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Heater Inspection Guidelines

INSTRUCTIONAL VIDEO PROVIDING ADDITIONAL SUPPORT CAN BE FOUND AT
http://hotstart.com/home/resources/installation-instructions/

HOTSTART heaters utilize a standard resistance heating element. These elements are designed with a fixed resistance for the desired wattage using the specified voltage. In the event your heater has failed or is not properly operating, testing the heater is easy with the right equipment.

What You Need

1. Phillips screwdriver. (Explosion proof models may require slip-joint pliers)
2. Needle nose pliers or nut driver (For removing the connectors from the element pins.)
3. Ohmmeter

How To Test

1. Disconnect the heater from the power source.
2. For heaters equipped with a thermostat, allow the coolant to cool down below the thermostat range (or remove the heater from the engine).
3. Check for continuity with an ohmmeter between the element terminals inside the electrical box at the element end of the heater. Be sure to remove all of the wires from the terminals to avoid getting a false reading. In multiple element configurations, one element can fail while the others remain functioning. This leads to a reduced wattage but not a complete failure. If this occurs, remove the jumpers and measure the elements separately. Make sure that the jumper position is noted so they can be properly reassembled.
4. If there is continuity through the element, check for continuity across the thermostat terminals (if applicable).
5. If there is no continuity between the element or thermostat terminals (make sure the temperature is well below the thermostat rating) the heater has failed. The next step is to determine the cause of failure (See below).
6. If there is continuity through both the element and the thermostat, the heater is fine and the problem is improper installation, faulty wiring or an air pocket.

Determining the Cause of Failure

Most engine heater failures are caused in one of the following ways:

1. The heater has been installed in a manner that prevents it from properly rejecting its heat to the engine. This is primarily only a problem with the 'tank-style heaters' as opposed to direct immersion heaters or pump-driven circulating heating systems.
2. The coolant conditions in the engine form build-up on the heating element(s) which causes the element(s) to fail. The scale build-up can be caused by minerals in the water used in the coolant mix, (hard water) an over-concentration of antifreeze relative to water or an over-concentration of the additives used in your coolant.
3. Thermostat failure can be a sign of an improper installation. 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. This can shorten 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.

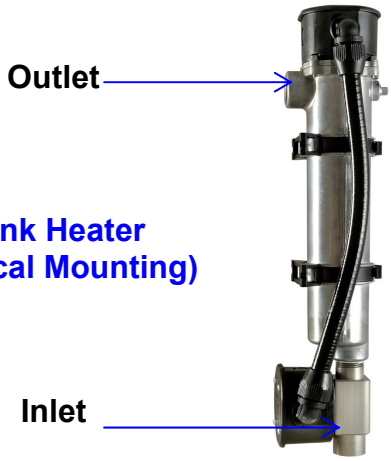
Tank Heater Installation Guidelines

As described in HOTSTART's installation instructions, the most critical thing to remember when inspecting a tank heater installation is that heat rises. The heater does not use a pump to force circulation of the hot coolant to the engine. Instead, the heat causes the coolant to rise, which results in circulation, provided that the heater is properly installed.

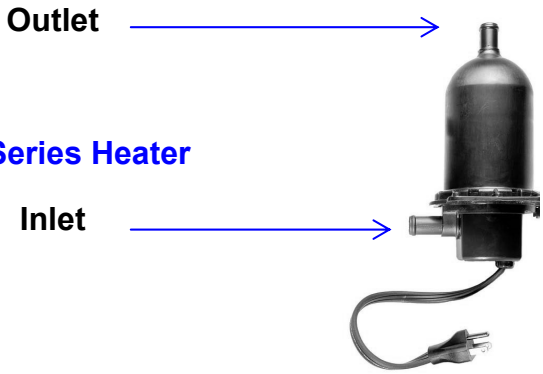
One of the first installation keys is to mount the tank heater low relative to where the heated coolant is being put back into the engine. It is recommended that the heater be mounted below the lowest level of the coolant jacket (this maximizes the path for the coolant to rise and induce flow). Another very important factor is to make sure that the outlet hose has a continuous rise from the point it leaves the heater to where it goes back into the engine. The heated coolant wants to rise and any dips in the hose routing will cause flow restriction and likely prevent the heater from heating the engine. It is also important to spot any possible restrictions in the lines such as kinks in the hoses or fittings and hoses that are too small. Restrictions can cause the coolant to boil in the tank and vaporized coolant cannot remove the heat from the element fast enough to keep it from overheating. The other consideration is to make sure the outlet is properly oriented (it must be at the highest point on the heater). The metal tank heaters can be mounted in either a horizontal or vertical orientation. The "TPS" tank heater can only be mounted vertically.

Below are some examples.

Tank Heater
(Horizontal Mounting)

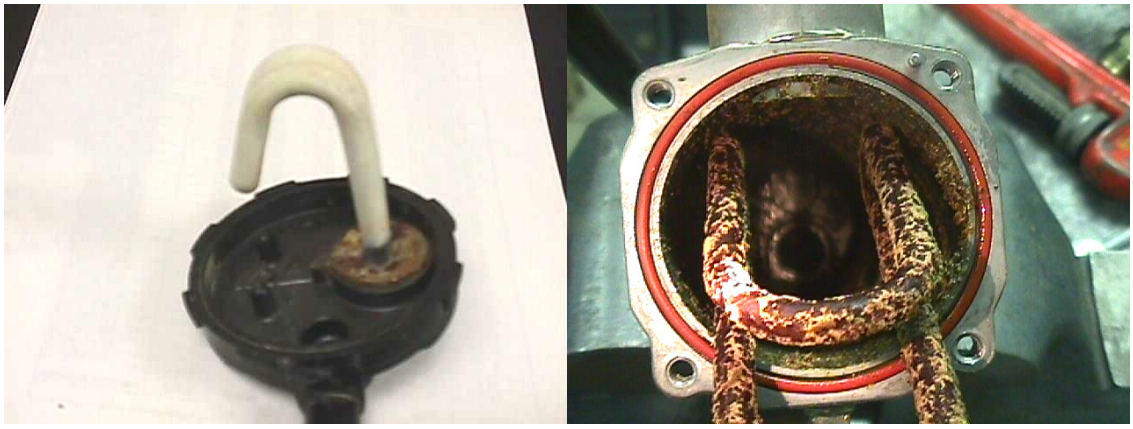


Tank Heater
(Vertical Mounting)



