



HOTSTART®

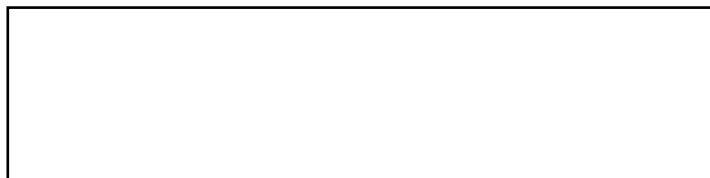
**Oil Circulating
Heating System
Hazardous Location**

Installation & Operation Manual


Identifying Your System

The HOTSTART heating system is designed to heat fluids for use in marine propulsion, diesel-powered generator sets, locomotives, gas compression, or any large-engine applications. The system is pre-wired, pre-plumbed, and assembled on a steel plate. Each heating system has an identification plate which includes the part number and serial number.

Warranty information can be found at www.hotstart.com or by contacting our customer service department at (509)536-8660. Have your model and serial numbers ready when contacting the warranty department.



NOTE: When ordering replacement parts, be sure to reference your heating system's Model and Serial Numbers found on the identification plate and the label above.

HOTSTART. 	SPOKANE, WA U.S.A.	REF. SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS
MODEL _____		
VOLTS _____	HERTZ _____	
AMPS. _____	PHASE _____	
CONTROL CIRCUIT VOLTS _____		
CONTROL CIRCUIT AMPS. _____ MAX		
SERIAL NUMBER _____	U.S. PATENTS 4,245,593, 4,249,491 CAN. PATENTS 1,087,473, 1,082,541	
CAUTION OPEN CIRCUITS BEFORE WORKING ON THIS EQUIPMENT OR REMOVING COVERS. KEEP COVERS TIGHTLY CLOSED WHILE CIRCUITS ARE ALIVE.		
ATTENTION DE' BRANCHEZ LE CIRCUIT AVANT DE'COUVRIR NE DE COUVREZPASTANT QUE LE CIRCUIT EST ACTIF		

Typical label – actual label may vary slightly from model to model, but the general layout is the same.



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Important Safety Information

WARNING

Hazardous voltage: All electrical work must be done by qualified personnel in accordance with all state and local codes.

System can start automatically and without warning. Before wiring, servicing, or cleaning the system turn off the power and install a lockout on the heater circuits at the service panel.

CAUTION

Please read carefully: The safety of any system incorporating this heater is the responsibility of the assembler. The safe and proper use of this heater is dependent upon the installer following sound engineering practices. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. All applicable electrical safety standards defined by local jurisdictions must be followed. (reference EU directive 2006/95/EC in EU countries)

The heater must be connected to a suitable ground (protective earthing conductor).

The power supply must be protected by a suitable overcurrent limiting device.

The means of disconnection from the power supply is required. Hotstart recommends that a power switch or circuit breaker be located near the heater for the safety and ease of use.

Installers and operators of this equipment must be thoroughly familiar with the instructions in this manual before commencing work.

Use proper lifting equipment and rigging to move this equipment. Create a plan before attempting to move. Proper lifting locations are identified with labels on each system, please use these locations when lifting and mounting the system.

Hot surfaces: avoid contact with the system while it is in service – some surfaces may stay hot even if the system is not energized.

Rotating equipment: system can start automatically and without warning – avoid contact unless a lockout at the service panel has been installed.

