216361-000 rev2

INSTALLATION & OPERATION MANUAL

DUAL FLUID CIRCULATING HEATING SYSTEM

MODEL

OCLP

HOTSTART®

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 steel plate. Each heating system has an identification plate which includes the part number and serial number.

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

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.

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

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 equipment is the responsibility of the assembler. The safe and proper use of this equipment 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 2014/34/EU 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 heating system 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 heating system 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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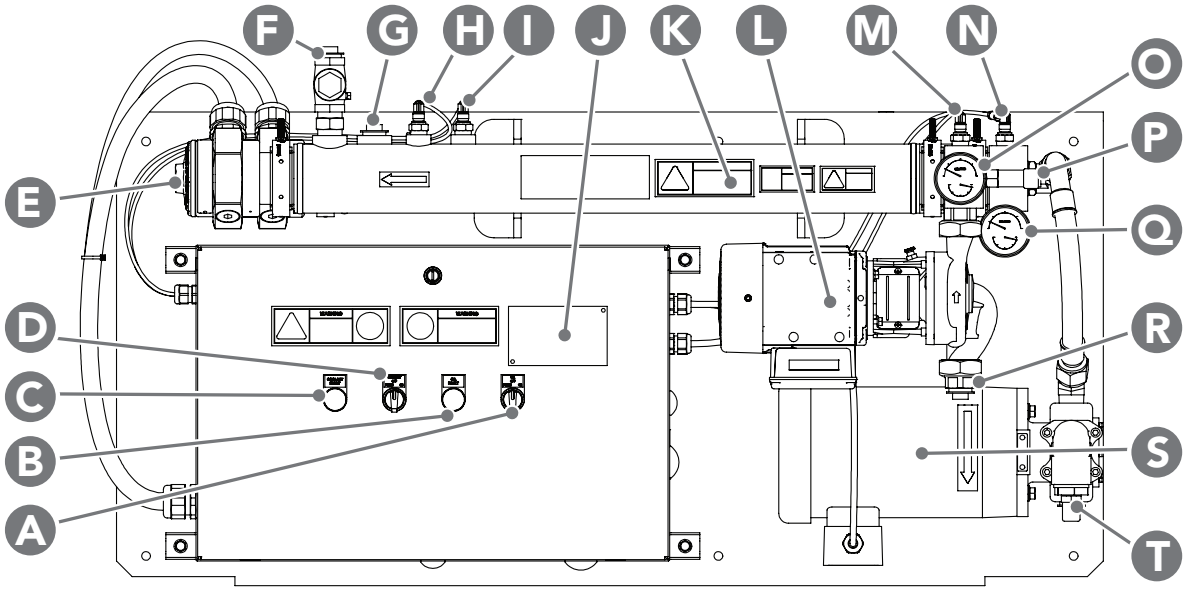
1 OVERVIEW

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 OCLP system components. Model style and configuration may vary. See part drawings for dimensions and specifications.



- **A.** *Oil ON/OFF/PRIME switch*
- **B.** *Oil FAULT light*
- **C.** *Coolant ON/OFF/PRIME switch*
- **D.** *Coolant FAULT light*
- **E.** *Element assemblies*
- **F.** *Coolant outlet (1.0" NPT)*
- **G.** *Oil outlet (1.0" NPT)*
- **H.** *Coolant high-limit resistance temperature device (RTD)*
- **I.** *Oil high-limit resistance temperature device (RTD)*
- **J.** *Identification plate*
- **K.** *Tank assemblies*
- **L.** *Coolant pump/motor*
- **M.** *Coolant control resistance temperature device (RTD)*
- **N.** *Oil control resistance temperature device (RTD)*
- **O.** *Coolant pressure/ temperature gauge*
- **P.** *Coolant pressure relief valve (0.5" NPT)*
- **Q.** *Oil pressure/temperature gauge*
- **R.** *Coolant inlet (1.0" NPT)*
- **S.** *Oil pump/motor*
- **T.** *Oil inlet (1.0" NPT)*

1.2 OPERATION OVERVIEW

The OCLP heating system is intended to maintain an engine's optimal starting temperature while the engine is shut down. The heating system may be activated locally or by optional remote control (*see* **SECTION 2.6.2**). The OCLP heating system should be deactivated upon engine start-up.

During heating system operation, a centrifugal pump takes coolant from the drain area low on the engine water jacket and forces it through the heating tank and into the coolant return line. Simultaneously, a rotary gear pump takes oil from the sump and forces it through the heating tank to the oil return line. The coolant pump and oil pump will continuously circulate fluid throughout the engine. To maintain consistent fluid temperature, the heating elements will cycle on and off at the user-selected temperature control point.

A coolant check valve (included with the OCLP unit and installed at the coolant outlet) and an oil check valve (user-supplied and installed near the oil suction port) prevent backflow while the engine is operating. When the engine is shut down, the heating system should be activated locally or remotely to resume maintaining the engine's optimal starting temperature.

