

INSTALLATION & OPERATION MANUAL

OIL CIRCULATING HEATING SYSTEM

MODEL


OSM

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 intended to be connected to control components by the end user. 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 1,067,473, 1,062,541
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

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 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:** 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.
- **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 heater 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 INSTALLATION

1.1 HEATING SYSTEM COMPONENTS

The OSM oil circulating heating system consists of the following main components. See Fig. 1 and Fig. 2.

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

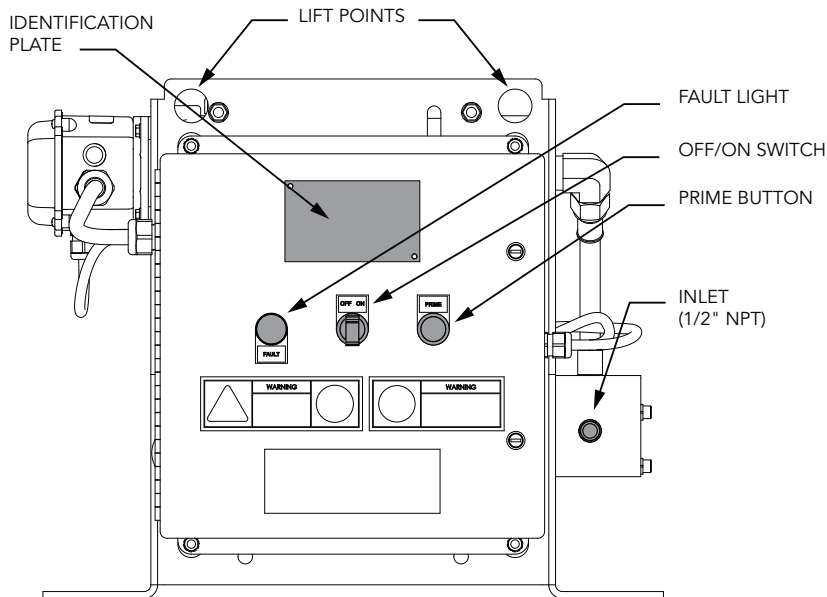


Figure 1. The components of the OSM model heating system as seen from the front of the unit.

