

## How to Size an Infrared Heating System

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There are three ways to transfer heat: conduction, which is via direct contact; convection, in which heat is transferred via heated air (or other gas); and radiation, where energy is transferred via the electromagnetic spectrum. Radiation can be subdivided into the categories of ultraviolet, infrared, microwave and radio frequency.

Infrared heat is used in scores of industries and in tens of thousands of applications. It sometimes is the only source of heat, but it also is used in conjunction with other methods such as convection. In appropriate applications, infrared benefits can include improved product quality, faster line speeds, lower energy and capital costs, reduced floor space requirements and lower maintenance costs.

**How Much Power Is Needed?** When deciding how much power you need, infrared heater suppliers typically look at watt density, which is measured as watts per square inch ( $W/in^2$ ). But, if the size of the heater or oven is known, the wattage gives you the same insight. If you do not know the required watt density, do you know the temperatures you are trying to reach? Watt density will be related to your desired temperature.

The size, wattage, voltage and phase are the key variables in coming up with a viable heater design. A design that works at 480 V may not be possible at 120 V. Three-phase may be possible at 440 V and not at 600 V -- it all depends on your process.

If you are not sure what voltage you have, you may be tempted to just design your system for 240 V. That can be done, but if the heater is designed to operate at 240 V and it is run at some other voltage, the power output will change in proportion to the square of the two voltages -- the actual voltage relative to the design voltage of 240 V. For example, running a  $10 W/in^2$  heater designed at 240 V at 208 V reduces the power by 25 percent.

**How Many Amps Will the Heater Draw?** For a single-phase heater, the amps equals watts divided by the voltage. For a three-phase heater, the amps equals watts divided by (voltage times 1.732). Keep in mind that most electrical codes require disconnects and other devices to have a safety margin. A heater that will draw 15 A should not be run on a 15 A circuit. A typical rule of thumb is 80 percent, so the 15 A heater can be run on a 20 A circuit. However, you should consult with a professional in your area who is familiar with your operation and local electrical codes.

**Will Increasing the Power Make my Process Run Faster?** There is a limit to the amount of energy a particular material can absorb over a given period of time. That varies for each material. In addition, infrared energy is transmitted in a variety of forms: long wave, medium wave and short wave. The material you are heating and even the color of the material can influence how susceptible the material is to the various wavelengths of energy. Any heat source emits energy over a range of wavelengths, but the distribution will have a peak wavelength that is related to temperature.

If the energy is being effectively directed to the product and the transmission is in the wavelength range that works most effectively with the material you are heating, then additional power can actually decrease the speed at which the product is heated. This results because the additional power will shift the wavelength distribution to one that is less effective. It also can have some unwanted side effects, including quality problems and higher operating and capital costs.

Nonetheless, there are cases where more power can speed up a process. But, other options also can improve your process in terms of speed, cost and quality, and these should also be considered.

Not all infrared heat sources are the same. Response time, uniformity, efficiency, power output, cost and reliability are just some of the factors that should be considered in selecting heaters for your application.

### **Sidebar: How To Checklist**

Keep these things in mind when sizing an infrared heating system.

- When deciding how much power you need, infrared heater suppliers typically look at watt density, which is measured as watts per square inch ( $W/in^2$ ).
- Watt density will be related to your desired temperature.
- If the heater is designed to operate one voltage and it is run at another, the power output will change in proportion to the square of the two voltages.
- There is a limit to the amount of energy a particular material can absorb over a given period of time. Nonetheless, there are cases where more power can speed up a process.
- Not all infrared heat sources are the same.