NOTICE

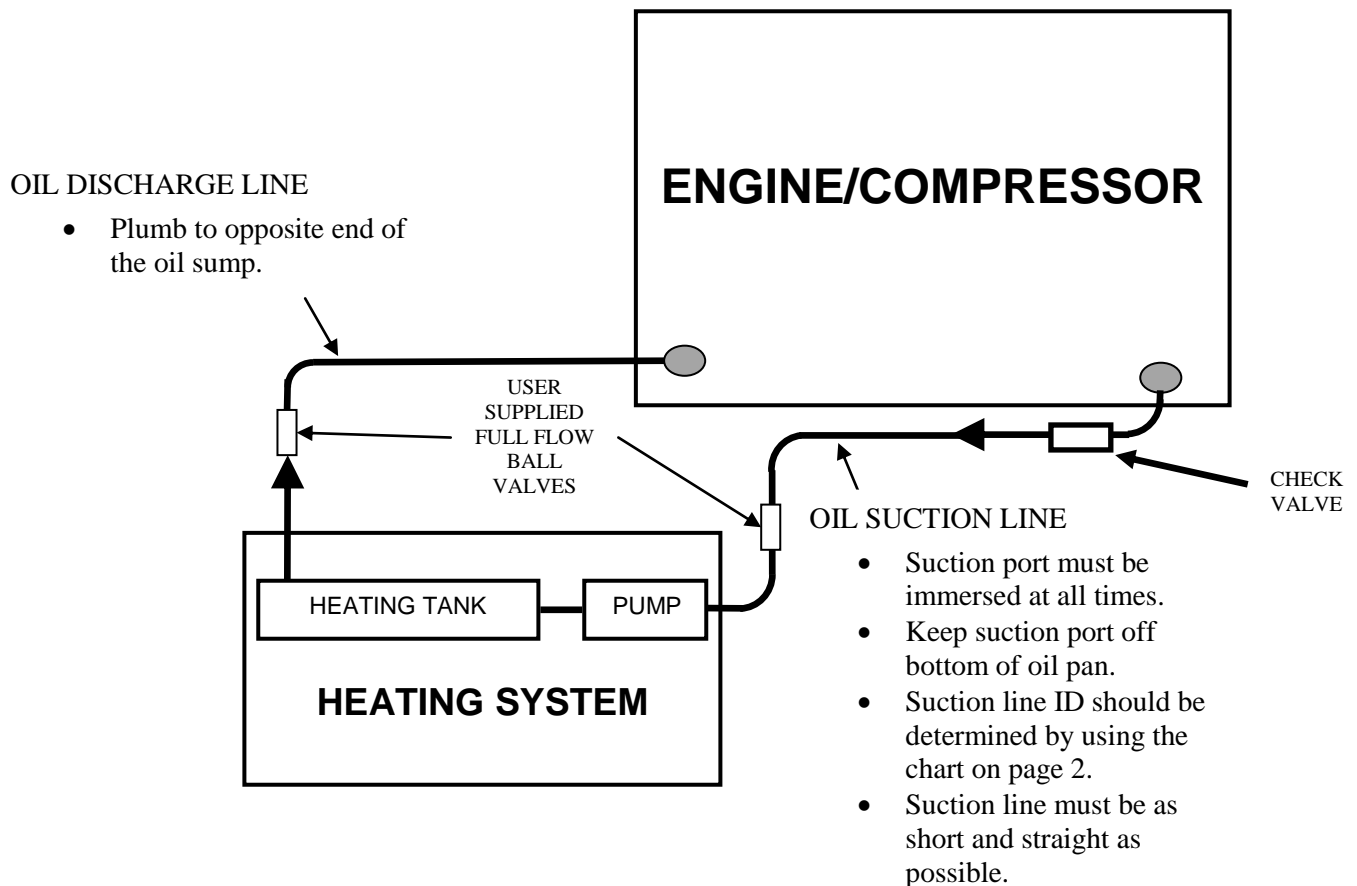
EU Countries Only: Equipment rated for the conditions listed in EN 601010-1 1.4.1 Ingress protection rating IP54. (Special conditions for specific applications may apply)

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1 Installation

1.1 Oil Plumbing Diagram



1.2 Mounting

System should be as close to the suction port as possible. It is recommended to mount at or below the oil level to insure a flooded suction. A check valve should be used at the suction port on the equipment. The system should not be mounted directly to the engine, as vibration can cause failures. Isolate when vibration is present. Heating system should be mounted with the base plate in the vertical position such that the outlet of the heating chamber is pointing up. Clearance is required for heating element removal.

⚠ CAUTION

Lifting hazard: Proper rigging and safety equipment must be used to move this equipment.

