



HOTSTART®

**Coolant Circulating
Heating System
TCR Controlled**


Installation & Operation Manual

Identifying Your System

The HOTSTART heating system is designed 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 and mounting channel. Each heating system has an identification plate which includes the part number and serial number. Please reference those numbers when ordering replacement parts.



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.



HOTSTART, Inc.

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Customer Support: (509) 536-8660
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Important Safety Information

⚠ WARNING

All electrical work must be done by qualified personnel in accordance with the National Electrical Code and applicable 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

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.

Hot surfaces: avoid contact with the system while it is in service – some surfaces may stay hot even if the system is not energized. Use common sense when performing any maintenance on this equipment.

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

Warranty Information

The warranty below has been drafted to comply with the Federal Law applicable to products manufactured after December 31, 1976. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

HOTSTART products are warranted against defects in workmanship and materials. No other express warranty, written or oral, applies. No person is authorized to give any other warranty or assume any liability except by written statement from an officer of HOTSTART, Inc.

The warranty extends for twelve months from date of shipment from factory or authorized distributor.

Products must be installed and maintained in accordance with HOTSTART, Inc. instructions. Users are responsible for the suitability of the products to their application. There is no warranty against damage resulting from corrosion, misapplication, improper specification or other operating conditions beyond our control. Claims against carriers for damage in transit must be filed by the buyer.

Unauthorized alterations to factory supplied equipment voids this warranty. Consult the factory if modifications are required.

Absolutely no material can be returned to HOTSTART, Inc. without prior factory authorization.

Upon factory authorization, return the defective part or product, freight prepaid, to: HOTSTART, Inc., 5723 E. Alki, Spokane, WA 99212. Telephone (509) 534-6171; FAX (509) 534-4216.

Defective items will be repaired or replaced, at our option, at no charge. Such repair or replacements is the exclusive right of HOTSTART, Inc. HOTSTART, Inc. is not liable for labor costs incurred in removal, reinstallation, or unauthorized repair of the product or for damage of any type whatsoever including incidental or consequential damage. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the preceding limitation or exclusion may not apply to you.

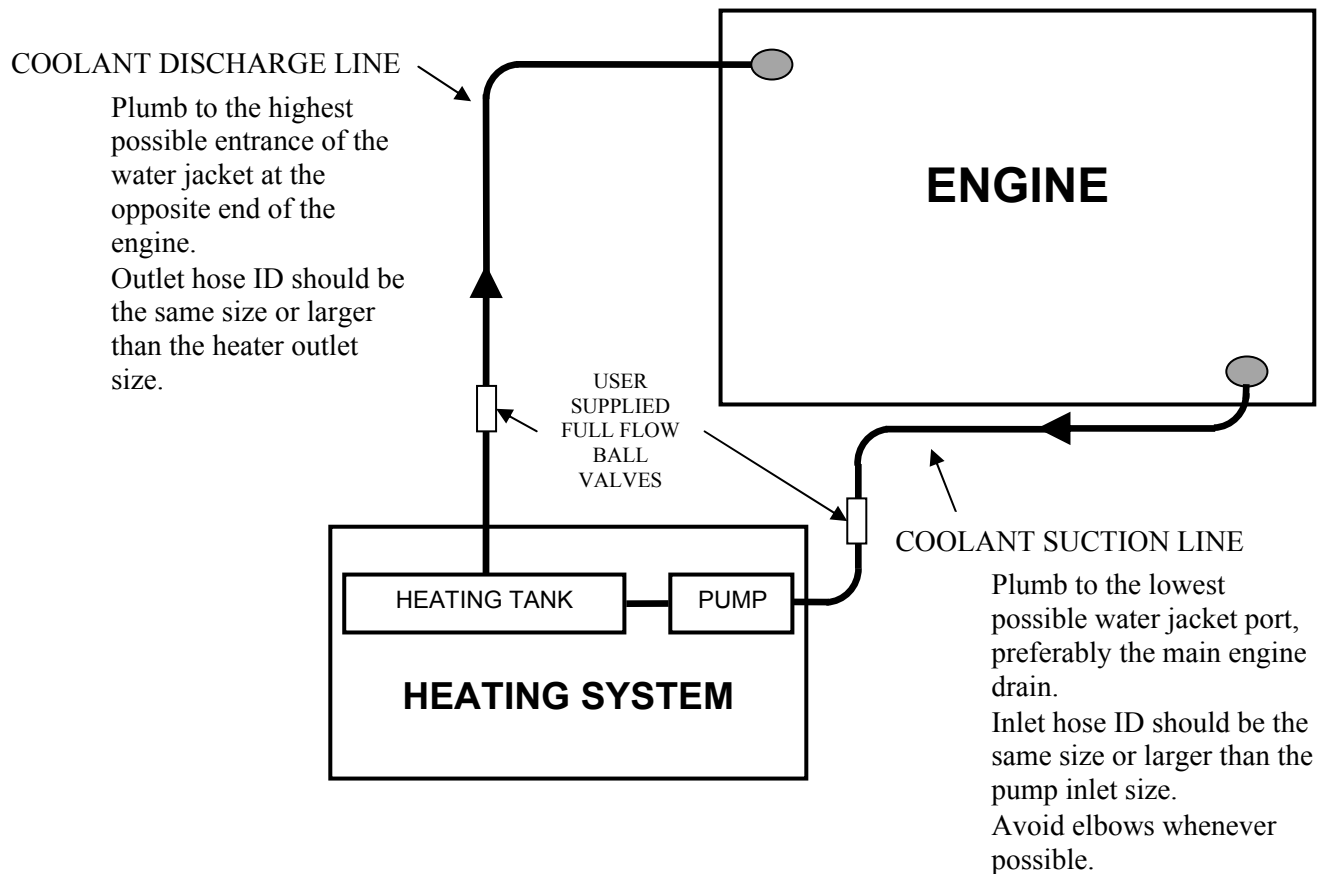
HOTSTART, INC.

