INSTALLATION & OPERATION MANUAL

OIL CIRCULATING HEATING SYSTEM
FOR HAZARDOUS LOCATIONS

MODEL

OLE
OLA
IDENTIFYING YOUR SYSTEM

The HOTSTART heating system is designed to heat fluids for use in heavy equipment applications. Each heating system component has an identification plate which includes the part number and serial number.

When ordering replacement parts, be sure to reference your heating system component's **MODEL NUMBER** and **SERIAL NUMBER** found on the identification plate and following label:

```
NOTE: Typical heating system identification plate. Your identification plate may vary.
```

```
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.
```

WARRANTY INFORMATION

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

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IMPORTANT SAFETY INFORMATION

**DANGER**

**Hazardous voltage:** Before wiring, servicing or cleaning the heating system, turn off the power and follow your organization’s lockout and tagout procedure. Failure to do so could allow others to turn on the power unexpectedly, resulting in harmful or fatal electrical shock.

**WARNING**

**Electrical hazard:** All electrical work must be done by qualified personnel in accordance with national, state and local codes.

**CAUTION**

**Read instructions 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.)

- **Read carefully:** Installers and operators of this equipment must be thoroughly familiar with the instructions in this manual before commencing work.
- **Hot surfaces:** Avoid contact with the system while it is in service. Some surfaces may remain hot even if the system is not energized.
- **Proper lifting:** 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; use these locations when lifting and mounting the system.
- **Rotating equipment:** The heating system can start automatically and without warning. Avoid contact unless a lockout at the service panel has been installed.
- **Grounding:** The heater must be connected to a suitable ground (protective earthing conductor).
- **Overcurrent limiting:** The power supply must be protected by a suitable overcurrent limiting device.
- **Power disconnection:** A means to disconnect the heater from the power supply is required. HOTSTART recommends that a power switch or circuit breaker be located near the heating system for safety and ease of use.

**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 OVERVIEW

WARNING

System location classification: Before installing the OLE or OLA heating system, ensure all system components are suitable for the intended installation location by referring to the location classification labeling attached to the individual system components.

1.1 HEATING SYSTEM COMPONENTS

NOTE: Component illustrations are for reference only and are not to scale. See part drawings for dimensions and specifications.

Figure 1. Typical OLE/OLA system components. Model style and configuration may vary. See part drawings for dimensions and specifications.
1.2 OPERATION OVERVIEW

The OLE/OLA heating system is intended to maintain optimal oil temperature while the engine or compressor is shut down. The heating system may be activated locally or by optional remote control (see SECTION 2.5.2). The OLE/OLA heating system must be deactivated upon engine start-up.

During heating system operation, a rotary gear pump takes oil from the sump and forces it through the heating tank to the oil return line. The oil pump will continuously circulate fluid throughout the engine or compressor. To maintain consistent fluid temperature, the heating element will cycle on and off at the user-selected temperature control point.

An oil check valve (user-supplied and installed near the oil suction port) prevents backflow while the engine or compressor is operating. When the engine or compressor is shut down, the heating system should be activated locally or remotely to resume maintaining the optimal oil temperature.

Figure 2. OLE/OLA system operation. Component illustrations are for reference only and are not to scale. See part drawings for dimensions and specifications.
2 INSTALLATION

⚠️ CAUTION

Pressure 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 cause damage to heating system components, damage to lubrication oil, leaks and unexpected release of heated oil.

Overheating hazard: After completing line installation, top off the fluid levels to compensate for the fluid used to fill the lines and heating tank. Do not operate the heating system without the presence of fluid. Position the heating tank to ensure it is completely full of fluid while in operation.

Pump priming: Fill supply line with fluid. Pump is not self-priming. Fluid must be present in the pump before start-up. Trapped air inside the pump will cause pump and seal damage.

Pump seal damage: Do not reduce the oil supply line to an inner diameter smaller than the pump inlet; pump seal damage could occur.

Check valve: HOTSTART recommends installing a customer-supplied swing-type or full-flow check (non-return) valve to prevent oil from flowing back into the oil sump. If the pump is installed above the minimum oil level, a check valve must be installed.