1.3 Oil Suction Line Requirements

OIL SUCTION LINE REQUIREMENTS

1. FIND YOUR PUMP, the part number is printed on the pump tag.	2. Find the hose diameter and length that will work for your instalation. Take into account the subtractions in steps 3 -5			3. Use the hose diameter from step 2, to adjust the max length for pump level and elevation.	4. For EACH 12in or 0.3M the pump is above the oil level, subtract the value below from the max hose lentgh	5. For EACH 1000ft or 300M of elevation, subtract the value below from the max hose length.
PART NUM PUMP MODEL PORT SIZE	Hose Diameter	Max Hose Length	Number of Fittings (90°)			
			Max	3/4in, 19mm	12in, 0.3M	1ft, 0.3M
228044-000 SG 1/2 inch	3/4in, 19mm	8ft, 2.4M	0	1in, 25mm		
		6ft, 1.8M	1	1.5in, 38mm	24in, .61M	2ft, .61M
	1in, 25mm	30ft, 9M	0	2in, 51mm	48in, 1.2M	5ft, 1.5M
		15ft, 4.6M	5			
228043-002 or 004 GG475 1 inch	1in, 25mm	6ft, 1.8M	0			
		4ft, 1.2M	1			
	1.5in, 38mm	40ft, 12M	0			
		30ft, 9M	5			
228048-002 HJ475 1.5 inch	1.5in, 38mm	16ft, 5M	0			
		10ft, 3M	2			
	2in, 51mm	50ft, 15M	0			
		40ft, 12M	5			
228050-002 HL475 1.5 inch	1.5in, 38mm	11ft, 3.4M	0			
		8ft, 2.4M	1			
	2in, 51mm	30ft, 9M	0			
		20ft, 6M	5			

1.4 Lube Oil Discharge Line

Size the discharge line per the outlet of the heating system. There are two options for the discharge line of the Hotstart oil heating system. The heated oil can be returned to the opposite end of the oil sump, or engine pre-lubing can be achieved by installing a tee in the discharge line along with a solenoid valve or manual three-way valve.

Note: See engine manufacturer requirements for pre-lubing. Hotstart does not specify flow rates or pressure for pre-lube systems.

NOTICE

Do not reduce the inlet line. Pump seal damage will occur.

Position the heating tank so that it is completely full of oil while in operation.

Fill the suction line with oil. Pump is **not** self-priming. Liquid must be present in the Pump before start-up. Trapped air inside the pump will cause pump and seal damage.

After completing oil line installation, top-off the oil level to compensate for the oil Used to fill the lines and heating tank. The system should be configured with user Supplied full port ball valves in the oil lines, allowing maintenance on the heating System without draining the engine oil.

1.5 Main Power Supply

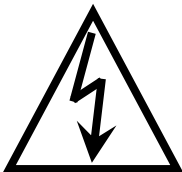
Connect the specified power from the customer supplied circuit breaker to the terminal blocks located in the main control box. For three phase applications, the terminal blocks are labeled L1, L2, and L3. For single phase applications, use the terminal blocks labeled L1 and L3 or L and N. The circuit breaker must be near the heating system and easily accessible.

The main power ground wire must be connected to the ground lug or ground block on the electrical panel located inside the electrical box.

The main power supply operates the heating elements and the circulating pumps. A transformer is used to operate the control circuit. The transformer and control circuits are overload protected with fuses and/or a circuit breaker.

⚠ WARNING

Hazardous Voltage: A lockout must be used at the service panel when work is being done inside the control box to avoid electrocution.

