Radiant Heat... Modern Technology With Old World Comfort

By Jean-Marie Falquet

The words "Radiant Heat" have become very popular in recent years. Considering that the sun's radiant warmth has driven most of the evolution of life on earth, this is hardly surprising. Indeed, one does not have to look very far for everyday applications of radiant heat. But what is it exactly, and what are the applications of radiant heat for home comfort?

How Does It Heat?

Unlike a forced air furnace or convection heater that heat the air directly, the primary role of a radiant heater is to generate infrared waves. When these invisible rays hit a surface they can be absorbed or reflected to a certain extent and are thus able to transfer their energy into heat. This is how french fries are kept warm under a heat-lamp. Air is mostly transparent to this radiation and is not directly heated by an infrared heater!

Those "heat waves" come in different intensities: in the case of a quartz heater with a very high core temperature (800° to 1000°C), the radiating waves are intense (higher frequency, lower wavelength) - hence the name "short infrared". Thus a small emitter can radiate a lot of energy and create a feeling of heat from a greater distance. On the other hand, a radiant floor (29°C or less surface temperature) generates a low intensity, barely perceptible, radiant wave. In order to be effective, it depends on a large surface to compensate for its low intensity (lower frequency, higher wavelength).

The amount of energy emitted by an infrared source depends on three factors:

(1) its surface emissivity - expressed by a number ranging from 0 (incapable of radiating) to 1 (a perfect radiator). Table 1 shows a list of common materials and their emissivity factors. The emissivity of an object depends on what it's made of and on some surface characteristics like its colour or whether it is smooth or rough;

(2) the surface area of the radiating object (the larger the surface, the more energy it can radiate);
(3) the absolute temperature of its surface, to the 4th power.

It follows that the single most important factor is temperature. Let's take a 1250 watt residential heater with an emitter temperature of 200°C or 473°K (this is its absolute temperature), and compare it to an industrial quartz heater (800°C or 1073°K). The residential heater's temperature is 2.3 times lower than the quartz. It will therefore radiate 28 times less energy per unit area. This is why the quartz heater can be both very powerful yet very compact.

Manufacturers have combined these three factors to design a wide range of radiant heaters in response to different needs:

- High intensity quartz heaters are used to heat small areas in open exposed environments.
- Medium to low temperature steel rod radiant heaters are appropriate for workshops, arenas or school gyms where less intensity is sufficient but tougher construction is essential.
- Very low temperature radiant floor or ceiling systems are used in commercial or residential applications where wall space severely limits heater placement.
- Wall-mounted low temperature radiant panel heaters combine better comfort and esthetics in residential living spaces (living or reading rooms, dens, dining rooms, kitchens.....) with varying combinations of radiant and convection heat.

Table 1. Coefficients of Emissivity *(1 = perfect radiator, 0 = perfect mirror)*

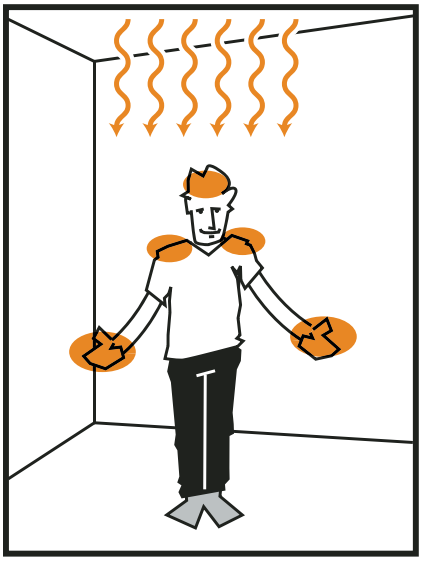
Aluminum, polished (airplane fuselage)	0.05
Cast iron, polished (wood stove)	0.21
Aluminum, anodized (architectural baseboard heater)	0.56
Cast iron, oxidized (old radiator)	0.64
Wood, planed oak (floor)	0.90
Plaster, rough coat (ceiling)	0.91
Concrete (floor slab)	0.92
Brick, common red (wall, hearth)	0.93
Paint, oil (wall hung heater)	0.94
Glass, polished (high-end radiant heater)	0.94
Skin, human	0.98

Comfort Heating

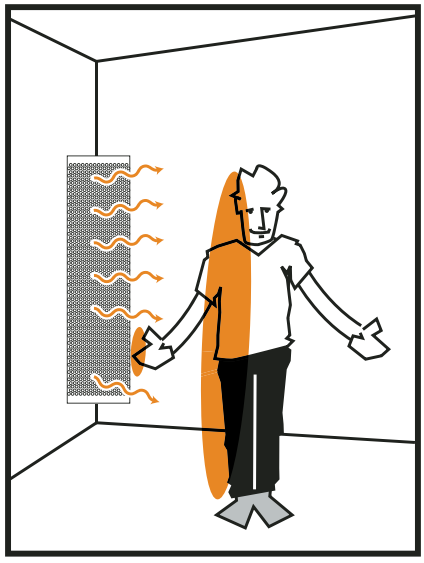
As infrared waves heat objects but do not heat the air directly, how are they perceived by the human body? Like the living world around us, we are the result of millions of years of evolution on the surface of the earth. Is it surprising then that we tend to enjoy the feeling of the sun's warmth on our skin? We tend to equate comfort with anything that reminds us of this warmth.

In order for radiant heat to be perceived as comfort, three factors must again be taken into account :

- Infrared receptivity: as it happens, our skin is both a very good receptor of infrared heat and a nearly perfect emitter (0.98 emissivity). This is why we are able to instantly perceive even very weak levels of infrared energy. Infrared heat may also warm our clothes which will eventually transmit that heat to our skin, depending on textile types.
- Temperature: we can only perceive the warmth of radiant heat if the temperature of the source of the heat waves is larger than that of our skin. For example, infrared heat from a radiant floor (surface temperature 29°C) will not be felt on our skin, which has an average temperature of 32°C.
- Exposed area: the greater the area exposed to infrared waves, the more heat we will receive. A source of heat placed horizontally from our position - which is able to "shine" heat over the entire length of our body - will be more effective than one that is placed vertically above, shining on the top of our head and shoulders (see below).



Radiant heat felt from above.



Radiant heat emitted horizontally.

In order to add comfort to a room, it follows that a radiant heater must be designed with a heating element that is warm enough to generate a feeling of warmth on the skin while not exceeding safe limits (outside surface less than 90°C). Its active surface must be sufficiently large to satisfy the wattage requirement of the room to be heated. Lastly, it must be placed in such a way as to "shine" horizontally on the room's occupants.

Sweet Heat

Since our comfort relies on a combination of comfortable air temperature and warm radiant feeling, it is desirable for a comfort heater to generate a sustained but very soft convection current throughout the room to spread heat as evenly as possible, in addition to providing infrared heat. When it is well balanced, this heating combination is sometimes called sweet heat.

As an example, some heaters utilize a built-in thermostat designed to balance convection and radiant heat. By controlling the two heating elements separately, this thermostat is able to give a priority to the infrared element when less heat is needed (thus providing a faster and more present feeling of heat) and call on the more powerful convection element for periods of more intense cold. This combination provides a more immediate comfort from a reasonably sized unit in an esthetically pleasing design. Here is a modern solution that brings back the comfort of old world water radiators - without the noise! **Ω**

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