Isolation valves: HOTSTART recommends installing full-flow ball valves to isolate the heating system in order to perform service on the system or engine without draining the oil.
2.1 OIL PLUMBING INSTALLATION

**NOTICE**

Heating system damage: Engine vibration will damage the heating system; isolate the heating system from vibration. Never mount the heating system or components directly to the engine. If the heating system is installed using rigid pipe, use a section of flexible hose to the supply and return ports to isolate the heating system from engine vibration.

### 2.1.1 OIL SUPPLY

Installing a short, straight oil supply line with a minimum of flow restriction is the most important step toward ensuring heating system longevity. When installing the OLE/OLA oil supply line, refer to the following HOTSTART guidelines:

- Due to the increased viscosity of lubrication oil, the oil supply line must be as short and as straight as possible. Any 90° elbows will reduce the maximum recommended oil supply length. See Table 1 for HOTSTART OLE/OLA oil supply recommendations:

<table>
<thead>
<tr>
<th>PUMP INLET</th>
<th>HOSE INNER DIAMETER</th>
<th>MAX. LINE LENGTH</th>
<th>MAX. ELBOW COUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 inch NPT</td>
<td>1 inch</td>
<td>20 feet (6 meters)</td>
<td>4</td>
</tr>
<tr>
<td>1 inch NPT</td>
<td>1-1/2 inch</td>
<td>20 feet (6 meters)</td>
<td>4</td>
</tr>
<tr>
<td>1-1/2 inch NPT</td>
<td>2 inch</td>
<td>20 feet (6 meters)</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 1. HOTSTART recommended hose inner diameters, line lengths and elbow counts for OLE/OLA oil supply lines.

**NOTE:** Each additional pair of 90° elbows will reduce the maximum recommended line length by five feet (1.5 meters). To minimize flow restriction, HOTSTART recommends using sweeping bends or 45° fittings.

- At a minimum, size the oil supply line per the pump inlet. **NOTICE!** Do not reduce the supply line inner diameter; pump seal damage will occur.

  **NOTE:** To maximize flow and allow the longest possible supply line, install the largest practical inner diameter hose; for most installations, HOTSTART recommends using a hose with a size larger inner diameter than the pump inlet.

- Install the oil suction port as low as possible in the oil sump, typically near or on the third inspection cover. **NOTICE!** Avoid installing the oil suction port in a location that may allow debris or sediment to enter the heating system.

- HOTSTART recommends installing a customer-supplied, swing-type or full-flow check (non-return) valve to prevent oil flowing into the sump. Install the check valve as close to the oil supply port as possible.

- To ensure consistent oil heating, it is acceptable to select a suction port on the opposite side of the sump.

### 2.1.2 OIL RETURN

When installing the OLE/OLA oil return line, refer to the following HOTSTART guidelines:

- At a minimum, size the oil return line per the pump outlet. **NOTICE!** Do not reduce the return line inner diameter.

Depending on your application, there may be additional requirements for locating the oil discharge port of the HOTSTART oil heating system:

- For diesel engine applications, the oil return line must be routed to the oil discharge port located at opposite end of the oil sump. See **SECTION 2.2**.
For large-sized (four- or six-throw reciprocating) compressor applications, the return line may be routed to the opposite end of the oil sump or the oil return line may be routed to a prelube location. See SECTION 2.3.

For small- and medium-sized compressors, the oil return line may be routed to the opposite end of the oil sump or the return line may be routed to a prelube location. See SECTION 2.3. If the return line is routed to a prelube location, HOTSTART requires installing a bypass to the compressor oil sump, including a customer-supplied tee fitting and pressure relief valve.

Should flow become restricted due to low ambient temperatures, the pressure relief valve along the bypass line will open and allow heated oil to route to the compressor’s oil sump. This alternate routing will allow the heating system to maintain optimal oil temperature while still providing the necessary pressure to the prelube system. See Fig. 3 and Fig. 4.