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1 Installation

1.1 Coolant Plumbing Diagram



HEATING SYSTEM

Must be mounted at or below engine coolant level.

Mount heater in a location that minimizes the length of the coolant suction line.

DO NOT mount directly to the engine. Mount on the floor or skid next to engine and properly isolate from vibration.

Pressure relief valve must be plumbed to a safe location.

Prime the pump using the prime button until the pressure gauge registers pressure, or flow is verified.

Clearance is required for heating element removal. Before permanently mounting the heating system, verify that sufficient clearance exists.

For alterations to the recommended coolant plumbing diagram please consult HOTSTART for authorization.

NOTICE

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

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

Fill the suction line with coolant. 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.

Follow engine manufacturer's recommendations for coolant mixture.

HOTSTART recommends using pre-mixed coolant. **Do not** use tap water to mix with coolant - element and engine damage will occur. Tap water contains calcium and other minerals which will precipitate from the solution and attach to the element and other engine components providing insulation from heat transfer. Only deionized or distilled water and a low-silicate antifreeze should be used in your coolant mixture. The antifreeze/water mixture should never exceed a 60% antifreeze to 40% water ratio.

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

▲ CAUTION

Pressure and steam hazard: power must be turned off and locked out at the service panel when the isolation valves are in the closed position. Failure to do so may result in the release of pressurized steam.

▲ CAUTION

Proper rigging and safety equipment must be used to move this equipment – weight is not centered. Plan ahead before attempting to move this equipment.

1.2 Main Power Supply

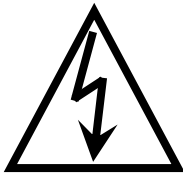
Connect the specified power ($\pm 10\%$ of the rated voltage) to the terminal blocks located in the main control box. For three phase applications, the terminal blocks are labeled L1, L2, and L3. For single phase applications, use the terminal blocks labeled L1 and L3 or L and N.

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

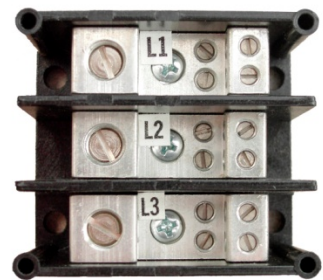
The main power supply operates the heating elements and the circulating pumps. A transformer is used to operate the control circuit at 120 V. The transformer and control circuits are overload protected with fuses and/or a circuit breaker.

