



OPERATING AND MAINTENANCE MANUAL

SEAFARE MSH and MH

6/29/23



-IMPORTANT-

Always reference the full model number and serial number when calling the factory.

HUBBELL ELECTRIC HEATER COMPANY
45 SEYMOUR STREET
STRATFORD, CT 06615

PHONE: (203) 378-2659
FAX: (203) 378-3593
Hubbellheaters.com



Table of Contents

SECTION I - GENERAL DESCRIPTION AND CONSTRUCTION	3
Outline Dimensions	3
Recovery Ratings And Amperage At Selected kW	5
GENERAL DESCRIPTION	6
TANK CONNECTIONS	6
OUTER SHELL, INSULATION, AND SUPPORTS	7
HEATING ELEMENT	7
ELECTRICAL ENCLOSURE	7
CONTROL THERMOSTAT	7
TEMPERATURE HIGH LIMIT SWITCH	8
MAGNETIC CONTACTOR	8
FUSED LOW VOLTAGE TRANSFORMER	8
INDIVIDUALLY FUSED ELEMENTS	8
OPTIONS	8
SECTION II – INSTALLATION	10
WATER HEATER PLACEMENT	10
SECURING OF HEATER	10
PIPING INSTALLATION	11
FILLING THE HEATER	11
ELECTRICAL INSTALLATION	12
FINAL CHECKS	12
SECTION III - TROUBLE SHOOTING	13
SECTION IV - SCHEDULED MAINTENANCE	14
MAINTENANCE AND OPERATION	14
FREEZING	14
QUARTERLY INSPECTION	14
ANNUAL INSPECTION	14
SECTION V - SERVICING & REPLACEMENT OF PARTS	16
MAGNETIC CONTACTOR	16
IMMERSION TEMPERATURE CONTROLLER	16
HEATING ELEMENT – STYLE A	17
HEATING ELEMENT – STYLE B	19
RELIEF VALVE	20
SECTION VI – MISCELLANEOUS CHARTS AND FORMULAS	21
NEMA ENCLOSURES	21
ELECTRICAL DATA	22
FORMULAS	23

TORQUE VALUES 24
ABS Approval..... 25

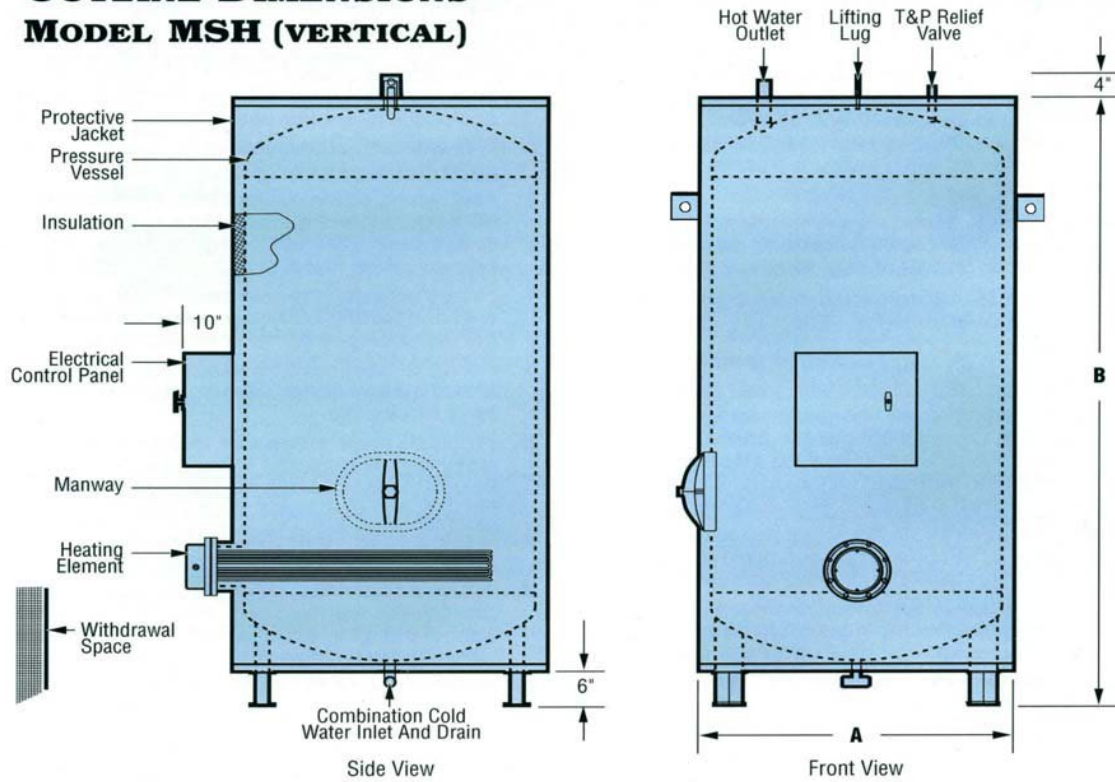
WARNING / CAUTION

1. Tank is to be completely filled with water and all air is to be vented before energizing.
2. Due to the rigors of transportation, all connections should be checked for tightness before the heater is placed in operation.
3. Safety relief valve must be installed in tapping provided.
4. The refractory material used in heating elements may absorb some moisture during transit, periods of storage, or when subjected to a humid environment. This moisture absorption results in a cold insulation resistance of less than one (1) megohms. If this heater has been subjected to the above condition, each heating element must be checked for insulation resistance before energizing. A low megohm condition can be corrected by removing the terminal hardware and baking the element in an oven at 300°F -500°F for several hours or until the proper megohm reading is obtained.
5. KEEP AWAY FROM LIVE ELECTRICAL CIRCUITS. Do not perform any maintenance, make any adjustments, or replace any components inside the control panel with the high voltage power supply turned on. Under certain circumstances, dangerous potentials may exist even when the power supply is off. To avoid casualties, always turn the power supply safety switch to off, turn off the charge or ground the circuit before performing any maintenance or adjustment procedure.
6. Generalized instructions and procedures cannot anticipate all situations. For this reason, only qualified installers should perform the installations. A qualified installer is a person who has licensed training and a working knowledge of the applicable codes, regulations, tools, equipment, and methods necessary for safe installation of an electric resistance water heater. If questions regarding installation arise, check your local plumbing and electrical inspectors for proper procedures and codes. If you cannot obtain the required information, contact the company.

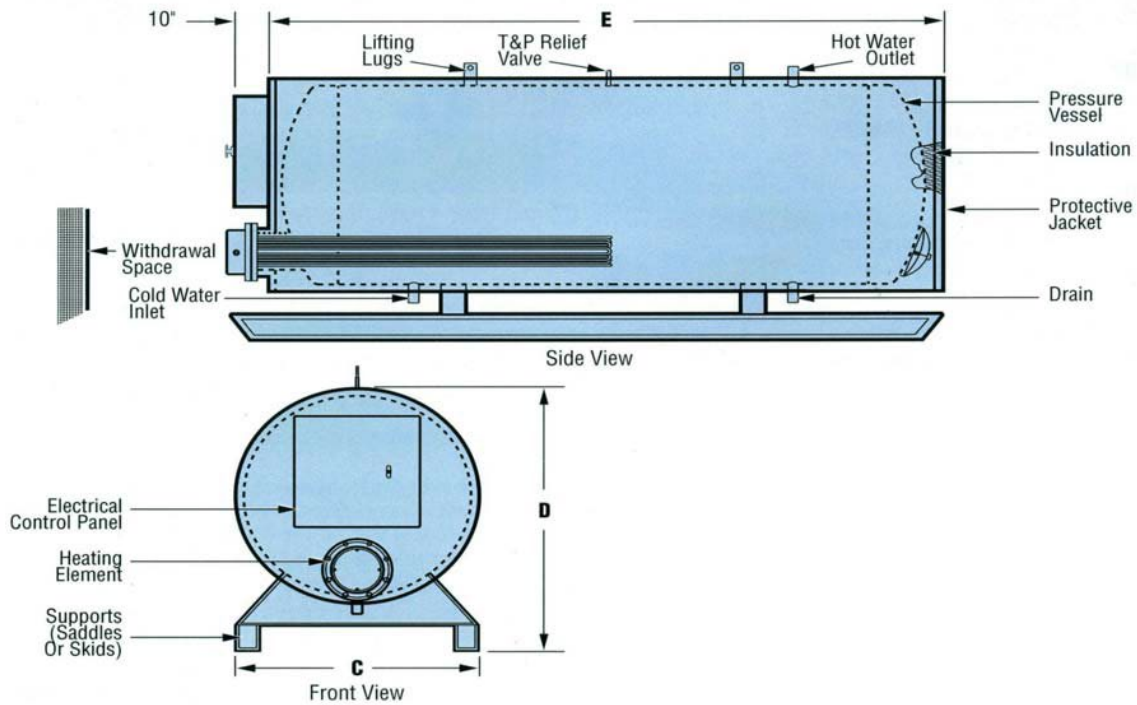
SECTION I - GENERAL DESCRIPTION AND CONSTRUCTION

Outline Dimensions

OUTLINE DIMENSIONS MODEL MSH (VERTICAL)



MODEL MH (HORIZONTAL)