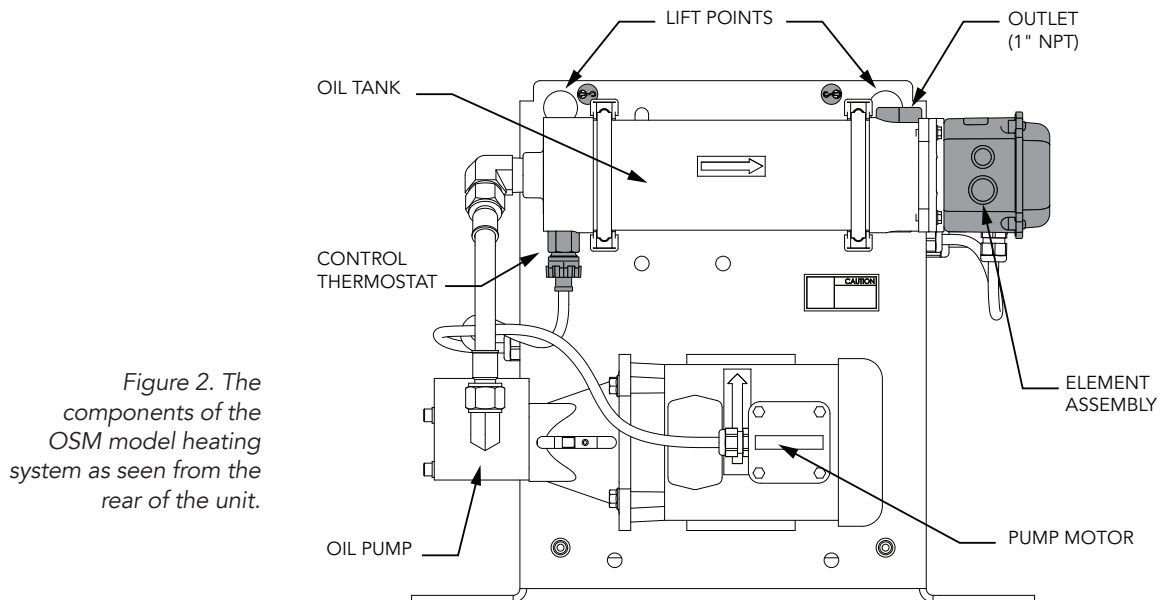
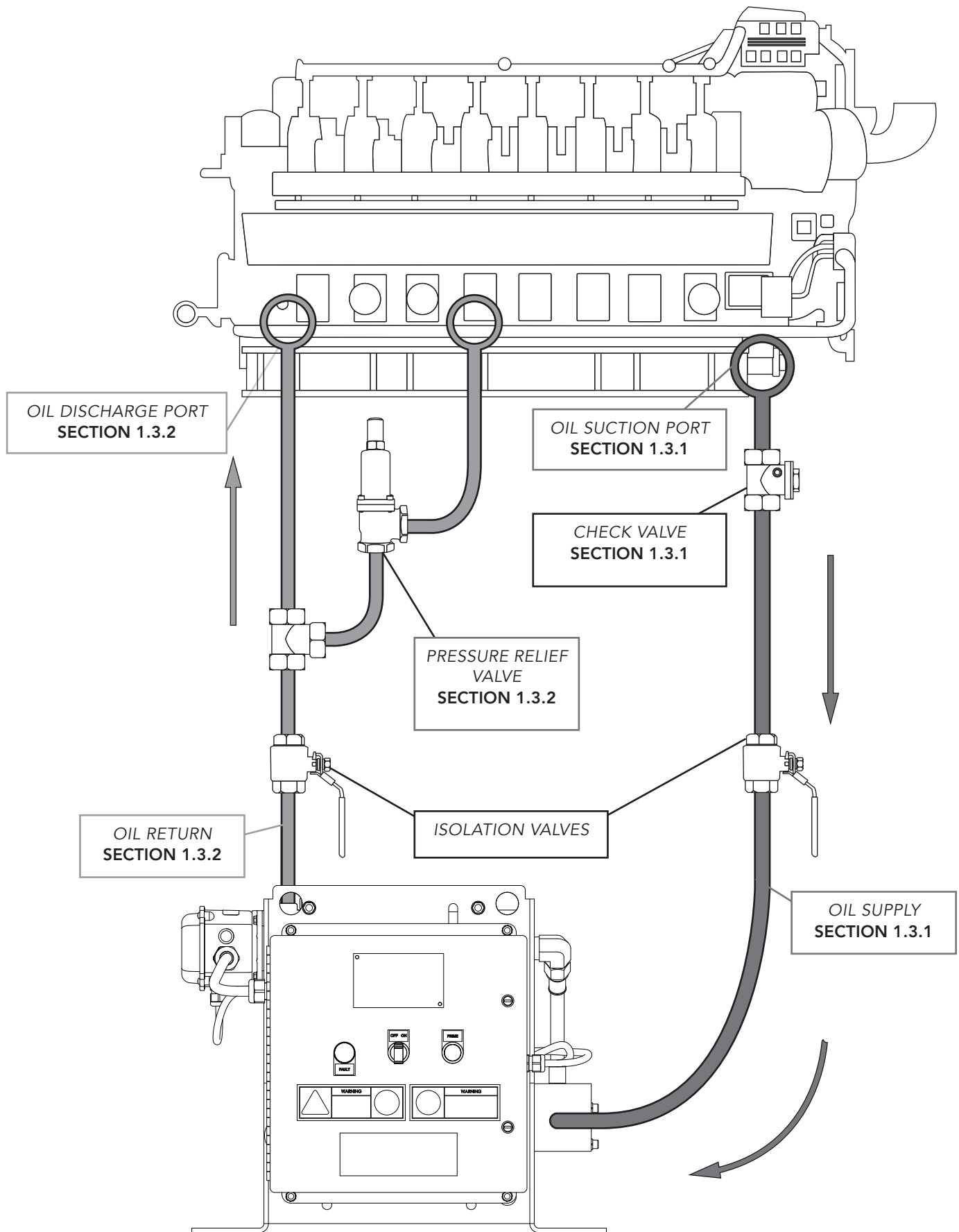


Figure 2. The components of the OSM model heating system as seen from the rear of the unit.

1.2 OIL PLUMBING ILLUSTRATION



1.3 OIL PLUMBING 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 oil.

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

Pressure hazard: This product generates heat during operation. Operation of heating system with closed isolation valves could result in high pressure and serious injury. It is the responsibility of the installer and operator to ensure that no unsafe condition can result from the generation of pressure. In EU countries, PED (97/23/EC) compliant pressure relief may be required. (125 psi minimum).