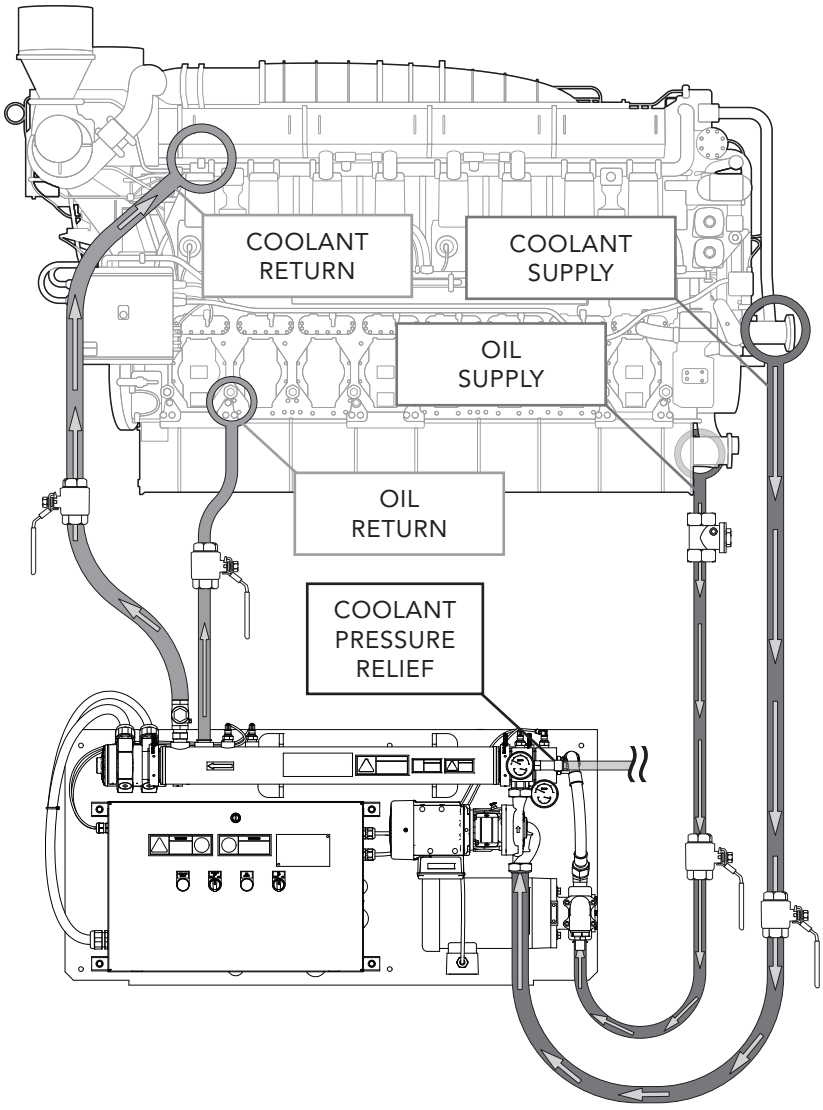


Figure 2. OCLP system operation. Component illustrations are for reference only and are not to scale. See part drawings for dimensions and specifications.

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, fluid leaks and unexpected release of heated coolant.

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 each 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 coolant supply line or oil supply line to an inner diameter smaller than the corresponding pump inlet; pump seal damage will occur.

Check valve: HOTSTART recommends installing a customer-supplied swing-type or full-flow check 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 oil or coolant.

Pressurized steam hazard: Coolant pressure relief valve outlet must be vented to the atmosphere in case an over-pressure release of heated coolant occurs. Do not connect pressure relief plumbing to coolant system.

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.

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.

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

2.1 OIL PLUMBING INSTALLATION

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 OCLP oil supply line, refer to the following HOTSTART guidelines:

PUMP INLET	HOSE INNER DIAMETER	MAX. LINE LENGTH	MAX. ELBOW COUNT
1 inch NPT	1-1/2 inch	20 feet (6 meters)	4

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

- 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 OCLP oil supply recommendations:

  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. **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 from draining back into the sump. Install the check valve as close to the oil supply port as possible.

2.1.2 OIL RETURN

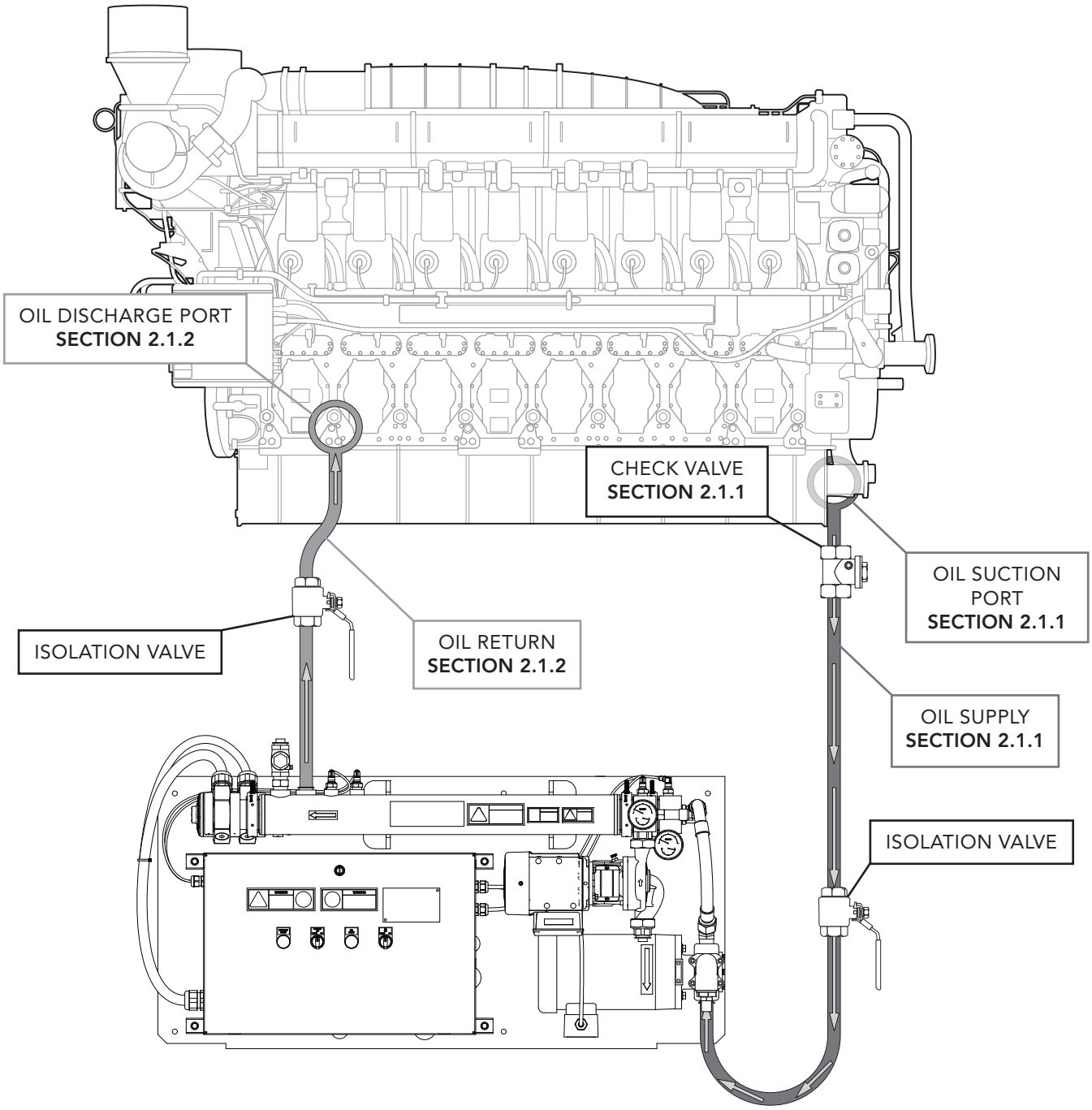
When installing the OCLP oil return line, refer to the following HOTSTART guidelines:

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

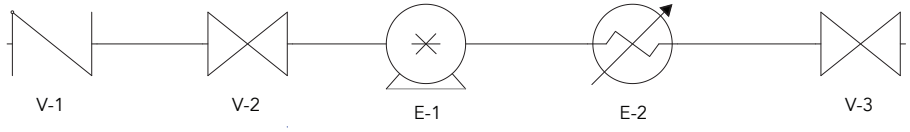
- The oil return line must be routed to an oil discharge port connected to either the lower end of the engine or directly to the oil sump. *See* **SECTION 2.2**.