NOTE: The pressure relief valve must be designated as full-flow bypass and must be set for a maximum of 65 psi. HOTSTART does not recommend non-code safety valves for this application.
2.2 OIL PLUMBING ILLUSTRATION (ENGINE)

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-1</td>
<td>USER SUPPLIED CHECK VALVE</td>
</tr>
<tr>
<td>V-2</td>
<td>USER SUPPLIED FULL FLOW ISOLATION VALVE</td>
</tr>
<tr>
<td>E-1</td>
<td>OIL PUMP</td>
</tr>
<tr>
<td>E-2</td>
<td>OIL HEATING ELEMENT</td>
</tr>
<tr>
<td>V-3</td>
<td>USER SUPPLIED FULL FLOW ISOLATION VALVE</td>
</tr>
</tbody>
</table>

OIL DISCHARGE PORT
SECTION 2.1.2

OIL SUCTION PORT
SECTION 2.1.1

CHECK VALVE
SECTION 2.1.1

ISOLATION VALVE

OIL RETURN
SECTION 2.1.2

OIL SUPPLY
SECTION 2.1.1

ISOLATION VALVE
2.3 OIL PLUMBING ILLUSTRATION (COMPRESSOR WITH PRELUBE)

- **OIL SUCTION PORT**: Section 2.1.1
- **CHECK VALVE**: Section 2.1.1
- **PRELUBE LOCATION**: Section 2.1.2
- **OIL RETURN**: Section 2.1.2
- **OIL DISCHARGE PORT**: Section 2.1.2
- **PRESSURE RELIEF VALVE**: (Up to 65 PSI) Section 2.1.2
- **ISOLATION VALVE**:

**COMPONENT DESCRIPTION**

- V-1: USER SUPPLIED CHECK VALVE
- V-2: USER SUPPLIED FULL FLOW ISOLATION VALVE
- E-1: OIL PUMP
- E-2: OIL HEATING ELEMENT
- V-3: USER SUPPLIED FULL FLOW ISOLATION VALVE
- V-4: OPTIONAL USER SUPPLIED PRV
## 2.4 MOUNTING

### CAUTION

**Lifting hazard:** Proper rigging and safety equipment must be used to move this equipment. Do not lift the heating system by any cords, electrical conduit or cabling. Create a plan before attempting to move. Proper lifting locations are identified on each system; use these locations when lifting and mounting the system.

**Overheating hazard:** When mounting the heating tank, position the tank so that it is completely full of fluid while in operation.

### NOTICE

**Heating system damage:** Engine vibration will damage the heating system; isolate the heating system from vibration. Never mount the heating system or components directly to the engine.

**Improper mounting hazard:** Reference heating system component drawings before mounting the system. Unless mounted properly, the heating system will be unstable.

### 2.4.1 TANK AND PUMP

Mount the heater in a vertical orientation with tank directly above control box and pump. Reference drawings for mounting position. When installing the heating system, note that the tank requires a minimum of 30 inches (63.5 cm) of clearance to remove element for maintenance. See SECTION 4.2.11.

---

## 2.5 ELECTRICAL CONNECTIONS

### WARNING

**Hazardous voltage:** Before wiring, servicing or cleaning the heating system, turn off the power and follow your organization’s lockout and tagout procedure. Failure to do so could allow others to turn on the power unexpectedly, resulting in harmful or fatal electrical shock.

**Electrical hazard:** 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 electrical shock.

### 2.5.1 MAIN POWER SUPPLY

1. Connect the specified power from the customer-supplied circuit breaker to the terminal blocks located in the main control box. See Fig. 7 on following page.

   **NOTE:** The specified power source must be within plus or minus 10% of the rated voltage.

   **NOTE:** The circuit breaker must be near the heating system and easily accessible. HOTSTART recommends connecting the heating system to a circuit breaker rated for 125% of the system’s maximum load.

   **NOTE:** 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.

   - For **three-phase applications**, the terminal blocks are labeled L1, L2 and L3 (A).
   - For **single-phase applications**, use the terminal blocks labeled L1 and L2 or L and N (A).

2. Connect the main power ground wire to the ground block (B).
2.5.2 CUSTOMER INTERFACE CONNECTIONS

The following customer interface connections are available for remote control and monitoring:

- **TB2:1/TB2:2**
  Remote On/Off 24 V DC shutdown (C)
  When activated, the remote on/off connection shuts down the heating system. When deactivated, normal heating will resume. Use this connection for remote operation of the heater when the LOCAL/OFF/REMOTE switch is turned to REMOTE.