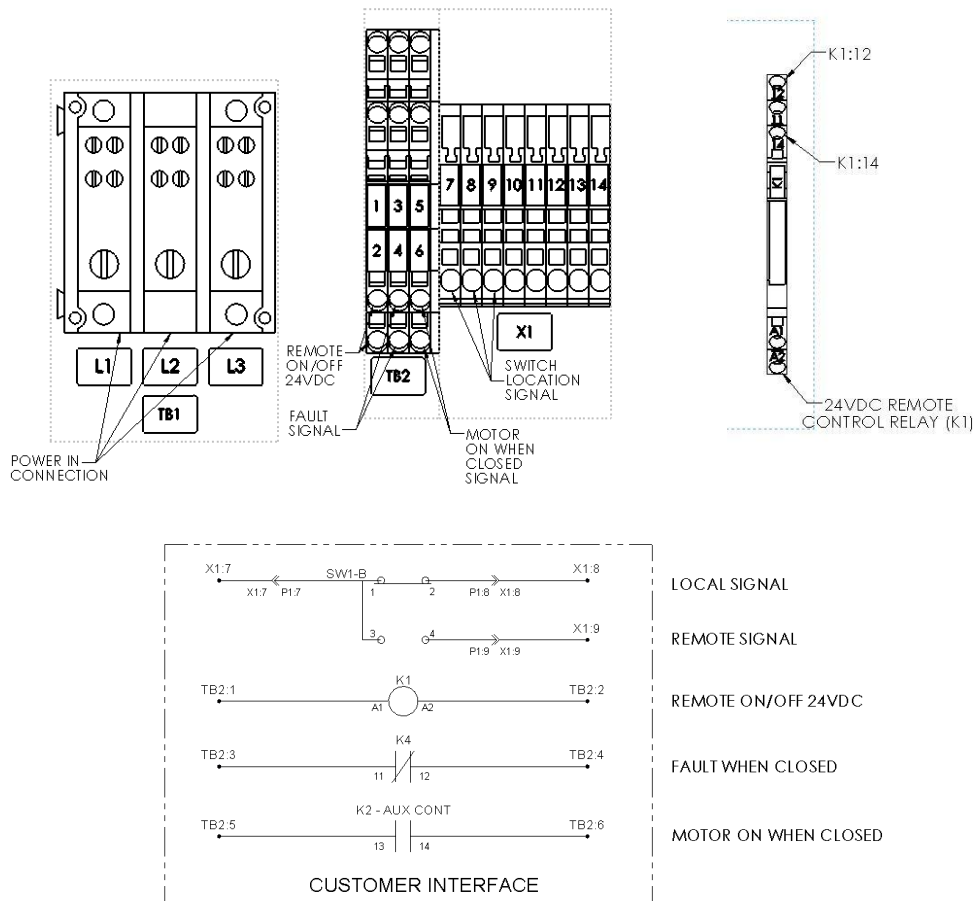


All wiring shall be done by qualified personnel in accordance with national, state, and local codes. Each system shall be grounded in accordance with the National Electrical Code. Failure to properly ground the system may result in electric shock.

1.6 Customer Interface Connections

Reference electrical schematic and control box drawing for proper wiring locations. Shown below are typical customer interface locations.

Local and Remote signals indicate switch position. The Fault signal indicates a fault. The Run signal indicates the pump is running. The 24 VDC connections are for remote control of the heater while the switch is in the Remote position. Typical wiring on 24VDC remote control relay is N/C, to switch to N/O move the wire from K1:12 to K1:14.



Typical Customer Interface: see included drawings and wiring diagram for specific system locations.

2 Heating System Start-Up

Step 1 Check and tighten all electrical and plumbing connections.

Step 2 Ensure isolation valves are open before energizing the system.

Step 3 **Check for proper rotation of the motor** by pressing the prime button while watching the motor shaft or fan. Single phase systems are pre-wired to rotate in the correct direction. On a three phase system, if the pump is not rotating in the correct direction, switch any two electrical leads at the main power terminal block.

NOTICE

DO NOT RUN MOTOR/PUMP ASSEMBLY DRY FOR MORE THAN A FEW SECONDS.

Running a pump that is not completely filled with liquid will cause damage to the pump seal.

Step 4 Bleed all trapped air from the heating system by opening a plug or pipe fitting at or near the pump. Press and hold the prime button to evacuate any remaining air in the lines. When all the air is evacuated, the discharge pressure gauge should indicate pressure.

Step 5 Energize the heating system by switching the control switch to the Local position. A pressure gauge should indicate pressure if the system is working correctly.

⚠ WARNING

Hazardous Voltage: A lockout must be used at the service panel when work is being done inside the control box to avoid electrocution.

Step 6 Once operation is satisfactory, turn the control dials on the Temperature Control Relay TCR1 to the desired temperature setting. HOTSTART recommends a control temperature (on TCR1) of 30 °C (86 °F). The high limit temperature setting (on TCR2) should be set at 90 °C (194 °F).

