The *Salamander* News

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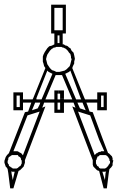
Technical Issues



It has been quite some time since we provided any technical information in *The Salamander News*. This issue will review highlights of important technical issues. To assist you on technical questions, we offer engineering and design support and we welcome and encourage you to consult with us in helping you to create the perfect solution for your infrared heating needs.

Infrared Heating Basics (July 1998 Issue)
When infrared energy strikes an object it may be absorbed, transmitted, or reflected from the surface. The sum of the amount of energy absorbed, transmitted, and reflected must equal 100% of the total incident energy. A true "blackbody" either absorbs (or emits) 100% of incident infrared radiation. No true "blackbody" source for industrial applications exists. The efficiency of a radiant heater is given by its emissivity value which is the ratio of the radiant energy emitted by an object at a given temperature and the radiant energy emitted by a "blackbody" at the same temperature. Radiant heating elements are available with a wide range of radiant efficiencies. Ceramic elements are rated the highest at 96%.

Wiring
Electrical connections should be made directly through high temperature ceramic terminal blocks (sold separately,) and not using them can result in injuries and loose connections. Nickel plated copper wire, with insulation suitable for the load amperage and operating temperatures, must be used to make the power connections to the ceramic terminal blocks.

Constructing Reflectors and Mounting Heaters (May 1998 Issue)
If you are making your own reflectors they should be constructed from 20 to 24 gauge [.036" (.9mm) to .025" .6mm)] aluminized steel or stainless steel. Emitter mounting is done by inserting the ceramic emitter through 15mm x 41mm slots (except the LTE size emitter which mounts in two 15mm x 44mm slots) cut into the reflector and secured in place by a "spring retaining clip".

Constructing and Zoning of Panels (June 1999 Issue)
Panels should be designed to fit your application requirements taking into consideration available space, voltage, working temperature, product specifications, and time requirements. Zoning may be needed to provide different amounts of heat to specific areas of the material to be heated. Each ceramic heater or any combination thereof, can be wired in independent zones. Each zone can be operated at different temperature levels depending on application requirements.

Optimum Heating Distance from the Ceramic Heater (April 1998 Issue)
The heater should be as close as practically possible, but far enough away that the infrared radiation pattern from each emitter (in a panel) will overlap each other, creating total coverage. Some materials are very heat sensitive and if the radiant patterns of the heat source do not overlap, "striping" can occur. The distance is dependent on the spacing between emitters. FTE emitters that are spaced 1" apart would require a distance of 8" to achieve even heating.

Radiant Emission Patterns of Ceramic Heaters (September 2000 Issue)
Salamander ceramic heaters are manufactured with three basic emitter faces: convex as in the ESE, concave as in the FTE, HTE, and LTE, and flat as in the FFE, HFE and HSE. These different shapes create three different emission patterns. The convex shape gives off a "wide area" pattern which is desired in comfort heating or other applications that require dispersed heating. A concave surface will emit a "concentrated" pattern which is highly effective when zone heating is desired as well as radiant heating in general. The flat surface will produce a "uniform" pattern for even heating at a close proximity between the emitter and the material to be heated.

Average Surface Temperature and Associated Peak Wavelengths Emitted
Like all infrared sources the *Salamander* emitter does not emit one single wavelength but a range of wavelengths. The peak wavelength emitted is dictated by the surface temperature of the emitter which can easily be monitored using closed loop or open loop control. In reference to Planck's Law, a heater will emit a range of wavelengths which is only dependent on the surface temperature of the emitter.

Controls used to Regulate the Temperature of the Ceramic Heaters (February 2001 Issue)
Since the ceramic emitters are relatively slow responding (8 minute warm-up time required to achieve operating temperature) closed loop control with an inexpensive proportional control and contactor will control the heaters typically between +/- 2°F. Percentage timers and SCR power controls can also be used very effectively. The control of ceramic emitters can be one of two types: **open-loop** or **closed-loop**. It is important to be able to differentiate between these two control systems in order to best advise your customers on the products available to them.

> **Open-loop** can control the temperature by two different methods. The first, controls by time, using a percentage-on/percentage-off duty cycle. When the timer is set for the on/off time cycle, the overall temperature of the emitter will stabilize. This can be done with either a mechanical timer or with a computer control. The second method of open-loop is through voltage control. In this method, a manual potentiometer control, or computerized control regulates the voltage potential applied to the elements, thus controlling the temperature.
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> **Closed-loop** control, a thermocouple is used to either measure the temperature of the element's coil or, more accurately, the surface temperature of the element. A feedback signal can also be created with a non contact infrared sensor that can sense the emitters or product temperature. As the temperature of the target changes, the thermocouple creates a millivoltage which is sent back to a temperature controller. The controller then converts the millivoltage into a temperature reading. There are varying ranges of temperature controllers available from a simple on/off, non-indicating controller to a sophisticated digital PID control with ramp soak programming, auto-tuning, etc.

Additional Technical Resources
- Our website contains a technical support section at **www.InfraredHeaters.com/techsupp.htm** and our technical manual is at **www.InfraredHeaters.com/page1.htm**
- Topics above with issue dates indicated are archived at **www.InfraredHeaters.com/acrobat.htm**
- Contact us at Mor Electric Heating

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