillary tube to insure the immersion bulb is in a horizontal position as shown in illustration 11 and tighten ferrule nut.
15. Resume water supply, fill tank and check for leaks.
16. Be sure tank is full or water and resume power supply to water heater. Verify proper thermostat operation.

DANGER
High voltage exposure. To avoid hazard to Life or property, be sure power is turned OFF to water heater while performing this procedure.

High Limit Control (ECO) Removal

1. **STOP, DANGER! Turn power "OFF" to water heater.**
2. Open control box door.
3. Turn off cold water supply to heater. Connect hose to drain spigot of water heater and route to an open drain. Open a nearby hot water faucet to vent heater for draining. Open drain spigot of water heater and allow heater to drain to a point below the Immersion bulb location (see illustration 12).
4. Close drain spigot and remove hose.
5. Locate hi-limit control inside lower control box mounted to the right inside surface of control box (see illustration 12).
6. Follow copper capillary tube from control to the immersion bulb location and remove immersion bulb from tank, 11/16" wrench.
7. Remove the two control mounting screws located outside the control box.
8. Disconnect wire leads to the control. NOTE: It may be necessary to identify wires for proper reconnection to new control.

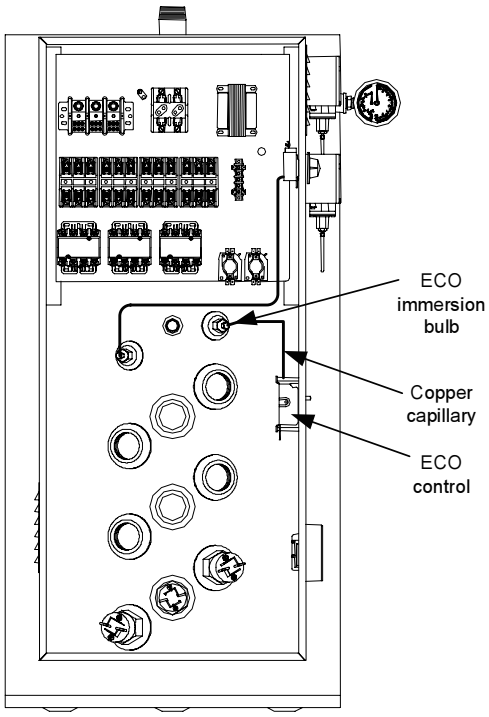


Illustration 12

High Limit Control (ECO) Replacement

9. Refer to control circuit wiring diagram located on the inside of the control box and properly reconnect wire leads to new control and install new control inside control box using screws from step 7.
10. Loosen ferrule nut of immersion bulb. (see illustration 13)

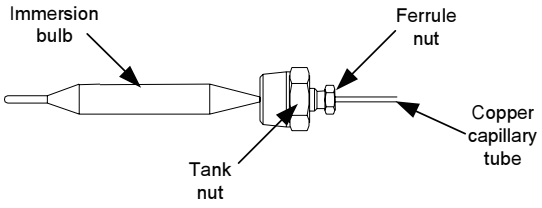


Illustration 13

11. Position tank nut at end of immersion bulb as shown in illustration 13. Insert immersion bulb into tank and tighten tank nut.
12. Gently pull copper capillary tube to insure the immersion bulb is in a horizontal position as shown in illustration 13 and tighten ferrule nut.
13. Resume water supply, fill tank and check for leaks.
14. Be sure tank is full of water and resume power supply to water heater. Verify proper high limit operation.

⚠ DANGER
High voltage exposure. To avoid hazard to Life or property, be sure power is turned OFF to water heater while performing this procedure.

⚠ WARNING
Heater components and stored water may be HOT when performing the following steps in this procedure. Take necessary precaution to prevent personal injury.

Heating Element Removal

1. **STOP, DANGER! Turn power "OFF" to water heater.**
2. Open control box door.
3. Turn off cold water supply to heater. Connect hose to drain spigot of water heater and route to an open drain. Open a nearby hot water faucet to vent heater for draining. Open drain spigot of water heater and allow heater to drain to a point below the heating element(s).
4. Close drain spigot and remove hose.
5. Disconnect wires from heating element terminals.
6. Remove heating element from tank using 2-1/8" deep well socket or appropriate wrench. Unscrew element counter-clockwise to remove from tank.
7. Be sure to remove old element gasket from the tank. It is not recommended to be re-used.