- If routed to the oil sump, the oil discharge port should be located at the side opposite the oil suction port to ensure consistent oil heating.

2.2 OIL PLUMBING ILLUSTRATION



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



2.3 COOLANT PLUMBING INSTALLATION

2.3.1 COOLANT SUPPLY

When installing the OCLP coolant supply line, refer to the following HOTSTART guidelines *(See* **SECTION 2.4***)*:

- At a minimum, size the coolant 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 coolant suction port as low as possible on the engine's water jacket. Where applicable, HOTSTART recommends a connection point at the suction side of the engine water pump **(A)**. **NOTICE!** At a minimum, suction port must be sized per the pump inlet (1" NPT).

- To minimize flow restriction, the coolant supply line must be as short and as straight as possible. Use elbow fittings sparingly; HOTSTART recommends using sweeping bends or 45° fittings.

  NOTE: For optimal pump performance, HOTSTART recommends a minimum of 6 inches (152 mm) of straight pipe installed into pump inlet.

2.3.2 COOLANT RETURN

When installing the OCLP coolant return line, refer to the following HOTSTART guidelines *(See* **SECTION 2.4***)*:

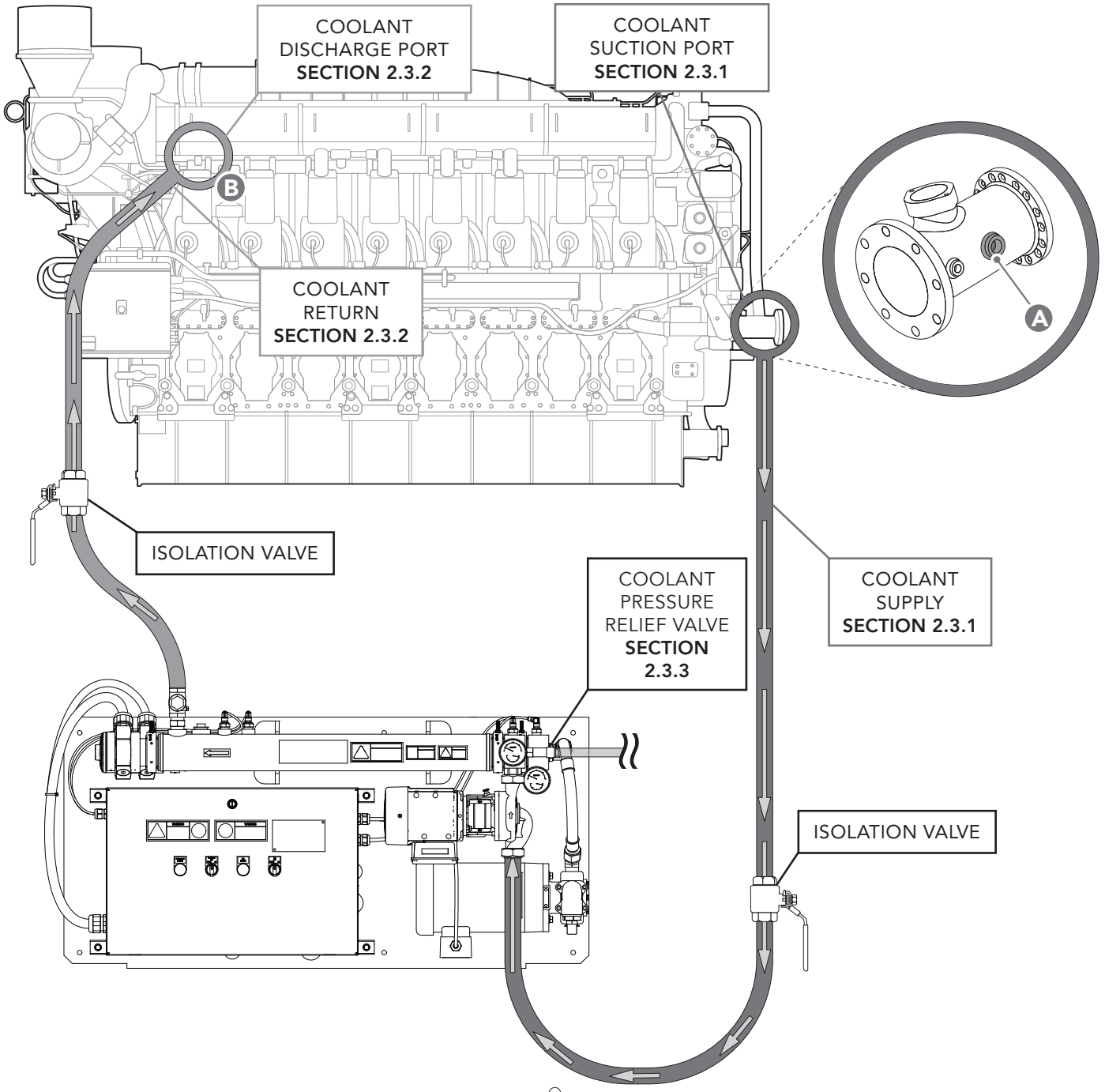
- Size the coolant return line per the coolant outlet. **NOTICE!** Do not reduce the return line inner diameter.

- Install the coolant discharge port as high as possible on the engine's water jacket at the end of the engine opposite the suction port, typically at the rear of the engine block on the engine water rails **(B)**.

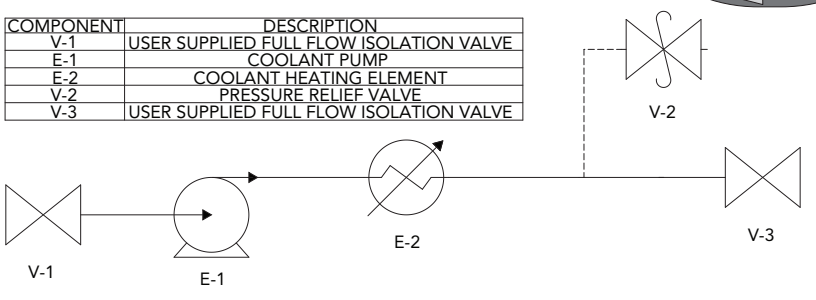
2.3.3 COOLANT PRESSURE RELIEF

- To safeguard personnel and equipment, attach an appropriately-sized pipe to the pressure relief valve and route to a safe area, bucket or catch-basin. **CAUTION!** Coolant pressure relief valve outlet must be plumbed to a safe area in case an over-pressure release of heated coolant occurs. Do not connect pressure relief plumbing to coolant system.