NOTICE

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

Pump seal damage: Do not reduce the oil supply line to an inner diameter smaller than the pump inlet; pump seal damage will occur. If the oil supply line will be longer than 10 feet, use a larger inner diameter hose than the pump inlet to reduce flow restriction.

Check valve: To minimize flow restriction along the oil supply line, 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 customer-supplied full-flow ball valves to isolate the heating system in order to perform service on the system without draining the oil.

1.3.1 OIL SUPPLY

When installing the OSM oil supply line, refer to the following HOTSTART guidelines:

- Size the oil supply line per the outlet of the heating system (1/2 inch NPT). **NOTICE!** Do not reduce the supply line inner diameter; pump seal damage will occur.
- To ensure that oil does not flow back into the sump, the oil suction port must be at or below the oil level.
- Install the oil suction port away from the bottom of the oil pan. To minimize flow restriction, the oil supply line must be as short and as straight as possible.
- If installing a check valve is necessary, HOTSTART recommends installing a swing-type or full-flow check valve to minimize flow restriction along the oil supply line. Install the check valve as close to the oil supply port as possible.

1.3.2 OIL RETURN

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

- Size the oil return line per the outlet of the heating system (1 inch NPT).
- Route the oil return line to the oil discharge port located at opposite end of the engine's oil sump. See **SECTION 1.2**.
- To ensure the safety of personnel and protect equipment in the event of flow restriction or blockage, HOTSTART recommends installing a customer-supplied pressure relief valve (50 psi) along the oil return line. Route the valve line to release to the oil sump. See **SECTION 1.2**.

1.4 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 oil 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. 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.

1.4.1 TANK AND PUMP

When mounting the OSM tank and pump, refer to the following HOTSTART guidelines:

- Mount the heater with the tank and pump in a horizontal orientation using the supplied hardware.
- Mount the heater base plates to a fixed, vibration-isolated surface.
- To ensure that oil does not flow back into the sump, HOTSTART recommends mounting the heater at or below the minimum oil level. **NOTICE!** If the pump is installed above the minimum oil level, a check valve **must** be installed.
- When installing the heating tank, note that the tank requires a minimum of 15 inches (38 cm) of clearance to remove the element for maintenance. See **SECTION 5.1.7**.

1.5 MAIN POWER SUPPLY



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.

1. Connect the specified power from the customer-supplied circuit breaker to the terminal blocks located in the main control box.

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 pump. 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**.
 - For **single-phase applications**, use the terminal blocks labeled **L1** and **L2** or **L** and **N**. See Fig. 3.
2. Connect the main power ground wire to the ground lug or ground block on the electrical panel located inside the electrical box.

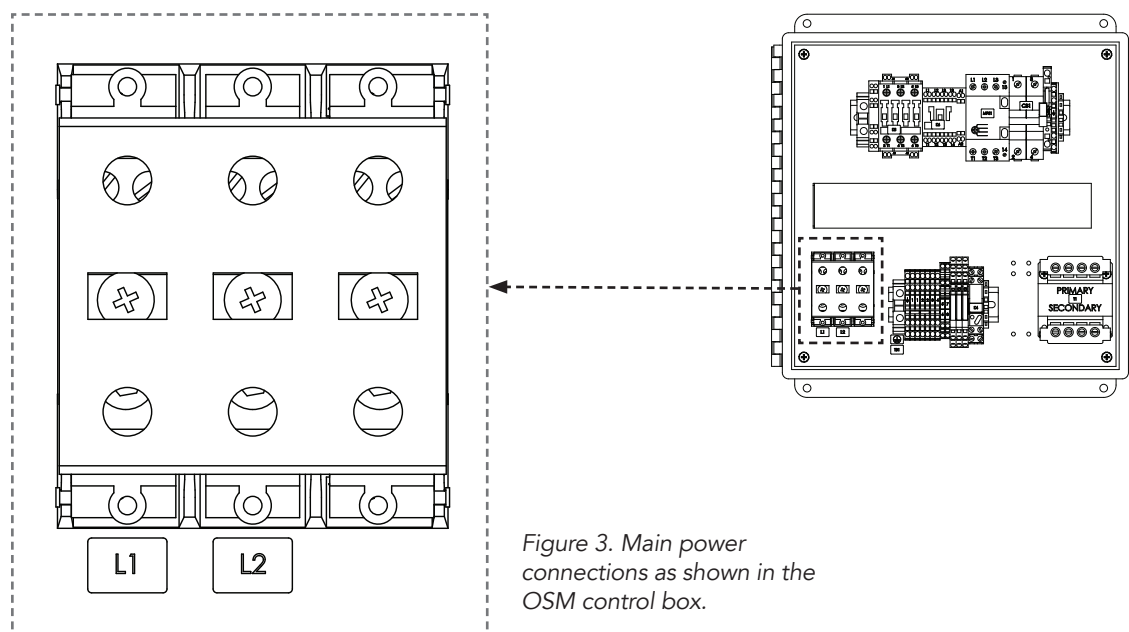


Figure 3. Main power connections as shown in the OSM control box.