Heating Element Replacement

1. Check new heating element terminal block for proper electrical rating. NOTE: Some heating elements have dual ratings, be sure to check all surfaces of the heating element terminal block (see illustration 14).
2. Apply new gasket to the new heating element. Be sure gasket is seated flat against heating element flange without rolls or gaps (see illustration 14).
3. Clean any debris from tank fitting where heating element is to be installed. Lubricate heating element threads as needed with thread lubricant.
4. Thread new heating element clockwise into tank fitting. Tighten heating element using 2-1/8" deep well socket or appropriate wrench. Do not over tighten, over tightening may damage gasket.
5. Reconnect wires to heating element, be sure connections are snug and corrosion free. Do not over tighten, doing so may damage terminal block.
6. Resume water supply to heater, be sure tank is full of water and check for leaks.
7. To resume operation, **BE SURE TANK IS FULL OF WATER** and restore power to water heater. Verify proper heater operation.

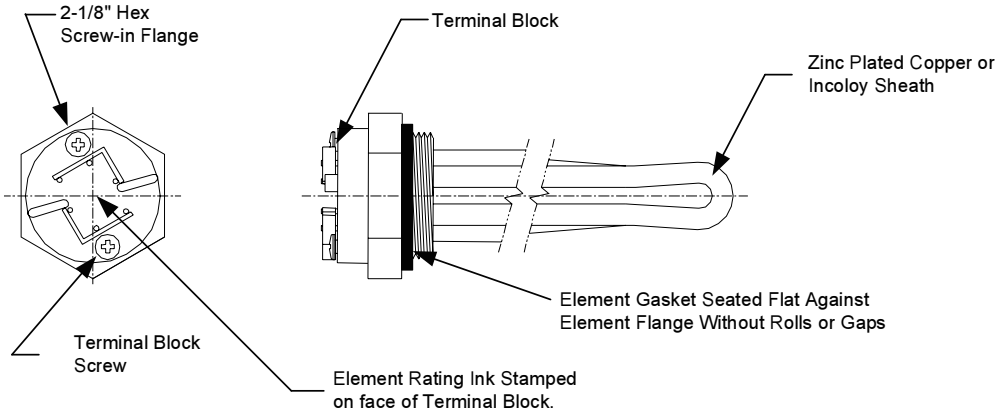


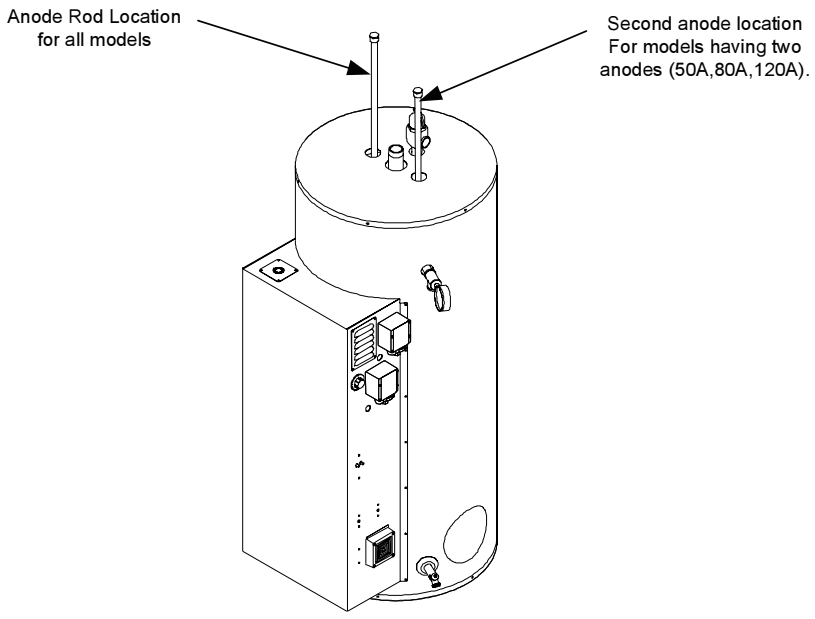
Illustration 14

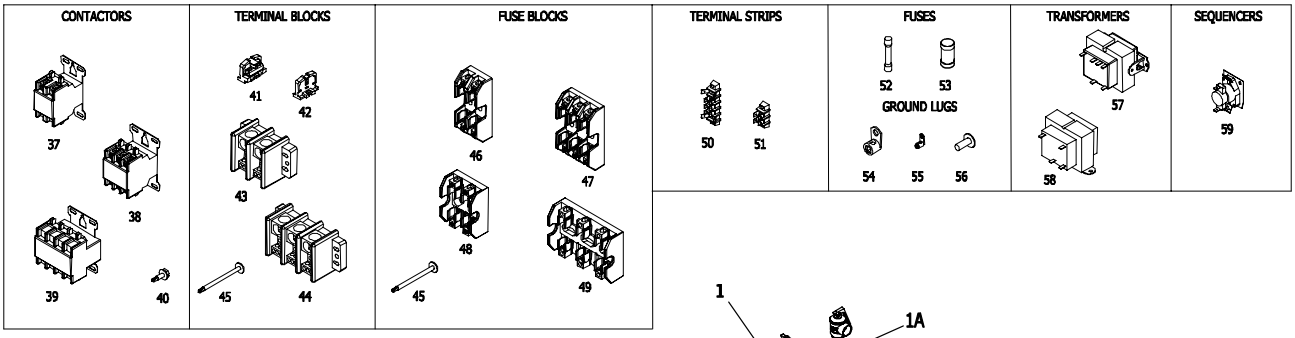
Anode Inspection and Replacement

⚠ DANGER
High voltage exposure. To avoid hazard to Life or property, be sure power is turned OFF to water heater while performing this procedure.

⚠ WARNING
Heater components and stored water may be HOT when performing the following steps in this procedure. Take necessary precaution to prevent personal injury.

1. **STOP, DANGER! Turn power "OFF" to water heater.**
2. Turn off cold water supply to heater. Connect hose to drain spigot of water heater and route to an open drain. Open a nearby hot water faucet to vent heater for draining. Open drain spigot of water heater and allow heater to drain to a point below the anode locations at the top of the tank.
3. Close drain spigot and remove hose.
4. Remove the plastic anode access plugs at the anode locations.
5. Remove anode from the water heater (1-1/16" socket).
6. Visually Inspect anode. Anode should show signs of depletion, this is normal. If depletion is ½ of the original anode diameter (original diameter approximately ¾"), replacement is recommended. If any of the steel core of the anode is exposed, replacement is recommended.
7. Upon completion of inspection or subsequent replacement, reinstall anode into heater. resume water supply, refill heater with water and check for leaks.
8. To resume operation, **BE SURE HEATER IS FULL OF WATER** and turn power "ON" to water heater.