  **NOTE:** The 24 V DC shutdown connection is wired NC (normally closed) from the factory; see system wiring schematic for directions to switch to NO (normally open) operation.

- **TB2:3/TB2:4**
  Fault Signal (D)
  The fault signal will indicate a heating system shutdown, triggered by either the high-limit temperature control relay or the motor protection switch (see SECTION 4.1.1).

- **TB2:5/TB2:6**
  Motor Run Signal (E)
  A motor run signal indicates the pump motor is running. If no signal is present, the pump motor is not running.

- **X1:7/X1:8/X1:9**
  Switch Location Signal (F, G, H)
  The switch location signal indicates the LOCAL/OFF/REMOTE switch position: OFF (F), LOCAL (G) or REMOTE (H).
3 COMPONENTS AND OPERATION

The following is an operational description for each of the OLE/OLA interface and system components.

NOTE: Components installed in control box may vary depending on the particular system configuration purchased.

3.1 INTERFACE COMPONENTS

3.1.1 LOCAL/OFF/REMOTE SWITCH

- **LOCAL** – The system is on.
- **OFF** – The system is shut off.
- **REMOTE** – The system will turn on and shut off on a signal from the 24 V DC remote connection. See SECTION 2.5.2.

3.1.2 PRIME BUTTON

Press and hold the **PRIME** button to energize the pump motor in order to remove any air in the heating system without energizing the elements. **NOTICE!** Do not run the motor/pump assembly dry for more than five seconds at a time.

NOTE: The **PRIME** function is intended for use during the first run procedure (see SECTION 3.3.1) or after performing maintenance on the heating system or plumbing (see SECTION 4.2).

3.1.3 RESET BUTTON

Press the **RESET** button to reset the pump motor protection switch without opening the control box. The reset function is intended for use immediately following resolving and repairing a system fault (see SECTION 4.1.1).

3.1.4 PRESSURE/TEMPERATURE GAUGE

The OLE/OLA model features a temperature/pressure gauge mounted at the heating tank inlet. The gauge will indicate a pressure increase when the pump motor is engaged by pressing and holding the **PRIME** button or during normal operation. The gauge will also indicate the fluid’s current temperature.

NOTE: Your system’s operating pressure may vary depending on the configuration of the engine.

3.1.5 PRESSURE RELIEF VALVE

**CAUTION**

Pressure relief valve: If the OLE/OLA heating system is for use with a pressurized fluid system, additional, user-supplied pressure relief must be installed along the heating system outlet plumbing. User-supplied pressure relief valve plumbing must be routed back to oil sump or to atmospheric pressure. Do not route pressure relief plumbing back to heating system tank.

The oil pump pressure relief valve is internal to the pump and releases pressure from the discharge side of the pump to the suction side of the pump at 75 psi (525 kPa). No plumbing for this component is required. The pressure relief valve cap must always point toward the inlet side of the pump.

The OLE/OLA heating system is designed to not exceed 125 psi (862 kPa); however, the oil pump will not exceed 75 psi (517 kPa). In the event the pressure relief valve is activated, the pump will continue to produce flow, but will not exceed a pressure of 75 psi (517 kPa).

Figure 8. Typical OLE/OLA pump assembly. Note that the pressure relief valve cap must always point toward the inlet side of pump.
3.2 SYSTEM COMPONENTS

3.2.1 MOTOR PROTECTION SWITCH

The motor protection switch (MPS) protects the pump motor from overloads. The MPS will be set at the full load amperage of the motor when shipped from the factory. To reset the MPS, the **LOCAL/OFF/REMOTE** switch must be switched to **OFF** and the operator must press the **RESET** button or press the MPS reset/on button (B). See Fig. 7. For additional troubleshooting, see **SECTION 4.5**.