1.6 CUSTOMER INTERFACE CONNECTIONS



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.

Reference electrical schematic drawing for proper wiring locations; the following illustrations are typical customer interface locations. See Fig. 4 and Fig. 5.

The **fault signal** will indicate a heating system shutdown, triggered by either the high-limit temperature thermostat or the motor protection switch (see SECTION 4.1). The **24 V dc remote on/off** connections are for remote control of the heating system while the switch is in the **ON** position. The **fault** connection will allow a fault signal to be transmitted to a remote location.

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

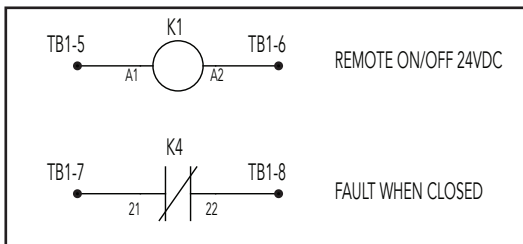


Figure 4. Customer interface wiring schematic. Reference electrical schematic drawing for proper wiring locations.

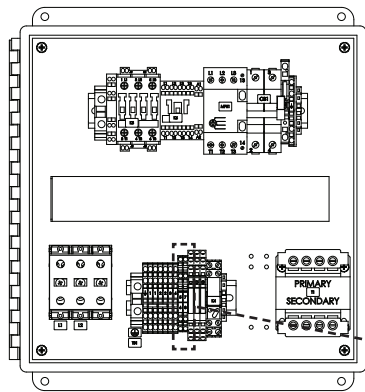
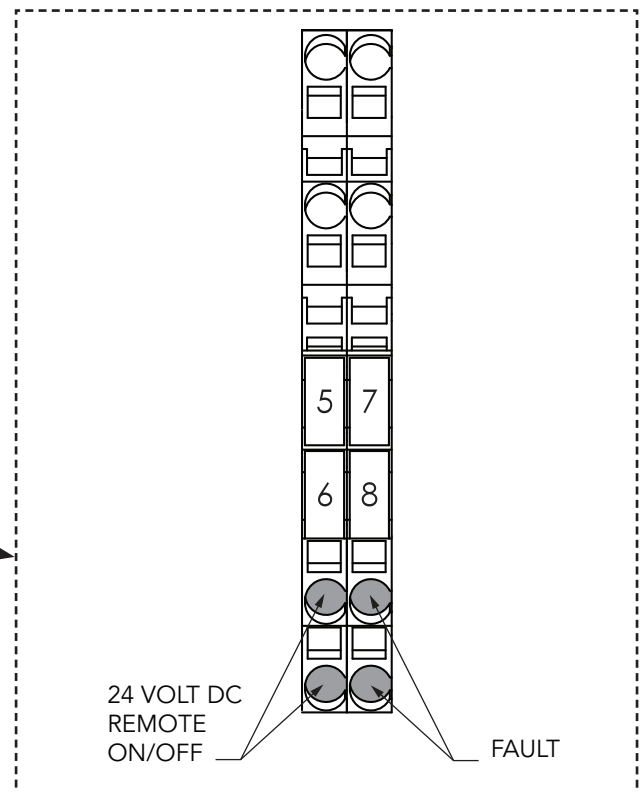


Figure 5. Customer interface connections as shown in the OSM control box. The 24 volt dc connection will allow remote control of the heating system. The fault connection will allow a fault signal to be transmitted to a remote location.



2 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 a few seconds. Running a pump that is not completely filled with oil will cause damage to the pump seal.

1. Check and tighten all electrical and plumbing connections.
2. Ensure isolation valves are open before energizing the system.
3. 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 a few seconds. If you are operating a three-phase heating system, check for proper rotation of the pump motor when the system is energized. 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. Operate the pump to evacuate any remaining air in the lines.
5. Energize the heating system and monitor the heating system's operation. Check for hot spots by placing your hand on the heating tank and plumbing. If any hot spots are felt, immediately stop the heater and pump. Evacuate any remaining air before re-energizing the heating system.