OVERALL DIMENSIONS, MODELS MSH AND MH

Storage Capacity (Gallons)	Overall Dimensions (Inches)					Storage Tank Diameter x Length	Inlet Outlet Sizing (NPT)	Approx. Shipping Weight (Lbs.)
	Vertical		Horizontal					
	Diameter "A"	Height "B"	Width "C"	Height "D"	Length "E"			
80	28	56	28	34	50	24 x 46	1.5	1000
120	28	75	28	34	69	24 x 65	1.5	1150
150	34	65	34	40	59	30 x 55	1.5	1300
175	34	73	34	40	67	30 x 63	1.5	1500
200	34	82	34	40	76	30 x 72	1.5	1700
225	34	89	34	40	83	30 x 79	1.5	1750
250	40	74	40	46	68	36 x 64	1.5	1850
275	40	80	40	46	74	36 x 70	1.5	2000
300	40	88	40	46	82	36 x 78	1.5	2180
325	40	92	40	46	86	36 x 82	1.5	2300
350	40	94	40	46	88	36 x 84	1.5	2500
375	46	81	46	52	75	42 x 71	1.5	2600
400	46	85	46	52	79	42 x 75	1.5	2700
425	46	88	46	52	82	42 x 78	1.5	2900
450	46	93	46	52	87	42 x 83	1.5	3000
475	52	79	52	58	73	48 x 69	2	3100
500	52	82	52	58	76	48 x 72	2	3225
525	52	85	52	58	79	48 x 75	2	3350
550	52	89	52	58	83	48 x 79	2	3400
575	52	93	52	58	87	48 x 83	2	3500
600	52	95	52	58	89	48 x 85	2	3650
700	52	107	52	58	101	48 x 97	2	4000
800	52	119	52	58	113	48 x 109	2	4300
900	52	132	52	58	126	48 x 122	2	4800
1000	52	145	52	58	139	48 x 135	2	5200
1250	58	149	58	64	143	54 x 139	2	5600
1500	58	174	58	64	168	54 x 164	2	6000
1750	64	168	64	70	162	60 x 158	3	7400
2000	64	185	64	70	179	60 x 175	3	8100
2500	76	169	76	82	163	72 x 159	3	8200
3000	76	197	76	82	191	72 x 187	3	8300
3500	88	174	88	94	168	84 x 164	6 FLG.	8900
4000	88	195	88	94	189	84 x 185	6 FLG.	9800
4500	N/A	N/A	94	100	178	90 x 174	6 FLG.	10700
5000	N/A	N/A	94	100	100	90 x 196	6 FLG.	11600

RECOVERY RATINGS AND AMPERAGE AT SELECTED KW

KW INPUT	BTU/HR RATING	Gallons Per Hour (GPH) Heated At Various Temperature Rises					Amperage Rating At Various Voltages				
		60°F Δ	80°F Δ	100°F Δ	120°F Δ	140°F Δ	208V 3Φ	240V 3Φ	380V 3Φ	415V 3Φ	480V 3Φ
15	51,195	103	77	62	51	44	42	36	23	21	18
20	68,260	137	103	82	68	59	56	48	30	28	24
25	85,325	171	128	103	85	73	69	60	38	35	30
30	102,390	205	154	123	103	88	83	72	46	42	36
35	119,455	239	179	144	120	103	97	84	53	49	42
40	136,520	273	205	164	137	117	111	96	61	56	48
45	153,585	308	231	185	154	132	125	108	68	63	54
50	170,650	342	256	205	171	146	139	120	76	70	60
55	187,715	376	282	226	188	161	153	132	84	77	66
60	204,780	410	308	246	205	176	167	145	91	84	72
65	221,845	444	333	267	222	190	181	157	99	91	78
70	238,910	478	359	287	239	205	195	169	106	97	84
75	255,975	513	384	308	256	220	208	181	114	104	90
80	273,040	547	410	328	273	234	222	193	122	111	96
85	290,105	581	436	349	290	249	236	205	129	118	102
90	307,170	615	461	369	308	264	250	217	137	125	108
95	324,235	649	487	390	325	278	264	229	145	132	114
100	341,300	683	513	410	342	293	278	241	152	139	120
110	375,430	752	564	451	376	322	306	265	167	153	132
120	409,560	820	615	492	410	351	333	289	183	167	145
125	426,625	854	641	513	427	366	347	301	190	174	151
150	511,950	1025	769	615	513	439	417	361	228	209	181
175	597,275	1196	897	718	598	513	486	421	266	244	211
200	682,600	1367	1025	820	683	586	556	482	304	279	241
225	767,925	1538	1153	923	769	659	625	542	342	313	271
250	853,250	1708	1281	1025	854	732	695	602	380	348	301
275	938,575	1879	1409	1128	940	805	764	662	418	383	331
300	1,023,900	2050	1538	1230	1025	879	834	723	456	418	361
325	1,109,225	2221	1666	1333	1110	952	903	783	494	453	391
350	1,194,550	2392	1794	1435	1196	1025	973	843	532	487	421
375	1,279,875	2563	1922	1538	1281	1098	1042	903	570	522	452
400	1,365,200	2733	2050	1640	1367	1171	1112	963	608	557	482
450	1,535,850	3075	2306	1845	1538	1318	1251	1084	685	627	542
500	1,706,500	3417	2563	2050	1708	1464	1390	1204	761	696	602
1000	3,412,000	6833	5125	4100	3417	2929	2779	2408	1521	1393	1204
1200	4094400	8200	6150	4920	4100	3514	3335	2890	1825	1671	1445
1400	4776800	9567	7175	5740	4783	4100	3891	3372	2130	1950	1686
1600	5459200	10933	8200	6560	5467	4686	4446	3854	2434	2229	1927

Notes:

1. The KW selections above are shown for convenience. A full selection of KW ratings from 1 to 1600 KW is available by entering the desired KW into the model number.

GENERAL DESCRIPTION

This book describes a packaged electric water heater, approved by ABS Americas (A Division of the American Bureau of Shipping) and the USCG (United States Coast Guard), which is a stationary, self-contained unit and is designed and constructed specifically for marine applications on board a surface vessel. The complete assembly consists of the storage tank, immersion electric heating element(s), thermostat, safety relief valve, safety high temperature cut out, magnetic contactor(s), power circuit fusing, fused low voltage control circuit transformer, and any other required electrical operating control. Optional equipment may be supplied with your unit. Please consult the product drawing for details specific to your assembly. The unit is factory assembled, insulated, jacketed, painted, wired, tested, and ready for electrical and plumbing service connections.

CONSTRUCTION:

TANK

Standard Tank Construction:

The standard storage tank is rated for 100 psi working pressure (150 psi test pressure) and constructed of all welded carbon steel, designed, and built in accordance with ASME Section IV and stamped, certified, and registered with the National Board of Boiler and Pressure Vessel Inspectors. It is internally lined with specially formulated HydraStone cement to a 5/8-inch minimum thickness for superior protection and tank longevity.

Optional Tank Linings:

1. Phenolic – An epoxy coating applied in two coats to a total thickness of 10-12 mils. Typically used in process applications using low conductivity deionized (DI), distilled, or food grade water.
2. Copper – A 3lb./sq. ft. copper sheet approximately 0.0646-inches thick covers all interior surfaces. All copper sheet seams are factory tested to ensure long lasting protection of the steel vessel.
3. Flame-Spray Copper – Molten copper is sprayed on the interior surfaces to a thickness of 5-6 mils. The copper bonds to the steel, and an additional overcoat of Phenolic lining is applied on the copper to seal all pores.
4. Galvanizing – The steel pressure vessel is pickled and hot dipped in molten zinc to create a barrier which internally and externally protects the steel vessel for cold and hot water storage.

Optional Non-Ferrous Tank Materials:

1. Copper-Silicon – A copper-silicon alloy offers tremendous tank longevity due to its ability to withstand the cycling effects induced from changes in water temperature and pressure. This material is suitable for storage of hot potable water in a variety of commercial and industrial applications.
2. 90/10 Copper-Nickel – A 90% copper and 10% nickel alloy similar to copper-silicon, but with added strength and corrosion resistance. Typically used in applications with corrosive environments (salt water) or critical applications.
3. Stainless Steel – Stainless steel 316L is well suited for high purity applications requiring a corrosion resistant tank with minimal leaching of impurities into the water. Well suited for process, RO, and DI water systems in the pharmaceutical, food, and electronic industries.

TANK CONNECTIONS

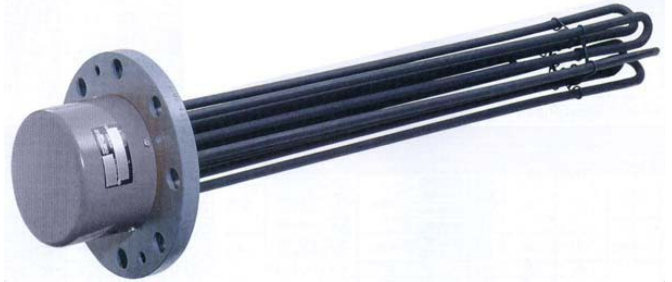
The heater is supplied with separate cold water and hot water connections. A FNPT connection is provided for mounting a combination safety temperature and pressure relief valve. An overflow line should be utilized from the relief valve outlet to a floor drain. See drawing for locations and sizes.

OUTER SHELL, INSULATION, AND SUPPORTS

The tank is encapsulated in 2-inches of high-density fiberglass insulation. The protective shell is constructed of galvaneal and is coated with a durable gray hammertone finish. The entire vessel is supported on heavy-duty integrally welded steel supports for sturdy floor mounting.