2.4 COOLANT PLUMBING ILLUSTRATION



COMPONENT	DESCRIPTION
V-1	USER SUPPLIED FULL FLOW ISOLATION VALVE
E-1	COOLANT PUMP
E-2	COOLANT HEATING ELEMENT
V-2	PRESSURE RELIEF VALVE
V-3	USER SUPPLIED FULL FLOW ISOLATION VALVE



2.5 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.

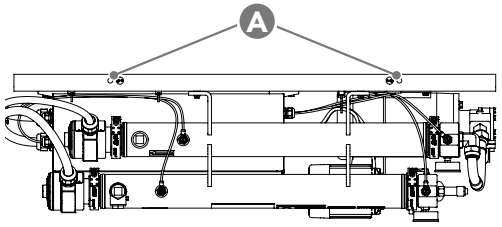


Figure 3. OCLP lift points **(A)**. *Do not lift system by any cords, electrical conduit or cabling.*

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.

2.5.1 TANK AND PUMP

Mount the unit in a vertical orientation with tank directly above control box and pump. Reference drawings for mounting position. When installing the heating system, HOTSTART recommends 30 inches (76 cm) of clearance to remove element for maintenance. Reference part drawings for minimum clearance required for your model.

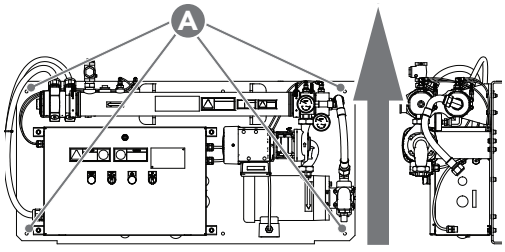


Figure 4. OCLP 0.438 inch (11.13 mm) diameter mounting holes × 4 **(A)**. *Mount unit in orientation shown. Do not mount at an angle or in any other orientation.*

2.6 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: The heating system must be connected to a suitable protective earthing conductor. The heating system's power supply must be connected to a suitable overcurrent limiting device. A means of disconnection from 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. Reference markings on heating system for specific ratings.

2.6.1 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 Figure 6 on following page.*

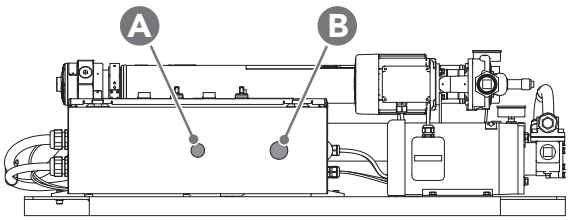


Figure 5. OCLP underside, showing 0.88" customer interface wiring entrance **(A)** *and 1.375" main power entrance* **(B)**.

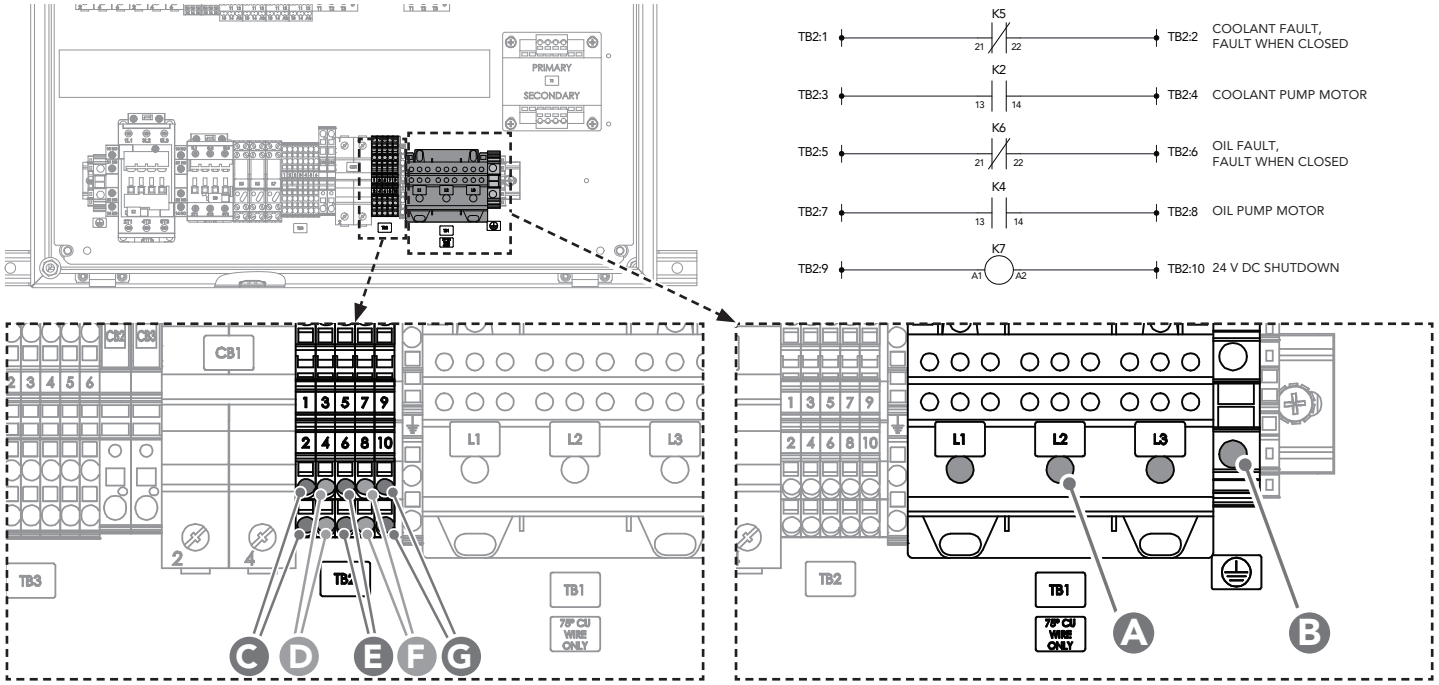
NOTE: The specified power source must be within plus or minus 10% of the rated voltage.

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 (A)**.

2. Connect the main power ground wire to the ground block **(B)**.



A. *Main power terminal block*
B. *Main power ground block*
C. *Coolant fault signal*
D. *Coolant motor run signal*
E. *Oil fault signal*
F. *Oil motor run signal*
G. *Remote On/Off 24 V DC shutdown*

Figure 6. Main power supply and customer interface connections as shown in the OCLP control box. Reference electrical schematic drawing for proper wiring locations; the following illustrations are typical customer interface locations.

2.6.2 CUSTOMER INTERFACE CONNECTIONS

NOTICE

Wiring connections: Reference electrical schematic drawings for proper wiring locations; the following are typical interface locations.