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.



1.3 Relay Wiring Connections

Reference electrical schematic and control box drawing for proper wiring locations.

1.4 Customer Outputs

The system has two types of customer outputs: lights on the front of the control box and dry contacts for a remote signal.

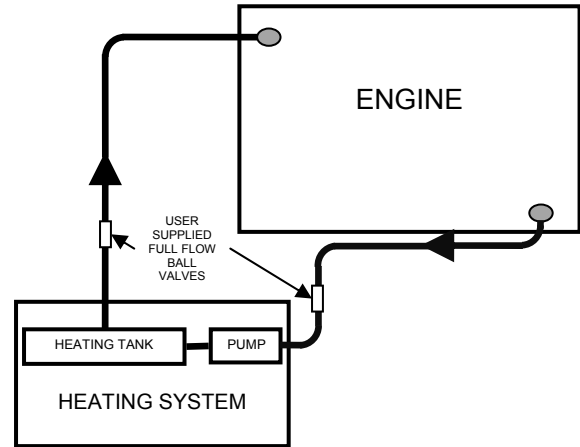
Amber light: Switch is in LOCAL position
Green light: Switch is in REMOTE position
Red Light: System FAULT

NOTICE

Reference electrical schematic and control box drawing for proper wiring locations.

2 Overview of Operation

The heating system will automatically start following engine shut-down. There is a 24 V DC relay in the system that receives a signal from the engine or equipment control to start and stop the heater. Upon heater start-up, the pump motor runs continuously and the heating element cycles on and off to maintain the set temperature of the heater. The heater acts as an after-cooler as it circulates coolant through the engine. When the engine has cooled to the set temperature minus the hysteresis, the heating element turns on and raises the temperature to the set temperature, and continues the cycle.



HOTSTART heating systems include indicator lights which represent the position of the selector switch and indicate that the power is on. The heating system also features a display light to indicate a fault.

If there is a failure in the system that causes a high temperature to occur, the high temperature controller shuts down the entire heating system, including the pump motor. To restart the system, the power switch or the 24 V DC start/stop signal has to be cycled off and back on. A failure in the motor that causes the motor protective switch to trip also shuts down the entire system. In this circumstance, the user must press the heating system's start button to reset the fault. The heating system's control box is equipped with a set of dry contacts for the transmission of an alarm signal.

3 Heating System Start-Up

- Step 1** Check and tighten all electrical and plumbing connections.
- Step 2** **Check for proper rotation of the motor** by pressing the prime button while watching the motor shaft or fan. It may be necessary to remove the screw in the top of the pump in order to see the shaft spin. 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.

<i>NOTICE</i>

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

- Step 3** 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 gage should indicate pressure.
- Step 4** Ensure isolation valves are open before energizing the system.
- Step 5** Energize the heating system by switching the control switch to the Local position. A pressure gauge should indicate pressure if working correctly.
- 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 40 °C (104 °F). The high limit Temperature setting (on TCR2) should be set at 60 °C (140 °F). The high limit TCR must be set at least 20 °C (68 °F) higher than the control TCR for proper heating operation.
- Step 7** Change the switch to the Remote position and verify that the 24 V DC controls operate properly (refer to Section 4.4 for operation).

4 System Components and Operation

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

- Prime Button
- 3-Position Switch (Local/Off/Remote)
- Indicator Lights
 - Remote
 - Local
 - Fault
- Automatic Control Relay
- Control TCR (Temperature Control Relay)
- High Limit TCR (Fault)
- Motor Protective Switch
- Time Delay Relay
- Pressure Relief Valve

Parts in the control box may vary, depending on the particular system configuration purchased.

4.1 Prime Button

The prime button is used to purge the air out of the system without switching the elements on. This button should be used before start-up of the system to verify that coolant is circulating.

4.2 Local/Off/Remote 3-Position Switch

Local – Manual control: the system turns on from the local switch independent of any automatic control.

Off – The system is shut off.

Remote – Automatic control: the system turns on and off via the relay control.



4.3 Indicator Lights

Remote – Illuminated when selector switch is in remote position.

