TROUBLESHOOTING & MAINTENANCE GUIDE

FOR THERMOSIPHON HEATERS

EVALUATING THE HEATER INSTALLATION

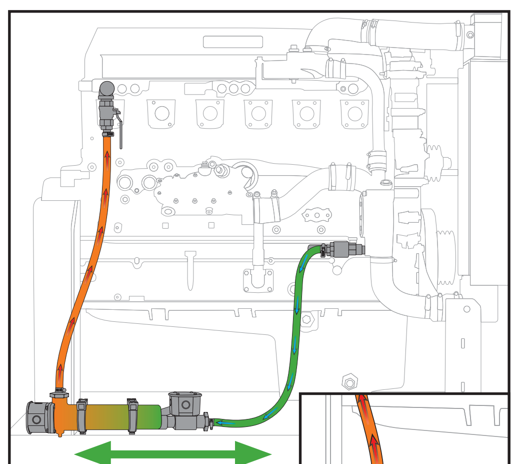
Thermosiphon heaters rely on proper installation techniques in order to function effectively. Installing the heating system correctly is critical; even seemingly minor adjustments to port location, hose routing or heater positioning can make the difference between a heater that preheats an engine effectively and a heater that heats poorly, not at all, or fails entirely. Symptoms of poor installation can include short-cycling (a heater's thermostat cycling more frequently than four times an hour) and abnormally high outlet temperatures. If left uncorrected, poor installations can result in premature thermostat failure or premature element failure.

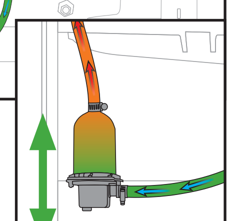
As described in HOTSTART's installation instructions, the most critical principle to keep in mind when inspecting a thermosiphon heater installation is that heat rises. A thermosiphon heater does not use a pump to force circulation of the hot coolant to the engine. Instead, the heating action itself causes the coolant to rise from the heater to the engine. Cold coolant then replaces the flowing heated coolant and the cycle continues. If the heater is installed correctly, this cycling results in coolant being circulated effectively.

The heater should be mounted below the lowest level of the coolant jacket; this maximizes the path for the coolant to rise and induce flow. Make sure that the return hose has a continuous rise from the point it leaves the heater to the engine port. As the heated coolant flows upward; any dips in the hose routing will cause flow restriction and likely prevent the heater from heating the engine. It is also important to correct any possible restrictions in the lines, such as narrow fittings and hoses or kinked lines. Flow restrictions can allow stagnant coolant to boil in the tank, causing the heater to overheat and potentially fail.

To function properly, the heater's outlet must be at the highest point on the heater. Some thermosiphon heaters with metal tanks may be mounted either in a horizontal or vertical orientation; check your heater's installation instructions. Models that feature a plastic tank housing, including the TPS model heater, must only be mounted in a vertical orientation.

A heater that is not isolated from engine vibration or that is mounted directly to the engine itself will suffer damage over time. Engine vibration will weaken the heater's internal components, causing them to loosen or detach entirely. Leaving a heater exposed to engine vibration will result in coolant leaks, premature thermostat failure or premature element failure.





Heater installation is the most important factor when troubleshooting a thermosiphon heater. To function, a heater's outlet port must be positioned correctly. Some thermosiphon heaters with metal tanks may be positioned horizontally or vertically. Heaters with plastic tanks must only be positioned vertically.

TESTING THE HEATER AND THERMOSTAT

Once you've evaluated the thermosiphon installation, testing the heater itself may determine the cause of failure.

TESTING TOOLS

- Phillips screwdriver
- Slip-joint pliers (for models rated for hazardous locations)
- Needle-nose pliers
- Ohmmeter
- A hot surface (above the heater's thermostat range)

An ohmmeter is used to test element and thermostat continuity. Be sure to test all elements in a multiple-element heating system.

TESTING FOR CONTINUITY

1. Disconnect the heater from the power source. Allow the heating system and coolant to cool down. If your heater is equipped with a thermostat, allow the coolant to cool below the thermostat range.

2. Using a Philips screwdriver (or slip-joint pliers) remove the element housing cover. If your heater has a seperate thermostat housing, remove the thermostat housing cover.

3. Remove all wires from the element terminals.

4. Using an ohmmeter, check for continuity and resistance between the element terminals. If your heater has multiple elements, be sure to check continuity between all element terminals; a single element failure can lead to reduced wattage but may not cause a complete heater failure.

   NOTE: If no resistance is found in an element, test for continuity between the element and the heater's grounding screw to determine if the element has failed.

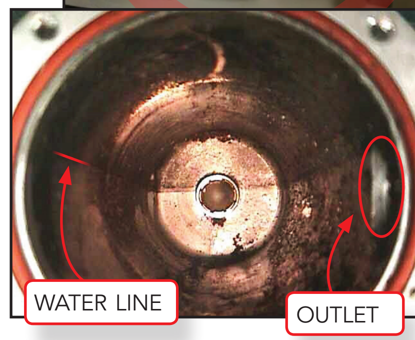
5. Using an ohmmeter, check for continuity across the thermostat. Apply heat (above the thermostat's range) while checking for continuity to ensure the thermostat opens the circuit properly.

TESTING THE THERMOSTAT

Thermostats typically cycle up to four times in one hour during normal use and have an expected lifespan of two to three years – a minimum of 100,000 cycles. Because thermostats have a finite life span, they may need to be replaced as a result of normal heater operation.

To test the thermostat, place the thermostat sensing surface against an extremely hot surface (any nearby hot surface above the thermostat's range, such as a common lighter flame). When the thermostat surface is heated, it should open, making an audible *click* or *snap*. When allowed to cool to room temperature, the thermostat should close, making another audible *click* or *snap*. To ensure that the thermostat is functioning properly, use an ohmmeter to check for continuity while opening and closing the thermostat.