HEATING ELEMENT

The water heater is supplied with a flanged electric immersion heating element assembly, composed of copper, incoloy, or stainless-steel sheathed elements. Each assembly is fastened to a corresponding tank flange using a gasket and hex head steel bolts and nuts. Specialized heating element construction may be included. These options include special watt density ratings, passivation, electropolishing, or special materials. See drawing for voltage, power ratings, and special options.



ELECTRICAL ENCLOSURE

A louvered control panel available in various sizes and with assorted types of handles is supplied. The standard cabinet is rated NEMA 1, but other NEMA rated enclosures are available, consult drawing for further information. A list of NEMA ratings are available in Section VI.

CONTROL THERMOSTAT

The control panel is supplied standard with a single-stage immersion thermostatic switch. As an option, any of the following may be supplied; a four-stage immersion thermostatic switch, a solid-state staging controller with thermistor, or a digital 1/16 DIN temperature controller with thermocouple. See drawing for specific details. The single-stage immersion thermostat can be adjusted through a range of 100° - 190° F. The four-stage immersion thermostat can be adjusted through a range of 100° - 250° F and is capable of switching four stages. The solid-state staging controller has a range of 100° - 200° F and provides control of up to ten stages. This thermostat automatically brings on-line the required number of heating steps in order to meet the hot water demand and will also operate each circuit in a circular mode to allow for equal usage of all heating circuits. A 1/16 DIN electronic temperature control package may be installed. A separate manufacturer’s operating manual will be supplied with all units except the single-stage immersion thermostat.



Single-Stage Immersion Thermostat



Four-Stage Immersion Thermostat



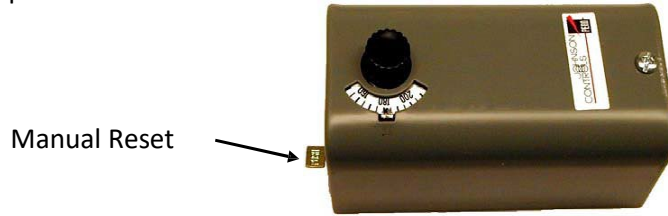
Solid State Staging Controller



1/16 DIN Digital Display

TEMPERATURE HIGH LIMIT SWITCH

As a safety device, an immersion high temperature cut-off switch with manual reset, adjustable through a range of 100° - 240° F, is provided. The high limit must be manually reset in order to engage the control circuit thereafter to restart the heater. Optionally a 1/16 DIN digital controller may be used as a high limit. A separate manufacturers operating manual will be supplied for this option.



MAGNETIC CONTACTOR

The magnetic contactor(s) is a heavy-duty resistive load type rated for 100,000 cycles. The contactor supplies power to the heating element(s) based on the resistive load (non-inductive) of the heater only when the thermostatic switch is engaged, thereby pulling in the contacts until the desired temperature is reached. At this point, the contacts will drop out, which in turn disconnects power from the elements.



FUSED LOW VOLTAGE TRANSFORMER

A fused low voltage transformer may be supplied. This option is used to step down higher voltages to 120-volt for safety when working with control circuits.



INDIVIDUALLY FUSED ELEMENTS

To limit the possibility of damage to circuits and elements in case of electrical overloads, fuses may be supplied for each circuit. Two types of fuses may be used; a type NON for voltages less than 250-volt or type JJS for voltages less than 600-volt.



OPTIONS

The following optional features may be included in your water heater. Reference included drawing specific to your heater for further details.

Stainless Steel Jacket

An optional stainless steel outer jacket may replace the standard galvanized covering. This optional jacket may be painted.

Skid Mounting

Optionally, the unit may be mounted on heavy duty all welded I-beams.

On / Off Switch

A built-in non-fused On/Off disconnect switch may be supplied with the control panel to disconnect power to the control panel.

Built-In Circuit Breaker

A built-in circuit breaker may be provided with or without shunt trip protection for protection from circuit overload.

Low Water Cut-Off

Used as a safety device, the electronic low water cut-off is used to detect a low water situation and disengage the operating coils in the magnetic contactor(s). Once the condition is remedied, the low water cut-off switch is automatically reset. Two types of low water cut-offs are available: the float type and the conductive style.



Float Type Low Water Cut-Off
Probe and Relay



Conductive Type Low Water Cut-Off
Probe and Relay

Audible Alarm

An audible alarm may be installed on the outside of the control panel to give warning of a fault condition.



Status Indicating Lamp(s)

Optional status indicating lamps may be installed to show when the unit is on, when the heating element is energized, or if there is an alarm condition.

Silicon Control Rectifier A silicon control rectifier (SCR) “zero fired” power controller for 0-100% proportional control of heaters may be supplied.

Circulating Pump Package An intra-tank circulation pump package with On/Off switch to continuously circulate water within the tank and thereby reduce stratification may be installed. An all-bronze circulator pump, rated 1/25 HP, 120V, 1Ph, is used.

Dial Temperature and Pressure Gauge

A combination temperature (70° - 250° F) and pressure (0 – 200 psi) gauge with 2½-inch dial may be supplied for in-line installation (shipped loose) or factory installed in the tank.



Vacuum Relief Valve

A vacuum relief valve may be provided with the unit to reduce the risk of back siphonage and back pressure of the system. The valve will be shipped loose for in-line installation. Instructions for installation are provided with the valve.



Special Customized Features

Please reference drawing for details.

SECTION II – INSTALLATION

WARNING / CAUTION

DO NOT TURN ON THE ELECTRIC POWER SUPPLY to this equipment until the heater is completely filled with water and all air has been released. *If the heater is NOT filled with water when the power is turned on, the heating elements will burn out.*

For protection against excessive pressures and temperatures, local codes require the installation of a temperature-and-pressure (T&P) relief valve certified by a nationally recognized laboratory that maintains periodic inspection of production of listed equipment of materials, as meeting the requirements for Relief Valves and Automatic Gas Shutoff for Hot Water Supply Systems. ANSI Z21.22-1971. THE CUSTOMER IS RESPONSIBLE TO PROTECT PROPERTY AND PERSONNEL FROM HARM WHEN THE VALVE FUNCTIONS.

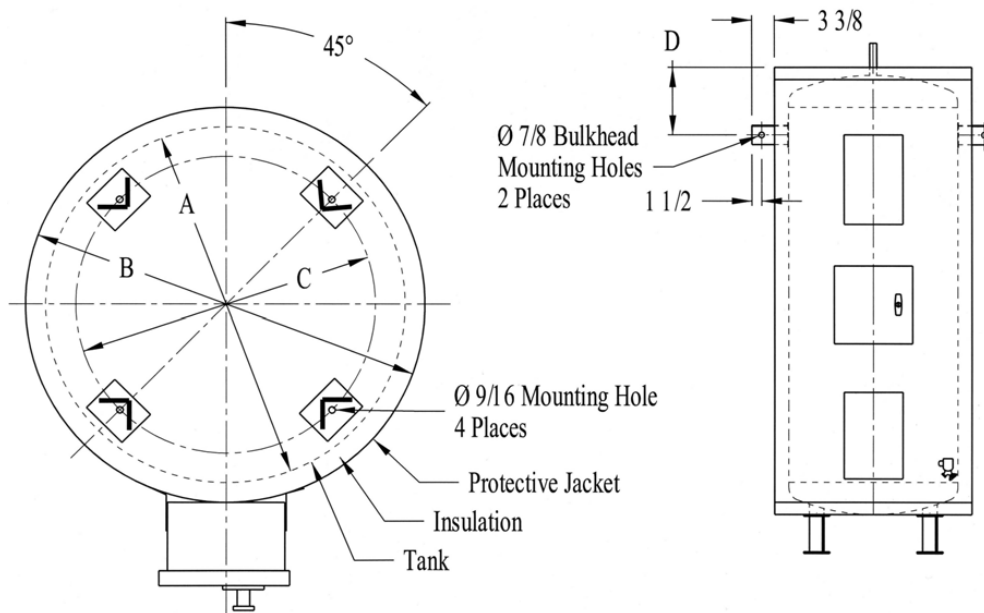
All water heaters have a risk of leakage at some unpredictable time. IT IS THE CUSTOMER'S RESPONSIBILITY TO PROVIDE A CATCH PAN OR OTHER ADEQUATE MEANS, SO THAT THE RESULTANT FLOW OF WATER WILL NOT DAMAGE FURNISHINGS OR PROPERTY.

WATER HEATER PLACEMENT

1. Place the heater on a solid foundation in a clean, dry location nearest to the point of most frequent hot water use.
2. The water heater should be protected from freezing and waterlines insulated to reduce energy and water waste.
3. Leave sufficient clearance for element withdrawal, if necessary.
4. Do not install in an area where flammable liquids or combustible vapors are present.

SECURING OF HEATER

1. The heater is supported by four 2-inch x 2-inch x ¼-inch thick angle iron legs each with a 4-inch x 4-inch x ¼-inch thick steel base pad. Each leg is provided with one 9/16-inch diameter bolt hole for one ½-inch bolt which should be used to secure heater to the deck.
2. In addition to the leg supports, two 3-inch x 3-inch x ¼-inch thick brackets with 7/8-inch diameter mounting holes are attached to the upper portion of the heater. These brackets should be attached to bulkhead secured tie-rods thus ensuring further support of the heater for shipboard installation.



