Process Radiant Heaters

Technical & Application Data

Radiation is the process by which energy is transmitted through space without significant loss. Radiant energy is transferred from source (emitter) to receiver (absorber) in the form of electromagnetic waves. Heat is the result of absorption of this radiant energy by the receiver.

Radiation differs from convection and conduction because it does not require the presence of a medium (solid, liquid or gas) to transmit energy from the source to its final destination. By eliminating the heat transfer medium, radiant heating also eliminates the losses associated with other methods. Therefore, radiant heating provides maximum efficiency for your application.

The **Electromagnetic Spectrum** covers the range of wave lengths of radiant energy. The infrared portion of the spectrum (0.72 to 1000 microns) includes those wavelengths which will produce heat upon being absorbed by an object (see Figure 1). The radiant energy, or wavelength, of an infrared element depends on its temperature: the higher the temperature, the shorter the peak wavelength. Infrared wavelengths are longer than visible light but shorter than microwaves. The energy output of a radiant source depends upon the absolute temperature of the source, raised to the fourth power. As source temperature increases, heating intensity becomes very great. The useful wavelengths for industrial applications are from 1 to 10 microns.

Infrared radiation is similar to visible light. It travels through space at the speed of light (186,000 miles/sec), moves in a straight line, can be focused by optical reflectors, will travel through a vacuum, and is absorbed, transmitted or reflected by objects or materials.

In order to heat a product, the waves must be absorbed. Usually less than 10% of the waves are reflected, and the other 90% is either absorbed by or transmitted through the material. The best way to determine the absorption efficiency of the product is through testing.

Radiant heating is suitable where immersion or direct contact heating is impossible, impractical or undesirable. When infrared is the method deemed most suitable for your application, the Chromalox product line provides the largest selection of elements, fixtures and controls. You should find the exact radiant heater which will best meet your job requirement. If a specially designed heater is required, check with your Local Chromalox Sales office.

Figure 1 — Electromagnetic Spectrum

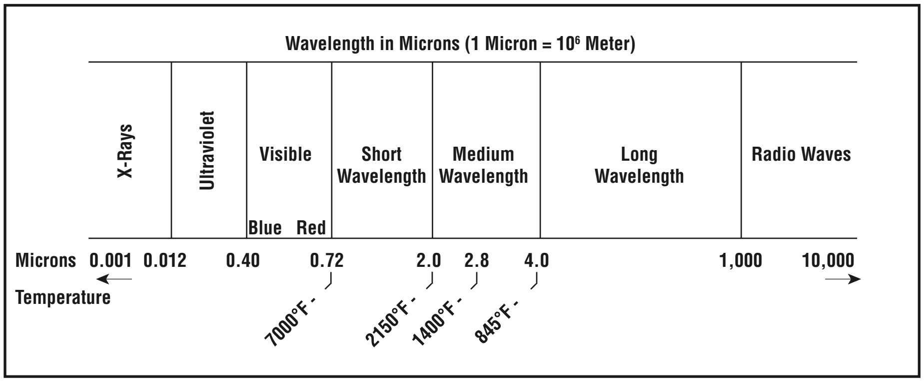


Figure 2 — Transfer of Energy

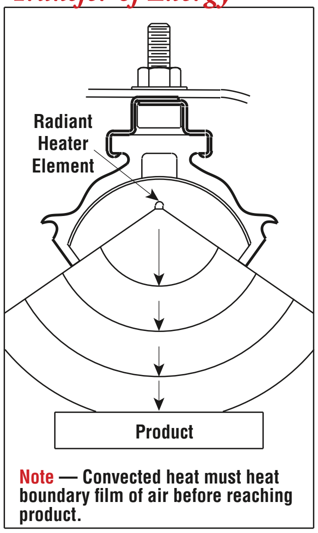
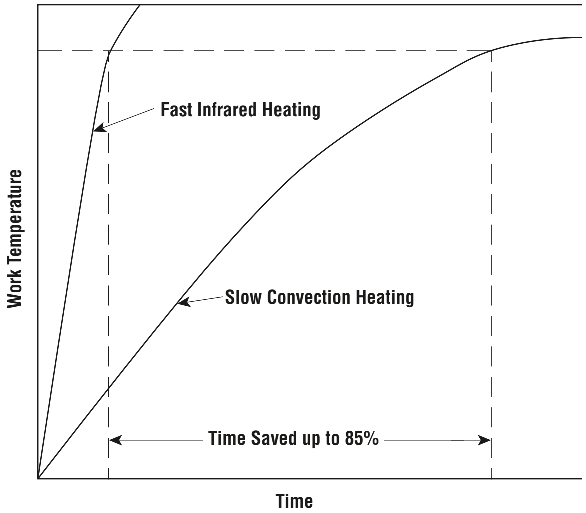


Figure 3 — Work Temperature Vs. Time



Radiation Vs. Convection — Convection and radiation are capable of transferring energy from a source to the work material without contact. They are naturally considered together when contact-free heating must be performed (see Figure 2). Due to the insulating effect of the boundary film of air which adheres tightly to all surfaces, gravity convection heating becomes exceedingly slow and more and more inefficient as production speeds increase (see Figure 3).

Forced convection of heated air directed at the work assists in breaking up the boundary film, but has the disadvantage of requiring enclosures and air handling equipment. If not recirculated, the spent heating medium must be discharged with consequent heat loss. The desire for faster heating by this means tends toward higher velocities which may lead to higher oven losses and possible damage to delicate surfaces or contamination of the work by airborne dust.

One factor promoting efficiency of application in radiant heating is that radiation falling on an opaque surface is immediately absorbed and transformed into heat. The surface (and by thermal conduction, the internal body) is frequently heated above the surrounding ambient temperature. Where exhaust ventilation must be provided to remove volatiles, noxious fumes or moisture, lower ambient temperatures reduce the amount of heat carried away by the exhaust air and the necessity for extensive oven insulation.