Infrared Heaters

Operating Principles of Infrared Heaters

This white paper presents the operational characteristics of infrared heaters. Data presented represents an in-depth analysis of industry practices and theoretical principals.

A Detroit Radiant Products Company **White Paper**

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Introduction

Infrared energy is a unique and efficient means of heating. It combines the benefits of low cost operation, silent performance, and environmentally friendly emissions in a variety of applications. Utilizing the same principles as the sun, infrared warms people, structures and flooring to provide comfortable heat where needed, replacing the more traditional forced air heaters that generate hot drafty blasts of air. This efficient heat source is often advantageous for use in difficult-to-heat applications with high air infiltration.

The discovery of infrared radiation is attributed to William Herschel in 1800. Herschel measured the temperatures of the various colors of the light spectrum and found that temperatures increased as the colors changed from violet to blue to green and on up the spectrum. He was surprised to find the highest temperature was recorded just beyond the red part of the spectrum where no visible light existed.

Our visible light spectrum is limited to (in order) red, orange, yellow, green, blue, and violet. The spectrums most closely related to the visible range are "infra" red and "ultra" violet. Infra is a Latin prefix for below, so infra red refers to below red. "Ultra" violet comes from the Latin prefix for beyond so ultraviolet means beyond or above violet.

Every object at a temperature above absolute zero will give off infrared energy. Scientists have not been able to obtain absolute zero in laboratory environments.

How Infrared Heaters Work

Unlike heat transfer by means of convection or conduction, radiant heat does not require a medium (hot air) to transfer heat. Infrared energy, which creates radiant heat, is part of the electromagnetic spectrum and closely resembles and behaves like visible light energy. This infrared heat energy is carried from the heater source, either high intensity or low intensity, by wave motion. Infrared energy is then converted to heat upon contact with a solid object, such as the floor. The floor in essence becomes a large, low level, secondary emitter. Heated surfaces subsequently reradiate warmth into the air by means of convection. Cool air is warmed as it sweeps across the floor surface and rises within the space. Warm air is displaced by cool air in a continuous cycle resulting in a comfortable building temperature. Heat is also transferred to adjacent objects by conduction and will flow from warmer objects to colder objects. As these objects come in contact with the warmed floor surface, heat transfers to that object by thermal conduction.

Applicable Definitions

Electromagnetic Spectrum: The electromagnetic spectrum is the range of all possible electromagnetic radiation frequencies. It extends from the long radio waves to the very short gamma ray waves frequently measured in terms of wavelength, frequency and photon energy.

Convection: The upward transfer of heat within the atmosphere. For example, air on a part of the Earth's surface warmed by strong sunlight will be heated by contact with the ground and will expand and flow upward, creating a region of low pressure below it; cooler surrounding air will then flow in to this low pressure region. The air thus circulates by convection.

Conduction: The transmission of heat caused by a temperature difference between the parts.

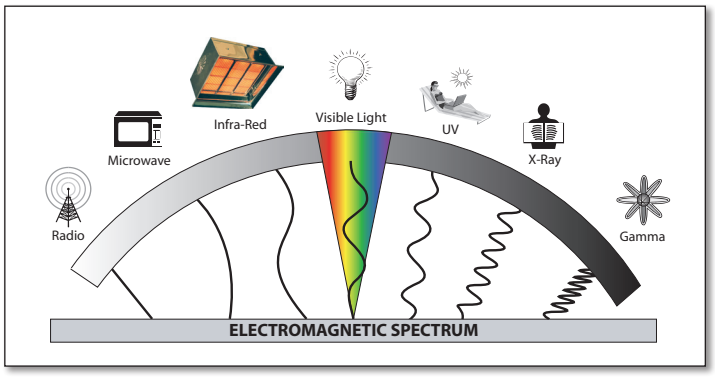
Reradiation: Radiation emitted as a result of the emission of previously absorbed radiation.

The Electromagnetic Spectrum

Infrared energy emitted by the sun travels 91 million miles through cold, dark space striking the Earth and heating the atmosphere by convection.

Infrared energy travels at the speed of light or 186,000 miles per second.

Infrared heaters can yield fuel savings from 20% up to 50% when compared with forced air heaters.