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

- **TB2:1/TB2:2**
  Coolant Fault Signal (C)
  The fault signal will indicate a coolant heating system shutdown, triggered by either the high-limit temperature control relay or the motor protection switch.
- **TB2:3/TB2:4**
  Coolant Motor Run Signal (D)
  A motor run signal indicates the coolant pump motor is running. If no signal is present, the coolant pump motor is not running.
- **TB2:5/TB2:6**
  Oil Fault Signal (E)
  The fault signal will indicate an oil heating system shutdown, triggered by either the high-limit temperature control relay or the motor protection switch.
- **TB2:7/TB2:8**
  Oil Motor Run Signal (F)
  A motor run signal indicates the oil pump motor is running. If no signal is present, the oil pump motor is not running.
- **TB2:9/TB2:10**
  Remote On/Off 24 V DC shutdown (G)
  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 heating system when the **ON/OFF/PRIME** switch is turned to **ON**.

  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.

2.6.3 MOTOR ROTATION CHECK

NOTICE

Pump rotation (three-phase only): For three-phase applications, check for proper pump rotation prior to introducing fluid to the pumps. Reverse rotation while the pump is filled with fluid will cause pump seal failure.

Pump damage: Do not run the motor/pump assembly dry for more than a few seconds. Running a motor/

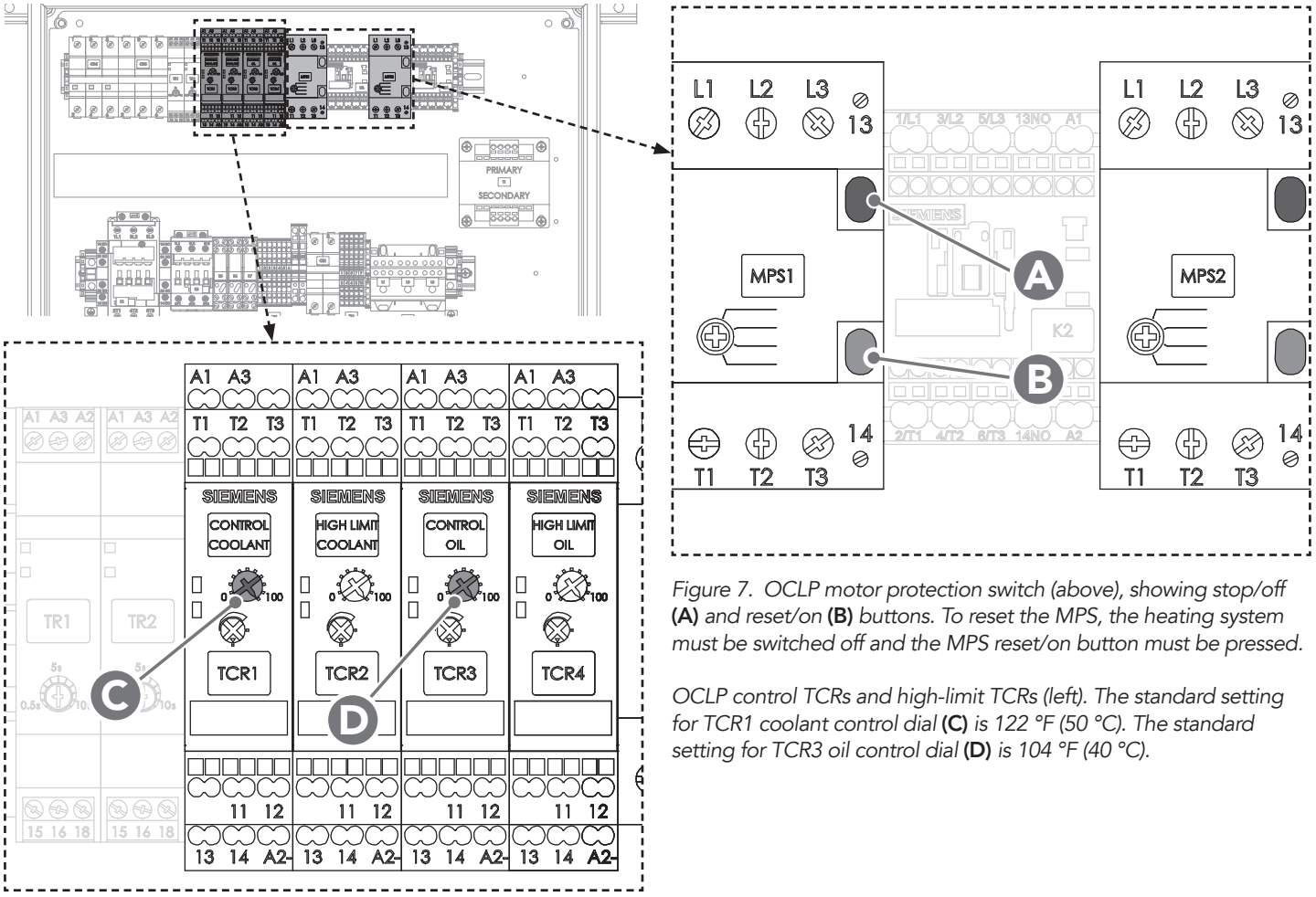


Figure 7. OCLP motor protection switch (above), showing stop/off **(A)** *and reset/on* **(B)** *buttons. To reset the MPS, the heating system must be switched off and the MPS reset/on button must be pressed.*

OCLP control TCRs and high-limit TCRs (left). The standard setting for TCR1 coolant control dial **(C)** *is 122 °F (50 °C). The standard setting for TCR3 oil control dial* **(D)** *is 104 °F (40 °C).*

pump for a prolonged period without being completely filled with fluid may cause damage to the pump seal.

The following procedures are for three-phase applications only. Single-phase systems are prewired to ensure the pump motor rotates in the correct direction.

1. With main power connected to the heating system motor *(see* **SECTION 2.5.1***)*, energize the pump while observing the rotation of the pump motor fan at the rear of each motor. Refer to rotation decal on motor for correct rotation.
   - ➤ If the pump motors do not rotate in the correct direction, disconnect power and switch any two electrical leads at the main power terminal block (**L1, L2, L3**). Reconnect power. *Repeat step 1* to ensure motors rotate in the correct direction.

3 COMPONENTS AND OPERATION

The following is an operational description for each of the OCLP 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 ON/OFF/PRIME SWITCH

- **ON** – The system is **on**. In this state, the 24 V DC shutdown may be used to activate or deactivate the system.
- **OFF** – The system is shut **off**.
- **PRIME** – Turn and hold the switch to **PRIME** to energize the corresponding pump motor in order to remove any air in the heating system without energizing the elements.