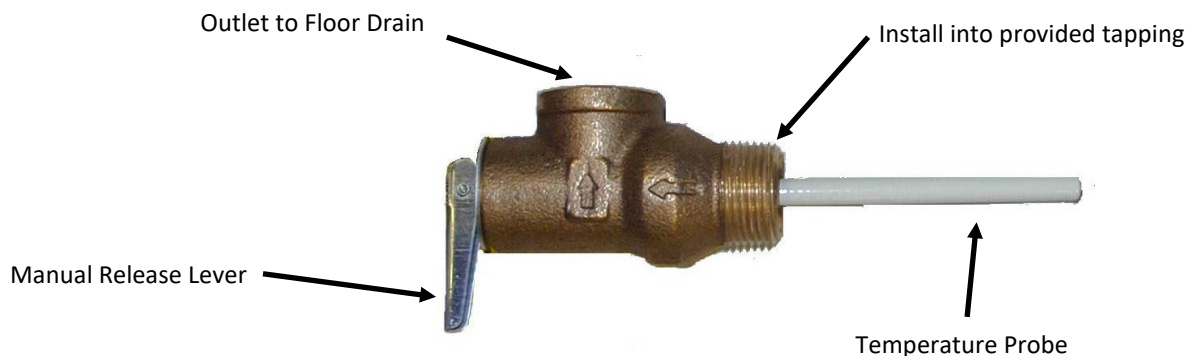
Mounting Dimensions

Tank Diameter "A"	Overall Diameter "B"	Bolt Circle "C"	Bulkhead Mounting Dimension "D"
24	28	18	15
30	34	24	20
36	40	30	20
42	46	36	22
48	52	42	24
54	58	48	26
60	64	54	28

PIPING INSTALLATION

NOTE: The most effective means for preventing deterioration from accelerated corrosion due to galvanic and stray current is the installation of dielectric fittings/unions. The installation of these fittings is the responsibility of the installation contractor.

1. Connect the cold-water inlet and hot water outlet to the appropriate connections as shown; refer to the drawing for location and sizes.
2. Install in-line vacuum breaker, if supplied.
3. Install in-line pressure and temperature gauge, if supplied.
4. Install the combination temperature and pressure safety relief valve in the tapping provided. Note that this is required by law for safety considerations.



Temperature and Pressure Relief Valve

5. Install a relief valve overflow pipe to a nearby floor drain. CAUTION: No valve of any type should be installed between the relief valve and tank or in the drain line.

FILLING THE HEATER

1. Completely close the drain valve and open the highest hot water valve to allow all air to escape from piping.
2. Open the valve to the cold-water inlet and allow the heater and piping system to completely fill, as indicated by a steady flow of water from the open faucet.

ELECTRICAL INSTALLATION

1. Enter electric enclosure with properly sized feeder leads (use 60° C copper wire for water heaters rated less than 100 amps; otherwise use 75°C copper wire). Be sure to properly ground the water heater.
2. Install these power leads into the box lugs on the terminal block or magnetic contactor.
3. Torque screws per torque chart included in Section VI.
4. All other electrical connections are made at the factory; therefore, no other electrical connections are necessary.

FINAL CHECKS

1. Check all connections for tightness.
2. Ensure that all the above steps are completed.
3. After the water is heated for the first time, monitor the water temperature as described in Section IV, Quarterly Inspection.

SECTION III - TROUBLE SHOOTING

Symptom	Probable Cause	Corrective Action / Remedy
No hot water	Circuit breaker tripped at source.	Reset circuit breaker.
	On/Off switch in 'OFF' position, if installed.	Turn switch to 'ON' position.
	Circuit breaker at control cabinet tripped, if installed.	Reset circuit breaker.
	Blown fuse in element fuse block, if installed.	Replace fuse.
	Blown fuse in transformer, if installed.	Replace fuse.
	High limit switch tripped.	Reset high limit switch.
	Loose wires.	Tighten wires. Torque screws per torque chart included in Section VI.
	Heating element inoperable.	Check heating element operation by clamping an Amprobe around each wire to the element. The ampere reading should agree with the nameplate 'AMP' figure.
	Low line voltage.	Have source electrical system checked by an electrician.
	Faulty thermostat.	Move thermostat dial through full range. A definite 'click' should be heard. If not, replace thermostat.
	Faulty low water cut-off, if installed.	Check to see if the tank is full of water. If not, fill the tank. If the problem continues and tank is full, check for continuity between the common and normally open contact of the relay board. If continuity is not observed, replace low water cut-off.
	Magnetic contactor does not energize.	Replace complete magnetic contactor. Because of the design of this particular contactor, it is more desirable to replace complete control rather than rebuilding coil, contacts and springs, etc.
Water temperature below settings at all times	Faulty thermostat.	Check thermostat adjustment. Monitor thermostat as described in Section IV, Quarterly Inspection. Replace if necessary.
	Blown fuse in element fuse block, if installed.	Replace fuse.
	Heating element not working on all phases	Check to see that heating element is working on all phases, by checking the resistance (ohms) value for each element and comparing with the chart included in Section VI.
	Heater improperly sized	Verify heater is properly sized for the flow rate and temperature rise of your system. See formulas included in Section VI. Replace elements with proper size as necessary.
Relief valve discharges continuously	Excessive temperature or pressure in tank	Temperature and pressure relief valves are made to operate if the water temperature exceeds 210°F or water pressure exceeds the pressure rating of the safety relief valve. If trouble is excessive temperature, then thermostat is not shutting off at the right setting and thermostat must be replaced.

SECTION IV - SCHEDULED MAINTENANCE

WARNING / CAUTION

Before performing any maintenance procedure, make certain power supply is **OFF** and cannot accidentally be turned on.

MAINTENANCE AND OPERATION

The water heater is automatic in its operation. It will maintain a full tank of water at the temperature setting of the thermostat. The water heater should not be turned on without first making sure that the tank is full of water and that all air has been released.

FREEZING

The tank should be fully drained in the event the electricity has been turned off and if there is danger of freezing.

QUARTERLY INSPECTION

1. Monitor thermostat.
 - a. Let the water heater completely heat to a designated thermostat setting.
 - b. After the thermostat satisfies (that is, when the thermostat actually clicks off), draw water from heater.
 - c. Compare the water temperature of drawn water to the temperature setting of the thermostat when it satisfies. Normal variation between the two points is approximately $\pm 5^{\circ}\text{F}$.
 - d. If these two readings do not coincide within acceptable tolerances and verification has been made of the accuracy of the temperature-reading gauge, replace the thermostat.
2. Lift test lever on relief valve and let water run through valve for a period of approximately 10 seconds. This will help flush away any sediment that might build up in water passageways.
3. Inspect element flange for leakage as follows:
 - a. Shut off Power Supply.
 - b. Remove element housing cover.
 - c. Visually inspect heating element gasket for evidence of leaks.
 - d. Rub finger around gasket that is between the heating element and tank flange for any evidence of moisture. If moisture is present or a water drip is observed, follow procedure outlined in Section V.
4. Check for loose electrical connections. Tighten as necessary.

ANNUAL INSPECTION

1. Flush tank as follows:
 - a. Shut off the power supply.
 - b. Close valve on hot water outlet piping.
 - c. Open valve on drain piping.
 - d. Cold water inlet line pressure will be strong enough to flush sediment from the bottom of the tank out through the drain. Let the water run for 3-4 minutes.
 - e. Close drain valve.
 - f. Open hot water valve.
 - g. Turn the power supply ON.

NOTE:

Cement lining is a durable lining that will provide many years of service protecting your steel pressure vessel from corrosion. The process of cement lining includes an inspection to ensure that the lining is applied to the correct thickness, covers all appropriate surfaces, and is free from defects or cracks greater than 3 mm (1/8") in width. Any deficiencies are repaired at the factory prior to shipment. However, it is characteristic to find hairline cracks in the cement lining prior to initial installation. After the vessel is first filled, the water will work its way into these cracks and begin the corrosion process. At the same time the cement lining undergoes a "wet curing" process whereby the cement absorbs water and expands. The water that is absorbed into the lining becomes trapped between the cement lining and the steel tank and once the cement is fully absorbed with water, the water in contact with the steel tank becomes deoxygenated which serves to protect the steel vessel. In addition, the cement leaches minerals and various impurities from the water which fills and "heals" the cracks. This "healing" together with the "wet curing" and expansion of the cement prevents any ongoing corrosion. In the unlikely event a crack greater than 3 mm (1/8") develops, the cement lining can be easily repaired in the field. For repair procedures please contact Hubbell.