3 SYSTEM COMPONENTS AND OPERATION

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

- **PRIME** button
- **OFF/ON** switch
- Motor protection switch (MPS)

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

3.1 PRIME BUTTON

The **PRIME** button is used to remove remaining air in the supply and return lines without energizing the heater element.

3.2 OFF/ON SWITCH

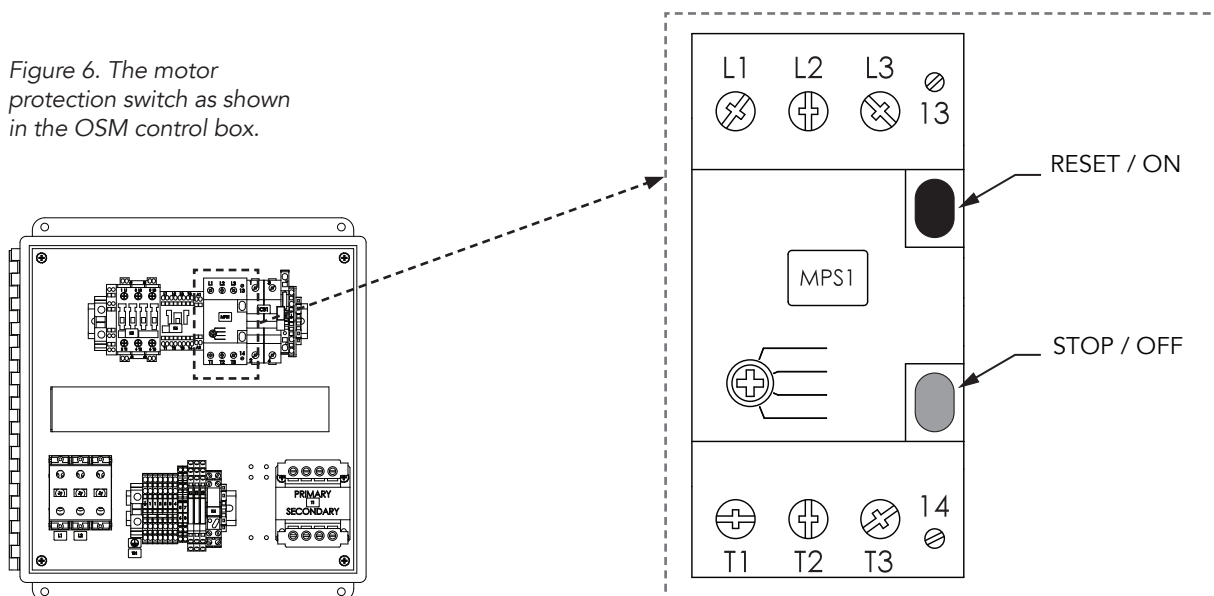
- **OFF** – The system is **off**.
- **ON** – The system is **on**.

3.3 MOTOR PROTECTION SWITCH (MPS)

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 **OFF/ON** switch must be switched to **OFF** and the operator must press the MPS reset button. See **SECTION 4.1**.

NOTE: The MPS cannot be reset from a remote location. If a pump motor failure causes the MPS to trip, it must be reset at the OSM control box.

Figure 6. The motor protection switch as shown in the OSM control box.



4 OVERVIEW OF OPERATIONS

When the system is energized, a positive displacement rotary gear pump takes oil from the oil sump and forces it through the heating tank and into the oil return line.

4.1 OIL FAULTS

If there is a failure in the system that causes a high temperature to occur, the high-limit thermostat will shut down the entire heating system, including the pump motor. The fault light will illuminate. To restart the system, the **OFF/ON** switch must be switched to **OFF** and then back to **ON** to resume operation.

A failure in the pump motor that causes the motor protection switch to trip will shut down the entire system. The fault light will illuminate. If this failure occurs, the MPS must be reset. See **SECTION 3.3**. Additionally, either the **OFF/ON** switch must be switched to **OFF** and then back to **ON** or the customer-supplied 24 V dc start/stop signal must be cycled off and then back on. For additional troubleshooting, see **SECTION 5.4**.

5 MAINTENANCE, REPAIR AND TROUBLESHOOTING

5.1 SYSTEM MAINTENANCE



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 heater.