Infrared waves fall next to visible light along the electromagnetic spectrum, a large spectrum of energy that includes microwaves, radio waves, ultraviolet and other forms of light invisible to the human eye. Similar to visible light energy, it radiates in all directions from the source, and can be focused or reflected the same as light. This may help explain why immediate warmth can be felt from an infrared heater once it is turned on.

Types of Infrared Heaters

Infrared energy can be generated by three types of heaters, high intensity, low intensity and electric. High intensity is characterized by an open flame, temperatures up to 1800°F on the surface and spot heating. An elongated flame is contained within a tube in a low intensity heater. This method results in lower surface temperature (1100°F) and a larger heating area. Electric infrared is created through electric resistance and is commonly used for spot heating. Medium wave lamps or short wave lamps are common, with short wave lamps providing light in addition to the radiant heat.

Infrared Heater Comparison

TOPIC	HIGH INTENSITY	LOW INTENSITY	ELECTRIC INFRARED
BTU Range	30,000 to 160,000 Btu/h	25,000 to 200,000 Btu/h	1,700 to 13,500 Btu/h
Burner	Atmospheric	Power	Quartz Lamp
Clearances to Combustibles	Greater	Lesser	Lesser
Combustion Air	Atmospheric	Atmospheric or Vented	N/A
Coverage	Spot Heating	Area Heating	Spot Heating
Heat Distribution	Limited	Multiple	Limited
Installation	Modular	Labor Intensive	Modular
Typical Heat Distribution	Intense and Focused	Softer with Differential	Intense and Focused
Typical Mounting Heights	Very High	High	Limited
Typical Surface Temperature	1600°F - 1800°F	600°F - 1100°F	1200°F
Venting	Indirect	Direct or Indirect	N/A

Frequently Asked Questions (FAQ's)

Q: ***What properties do infrared heaters and the sun share?***

The sun emits numerous waves which include infrared. Infrared waves are converted to heat and are not harmful. Surprisingly, every object that is above the temperature of absolute zero emits infrared heat. Far infrared waves are thermal and can be felt from the sun, a fire or a warm road. Shorter, near infrared waves do not generate heat and are commonly used by remote controls for televisions.

Q: ***Does infrared heat contain harmful radiation similar to the sun?***

No. Unlike the sun, infrared heat does NOT emit harmful ultraviolet radiation rays.

Q: ***Since infrared is similar to visible light, is infrared energy visible?***

Some animals, such as snakes, or technologies such as forward-looking infrared (FLIR), are able to see infrared energy.

Q: ***How does infrared save energy?***

A: Dense objects, such a concrete floor, retain infrared energy or heat for long periods of time. Tests show that it takes approximately 24 hours to fill a cold slab (floor) with infrared energy. Inversely it will take 48-72 hours for the floor to release this stored energy or warmth. This method of heating generates heat at the floor level and warms the occupied area providing a comfortable space. The air in areas such as loading docks are exposed to large amounts of circulating cold air when doors are opened, quickly depleting warm air. Infrared energy stored in the concrete slab provides a fast recovery of heat into the space.

Q: ***What are other benefits of infrared heaters?***

A: Infrared heaters operate quietly. Blowers are not necessary to circulate the infrared heat energy, therefore drafts and dust are eliminated. With few mechanical parts, maintenance is minimal. Infrared heaters can provide up to a 50% savings in fuel costs over traditional gas forced-air systems. Systems can be inexpensive to install and can be located where heat is needed most.

Q: ***What is better, high intensity or low intensity infrared heating?***

A: Specific needs will determine the best solution for each application. Low intensity heating is most effective for heating large buildings or areas (airplane hangars, manufacturing buildings and warehouses) while high intensity heaters are best suited for spot heating (loading dock, golf driving range or car washes). Electric infrared is commonly used in entrance ways to hotels or restaurant patios. Consult an experienced HVAC dealer to achieve the best results in applying an infrared heating system.

Summary

The operating principles of overhead gas-fired infrared heaters prove very beneficial when compared with other heating methods; such as a gas-forced air heater. Users that seek a economical, quiet and draft-free heating source would benefit from the natural heating methods of the sun. Infrared heating is a viable option for consumers seeking efficient and green friendly alternatives.