Local – Illuminated when selector switch is in local position.

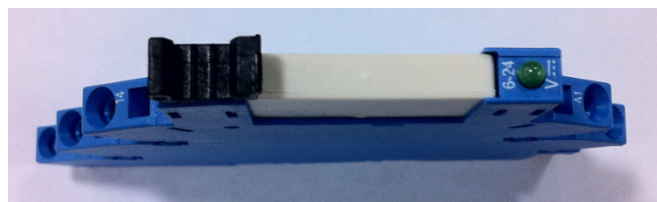
Fault – Illuminated when system has a fault (refer to troubleshooting section for specific faults).

To reset, turn remote switch off and back on again.

4.4 Automatic Control Relay

When the switch is in the Remote position, the system requires a 24 V DC signal be applied to the remote on/off terminal blocks in the control box (see wiring schematic) for the system to operate.

The control relay can be wired N/O or N/C. Refer to the system wiring diagram to see how your system is wired. To change the operation, move the wire on the relay K1 from the N/C to N/O or vice versa.



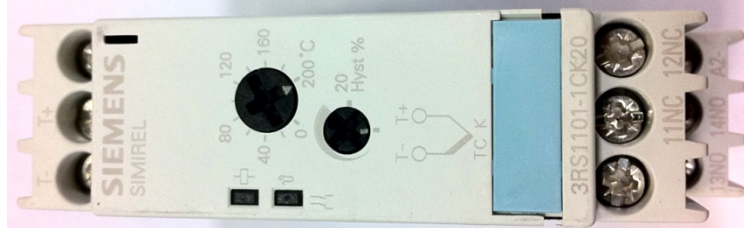
Automatic Control Relay

4.5 Control TCR (Temperature Control Relay)

The control TCR is used to control the temperature of the engine coolant. It uses a Resistance Temperature Device (RTD) to sense the coolant temperature of the fluid coming from the engine to the heater. It should be set at 40 °C (104 °F) and 10% (4 °C) hysteresis.

4.6 High Limit TCR

The high limit TCR is a protective device to prevent overheating of the coolant in the system. This relay default setting is preset at 60 °C (140 °F) and should always be at least 20 °C higher than the control TCR set point. The high limit TCR hysteresis is not used in the high limit control.

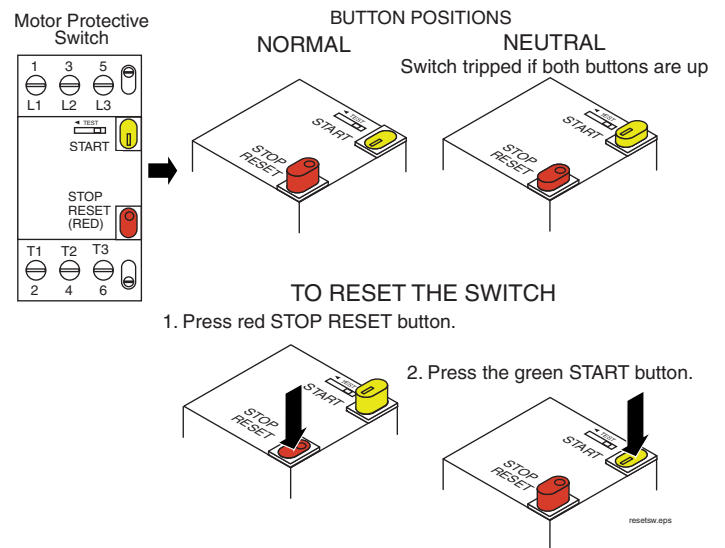


4.7 Motor Protective Switch (MPS)

On an Explosion Resistant model, press the RESET button on the control box lid to reset the motor protective switch (inside the control box).

On a NEMA 4 or 12 model, it is necessary that you open the control box to reset the motor protective switch:

1. Check the position of the black START and the red STOP RESET buttons on the motor protective switch. In normal operation the red STOP RESET button is up and the black START button is down.
2. If both buttons are up, the switch has been tripped. To reset, first press the red STOP RESET button and then press the black START button. The switch is reset.