3.1.2 PRESSURE/TEMPERATURE GAUGES

The OCLP model features a temperature/pressure gauge mounted at each heating tank inlet. The gauges will indicate a pressure increase when the corresponding 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.

3.1.3 PRESSURE RELIEF VALVE

⚠ CAUTION

Pressurized steam hazard: Coolant pressure relief valve outlet must be plumbed to a safe area in case an over-pressure release of heated coolant occurs.

The coolant pressure relief valve is mounted at the coolant heating tank outlet and is set to relieve at 100 psi (690 kPa). During normal operation, pressure release events are rare. To safeguard personnel and equipment, attach an appropriately sized pipe to the pressure relief valve outlet and direct flow to a safe area, bucket or other catch-basin.

3.2 SYSTEM COMPONENTS

3.2.1 MOTOR PROTECTION SWITCH

The motor protection switches (MPS1 and MPS2) protect the pump motors from overloads. The MPS will be set at the full load amperage of the corresponding motor when shipped from the factory. To reset the MPS, the **ON/OFF/PRIME** switch must be switched to **OFF** and the operator must press the **RESET** button or press the MPS reset/on button **(B)**. *See Figure 7*. For additional troubleshooting, *see* **SECTION 4.5**.

3.2.2 CONTROL TCR (TEMPERATURE CONTROL RELAY)

The control TCRs (TCR1 and TCR3) are used to control the temperature of the corresponding 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 coolant control temperature relay (TCR1) is 122 °F (50 °C). The standard setting for the oil control temperature relay (TCR3) is 104 °F (40 °C). *See Figure 7*.

3.2.3 HIGH-LIMIT TCR (TEMPERATURE CONTROL RELAY)

The high-limit TCRs (TCR2 and TCR4) are 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 coolant and oil high-limit TCR is 194 °F (90 °C) and should always be at least 18 °F (10 °C) higher than the corresponding control TCR set point. The high-limit TCR hysteresis is not used in the high-limit control. *See Figure 7*.

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.

FIRST RUN PROCEDURE

1. For three-phase applications, ensure a motor rotation check has been performed prior to introducing fluid to the pumps (*see* **SECTION 2.6.3**).

   NOTE: Single-phase systems are prewired to ensure the pump motor rotates in the correct direction. A motor rotation check is not necessary for single-phase systems.

2. Check and tighten all electrical and plumbing connections.

3. Ensure isolation valves are **open** before energizing the system.

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 **ON/OFF/PRIME** switch to **ON** to energize the heating system.

6. Turn the control dial on the temperature control relay TCR1 to the desired temperature setting for engine coolant. Turn the control dial on the temperature control relay TCR3 to the desired

temperature setting for engine oil. HOTSTART recommends a control temperature on TCR1 of 122 °F (50 °C) and a control temperature on TCR3 of 104 °F (40 °C). The high-limit temperature setting on TCR2 and TCR4 should be set at 194 °F (90 °C). *See* **SECTION 3.2.2** *and* **SECTION 3.2.3**.

7. Turn the **ON/OFF/PRIME** switch to **ON** to verify the 24 V DC remote signal connection (if installed).
8. Disconnect power to the heating system and tighten all electrical connections. *See* **SECTION 4.2.2**.

4 MAINTENANCE AND TROUBLESHOOTING

4.1 SYSTEM FAULTS

A failure in the pump motor that causes the motor protection switch (MPS1 or MPS2) to trip will shut down the corresponding heating system. A fault signal will be transmitted. If this failure occurs, the **ON/OFF/PRIME** 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 or TCR4) will shut down the corresponding heating system, including the pump motor. A fault signal will be transmitted. To restart the system, the **ON/OFF/PRIME** switch must be switched to **OFF** and then back to **ON** 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**.

4.1.1 COOLANT FAULTS

A fault signal will be transmitted if:

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

4.1.2 OIL FAULTS

A fault signal will be transmitted if:

- The oil pump motor protection switch is tripped (MPS2).
- The oil high-limit temperature is exceeded (TCR4).

4.2 SYSTEM MAINTENANCE

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. After initial first run, disconnect power and tighten electrical connections (*see* **SECTION 3.3**). 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 SYSTEM DRAINING

HOTSTART recommends installing T-connectors or similar connections intended for draining purposes during initial installation. If no user-installed drain points are available, disconnect the following points for draining purposes (*see* **SECTION 4.2.11** *and* **SECTION 4.2.12**):

- Coolant pump inlet **(A)**
- Oil pump outlet **(B)**

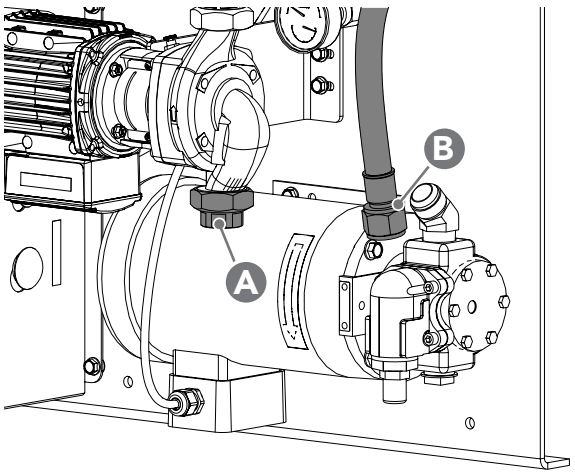


Figure 8. OCLP, showing recommended draining disconnect points at coolant pump inlet **(A)** *and oil pump outlet* **(B)** .

4.2.5 MAGNETIC CONTACTORS

Magnetic contactors are used as voltage switching controls for motors and heating elements in HOTSTART heating systems. The contactors use 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.

4.2.6 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** *and* **SECTION 2.1.2**)

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

4.2.7 PRESSURE RELIEF VALVE

The pressure relief valve on coolant systems must be periodically checked and replaced when appropriate. At a minimum, the valve should be removed from the system, checked for deposits and corrosion, and tested to ensure that it relieves the proper pressure.

4.2.8 PRESSURE/ TEMPERATURE GAUGES

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

4.2.9 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**.

4.2.10 TEMPERATURE CONTROL RELAY (TCR)

⚠ 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 OCLP heating system does not maintain the desired preset control temperature or signals a high-limit temperature fault immediately upon system start-up, 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. Verify fluid is present and flow is not restricted. Check temperature gauge to ensure the liquid in the tank is below 122 °F (50 °C).

2. Verify the control TCR is set correctly. Verify that high-limit TCR is set at least 18 °F (10 °C) higher than the control TCR set point.

3. Using the ohmmeter, measure the resistance between TCR terminals **T1** and **T2** *(See Figure 9)*:
   - ➤ If the measured resistance is **between 80 and 120 ohms** continue troubleshooting. *Proceed to step 4.*
   - ➤ If the resistance is **lower than 80 ohms** or **higher than 120 ohms**,contact HOTSTART for further assistance.