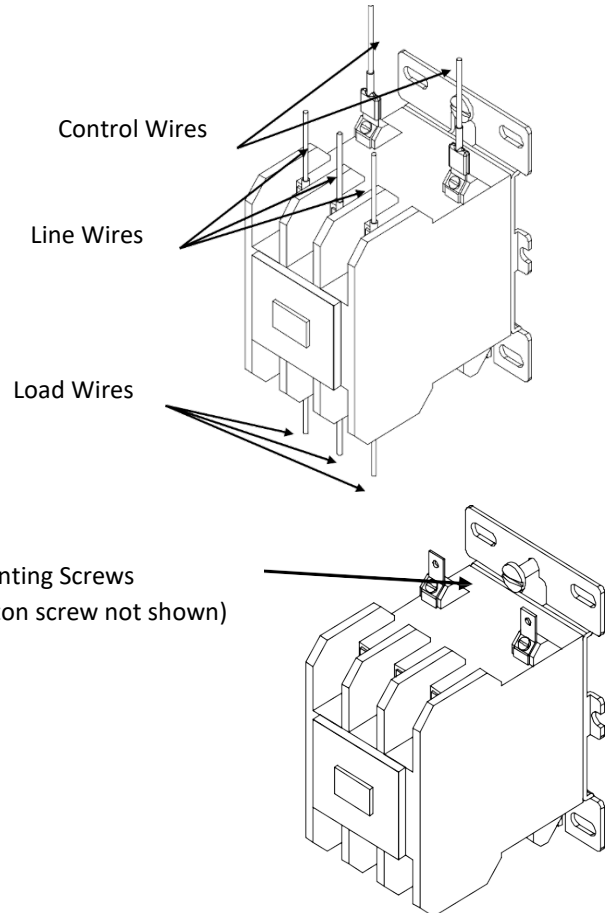
SECTION V - SERVICING & REPLACEMENT OF PARTS

WARNING / CAUTION

Before servicing or replacing any part make sure to turn the power supply switch to the OFF position.

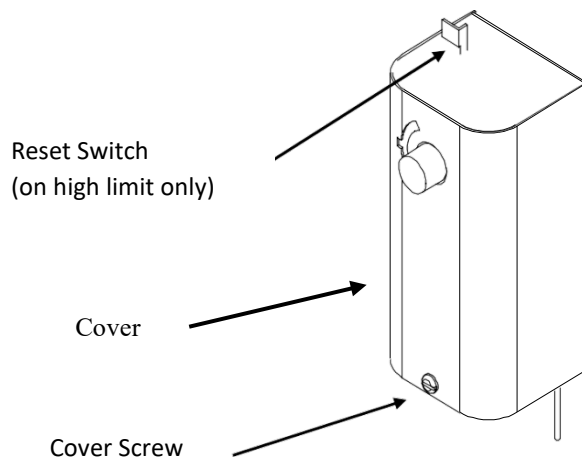
MAGNETIC CONTACTOR

1. Disconnect power from unit.
2. Disconnect line and load wires to contactor.
3. Disconnect two (2) 14-gauge control circuit wires.
4. Loosen two (2) holding screws and remove contactor.
5. Replace with new contactor using reverse procedure.

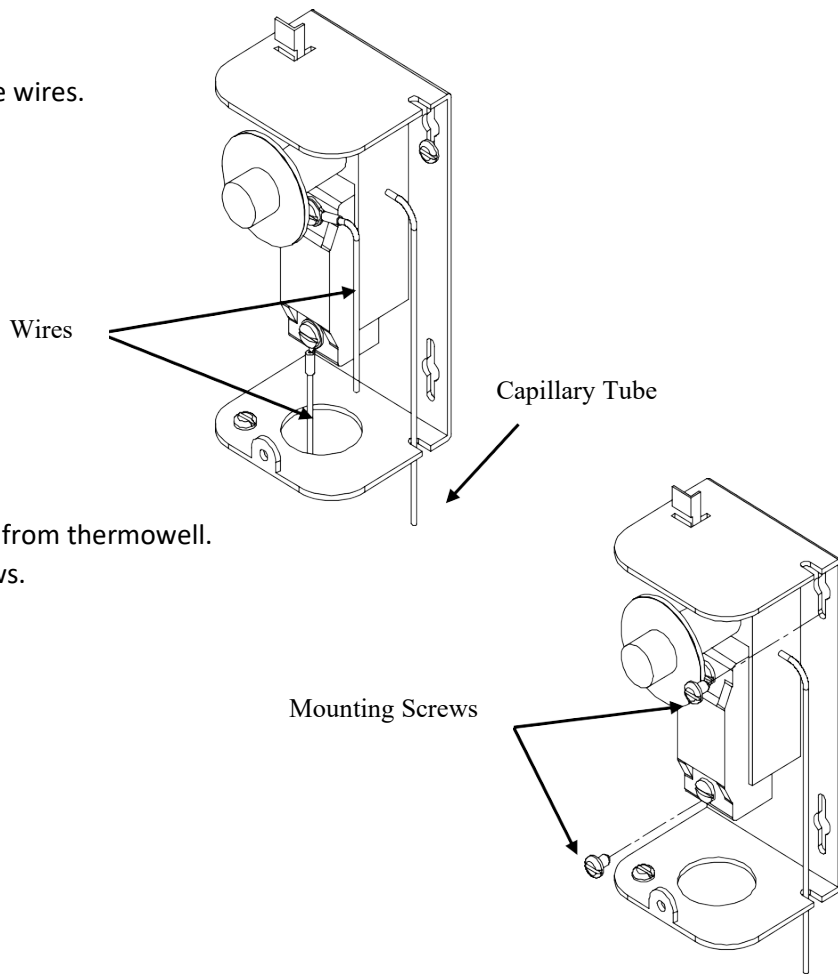


IMMERSION TEMPERATURE CONTROLLER

1. Disconnect power from unit.
2. Remove access cover.
3. Remove high limit cover screw and cover.



4. Disconnect the two (2) 14-gauge wires.

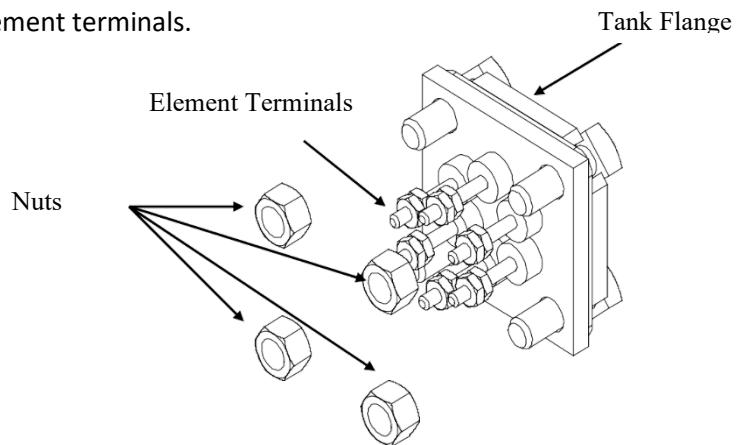


5. Remove capillary tube and bulb from thermowell.
6. Remove two (2) mounting screws.

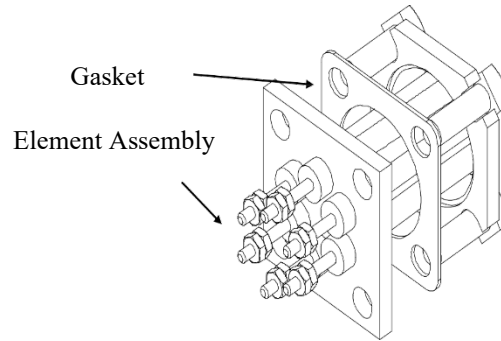
7. Remove control and install new high limit switch by performing above steps in reverse order. (Note: Be sure to place capillary tube into slot in base prior to installing cover.)

HEATING ELEMENT – STYLE A

1. Disconnect power from unit.
2. Shut off incoming water supply.
3. Attach hose to drain connection.
4. Lift manual release lever on relief valve to let air into system or break union on outgoing water line.
5. Drain water from tank.
6. Disconnect the wires from the heating element terminals.
7. Remove the 3/8-16 nuts.



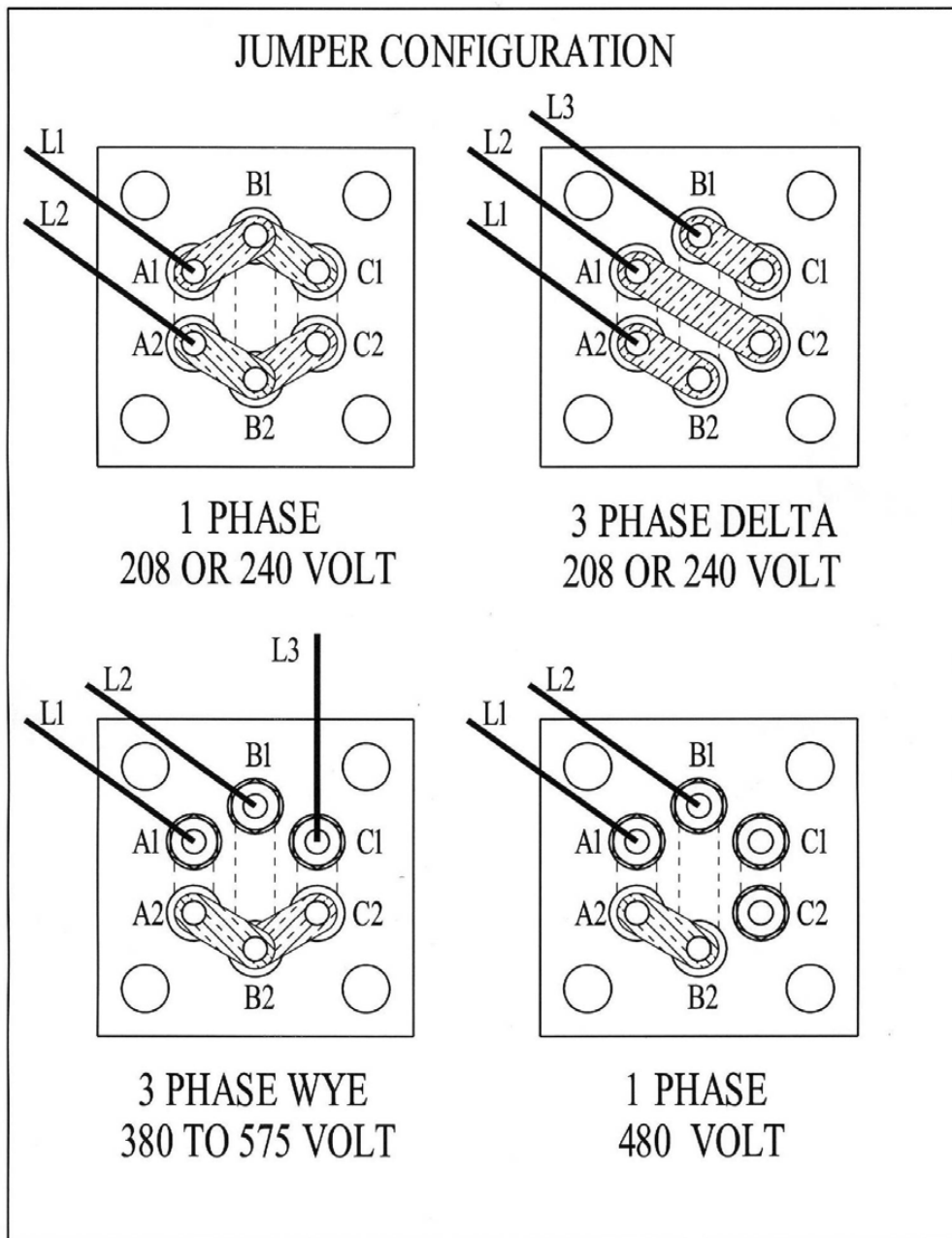
8. Withdraw element assembly and remove gasket.



