

Tips for Extending the Life of Cartridge Heaters

Avoiding Contamination

- When using a release agent, such as Thermal's Ease-Aid, to ease heater removal from its hole, be sure to wait until agent is bone dry before inserting the heater into the hole. If the heater is inserted before the agent is dry, some of the liquid will usually be pushed towards the lead end and then will soak into the heater through the lead insulation or through the lava or ceramic plug at that end. When that happens, the heater can be expected to fail as soon as the power is applied. (Choosing the lead option of Teflon wire insulation and a Teflon plug can reduce the likelihood of water entering the heater, but this does not provide a fully hermetic seal, and the lead end of the heater must be restricted to 400°F)
- Moisture, oil or other liquids on the lead wires can be wicked into the heater and cause early failure.
- Oil or other organic material on the lead end cap of the heater will carbonize at elevated temperature, causing a short from the leads to the sheath.

Avoiding Over-Temperature

- A loose fit of the cartridge heater in its hole will reduce the heater's life time because the heat generated is not transferred efficiently to the object or material being heated, causing the heater to run at a higher temperature to transfer its energy. The higher the operating temperature, the shorter the lifetime. A rule-of-thumb for the fit is to make the hole diameter no more than .005 inches greater than the diameter of the heater.
- Choose the lowest wattage heater that will maintain the desired operating temperature of the part being heated and still provide a short enough start-up time. Choosing a heater with higher wattage than required will result in the controller turning the heater on and off to maintain the desired temperature and a higher operating temperature during on-time. These conditions will shorten the heater life.
- If used as an immersion heater, the type of fluid and its velocity passing over the heater are important factors. Ask for assistance from a Thermal Applications Engineer.

Excessive Cycling

- The way that Thermal Corporation evaluates the lifetime of their own cartridge heaters and those from competitors is to cycle the units from 150° F to 1,400° F and count the cycles to failure. Cycling reduces lifetime because the surface of the element wire oxidizes rapidly at higher temperatures; if the higher temperature is maintained, the oxide coating actually protects the wire from further oxidation, but if the wire temperature is reduced substantially, the oxide coating breaks off due to contraction and exposes fresh metal to more oxidation. With continuous cycling, the wire diameter is eventually reduced, and the resistance of the element is increased to the point that it becomes too hot. At that point, the element wire either melts and breaks open the circuit, or it causes the insulation over the wire to break down, causing a short to the sheath.

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What Shortens the Lifetime of Resistance Heaters ?

Aside from mechanical abuse and manufacturing defects, there are three basic causes of early heater failure:

	CONTAMINATION	OVER-TEMPERATURE	EXCESSIVE CYCLING
WHAT IT IS	Any foreign material that is electrically conductive or becomes so when heated.	Anything that causes the temperature of the resistance wire in the heater or the lead wire to exceed its temperature rating.	Turning the power to the heater on and off on a cycle that allows the resistance wire in the heater to cool off by several hundred degrees below the temperature reached when the power is "on".
WHAT IT DOES	Makes a conductive path between the resistance or lead wire and any "grounded" object (such as the heater sheath or metal lead protection), thus causing an electrical short.	If the insulation rating is very high (such as ceramic, as used in cartridge heaters), the resistance wire itself may oxidize or melt; otherwise, the insulation breaks down, allowing the resistance wire to short through.	Any temperature cycle (even one) shortens heater life because it causes more rapid oxidation on the surface of the resistance wire. This tends to break off the oxide coat when cooling. The greater the temperature difference in the cycle, and the more cycles over time, the shorter the lifetime.
TYPICAL CAUSES	<p><u>Water.</u> When soaked into the insulation of either the lead wire or the element, water makes a good short. Even high humidity can cause a problem.</p> <p><u>Oil, plastic, or other hydrocarbons.</u> These materials may be insulators at room temperatures, but conductors at higher temperatures. It only requires trace amounts to cause a short.</p>	<p>The basic cause of over-temperature is that the heat is not being removed from the heating element fast enough (for example, wattage too high for application). If the wattage of the heater was selected well for the application, then one of these factors is typically responsible:</p> <ul style="list-style-type: none"> • Heater is not in good contact with the surface of the object being heated. • Higher than design voltage applied to heater. • Heater is not being used as directed (for example, strap not tight on band heaters, or reduced flow rate on immersion heaters). • Thermocouple used to monitor the temperature of the part being heated is not in good contact with the part, or located some distance from the heater. 	<p>Wattage of heater is much larger than needed and being used with a temperature controller that turns the heater on long enough to get hot, then keeps it off long enough to become cool.</p>

TYPICAL CAUSES OF MECHANICAL ABUSE:

Pulling on the leads – Overtightening of post terminals – Using only one nut (or tightening the bottom nut) on post terminals – Lead wire insulation being rubbed off by motion of the leads (can occur inside metal hose).

Heaters manufactured by Thermal Corporation are all made to meet customer specifications.

We manufacture a wide variety of cartridge heaters, band heaters, strip heaters, thermocouples and RTD probes. We also supply a complete line of temperature controllers and accessories.



For a catalog or questions, contact our experienced and knowledgeable customer service team at 1-800-633-2962, or visit our website at www.thermalcorp.com

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