4.8 Time Delay Relay

If a fault occurs and the high limit TCR or the MPS is tripped, the time delay relay coil is energized and shuts the motor and heating element off. This requires a manual reset of the system; this is done by cycling the power off and on again. Perform this function ONLY after resolving the initial fault that caused the system to shut down.

4.9 Pressure Relief Valve

The system is equipped with a pressure relief valve that is preset to relieve at 90 psi. Attach pipe that is sized to the outlet of the pressure relief valve and direct it toward a safe area. During normal operation, pressure releases are rare but it is recommended that a bucket or other catch-basin be located under the release pipe to avoid damage to surrounding items if a release occurs.



Pressure Relief Valves

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:

- Plumbing Connections
- Electrical Connections and Contacts
- Heating Tanks/Elements
- System Mounting
- Pump Seal



HAZARDOUS VOLTAGE:

BEFORE WIRING, SERVICING OR CLEANING THE SYSTEM, TURN OFF THE POWER AND INSTALL A LOCKOUT ON THE HEATER CIRCUITS AT THE SERVICE PANEL. FAILURE TO DO SO COULD ALLOW OTHERS TO TURN ON POWER UNEXPECTEDLY, WHICH MAY 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

Excessive vibration will 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

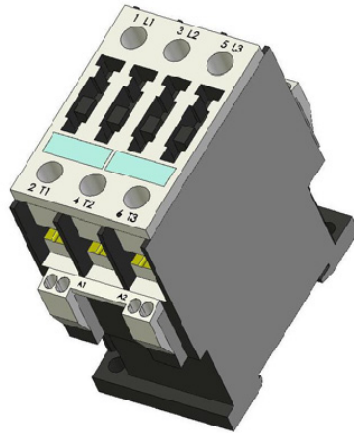
Excessive vibration may cause mounting bolts to loosen. Periodically check and tighten all mounting bolts.

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 Heating Element Replacement & Element RTD 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

BEFORE WIRING, SERVICING OR CLEANING THE SYSTEM, TURN OFF THE POWER AND INSTALL A LOCKOUT ON THE HEATER CIRCUITS AT THE SERVICE PANEL. FAILURE TO DO SO COULD ALLOW OTHERS TO TURN ON POWER UNEXPECTEDLY, WHICH MAY CAUSE FATAL ELECTRICAL SHOCK.

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

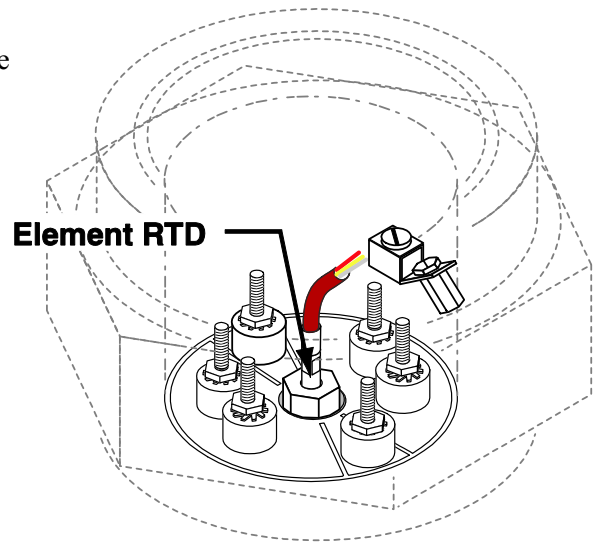
Step 2 Drain the fluid from the heating tank.

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.

Remove the ground (green) and power electrical wires from the posts inside the cap.

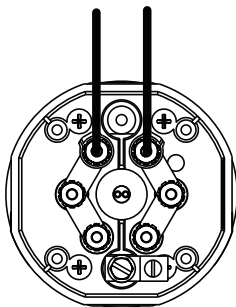


Step 5 Remove the RTD from the heating element (refer to Section 5.1.7).

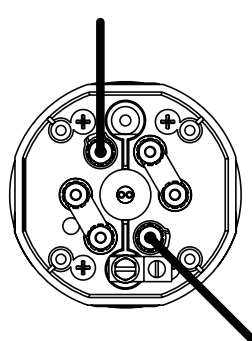
Step 6 Remove the conduit connector and electrical wires from the heating element.