3.2.2 CONTROL TCR (TEMPERATURE CONTROL RELAY)

The control TCR is used to control the temperature of the fluid. The control TCR uses a resistance temperature device (RTD) to sense the temperature of the fluid as it enters the heater. The standard setting for the control temperature relay (TCR1) is 104 °F (40 °C). See Fig. 9.

3.2.3 HIGH-LIMIT TCR (TEMPERATURE CONTROL RELAY)

The high-limit TCR (TCR2) is a protection device to prevent fluid overheating. The high-limit TCR uses a resistance temperature device (RTD) located near the tank outlet. The default setting for the high-limit TCR is 194 °F (90 °C) and should always be at least 18 °F (10 °C) higher than the control TCR set point. The high-limit TCR hysteresis is not used in the high-limit control. See Fig. 9.
3.3 HEATING SYSTEM START-UP

**WARNING**

Hazardous voltage: Before wiring, servicing or cleaning the heating system, turn off the power and follow your organization’s lockout and tagout procedure. Failure to do so could allow others to turn on the power unexpectedly, resulting in harmful or fatal electrical shock.

**NOTICE**

Pump damage: Do not run the motor/pump assembly dry for more than five seconds at a time. Running a pump that is not completely filled with fluid will cause damage to the pump seal.

Proper heating operation: The high-limit temperature control relay (TCR2) must be set at least 18 °F (10 °C) higher than the control temperature control relay (TCR1) for proper heating operation. This will prevent nuisance tripping of the high-limit circuit.

3.3.1 FIRST RUN PROCEDURE

1. Check and tighten all electrical and plumbing connections.

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

3. If you are operating a three-phase heating system, check for proper rotation of the pump motor. Press and hold the PRIME button to check the pump for proper rotation. **NOTICE!** Do not run the motor/pump assembly dry for more than five seconds at a time. If the pump motor is not rotating in the correct direction, switch any two electrical leads at the main power terminal block.

   **NOTE:** Single-phase systems are prewired to ensure the pump motor rotates in the correct direction.

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.

   **NOTE:** When priming the pump, the pressure gauge should indicate an increase in pressure. Your system’s operating pressure may vary depending on the configuration of the engine.

5. Turn the LOCAL/OFF/REMOTE switch to LOCAL to energize the heating system.

6. Turn the control dials on the temperature control relay TCR1 to the desired temperature setting for engine oil. HOTSTART recommends a control temperature on TCR1 of 104 °F (40 °C). The high-limit temperature setting on TCR2 should be set at 194 °F (90 °C). See **SECTION 3.2.2** and **SECTION 3.2.3**.

7. Turn the LOCAL/OFF/REMOTE switch to REMOTE to verify the 24 V DC remote signal connection (if installed).

4 MAINTENANCE, REPAIR AND TROUBLESHOOTING

4.1 SYSTEM FAULTS

4.1.1 OIL FAULTS

A fault signal will be transmitted if:

- The oil pump motor protection switch is tripped (MPS1).
- The oil high-limit temperature is exceeded (TCR2).

A failure in the pump motor that causes the motor protection switch (MPS1) to trip will shut down the heating system. A fault signal will be transmitted. If this failure occurs, the LOCAL/OFF/REMOTE switch must be switched to OFF and the operator must press the RESET button (or the MPS reset/on button) to reset the fault. (See **SECTION 3.1.3**.)

If there is a failure that causes a high temperature to occur, the high-limit temperature controller (TCR2) will shut down the heating system, including the pump motor. A fault signal will be transmitted. To restart the system, the LOCAL/OFF/REMOTE switch must be switched to OFF and then back to LOCAL or REMOTE to resume operation once the fluid temperature drops below the high-limit preset (See **SECTION 3.2.3**.)

For additional troubleshooting, see **SECTION 4.5**.
4.2  SYSTEM MAINTENANCE

**WARNING**

**Hazardous voltage:** Before wiring, servicing or cleaning the heating system, turn off the power and follow your organization’s lockout and tagout procedure. Failure to do so could allow others to turn on the power unexpectedly, resulting in harmful or fatal electrical shock.

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 heating system.

**NOTE:** After maintenance is performed, refer to SECTION 3.3 for system start-up procedures.

### 4.2.1 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.

### 4.2.2 ELECTRICAL CONNECTIONS

Vibration may cause terminals to loosen. At start-up, tighten electrical connections. Check connections again in a week. Tighten all electrical connections every three months.