- Plumbing connections
- Electrical connections
- System mounting
- Magnetic contactors
- Pump seal
- Control thermostat
- Heating tank and elements

NOTE: After maintenance is performed, refer to **SECTION 2** for system start-up procedures.

5.1.1 PLUMBING CONNECTIONS

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

5.1.2 ELECTRICAL CONNECTIONS

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

5.1.3 SYSTEM MOUNTING

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

5.1.4 MAGNETIC CONTACTORS

Magnetic contactors are used as voltage switching controls for motors and heating elements in HOTSTART heating systems. The contactors use 120 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 replacing contactors every five years.

5.1.5 PUMP SEAL

Pump mechanical seals are controlled leakage devices and are not intended to create a zero leak seal. Some leaking from seal is expected during normal operation. If seal becomes worn, replacement pump seals are available.

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

5.1.6 CONTROL THERMOSTAT



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.

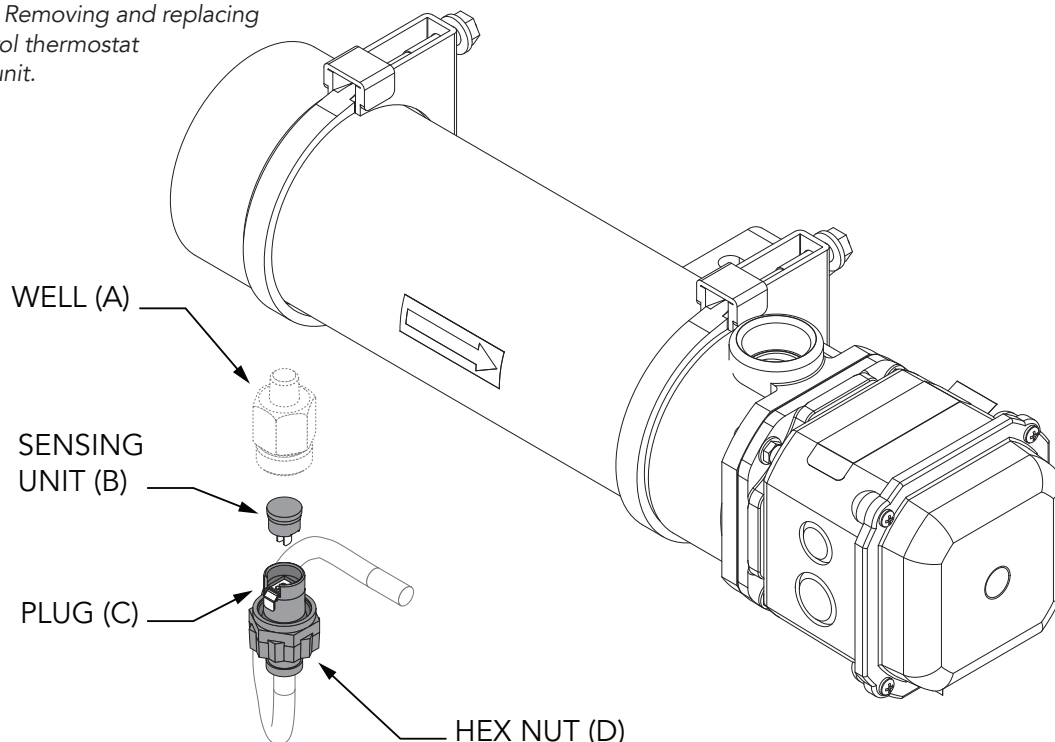
To replace the control thermostat sensing unit, use the following procedures. See Fig. 7.

1. De-energize the heating system. Follow your organization's lockout and tagout procedures.
2. Unscrew the hex nut (D) from well (A).

NOTE: Thermostat well (A) is shown separate from oil tank for illustration purposes. The thermostat well is a dry well; removing well from oil tank is not required to complete this procedure.

3. Pull plug (C) from well (A). Sensing unit (B) will be attached to plug.
4. Remove sensing unit (B) from plug (C).
5. Insert new sensing unit into plug. Push plug into well. Hand tighten hex nut to well.
6. To ensure proper installation and temperature regulation, re-energize and operate heating system. Refer to **SECTION 2** for system start-up procedures.

Figure 7. Removing and replacing the control thermostat sensing unit.



5.1.7 HEATING TANK/ELEMENTS



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.

To replace the heating element or perform routine maintenance, use the following procedures. See Fig. 8. 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. Follow your organization's lockout and tagout procedures.
2. Close isolation valves. Drain the fluid from tank **(A)**.
3. Remove enclosure cover **(F)** from wiring enclosure **(D)**.
4. The wire connections inside the enclosure correspond to one of the phase configurations shown on the following page. Note your unit's phase configuration and wire connection positions. See Fig. 9.