4. Using the ohmmeter, test for continuity between TCR terminals **T2** and **T3**:
   - ➤ If there **is continuity** between TCR terminals **T2** and **T3**, the TCR, RTD and RTD cable are functioning correctly. Close control panel. Allow fluid to cool below high-limit preset temperature. Perform system start-up *(see* **SECTION 3.3***)*. If fault or temperature problems persist after start-up, contact HOTSTART for further assistance.
   - ➤ If there **is no continuity** between TCR terminals **T2** and **T3**, locate connected RTD on the heating tank. Unscrew the RTD plug from RTD. *See Table 1 and Figure 11, Figure 12* on the following page.

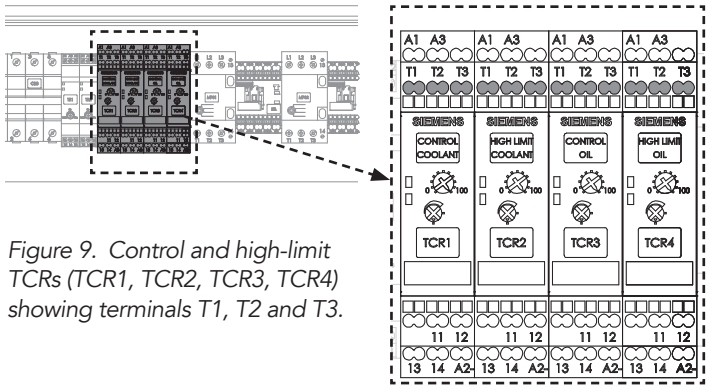


Figure 9. Control and high-limit TCRs (TCR1, TCR2, TCR3, TCR4) showing terminals T1, T2 and T3.

TCR		TYPE		RTD Position
TCR1	Coolant	Control	50 °C	Top Tank Inlet
TCR2	Coolant	High-limit	90 °C	Top Tank Outlet
TCR3	Oil	Control	40 °C	Bottom Tank Inlet
TCR4	Oil	High-limit	90 °C	Bottom Tank Outlet

Table 1. TCR types, default temperature settings and corresponding RTD positions.

5. Using the ohmmeter, touch the probes to RTD **pin 1** and **pin 3**. *See Figure 10.* Note the resistance. Touch the probes to RTD **pin 1** and **pin 4** to check for continuity:
   - ➤ If the resistance between RTD **pin 1** and **pin 3** is **between 80 and 120 ohms** and there **is continuity** between RTD **pin 1** and **pin 4**, the RTD is functioning properly. Replace the RTD cable.
   - ➤ If the resistance between RTD **pin 1** and **pin 3** is **not between 80 and 120 ohms** or there is **no continuity between pin 1** and **pin 4**, the RTD is malfunctioning. Replace the RTD. *See* **SECTION 4.2.11**

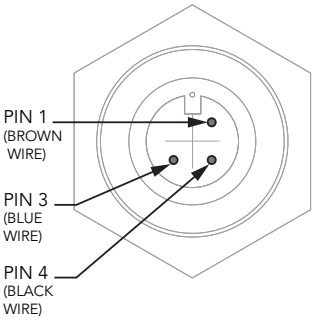


Figure 10. RTD pins 1, 3 and 4. The resistance between pin 1 and pin 3 should measure between 80 and 120 ohms. There should be continuity between pin 1 and pin 4.

4.2.11 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 4.2.10**.

1. De-energize the heating system. Allow fluid to cool.
2. Close isolation valves. Drain fluid from the heating tank (*see* **SECTION 4.2.4**). Locate the RTD that requires replacement. *See Figure 11*.
3. Unscrew RTD plug. Remove plug. *See Figure 12*.
4. Unscrew RTD from tank. *See Figure 12*.
5. Screw replacement RTD to tank. When tightening, ensure plug is aligned with notch orientated as shown in *Figure 13*.
6. Fit RTD plug to RTD. Ensure plug is aligned correctly with notch. Push plug in firmly. Screw RTD plug to RTD to secure in place.
7. To ensure proper installation and temperature regulation, re-energize and operate heating system. *Refer to* **SECTION 3.3** *for system start-up procedures.*

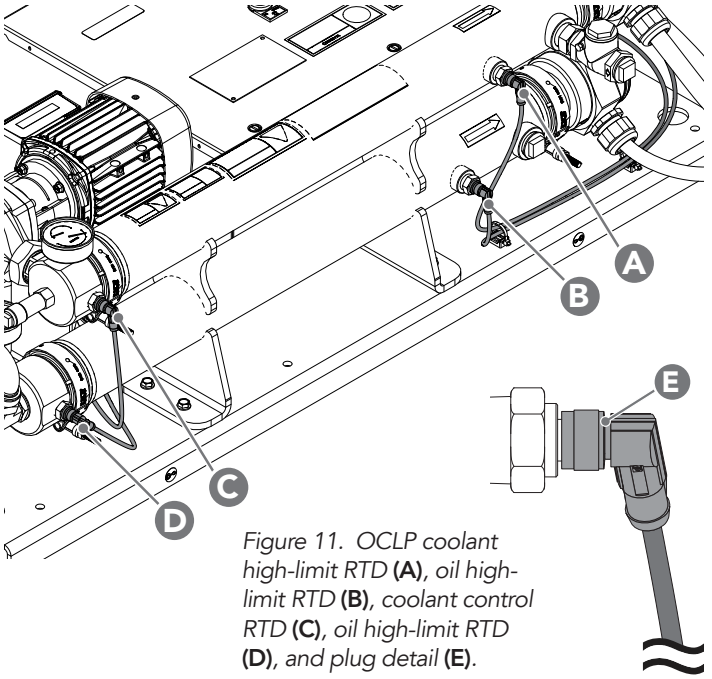


Figure 11. OCLP coolant high-limit RTD **(A)**, *oil high-limit RTD* **(B)**, *coolant control RTD* **(C)**, *oil high-limit RTD* **(D)**, *and plug detail* **(E)**.

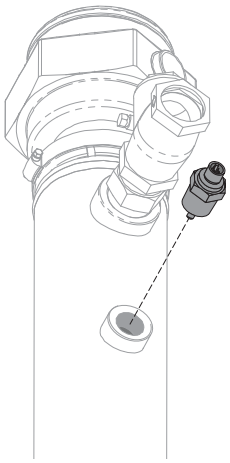


Figure 12. High-limit RTD plug shown removed from OCLP heating tank.