9. Install a new gasket and insert a new heating element.

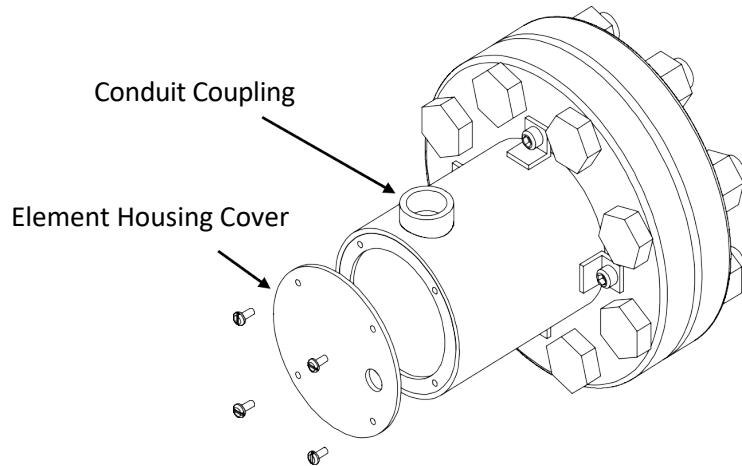
10. Rewire element according to the voltage and phase rating of the unit as shown below.

11. Fill the tank and check around the gasket for any leaks.

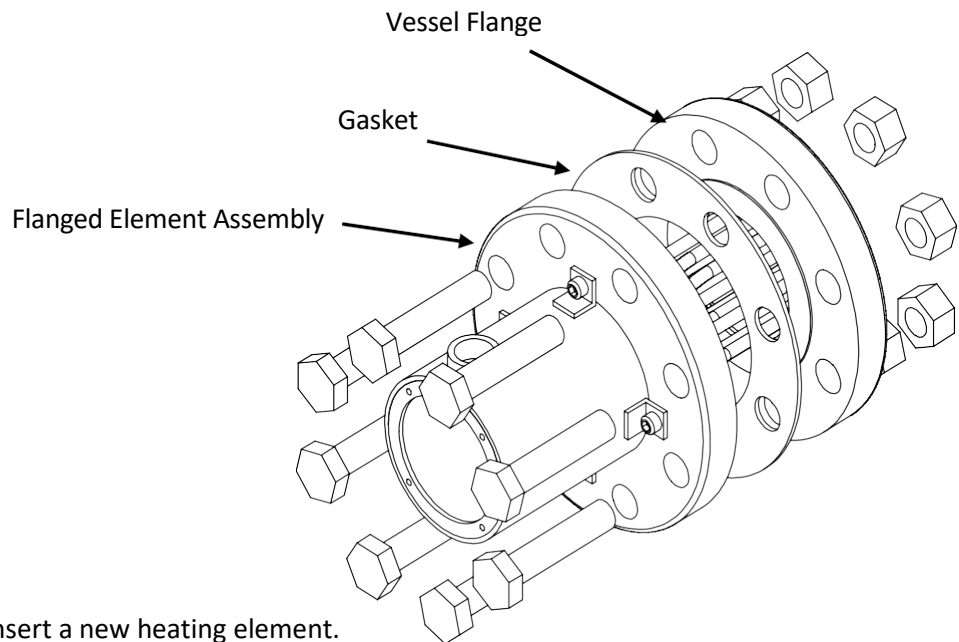


HEATING ELEMENT – STYLE B

1. Disconnect power from unit.
2. Shut off incoming water supply.
3. Attach hose to drain connection.
4. Lift manual release lever on relief valve to let air into system or break union on outgoing water line.
5. Drain water from tank.
6. Remove element housing cover.
7. Disconnect the wires from the heating element terminals.
8. Disconnect conduit from coupling.



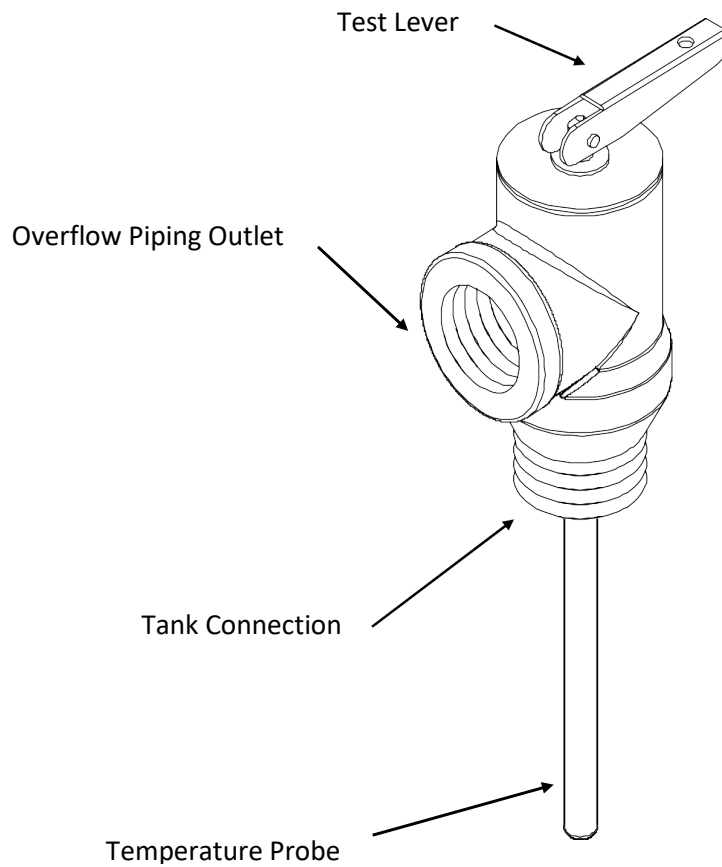
9. Remove nuts and bolts from flanges.
10. Withdraw element assembly and remove gasket.



11. Install a new gasket and insert a new heating element.
12. Rewire element according to the voltage and phase rating of the unit as shown below.
13. Fill the tank and check around the gasket for any leaks.

RELIEF VALVE

1. Disconnect power from unit.
2. Shut off incoming water supply.
3. Lift test lever on relief valve to relieve pressure in tank.
4. Disconnect overflow piping.
5. Unscrew relief valve, remove assembly, and replace with new one.
6. Connect overflow piping.
7. Turn on incoming water supply and check for leaks.
8. Turn the safety switch to ON position.



SECTION VI – MISCELLANEOUS CHARTS AND FORMULAS

NEMA ENCLOSURES

Type	Intended Use and Description		
1	Enclosures are intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment or locations where unusual service conditions do not exist.	4X	Enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, and hose-directed water; undamaged by the formation of ice on the enclosure.
2	Enclosures are intended for indoor use primarily to provide a degree of protection against limited amounts of falling water and dirt.	12	Enclosures are intended for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping noncorrosive liquids.
3	Enclosures are intended for outdoor use primarily to provide a degree of protection against windblown dust, rain, and sleet; undamaged by the formation of ice on the enclosure.	13	Enclosures are intended for indoor use primarily to provide a degree of protection against dust, spraying of water, oil, and noncorrosive coolant.
4	Enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against wind-blown dust and rain, splashing water, and hose-directed water; undamaged by the formation of ice on the enclosure.		

The preceding descriptions are not intended to be complete representations of National Electrical Manufacturers Association standards for enclosures.