If there is a continuity through both the element and the thermostat and the thermostat opens and closes properly, the problem is likely caused by improper installation, restricted coolant flow, faulty wiring or an air pocket. Premature thermostat failure can be a sign of an improper installation or vibration damage. Additionally, if a heater is installed in such a manner that the hot coolant flows back toward the thermostat, it will cause the thermostat to cycle on and off rapidly, shortening the life of the thermostat. Exceeding the maximum ratings of the thermostat can also cause thermostat failure; **never use a voltage different from the heater rating**. A prematurely failed thermostat can result in a heater producing no heat or a heater continuously heating coolant to abnormally high temperatures.



This heater was mounted with the outlet facing sideways. The coolant never reached the top portion of the tank. This exposed the elements to air and eliminated the heater's ability to "pull" cold coolant from the engine. It is critical that the heater is completely full of coolant at all times. This means the outlet of the heater must be at the highest point of the heater for it to work correctly.

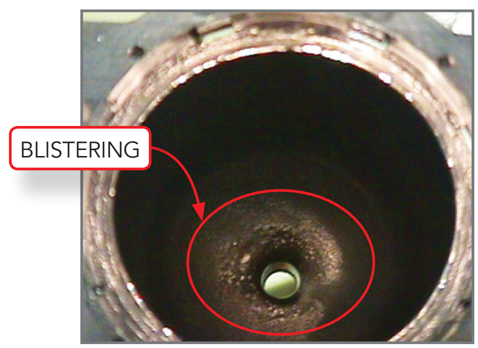
DETERMINING CAUSES OF FAILURE

Most thermosiphon heater failures are caused by one of the following conditions:

FLOW RESTRICTION AND AIR POCKETS

Air pockets or flow restriction can be caused by an improper installation, incorrect orientation of the heater, failure to purge air from the coolant system or simply closed isolation valves. Heaters that cannot circulate any coolant will fail quickly. Heaters that are able to circulate some coolant – but suffer from restricted flow – may prematurely fail or preheat the engine poorly. Air pockets will collect in any high points along the supply or return line; pockets may also form if heated coolant becomes trapped in the tank. If so, the heater will no longer be able to receive coolant from the engine and the element will become exposed to air.

The engine should be properly purged to eliminate any air pockets before the heater is energized. To ensure that no air pockets remain within the cooling system, HOTSTART recommends running the engine up to operating temperature to open the engine thermostat after the heating system is installed. It is also recommended to check the hose returning heated coolant to the engine and make sure there is no point in the line where it flows downward; any dips along the hose will stop the flow of hot coolant.



Blistering on the inside of a thermosiphon heating tank is a tell-tale sign of a flow restriction problem. If coolant is unable to circulate properly, it may overheat in the tank, eventually causing heater element failure.

POOR COOLANT CONDITION

If coolant is mixed or prepared improperly, a build-up of particulate (called scale) can accumulate on the element, eventually causing the element to fail. Hard water, usually unfiltered tap water containing dissolved minerals, is one of the most common causes of heater element failure due to scaling. An over-concentration of antifreeze or coolant additives can also cause scale to accumulate on the heater element. Symptoms resulting from poor coolant condition include ineffective engine preheating or a prematurely failed heating element.

As the layers of minerals continue to build up over time, the element's temperature eventually increases to the point of heater failure. Similarly, an over-concentration of coolant or coolant additives will cause a gel-like slime to accumulate on the element. In severe cases, it may burn onto the element causing a black sludge to form.

If antifreeze is added to an engine before being mixed with water, it will sink to the bottom of the engine. Because thermosiphon heaters are designed to sit at the lowest point of the water jacket, the heater's tank will be filled with undiluted antifreeze. If energized with pure antifreeze, scale will accumulate on the heating element almost immediately. The engine's water jacket, radiator and coolant lines are a series of pipes, rather than a mixing tank. As a result, even if the engine's water pump engages, it will continuously cycle water and antifreeze seperately. To avoid this common cause of failure, antifreeze and water must be adequately mixed before filling an engine with coolant.

Over time, scale build up can lower heating performance and eventually cause element failure. Tap water, over-concentrations of antifreeze and coolant additives can all cause scale-related element problems. Because engine coolant is heated inside the thermosiphon tank, the heater itself can be a great diagnostic tool for cooling system conditions that could have additional detrimental effects on the water pump, the after cooler, the oil cooler and the radiator. If your heater is suffering from poor coolant condition, it's likely that these engine-critical components are as well.

To correct problems caused by poor coolant condition, drain and thoroughly flush the coolant system before installing a replacement heater. Check your engine manufacturer's recommendations for the proper coolant. Only deionized or distilled water and a low-silicate antifreeze should be used in your coolant mixture – no hard water or water softened with salts should be used. The antifreeze and water mixture should never exceed a 60% antifreeze to 40% water ratio. **Do not over-concentrate the mixture**. Coolant containing anti-leak additives will also cause scaling and eventually element failure.

FOR MORE INFORMATION

For more information on repairing thermosiphon heaters and our warranty, see the HOTSTART website or contact our customer service department at **509.536.8660**. When calling, refer to the model or serial number labeled on your heater. Our customer service staff can help you troubleshoot heaters, replace parts and provide further warranty information. When calling, keep in mind the HOTSTART warranty guarantees our products for a full year; however, it may not cover damage incurred by improper installation or operation.

For online help installing or troubleshooting your heater, click the **RESOURCES** tab on the HOTSTART home page. Here you can review product manuals and view our product videos, including our HOTSTART Engine Heater Maintenance & Troubleshooting video, which demonstrates many of the troubleshooting techniques and tips found in this guide.