### 4.2.3 SYSTEM MOUNTING

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

### 4.2.4 MAGNETIC CONTACTORS

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

The contacts on the magnetic contactor should be inspected periodically for welding, arc erosion and mechanical wear. If any of these conditions exist, replace the magnetic contactor. HOTSTART recommends contactors be replaced every five years.

### 4.2.5 PUMP SEAL

If seal becomes worn, replacement pump seals are available. To ensure pump seal longevity, ensure the supply lines do not restrict flow excessively (see SECTION 2.1.1)

**NOTE:** Instructions to replace the pump seals are included with replacement seals.

### 4.2.6 PRESSURE RELIEF VALVE

The oil pump pressure relief valve is internal to the pump and releases pressure from the discharge side of the pump to the suction side of the pump. No maintenance for this part is required.

### 4.2.7 PRESSURE/ TEMPERATURE GAUGE

The oil pressure/temperature gauge will indicate a pressure increase when the pump motor is engaged by pressing the PRIME button or during normal heater operation. The gauge will also indicate the current fluid temperature. No maintenance for this part is required.

### 4.2.8 VOLATILE CORROSION INHIBITOR

A volatile corrosion inhibitor (VCI) is provided with each control box and should be replaced once a year.

**NOTE:** Heating systems placed in extended storage will require that the VCI is replaced at six month intervals. See SECTION 4.4.
4.2.9 TEMPERATURE CONTROL RELAY

**WARNING**

**Hazardous voltage:** Before wiring, servicing or cleaning the heating system, turn off the power and follow your organization's lockout and tagout procedure. Failure to do so could allow others to turn on the power unexpectedly, resulting in harmful or fatal electrical shock.

If the OLE/OLA heating system does not maintain the desired preset control temperature or consistently signals a high-limit temperature fault, the TCR (temperature control relay), the RTD (resistance temperature device), or the RTD cable may require replacement. To perform this troubleshooting, you will need:

- Ohmmeter

1. De-energize the heating system. Check the temperature gauge to ensure the fluid in the tank is below 122 °F (50 °C).

2. Using the ohmmeter, measure the resistance between TCR terminals T1 and T2. See Fig. 10.
   - If the measured resistance is **between 80 and 120 ohms** continue troubleshooting. **Proceed to step 3.**
   - If the resistance is **lower than 80 ohms** or **higher than 120 ohms**, contact HOTSTART for further assistance.

3. Use the ohmmeter to test for continuity between TCR terminals T2 and T3.
   - If there is **continuity** between TCR terminals T2 and T3 and the OLE/OLA does not maintain temperature or consistently signals a high-limit fault, the TCR requires replacement. Contact HOTSTART for further assistance.
   - If there is **no continuity** between TCR terminals T2 and T3, locate the connected RTD on the heating tank. Remove corresponding RTD enclosure cover. See Fig. 12 on following page.

4. Disconnect RTD white lead (A) from connector. Disconnect RTD red lead (B) from connector. Using the ohmmeter, touch the probes to white lead (A) and red lead (B). See Fig. 11. Note the resistance.

5. Disconnect RTD red lead (C) from connector. Touch the probes to RTD white lead (A) and red lead (C) to check for continuity.
4.2.10 CONTROL RESISTANCE TEMPERATURE DEVICE (RTD)

**WARNING**

**Hazardous voltage:** Before wiring, servicing or cleaning the heating system, turn off the power and follow your organization’s lockout and tagout procedure. Failure to do so could allow others to turn on the power unexpectedly, resulting in harmful or fatal electrical shock.

High-limit or control resistance temperature devices (RTDs) sense temperature to either control fluid temperature or protect the system and fluid from overheating. To replace a resistance temperature device (RTD), use the following procedures.