NOTICE

The high limit TCR must be set at least 10 °C (18 °F) higher than the control TCR for proper heating operation. This will avoid nuisance tripping of the high limit circuit.

Step 7 Change the switch to the Remote position and verify that the 24 V DC controls operate properly (refer to Section 4.3 for operation).

3 Overview of Operation

When the system is energized, a positive displacement rotary gear pump takes oil from the engine sump and forces it through the heating tank and into the return line. The return line can be routed back to the sump, or can be sent to the top of the engine for pre-lube and post-lube purposes.

Note: See engine manufacturer requirements for pre-lubing. Hotstart does not specify flow rates or pressure for pre-lube systems.

<i>NOTICE</i>

Continual pre-lubing can cause permanent engine damage. Consult the engine manufacturer for proper pre-lube techniques.

The heating system is designed to run continuously while the engine is not running. The heating element will cycle on and off with the system temperature controller to maintain the temperature.

4 System Components and Operation

The control box contains the electrical control components for the heating system. The following is an operational description for the standard parts located on the system, including:

- Prime Button
- 3-Position Switch (Local/Off/Remote)
- Remote Control Relay
- Control TCR (Temperature Control Relay)
- High Limit TCR
- Motor Protective Switch (MPS)

4.1 Prime Button

The prime button is used to assist with removal of remaining air in the suction and discharge lines (without energizing the heating elements). This can be verified by an increase in pressure on the pressure gauge.

4.2 Local/Off/Remote 3-Position Switch

- Local – Manual control: the system turns on independent of the remote control relay.
- Off – The system is shut off.
- Remote – Automatic control: the system turns on and off via the remote control relay.

4.3 Remote Control Relay

Typical wiring on 24VDC remote control relay is N/C. In this position the automatic control relay allows the system to run and requires a 24 V DC signal to de-energize the system. To switch to N/O move the wire from terminal 12 to terminal 14 on the remote control relay.

4.4 Control TCR (Temperature Control Relay)

The control TCR is used to control the temperature of the engine oil. It uses a Resistance Temperature Device (RTD) to sense the oil temperature of the fluid coming from the engine to the heater. The standard setting for the control TCR is 30 °C (86 °F) and 10% hysteresis. The TCR will turn the heater off at the set point of 30 °C (86 °F) and turn the heater on at 27 °C (81 °F) with these set points.

4.5 High Limit TCR

The high limit TCR is a protective device to prevent overheating of the oil in the system, and the RTD is located in the element enclosure. The default setting is 90 °C (194 °F) and should always be at least 10 °C (18 °F) higher than the control TCR set point. The high limit TCR hysteresis is not used in the high limit control.

4.6 Motor Protective Switch (MPS)

The MPS protects the motor from overloads. The MPS will be set at the full load amperage of the motor when shipped from the factory. On hazardous location models, press the RESET button on the control box lid to reset the motor protective switch (inside the control box).

5 Maintenance, Repair, and Troubleshooting

5.1 System Maintenance

Instructions for the following maintenance procedures are provided to ensure trouble-free operation of your heating system. Replacement parts must meet or exceed original part requirements in order to maintain the compliance level of the original heater.

- Plumbing Connections
- Electrical Connections and Contacts
- System Mounting
- Magnetic Contactors
- Pump Seal
- Volatile Corrosion Inhibitor
- Heating Tanks/Elements

After maintenance is performed, refer to the start-up section of this manual.

WARNING

Hazardous voltage: Before wiring, servicing or cleaning the system, turn off the power and install a lockout at the service panel. Failure to do so could allow others to turn on power unexpectedly, which many cause fatal electrical shock.

5.1.1 Plumbing Connections

Periodically check plumbing connections for leaks and, if necessary, tighten connections. A loose connection on the suction side will cause a loss of flow and cavitation in the pump. It can also pull air into the heating tank and cause an element failure.

5.1.2 Electrical Connections

Vibration may eventually cause terminals to loosen. Tighten at start-up and check again in a week. Tighten all electrical connections every 3 months.

5.1.3 System Mounting

Vibration may cause mounting bolts to loosen. Periodically check and tighten all mounting bolts.