Table 1. COMPARISON OF SPECIFIC APPLICATIONS OF ENCLOSURES FOR INDOOR NON-HAZARDOUS LOCATIONS

Provides a Degree of Protection Against the Following Environmental Conditions	Type of Enclosure										
	1*	2*	4	4X	5	6	6P	11	12	12K	13
Incidental contact with the enclosed equipment	X	X	X	X	X	X	X	X	X	X	X
Falling dirt	X	X	X	X	X	X	X	X	X	X	X
Falling liquids and light splashing		X	X	X		X	X	X	X	X	X
Dust, lint, fibers, and flyings †			X	X	X	X	X		X	X	X
Hosedown and splashing water			X	X		X	X				
Oil and coolant seepage									X	X	X
Oil or coolant spraying and splashing											X
Corrosive agents				X			X	X			
Occasional temporary submersion						X	X				
Occasional prolonged submersion							X				

* These enclosures may be ventilated. However, Type 1 may not provide protection against small particles of falling dirt when ventilation is provided in the enclosure top.

† These fibers and flyings are nonhazardous materials and are not considered the Class III type ignitable fibers or combustible flyings. For Class III type ignitable fibers or combustible flyings see the National Electrical Code®, Section 500-6(a).

Table 2. COMPARISON OF SPECIFIC APPLICATIONS OF ENCLOSURES FOR OUTDOOR NON-HAZARDOUS LOCATIONS

Provides a Degree of Protection Against the Following Environmental Conditions	Type of Enclosure						
	3	3R**	3S	4	4X	6	6P
Incidental contact with the enclosed equipment	X	X	X	X	X	X	X
Rain, snow, and sleet §	X	X	X	X	X	X	X
Sleet ††			X				
Windblown dust	X		X	X	X	X	X
Hosedown				X	X	X	X
Corrosive agents					X		X
Occasional temporary submersion						X	X
Occasional prolonged submersion							X

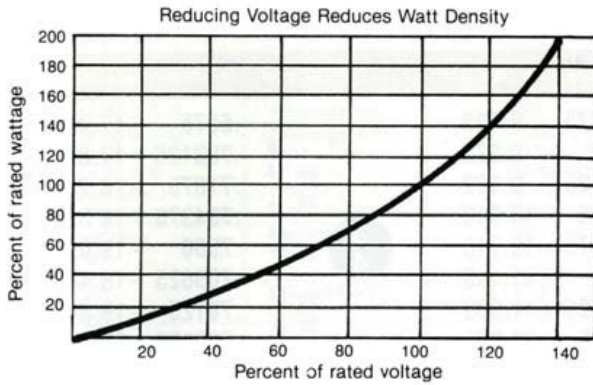
§ External operating mechanisms are not required to be operable when the enclosure is ice covered.

†† External operating mechanisms are operable when the enclosure is ice covered.

** These enclosures may be ventilated.

ELECTRICAL DATA

Wattage Change with Voltage Change



PERCENT RATED WATTS ON REDUCED VOLTAGE

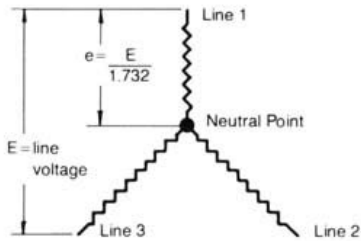
- 230-volt heater on 208 volts—82%
- 240-volt heater on 208 volts—75%
- 480-volt heater on 277 volts—33%
- 480-volt heater on 440 volts—84%
- 480-volt heater on 318 volts—44%
- 550-volt heater on 480 volts—76%

$$W_2 = W_1 \times \left(\frac{e_2}{e_1}\right)^2$$

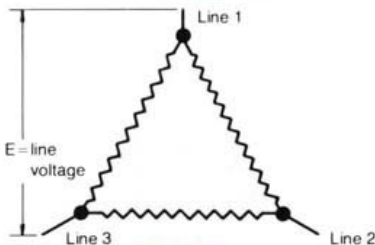
Where:

- w_2 = New wattage output
- w_1 = Rated wattage
- e_2 = Applied voltage
- e_1 = Rated voltage

Three Phase Circuits



WYE OR STAR



DELTA

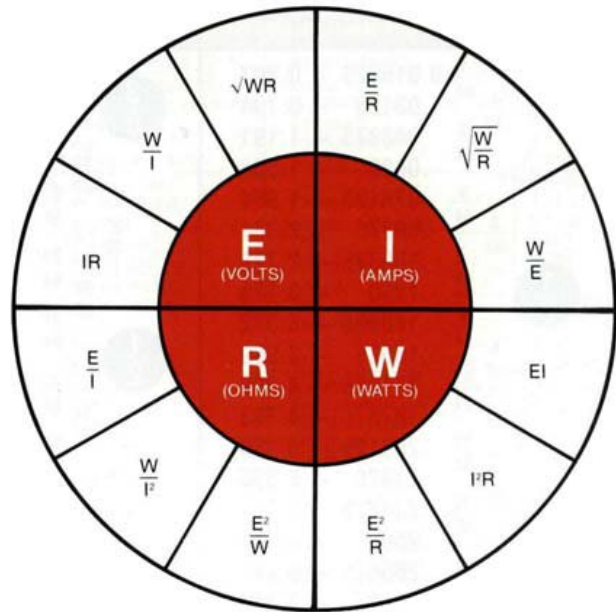
If elements are designed for 3-phase Delta connection, wattage output may be reduced to $\frac{1}{3}$ by reconnecting to 3-phase WYE

For current in 3-phase circuits $I = \frac{W}{E \times 1.732}$

For resistance in 3 phase circuit (across any two terminals)

$$R = \frac{E^2}{\frac{1}{2}W}$$

ohms Law



Amperage Conversion Table

Watts	Volts, Single Phase			Volts 3 Phase Balanced Load		Watts
	120	240	480	240	480	
100	.83	.42	.21	.24	.13	100
150	1.25	.63	.31	.36	.18	150
200	1.67	.83	.42	.49	.25	200
250	2.08	1.04	.52	.61	.30	250
300	2.50	1.25	.63	.73	.37	300
350	2.92	1.46	.73	.85	.43	350
400	3.33	1.67	.84	.97	.49	400
450	3.75	1.88	.93	1.10	.55	450
500	4.17	2.08	1.04	1.20	.60	500
600	5.00	2.50	1.25	1.45	.73	600
700	5.83	2.92	1.46	1.70	.85	700
800	6.67	3.33	1.67	1.93	.97	800
900	7.50	3.75	1.87	2.17	1.09	900
1000	8.33	4.17	2.10	2.41	1.21	1000
1100	9.17	4.58	2.30	2.65	1.33	1100
1200	10.0	5.00	2.51	2.90	1.45	1200
1250	10.4	5.21	2.61	3.10	1.55	1250
1300	10.8	5.42	2.71	3.13	1.57	1300
1400	11.7	5.83	2.91	3.38	1.69	1400
1500	12.5	6.25	3.12	3.62	1.82	1500
1600	13.3	6.67	3.34	3.86	1.93	1600
1700	14.2	7.08	3.54	4.10	2.05	1700
1800	15.0	7.50	3.75	4.34	2.17	1800
1900	15.8	7.92	3.96	4.58	2.29	1900
2000	16.7	8.33	4.17	4.82	2.41	2000
2200	18.3	9.17	4.59	5.30	2.65	2200
2500	20.8	10.4	5.21	6.10	3.05	2500
2750	23.0	11.5	5.73	6.63	3.32	2750
3000	25.0	12.5	6.25	7.23	3.62	3000
3500	29.2	14.6	7.30	8.45	4.23	3500
4000	33.3	16.7	8.33	9.64	4.82	4000
4500	37.5	18.8	9.38	10.84	5.42	4500
5000	41.7	20.8	10.42	12.1	6.1	5000
6000	50.0	25.0	12.50	14.50	7.25	6000
7000	58.3	29.2	14.59	16.9	8.5	7000
8000	66.7	33.3	16.67	19.3	9.65	8000
9000	75.0	37.5	18.75	21.7	10.85	9000
10000	83.3	41.7	20.85	24.1	12.1	10000

FORMULAS

RECOVERY

$$\text{GPH} \times \text{_____} \text{ } ^\circ\text{F } \Delta\text{T} \times 0.00244 = \text{KW}$$

$$\text{KW} \times 410 \div \text{GPH} = \text{_____} \text{ } ^\circ\text{F } \Delta\text{T}$$

$$\text{KW} \times 410 \div \text{_____} \text{ } ^\circ\text{F } \Delta\text{T} = \text{GPH}$$