CONTACTORS
37
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TERMINAL BLOCKS
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FUSE BLOCKS
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49
TERMINAL STRIPS
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51
FUSES
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53
GROUND LUGS
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56
TRANSFORMERS
57
58
SEQUENCERS
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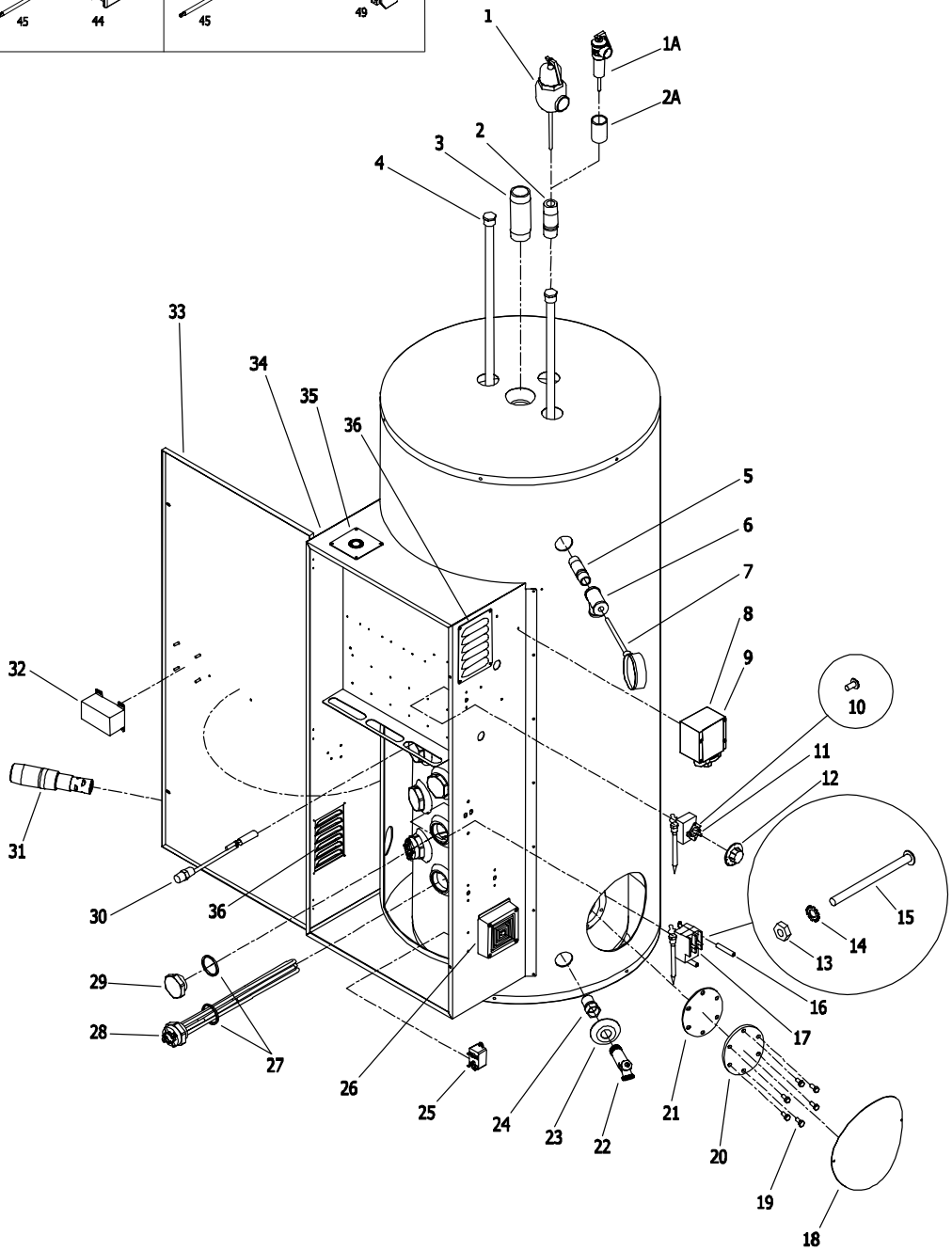
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Item	Description
1	T&P Relief Valve.
2	Nipple Plastisert.
3	Hot Water Outlet Nipple.
4	Magnesium Anode.
5	Nipple Galvanized.
6	Pipe Tee Galvanized.
7	Combination T&P Gage (optional).
8	High Pressure Switch (optional).
9	Low Pressure Switch (optional).
10	Screw.
11	Immersion Thermostat.
12	Thermostat Dial.
13	Hex Nut.
14	Lock Washer.
15	Screw.
16	High Limit Spacer.
17	High Limit Switch.
18	Cleanout Access Cover.
19	Cleanout Cover Screw.
20	Cleanout Cover.
21	Cleanout Gasket.
22	Brass Drain Valve.
23	Finish Flange.
24	Extender.
25	Alarm Horn Relay (optional).
26	Alarm Horn (optional).
27	Heating Element Gasket.
28	Heating Element.
29	Heating Element Plug.
30	Low Water Switch (optional).

Item	Description
31	Low Water Switch (optional).