5.1.4 Magnetic Contactors

Magnetic contactors are used as voltage switching controls for motors and heating elements in HOTSTART Heating Systems. The contactors use 120 or 240 V coils. To test for failure, check for continuity across the coil connections; an open or direct-short reading indicates a failed contactor coil.

The contactor contacts should be inspected periodically for welding, arc erosion, and mechanical wear. If any of these conditions exist, clean the contacts or replace the contactor.

5.1.5 Pump Seal

Leakage can occur at any time throughout the life of the seal. Always replace the seal at the first sign of leakage. If the heating system is installed on an engine that is used for a critical application, replace the seal annually. Instructions to replace the seal are included with the new seal.

5.1.6 Volatile Corrosion Inhibitor (VCI)

A VCI is provided with each control box and should be replaced once a year.

5.1.7 Heating Element Replacement

To replace the heating element or perform routine maintenance, observe the following procedure. The wattage and phase of the heating element are listed on the identification label on the outside of the element. Reference this label for the replacement element part number.

⚠ WARNING

Hazardous voltage: Before wiring, servicing or cleaning the system, turn off the power and install a lockout at the service panel. Failure to do so could allow others to turn on power unexpectedly, which many cause fatal electrical shock.

Step 1 Turn the heating system OFF, close isolation valves, and lock out at the service panel.

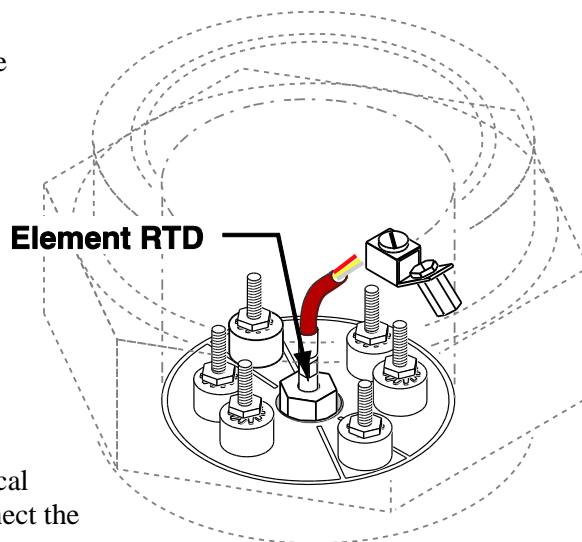
Step 2 Drain the fluid from the heating tank.

Step 3 Remove the cap from the heating element service entrance enclosure.

Step 4 The wire connections inside the enclosure correspond to one of the phase configurations shown at the bottom of the page. Note your unit's phase configuration.

*Replacement elements can be a different phase configuration. Wire replacement elements to the cup washers on the replacement element studs.

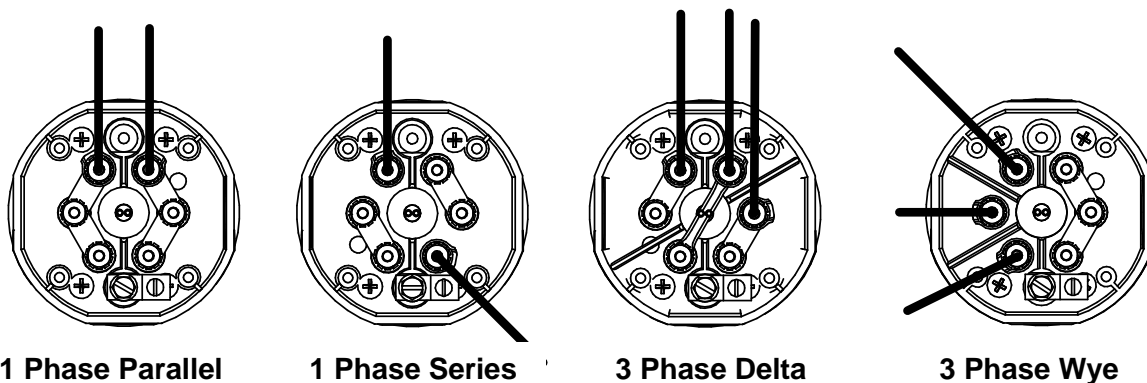
Disconnect the ground (green) and power electrical wires from the posts inside the cap. Also disconnect the element RTD wires.