**NOTE:** Before removing and replacing an RTD, ensure the RTD is malfunctioning. See SECTION 4.2.9.

1. De-energize the heating system. Allow fluid to cool.

2. Close isolation valves. Drain the fluid from the heating tank. Locate the RTD that requires replacement. See Fig. 12.

3. Unscrew RTD enclosure cover and disconnect RTD leads from wire connectors. See Fig. 11 on previous page.

4. Unscrew RTD enclosure from RTD. For OLA RTD enclosure removal, both enclosures may need to be removed for access.

5. Unscrew RTD from tank. See Fig. 13.

6. Screw replacement RTD to tank. Reconnect RTD leads to wire connectors:

<table>
<thead>
<tr>
<th>RTD LEAD</th>
<th>CONNECTOR</th>
<th>WIRE COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>white</td>
<td>TS(1 or 2):WHT</td>
<td>white</td>
</tr>
<tr>
<td>red</td>
<td>TS(1 or 2):RED</td>
<td>red</td>
</tr>
<tr>
<td>red</td>
<td>TS(1 or 2):RED</td>
<td>black</td>
</tr>
<tr>
<td>green</td>
<td>Ground (↓)</td>
<td>bare/silver</td>
</tr>
</tbody>
</table>

7. Screw RTD enclosure to RTD.

8. To ensure proper installation and temperature regulation, re-energize and operate heating system. Refer to SECTION 3 for system start-up procedures.
4.2.11 HEATING TANK/ELEMENTS

**WARNING**

**Hazardous voltage:** Before wiring, servicing or cleaning the heating system, turn off the power and follow your organization's lockout and tagout procedure. Failure to do so could allow others to turn on the power unexpectedly, resulting in harmful or fatal electrical shock.

At least once per year, clean the interior of the heating tank and the heating element with a wire brush and/or damp cloth. Periodically check the sediment build-up around the element loops. Any scaling or build-up will shorten element life.

To replace the heating element or perform routine maintenance, use the following procedures. See Fig. 14.

1. De-energize the heating system. Allow fluid to cool.
2. Close isolation valves.
3. Drain the fluid from the heating tank (F).
4. Remove the cap (A) from the heating element service entrance enclosure.
5. The wire connections inside the enclosure correspond to one of the phase configurations shown on the following page. Note your unit's phase configuration. See Fig. 16.
   
   **NOTE:** Replacement elements may be a different phase configuration.
6. Disconnect the ground (green/yellow) and power electrical wires from the posts inside the cap.
7. Unscrew cable gland from conduit connector entrance (C). Remove element conduit (H) and wires from the heating element. See Fig. 15.
8. Loosen V-clamp screw to remove V-clamp (D) Detach the heating element from the tank as shown.

9. Replace the heating element (G) or perform the necessary cleaning procedure. Ensure the O-ring (E) is in place.

4.2.12 REASSEMBLY OF HEATING ELEMENT AND TANK

To reassemble the heating element and tank, follow the steps listed in **SECTION 4.2.11** in **reverse order**. Make sure the ground and power electrical wires are properly reconnected using the provided washers, cup washers and nuts.
Figure 14. Removing and replacing the heating tank element. The heating system should be drained, cleaned and flushed annually. See SECTION 4.3.

A. Element service entrance cap  
B. Element identification plate  
C. Conduit connector entrance  
D. V-clamp  
E. O-ring  
F. Tank  
G. Element

Figure 15. OLE/OLA, showing element conduit (H).

Figure 16. Heating tank element phase configurations. Replacement elements may be a different phase configuration.
### 4.3 RECOMMENDED MAINTENANCE

<table>
<thead>
<tr>
<th>INTERVAL</th>
<th>MAINTENANCE TASK</th>
</tr>
</thead>
<tbody>
<tr>
<td>At initial start-up</td>
<td>Tighten electrical connections. See Section 3.1.1.</td>
</tr>
<tr>
<td>One week after initial start-up</td>
<td>Check and tighten electrical connections. See Section 4.2.2.</td>
</tr>
<tr>
<td>Every three months</td>
<td>Tighten electrical connections.</td>
</tr>
<tr>
<td>Annually</td>
<td>Drain, clean and flush heating system.</td>
</tr>
<tr>
<td></td>
<td>Check for cracked or weakened hoses and replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>Check electrical wiring and connections for wear and excessive heat.</td>
</tr>
<tr>
<td></td>
<td>Check mounting bolts and tighten if necessary.</td>
</tr>
<tr>
<td></td>
<td>Remove element and clean element and tank. See Section 4.2.11.</td>
</tr>
<tr>
<td>Every five years</td>
<td>Replace magnetic contactors. See Section 4.2.4.</td>
</tr>
</tbody>
</table>