Step 7 Remove the V-clamp to detach the heating element from the tank as shown on the next page.

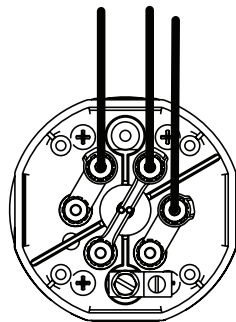
Step 8 Replace the heating element or perform the necessary cleaning procedure. Ensure the O-ring is in place.



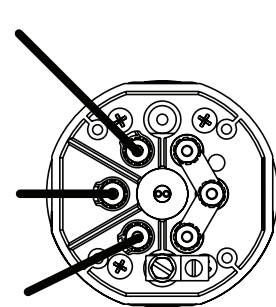
1 Phase Parallel



1 Phase Series



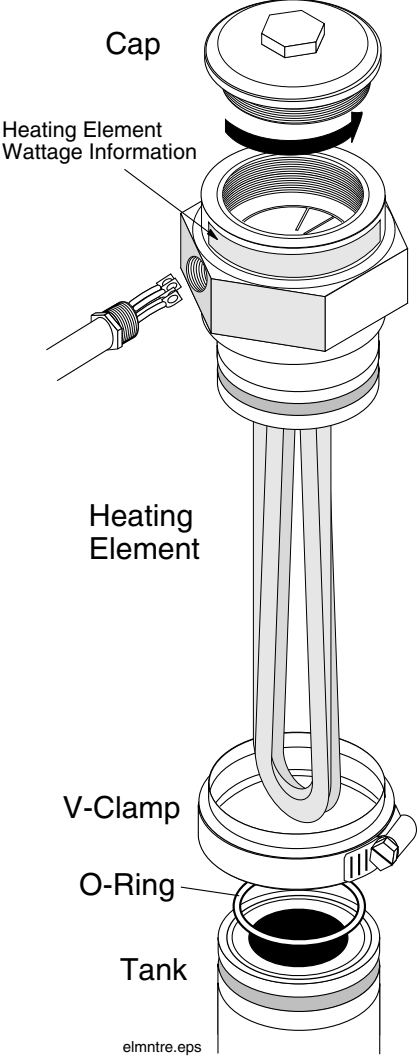
3 Phase Delta



3 Phase Wye

5.1.7 Reassembly of Heating Element and Tank

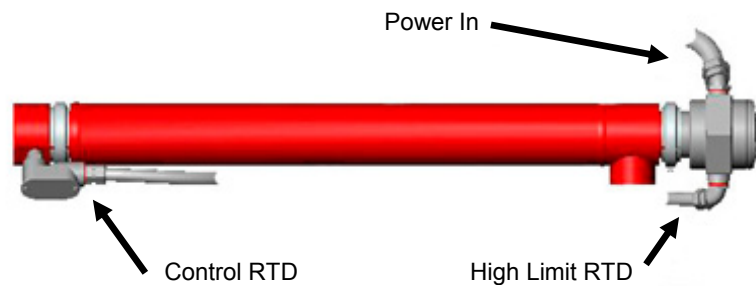
To reassemble the heating element and tank, follow the steps listed on the previous page in reverse order. Make sure the ground and power electrical wires are properly reconnected using the washers, cup washers and nuts supplied (please note diagram at bottom of page).



5.1.8 RTD Replacement

(Tank RTD Replacement)

One of the system RTDs is located inside the RTD housing at the end of each heating tank as shown below. To replace this RTD, follow the steps listed below.



⚠ WARNING

BEFORE WIRING, SERVICING OR CLEANING THE SYSTEM, TURN OFF THE POWER AND INSTALL A LOCKOUT ON THE HEATER CIRCUITS AT THE SERVICE PANEL. FAILURE TO DO SO COULD ALLOW OTHERS TO TURN ON POWER UNEXPECTEDLY, WHICH MAY CAUSE FATAL ELECTRICAL SHOCK.

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

5.2 Troubleshooting

Symptom	Possible Causes	Solution
Fault Light On	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