Note: 1 KW will heat 4.1 GPH at a 100°F ΔT

ELECTRICAL

$$\frac{\text{KW} \times 1000}{\text{Volts}} \div 1.73 = \text{Amps } 3 \Phi$$

$$\frac{\text{KW} \times 1000}{\text{Volts}} = \text{Amps } 1 \Phi$$

METRIC CONVERSION

$$\text{Liters} \times 0.2641 = \text{Gallons}$$

$$\text{Gallons} \times 3.79 = \text{Liters}$$

$$\text{Gallons} \times 0.003785 = \text{m}^3$$

$$\text{m}^3 \times 264.2 = \text{Gallons}$$

$$1^\circ\text{C } \Delta\text{T} = 1.8^\circ\text{F } \Delta\text{T}$$

$$^\circ\text{F} = (^\circ\text{C} \times 1.8) + 32$$

$$^\circ\text{C} = (^\circ\text{F} - 32) \times 0.556$$

$$\text{psi} \times 0.06896 = \text{Bar}$$

$$\text{Bar} \times 14.5 = \text{psi}$$

$$\text{psi} \times 6.86 = \text{kPa}$$

$$\text{kPa} \times 0.1456 = \text{psi}$$

$$\text{Lbs} \times 0.4536 = \text{Kg}$$

$$\text{Kg} \times 2.2 = \text{Lbs}$$

$$\text{Watts/Sq.Cm.} \times 6.4 = \text{Watts/Sq.In.}$$

$$\text{Watts/Sq.In.} \times 0.155 = \text{Watts/Sq.Cm.}$$

TORQUE VALUES

BOLT SIZE	18-8 S/S IN.-LBS.	BRASS IN.-LBS.	SILICON BRONZE IN.-LBS.	ALUMINUM 2024-T4 IN.-LBS.	316 S/S IN.-LBS.	MONEL IN.-LBS.
4-40	5.2	4.3	4.8	2.9	5.5	5.3
4-48	6.6	5.4	6.1	3.6	6.9	6.7
5-40	7.7	6.3	7.1	4.2	8.1	7.8
5-44	9.4	7.7	8.7	5.1	9.8	9.6
6-32	9.6	7.9	8.9	5.3	10.1	9.8
6-40	12.1	9.9	11.2	6.6	12.7	12.3
8-32	19.8	16.2	18.4	10.8	20.7	20.2
8-36	22.0	18.0	20.4	12.0	23.0	22.4
10-24	22.8	18.6	21.2	13.8	23.8	25.9
10-32	31.7	25.9	29.3	19.2	33.1	34.9
1/4-20	75.2	61.5	68.8	45.6	78.8	85.3
1/4-28	94.0	77.0	87.0	57.0	99.0	106.0
5/16-18	132	107	123	80	138	149
5/16-24	142	116	131	86	147	160
3/8-16	236	192	219	143	247	266
3/8-24	259	212	240	157	271	294
7/16-14	376	317	349	228	393	427
7/16-20	400	327	371	242	418	451
1/2-13	517	422	480	313	542	584
1/2-20	541	443	502	328	565	613
9/16-12	682	558	632	413	713	774
9/16-18	752	615	697	456	787	855
5/8-11	1110	907	1030	715	1160	1330
5/8-18	1244	1016	1154	798	1301	1482
3/4-10	1530	1249	1416	980	1582	1832
3/4-16	1490	1220	1382	958	1558	1790
7/8-9	2328	1905	2140	1495	2430	2775
7/8-14	2318	1895	2130	1490	2420	2755
1-8	3440	2815	3185	2205	3595	4130
1-14	3110	2545	2885	1995	3250	3730

Confirmation of Product Type Approval

Company Name: HUBBELL ELECTRIC HEATER COMPANY

Address: 45 SEYMOUR STREET CT 06615-0288 United States

Product: Heater, Water

Model(s): MSH & MH Series, Shipboard Electric Water Heater

Certificate Type	Certificate Number	Issue Date	Expiry Date
Product Design Assessment (PDA)	19-HS1822005-PDA	06-FEB-2019	05-FEB-2024
Manufacturing Assessment (MA)	19-NY3633016	25-FEB-2019	17-MAR-2024
Product Quality Assurance (PQA)	NA	NA	NA

Tier

5

Intended Service

Marine Applications - Designed to provide Potable Hot Water for Onboard Commercial Marine requirements (Non-Pleasure Craft). Units are designed for Weather deck locations.

Description

Packaged Electric Storage/ Pressure Vessel Type Water Heaters. Vertical or Horizontal, Jacketed, Insulated including all necessary and required operating controls.

Ratings

Model MSH & MH with 26" to 88" O.D.;

Maximum Working Pressure: 160 psig;

Maximum Design Temperature: 100 °C (210°F);

Storage Capacity: 80 to 5000 Gallons (U.S.);

Heating Element: 15 to 1600 KW;

Relief Valve Type: T&P, 210 °F, 160 psi;

Service Restrictions

- Unit Certification is required for the storage tank in accordance with the requirements of 4-4-1/7 of the Marine Vessels Rules.

- For weather deck locations, NEMA 4 or 4X enclosures to be employed.

Comments

1. The Manufacturer has provided a declaration about the control of, or the lack of Asbestos in this product.
2. Welding is to be performed in accordance with approved procedures. Procedure qualification records, welder qualifications and production welds are to be maintained for records.
3. Overcurrent protection shall be supplied by the end user at the time of final installation.
4. Acceptance is based on Manufacturer's guarantee that the Electric Water Heater is constructed to the standard and conforms to the identifications to which it is marked.
5. Seating arrangements on board ship are to be to the attending Surveyor satisfaction, as per Marine Vessels Rules 4-4-1/19.1. For vertically mounted units, anti-rolling stays should be provided to minimize the loads applied to the lower head to shell weld due to the motions of the vessel.

Notes, Drawings and Documentation

Drawing No. ABSMH3000HLW, ASME MH3000 Vessel Detail

Drawing No. ABSMH3000U, ASME MH3000 Vessel Detail

Drawing No. ABSMSH120, ASME MSH120 Vessel Detail

Drawing No. ABSMSH525, ASME MSH525 Vessel Detail

ASME Certificate of Authorization "H", Certificate No. 33,772 dated 12 Dec. 2016, Expires 30 Jan. 2020

ASME Certificate of Authorization "U", Certificate No. 33,773 dated 12 Dec. Nov. 2016, Expires 30 Jan. 2020

ASME Certificate of Authorization "HLW", Certificate No. 37,239 dated 12 Dec. 2016, Expires 30 Jan. 2020

BDJS.E51660 Boiler Electric - UL Certification

KSDT.E70324 Household Water Heaters, Storage Tank - UL Certification

KSBZ.E70323 Commercial Storage Tank and Booster Water Heaters - UL Certification

ASME Calculations Model MH300-75SLR (Dwg 13-54352-01)

ASME Calculations Model MSH600-TK-XX (Dwg 14-58254-01)

Drawing No. 11-42252 Model ME120-1.5-1.5SLTA Shipboard Electric Heater 120 Gallon 1.5Kw Lower/Upper 120V 60Hz

Drawing No. 13-53944 Model MSE120-0-36SLT4 120 Gallon 36Kw 480V 60Hz

Product Catalog, Model MSH & MH Shipboard Electric Water Heater

Term of Validity

This Product Design Assessment (PDA) Certificate 19-HS1822005-PDA, dated 06/Feb/2019 remains valid until 05/Feb/2024 or until the Rules or specifications used in the assessment are revised (whichever occurs first).

This PDA is intended for a product to be installed on an ABS classed vessel, MODU or facility which is in existence or under contract for construction on the date of the ABS Rules or specifications used to evaluate the Product.

Use of the Product on an ABS classed vessel, MODU or facility which is contracted after the validity date of the ABS Rules and specifications used to evaluate the Product, will require re-evaluation of the PDA.

Use of the Product for non ABS classed vessels, MODUs or facilities is to be to an agreement between the manufacturer and intended client.

ABS Rules

Rules for Conditions of Classification, Part 1, 2019 Marine Vessels Rules 1-1-4/.7, 1-1-A3, 1-1-A4, which covers following:

Marine Vessels Rules (2019) 4-4-1/1.5, 1.9, 17.1

International Standards

NA

EU-MED Standards

NA

National Standards

2017 ASME Boiler and Pressure Vessel Code Section IV – rules for construction of Heating Boilers

Government Standards

46CFR 53.01-03;

Other Standards

NA



A handwritten signature in black ink, appearing to read "James J. Wick".

Corporate ABS Programs
American Bureau of Shipping
Print Date and Time: 02-Nov-2020 9:24

ABS has used due diligence in the preparation of this certificate, and it represents the information on the product in the ABS Records as of the date and time the certificate is printed.

If the Rules and/or standards used in the PDA evaluation are revised or if there is a design modification (whichever occurs first), a PDA revalidation may be necessary.

The continued validity of the MA is dependent on completion of satisfactory audits as required by the ABS Rules. The validity of both PDA and MA entitles the product to receive a **Confirmation of Product Type Approval**.

Acceptance of product is limited to the "Intended Service" details prescribed in the certificate and as per applicable Rules and Standards.

This Certificate is valid for installation of the listed product on ABS units which exist or are under contract for construction on or prior to the effective date of the ABS Rules and standards applied at the time of PDA issuance. ABS makes no representations regarding Type Approval of the Product for use on vessels, MODUs or facilities built after the date of the ABS Rules used for this evaluation.

Type Approval requires Drawing Assessment, Prototype Testing and assessment of the manufacturer's quality assurance and quality control arrangements. The manufacturer is responsible to maintain compliance with all specifications applicable to the product design assessment. Unless specifically indicated in the description of the product, certification under type approval does not waive requirements for witnessed inspection or additional survey for product use on a vessel, MODU or facility intended to be ABS classed or that is presently in class with ABS.

Due to wide variety of specifications used in the products ABS has evaluated for Type Approval, it is part of our contract that; whether the standard is an ABS Rule or a non-ABS Rule, the Client has full responsibility for continued compliance with the standard.

Questions regarding the validity of ABS Rules or the need for supplemental testing or inspection of such products should, in all cases, be addressed to ABS.

Certificate Number: 19-HS1822005-PDA



45 SEYMOUR STREET
STRATFORD, CT 06615

PHONE: (203) 378-2659

FAX: (203) 378-3593

Hubbellheaters.com