NOTE: Replacement elements may be a different phase configuration.

5. Disconnect the ground (green/yellow) and power electrical wires from the element posts inside wiring enclosure **(D)**.
6. Note the positions of the QD (quick disconnect) terminals on the high-limit thermostat **(G)** spade connectors. Remove the QD connections.
7. Remove wiring enclosure **(D)** from element plate **(I)**.
8. Remove element plate screws **(C)**. Remove element **(B)** from tank **(A)**.
9. Replace the heating element **(B)** or perform the necessary cleaning procedure. Ensure the element O-ring **(J)** is in place.

5.1.8 REASSEMBLY OF HEATING ELEMENT AND TANK

To reassemble the heating element and tank, follow the steps listed in **SECTION 5.1.7** in **reverse order**. Make sure the ground and power electrical wires are properly reconnected using the provided washers, cup washers and nuts. Ensure that the high-limit thermostat **(G)** is held in place with thermostat plate **(E)**. Reconnect electrical connections to original positions. Ensure the enclosure O-ring **(H)** is in place.

NOTE: To prevent oil leaks, HOTSTART recommends tightening element plate screws **(C)** to 144 lbf · in (16 N · m).

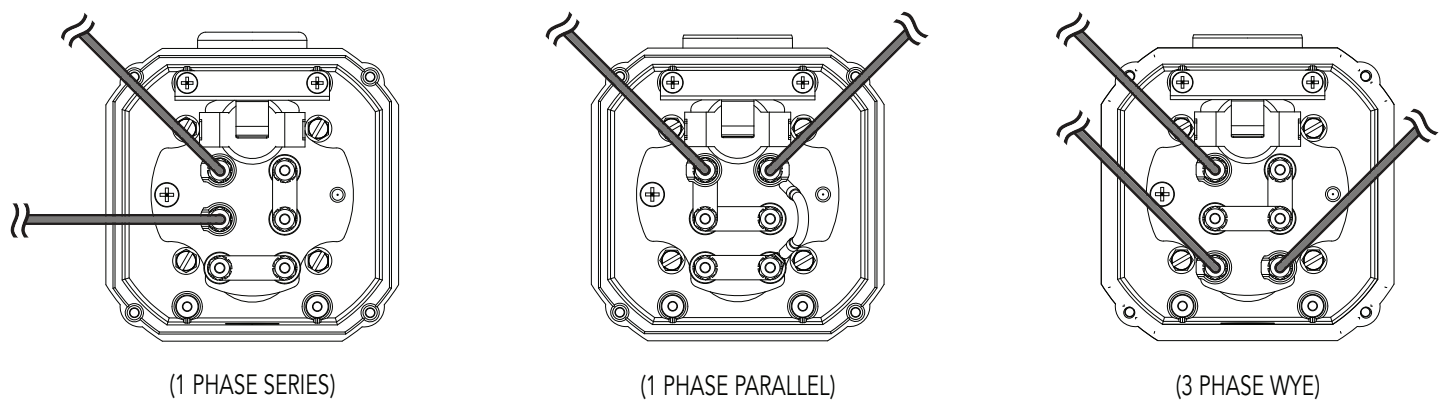
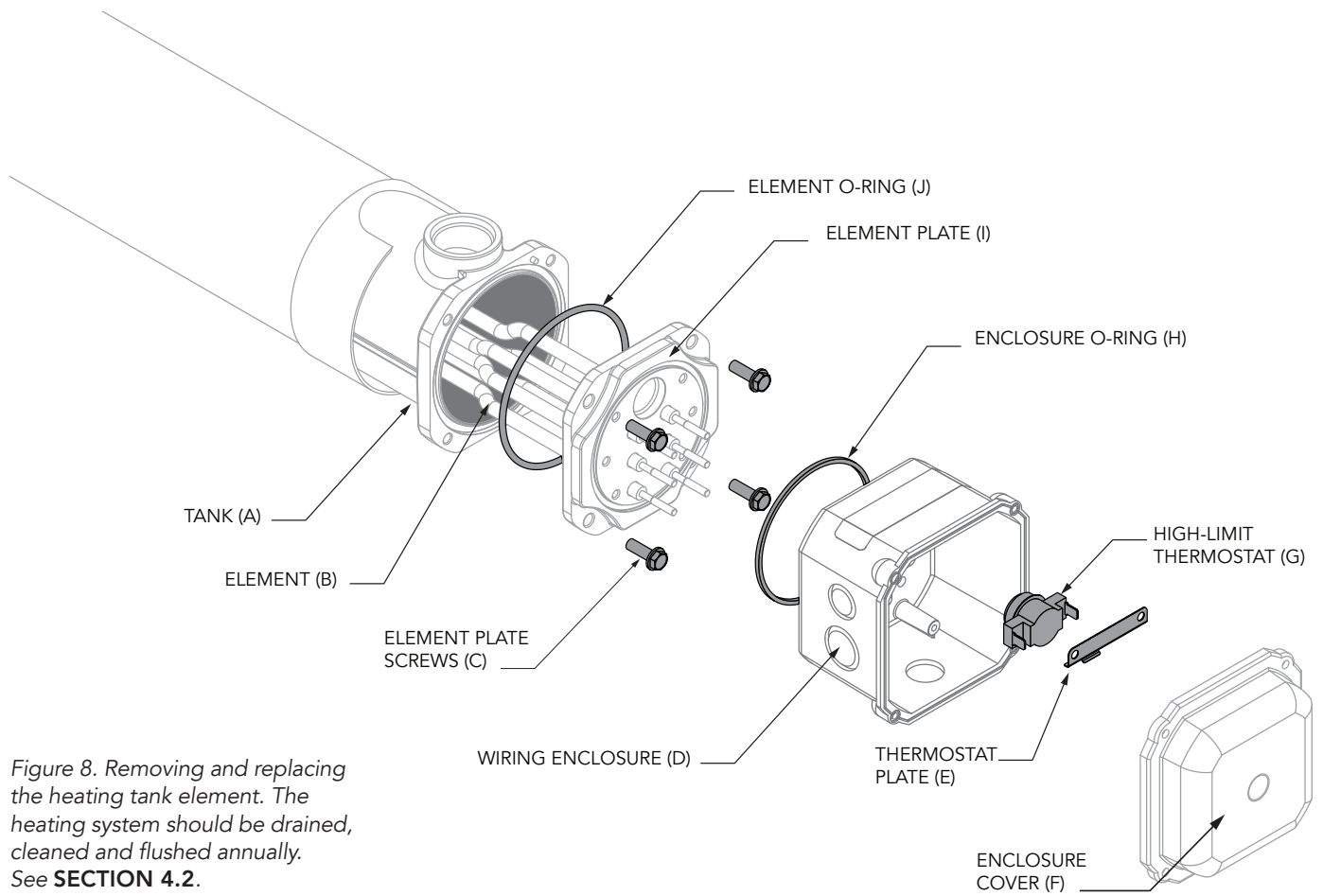