TPS Series Heater

Water Condition



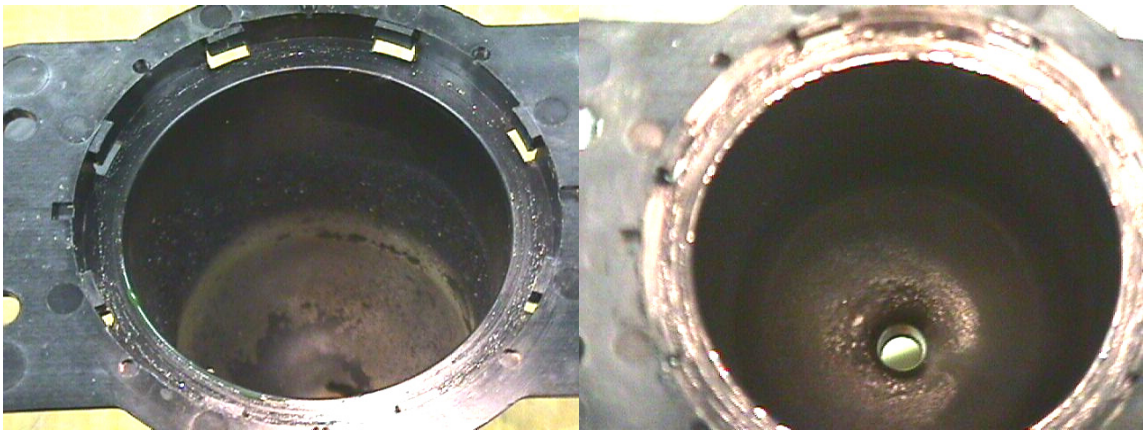
Hard water and contaminated coolant will limit heater performance and cause premature element failure. Hard water is one of the most common causes for failure of a heating element. The surface temperature of the heating element causes the minerals in the water to attach to the sheath. These minerals collect to form an insulation layer that increases the internal element temperature. As the insulation layer thickness continues to increase, the element temperature eventually increases to the point of failure.

Solution

Drain and thoroughly flush the coolant system. Putting a new heater in this environment will not solve the problem – it will just ruin another 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. The antifreeze/water mixture should never exceed a 60% antifreeze to 40% water ratio. **Do not over-concentrate**. The use of hard water or water softened with salts is one of the most common causes of failure to the heating element. A cooling system containing anti-leak additive will also result in element failure.

Because engine coolant reaches its hottest temperature inside the heating chamber, the heater itself can be a great diagnostic tool for cooling system conditions that could have detrimental effects on the water pump, the after cooler, the oil cooler and the radiator.

Air Pocket

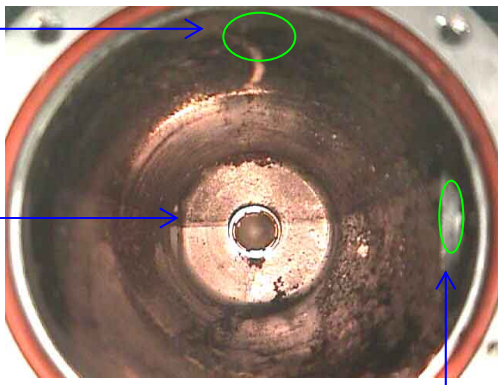


This is a fairly common problem that leads to a "false failure". The heater has been subjected to an air pocket preventing the coolant from circulating. Although the heated coolant can't circulate, the heater thermostat continues to turn the heater on and off. The engine will then cool down, activating the low coolant temperature alarm. More often than not, the heater is still functional, but it is replaced without being checked. In the most extreme cases the tank can actually melt or "blister". (Shown in the above-right picture.)

Solution

The engine should be thoroughly "purged" to eliminate any air pockets before the heater is energized. HOTSTART recommends running the engine up to operating temperature to open the engine thermostat after the installation. This will insure that no air pockets are left within the cooling system. Also check the outlet hose and make sure there is no point in the line where it flows downward. Remember that heat rises and a downward trend will stop the flow of hot water.

The heater below was actually 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.



Coolant Condition


Coolant concentration and additive levels are critical for proper heater and engine function. Always follow the engine manufacturer guidelines for coolant and additive levels. Over-concentration of coolant will cause a gel-like slime to accumulate on the element. In severe cases, it may burn on the element causing a black sludge to form. Over-concentration of additives will cause a similar slime, but usually in a different color.

Anti-freeze should never be added to an engine without being mixed with water first.

If the anti-freeze is added before the water, it will sit at the bottom of the engine. Tank heaters are designed to sit at the lowest point of the water jacket. If anti-freeze is added without mixing it with water first, the heater will be filled with pure anti-freeze. If energized in pure anti-freeze, scale will form almost immediately. The water pump will **NOT** mix the coolant in the engine. The pump will move a batch of water, then a batch of anti-freeze and it will keep repeating this cycle. The coolant jacket, radiator and coolant lines are more like a series of pipes than a tank.