Step 5 Remove the conduit connector and electrical wires from the heating element.

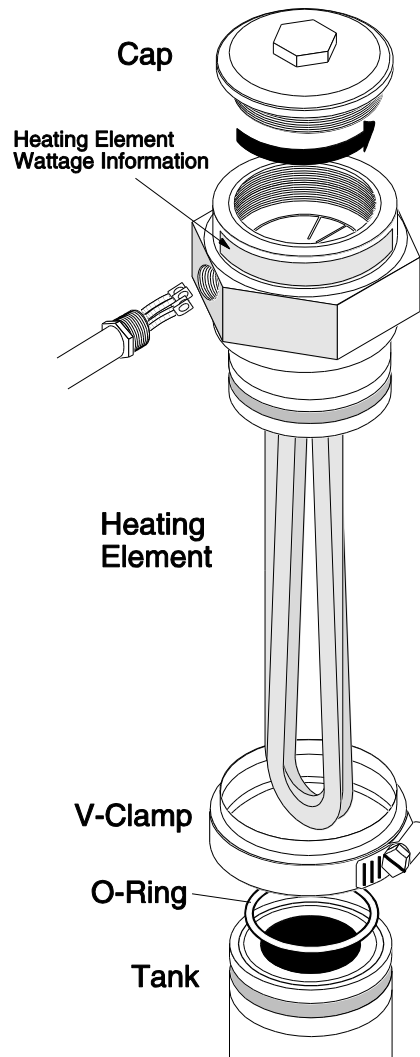
Step 6 Remove the V-clamp to detach the heating element from the tank as shown on the next page.

Step 7 Replace the heating element or perform the necessary cleaning procedure. Ensure the O-ring is in place.



5.1.8 Reassembly of Heating Element and Tank

To reassemble the heating element and tank, follow the steps listed on the previous page in reverse order. Make sure the ground and power electrical wires are properly reconnected using the washers, cup washers and nuts supplied (please note diagram at bottom of the previous page).



5.1.9 RTD Replacement

The high limit RTD is located inside the element enclosure and the other control RTD is located at the inlet side of the tank as shown below. To replace this RTD, follow the steps listed below.



⚠ WARNING

Hazardous voltage: Before wiring, servicing or cleaning the system, turn off the power and install a lockout at the service panel. Failure to do so could allow others to turn on power unexpectedly, which many cause fatal electrical shock.

- Step 1** Remove the cover of the service entrance enclosure.
- Step 2** Disconnect the RTD wires in the service entrance taking care to note current wiring.
- Step 3** Drain the tank and remove the RTD.
- Step 4** Reassemble in reverse order.

To remove the element RTD open the element enclosure and unscrew the RTD from the element burr using a 7/16 end wrench. To re-assemble screw the RTD back into the element burr.

5.2 Troubleshooting

Faults indicated by the system only occur from an overheating condition or a tripped motor protective switch.

Symptom	Possible Causes	Solution
Indicated System Fault	Pump not primed properly	Bleed all trapped air from lines, restart system
	Isolation valves may be closed	Open valves, restart system
	Hose kinked or crushed	Remove obstruction, restart system
	Leak in suction line	Repair leak, restart system
	Pump motor turning backwards	Reverse any two leads on power in (3 phase systems), restart system
	TCR1 failed closed	Check and replace if needed, restart system
	Motor failure	Check and replace if needed, restart system
	Motor contactor failure	Check contacts and coil replace if needed, restart system
	Motor protective switch tripped	Check and reset, if problem happens again check motor, restart system
Low Temperature	Motor failure	Check and replace if needed
	TCR1 failed	Check and replace if needed
	Heater has been turned off, fluid is cold	Allow time for heater to heat fluid
	Heating element failed	Check elements for continuity and replace if needed
	Element fuses failed or Breaker Tripped	Check all element fuses for continuity and replace as necessary or reset breaker
	Element contactor failed	Check contacts and coil replace if needed
	Motor contactor failed	Check contacts and coil replace if needed
	Motor failed	Check and replace if needed
	TCR1 failed open	Check and replace if needed