

SmartHeat SLT Thin-Film Heaters

Overview

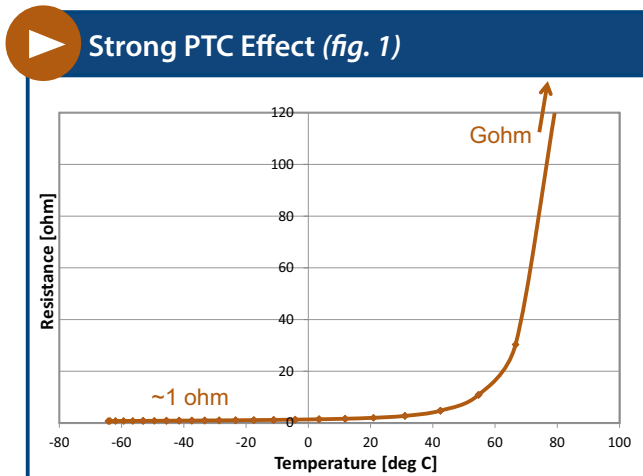
Minco's SmartHeat SLT (Self-Limiting Technology) line of heaters offer a smart alternative to traditional heaters and temperature control devices, providing consistent thermal outcomes and self-tuning in dynamic environments. Utilizing a patented polymer compound, SmartHeat SLT heaters pinpoint exactly when and where heat is required for thermal uniformity without the need for external control.



Features

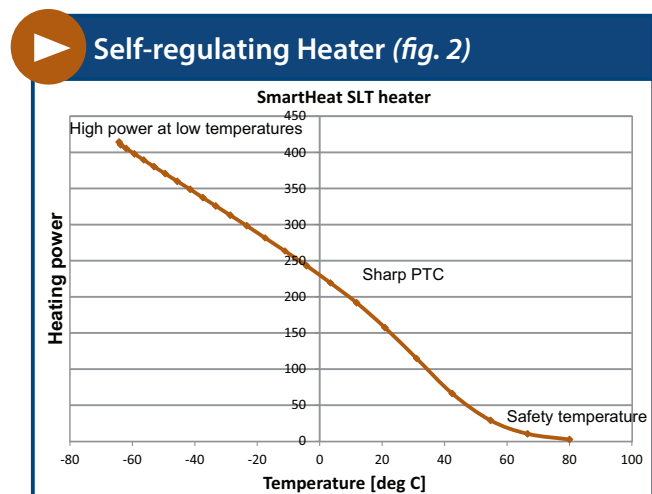
A SmartHeat SLT heater strives to maintain a constant temperature. It will produce high power when attached to a cold object and rapidly bring the object to a designed set point temperature. SmartHeat SLT heaters are defined by a strong PTC (Positive Temperature Coefficient) characteristic, meaning that their resistive properties are determined by the environment.

This sharp PTC effect is illustrated in Figure 1.



For low temperatures, resistivity is low and the heater conducts current. As temperatures increase, the resistivity grows linearly. Above the prescribed set point, the curve transitions to exponential growth, and the heater conducts negligible current.

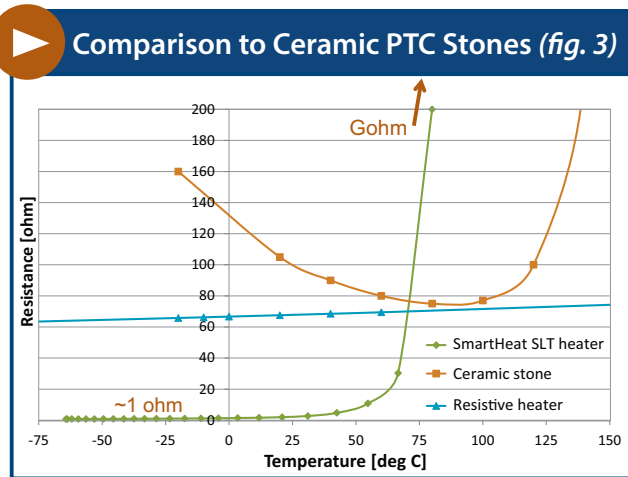
Power emission characteristic of Minco's SmartHeat SLT heaters is shown in Figure 2.



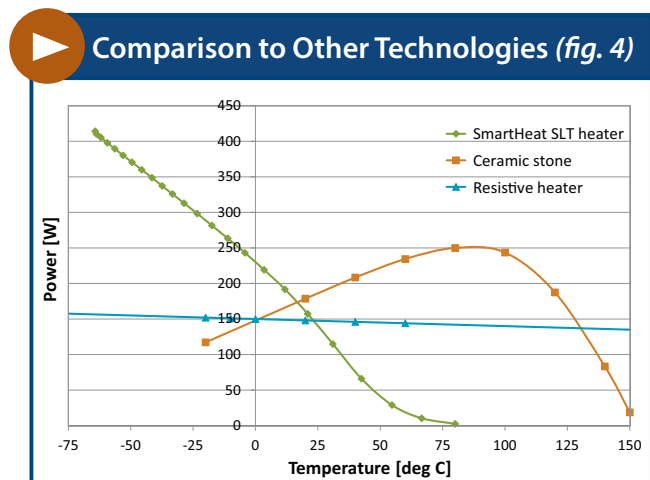
Thermal performance depends on the ambient temperature, thermal load, and contact resistance between the heating element and the heat sink. It is this combination of factors that determines the temperature of the heater and in turn the emitted power. The heater will reach equilibrium with its surroundings, such that the power emitted is equivalent to the power required to maintain the prescribed set point.

If a SmartHeat SLT heater is isolated from its surroundings (i.e., it is not attached to anything), within seconds it will heat up to a set point, and power emission will be low. At the other extreme, if a SmartHeat SLT heater is connected with good thermal contact to a dense metallic object, the heater will increase its power output to maintain the same approximate temperature. The exact operating point of a SmartHeat SLT heater for a specific environment and thermal load can be approximated during the design phase, and refined during prototype.

Minco SmartHeat SLT heaters offer unique benefits over conventional resistive heaters and ceramic PTC stones. Unlike ceramic stones, the PTC effect of a SmartHeat SLT heater acts in the whole temperature range from -45°C (-49°F) to the prescribed set point temperature. By way of comparison, the PTC characteristics of a Minco SmartHeat SLT heater, a constant heater, and a ceramic PTC are shown in Figure 3.



The SmartHeat SLT heater acts as a PTC device with resistance growth at all temperatures, from -45°C (-49°F) to the set point temperature. A ceramic stone actually exhibits an NTC (Negative Temperature Coefficient) characteristic over a large temperature band, as illustrated in Figure 4.



Applications

Medical	Defense	Aerospace
IV Fluid Warming	Anti-Fog Optics/Lens	De-icing Sensors (TAT, AOA)
Reagent Storage Warming	Warming Handheld Electronic Displays	Warming Grey/Potable Water
Humidification (Sleep Apnea)	Lithium Ion Battery Warming	Cockpit Display Warming

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