32	Electrical Door Lock (optional).
33	Control Box Door.
34	Control Box.
35	Knockout Plate.
36	Louver Plate.
37	Contactor 2 Pole.
38	Contactor 3 Pole.
39	Contactor 4 Pole.
40	Screw.
41	Terminal Block “A”.
42	Terminal Block End “A”.
43	Terminal Block 2 Pole.
44	Terminal Block 3 Pole.
45	Screw.
46	Fuse Block 2 Pole Class G.
47	Fuse Block 3 Pole Class G.
48	Fuse Block 2 Pole Class T.
49	Fuse Block 3 Pole Class T.
51	Terminal Strip 2 post.
52	Fuse Class G.
53	Fuse Class T.
54	Ground Lug Large.
55	Ground Lug Small.
56	Screw.
57	Control Circuit Transformer.
58	Control Circuit Transformer (600 Volt).
59	Time Delay Sequencer.

Glossary of Terms

Term	Definition	Unit of measure
Voltage -	Electrical potential	Volts
Current-	Rate of voltage flow	Amperes (amp)
Resistance-	Ability of a device to dissipate power irreversibly	Ohms
Energy-	Ability to do work	kW/hr, Joule
Power-	Energy per unit of time	Watts, kW, VA

One kilowatt (1kW) = 1,000 Watts. = 3,412 BTU
DC = Direct Current
AC = Alternating Current
Hz = Hertz

°F = Degrees Fahrenheit
°C = Degree Centigrade

BTUH = British thermal units per hour
PSI = Pounds per square inch
GPM = Gallons per minute
GPH = Gallons per hour
ECO = Energy cut off
NPT = National pipe thread
ASME = American Society of Mechanical Engineers

NOTES

BRADFORD WHITE®
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