Figure 9. Heating tank element phase configurations. Replacement elements may be a different phase configuration.

5.2 RECOMMENDED MAINTENANCE

INTERVAL	MAINTENANCE TASK
At initial start-up	Tighten electrical connections. See SECTION 2 .
One week after initial start-up	Check and tighten electrical connections. See SECTION 5.1.2 .
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. See SECTION 5.1.7 .
Every three years or 25,000 hours of operation	HOTSTART recommends replacing the control thermostat sensing unit every three years or 25,000 hours of operation. Thermostats are rated for 100,000 cycles. See SECTION 5.1.6 .
Every five years	Replace magnetic contactors. See SECTION 5.1.4 .

5.3 STORAGE REQUIREMENTS

If long-term storage is necessary, precautions must be taken to ensure that the heating system is operational for start-up. If possible, store the system in its original packaging. If storing the heating system in the original packaging is not possible, 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.

5.4 TROUBLESHOOTING

SYMPTOM	POSSIBLE CAUSES	SOLUTION
Oil temperature too high	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 2 .
	Control thermostat failure: closed	Check and replace if necessary. See SECTION 5.1.6 .
	Motor failure	Check and replace if necessary. Restart system.
	Motor contactor failure	Check contacts and replace if needed. Restart system.
Oil temperature too low	Motor protection switch tripped	Check and reset switch. If problem occurs again, check motor. Restart system.
	Motor failure	Check motor. Replace if necessary.
	Heater 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 contactor failed	Check contacts and coil. Replace if necessary.
	Motor contactor failed	Check contacts and coil. Replace if necessary.
Control thermostat failure: open	Check and replace if necessary. See SECTION 5.1.6 .	