### 4.4 STORAGE REQUIREMENTS

If long-term storage is necessary, precautions must be taken to ensure that the heating system is operational for start-up. Steps must be taken to ensure that water ingress is mitigated at all locations. All plugs and caps must remain tight and a suitable cover must be provided for the system. The cover must shield the system from direct rain and protect from any directed spray that may occur.

For any storage longer than three months, desiccant bags must be placed next to the system if it is still in the original packaging and inside the control box. If the storage duration will be one year or longer, the volatile corrosion inhibitor inside the control box must be replaced at six month intervals.

New pump motors placed in long-term storage for a year or longer may require relubrication before initial use. If your pump motor has provisions for relubrication, refer to the pump motor manufacturer’s relubrication recommendations. Refer to the pump motor nameplate for lubrication type.
### 4.5 TROUBLESHOOTING

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>POSSIBLE CAUSES</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil system fault</td>
<td>Pump not primed properly</td>
<td>Bleed all trapped air from lines. Restart system.</td>
</tr>
<tr>
<td></td>
<td>Isolation valves may be closed</td>
<td>Open valves. Restart system.</td>
</tr>
<tr>
<td></td>
<td>Hose kinked or crushed</td>
<td>Remove obstruction. Restart system.</td>
</tr>
<tr>
<td></td>
<td>Leak in suction line</td>
<td>Repair leak. Restart system.</td>
</tr>
<tr>
<td></td>
<td>Pump motor turning backwards</td>
<td>Reverse any two leads on power (in three-phase system). Restart system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>See SECTION 3.3.1.</td>
</tr>
<tr>
<td></td>
<td>Control TCR failure: closed</td>
<td>Check and replace if necessary. See SECTION 4.2.9.</td>
</tr>
<tr>
<td></td>
<td>Motor failure</td>
<td>Check and replace if necessary. Restart system.</td>
</tr>
<tr>
<td></td>
<td>Motor contactor failure</td>
<td>Check contacts and replace if needed. Restart system.</td>
</tr>
<tr>
<td></td>
<td>Motor protection switch tripped</td>
<td>Check and reset switch. If problem occurs again, check motor. Restart system</td>
</tr>
<tr>
<td></td>
<td>RTD failure</td>
<td>Check TCR and RTD. See SECTION 4.2.9.</td>
</tr>
<tr>
<td></td>
<td>RTD cable failure</td>
<td>Check TCR and RTD. See SECTION 4.2.9.</td>
</tr>
<tr>
<td>Oil temperature too low</td>
<td>Motor failure</td>
<td>Check motor. Replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>Heater has been turned off and fluid is cold</td>
<td>Allow time for the heating system to heat fluid.</td>
</tr>
<tr>
<td></td>
<td>Heating element failed</td>
<td>Check elements for continuity. Replace element if necessary.</td>
</tr>
<tr>
<td></td>
<td>Element breaker tripped</td>
<td>Check for element short to ground. If no short, reset breaker.</td>
</tr>
<tr>
<td></td>
<td>Element contactor failed</td>
<td>Check contacts and coil. Replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>Motor contactor failed</td>
<td>Check contacts and coil. Replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>Control TCR failure: open</td>
<td>Check and replace if necessary. See SECTION 4.2.9.</td>
</tr>
<tr>
<td></td>
<td>Control TCR set point too low</td>
<td>Adjust set point for control TCR. See SECTION 3.2.2.</td>
</tr>
<tr>
<td></td>
<td>RTD failure</td>
<td>Check TCR and RTD. See SECTION 4.2.9.</td>
</tr>
<tr>
<td></td>
<td>RTD cable failure</td>
<td>Check TCR and RTD. See SECTION 4.2.9.</td>
</tr>
</tbody>
</table>