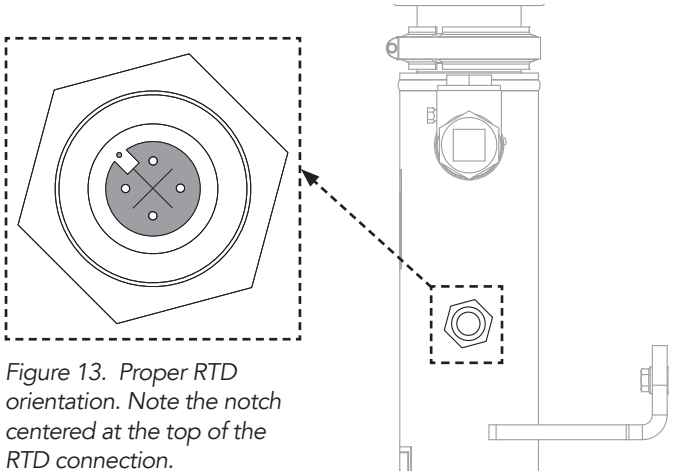
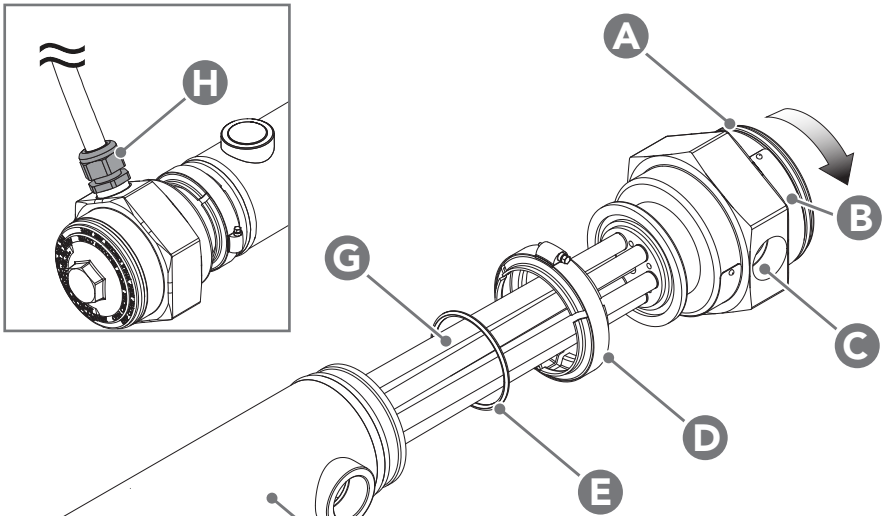


Figure 13. Proper RTD orientation. Note the notch centered at the top of the RTD connection.

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*
H. *Element conduit cable gland*

4.2.12 HEATING TANK/ELEMENT

⚠ 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 Figure 14*. The wattage and phase of the heating element are listed on the identification plate on the outside of the element **(B)**. Reference this label for the replacement part number.

1. De-energize the heating system. Allow fluid to cool.
2. Close isolation valves. Drain the fluid from the heating tank **(F)**. *See* **SECTION 4.2.4**.
3. Remove the cap **(A)** from the heating element service entrance enclosure.
4. Note your unit's jumper configuration. *See Figure 15*. **NOTICE!** Elements are configured from the factory. Retain original jumper placement during element reassembly. Altering element configuration or jumper placement may cause heating system failure.

NOTE: Replacement elements may be a different jumper configuration.

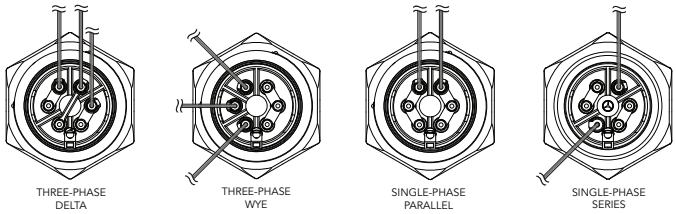


Figure 15. Heating tank element jumper configurations. Replacement elements may be a different jumper configuration.

5. Disconnect the ground (green/yellow) and power electrical wires from the posts inside the cap.
6. Unscrew cable gland **(H)** from conduit connector entrance **(C)**. Remove electrical cable and wires from the heating element. *See Figure 14*.
7. Loosen V-clamp screw to remove V-clamp **(D)** Slide the heating element out from tank as shown.
8. Replace the heating element **(G)** or perform the necessary cleaning procedure. Ensure the O-ring **(E)** is intact and in place.

4.2.13 REASSEMBLY OF HEATING ELEMENT AND TANK

To reassemble the heating element and tank, follow the steps listed in **SECTION 4.2.12** in **reverse order**. Make sure the ground and power electrical wires are properly reconnected using the provided washers and nuts

4.3 RECOMMENDED MAINTENANCE

INTERVAL	MAINTENANCE TASK
At initial start-up	Tighten electrical connections. *See* **SECTION 4.2.2**.
One week after initial start-up	Check and tighten electrical connections. *See* **SECTION 4.2.2**.
Every three months	Tighten electrical connections.
Annually	Drain, clean and flush heating system.
	Check for cracked or weakened hoses and replace if necessary.
	Check electrical wiring and connections for wear and excessive heat.
	Check mounting bolts and tighten if necessary.
	Remove element and clean element and tank.
Every five years	Replace magnetic contactors. *See* **SECTION 4.2.5**.

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

SYMPTOM	POSSIBLE CAUSES	SOLUTION
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 three-phase system). Restart system. *See* **SECTION 3.3**.
	Control TCR failure: closed	Check and replace if necessary. *See* **SECTION 4.2.10**.
	Motor failure	Check and replace if necessary. Restart system.
	Motor contactor failure	Check contacts and replace if needed. Restart system.
	Motor protection switch tripped	Check and reset switch. If problem occurs again, check motor. Restart system.
	RTD failure	Check TCR and RTD. See **SECTION 4.2.10**.
	RTD cable failure	Check TCR and RTD. See **SECTION 4.2.10**.
Fluid temperature too low	Motor failure	Check motor. Replace if necessary.
	Heating system has been turned off and fluid is cold	Allow time for the heating system to heat fluid.
	Heating element failed	Check elements for continuity. Replace element if necessary.
	Element breaker tripped	Check for element short to ground. If no short, reset breaker.
	Element contactor failed	Check contacts and coil. Replace if necessary.
	Motor contactor failed	Check contacts and coil. Replace if necessary.
	Control TCR failure: open	Check and replace if necessary. *See* **SECTION 4.2.10**.
	Control TCR set point too low	Adjust set point for control TCR. *See* **SECTION 3.2.2.**
	RTD failure	Check TCR and RTD. See **SECTION 4.2.10**
	RTD cable failure	Check TCR and RTD. See **SECTION 4.2.10**.