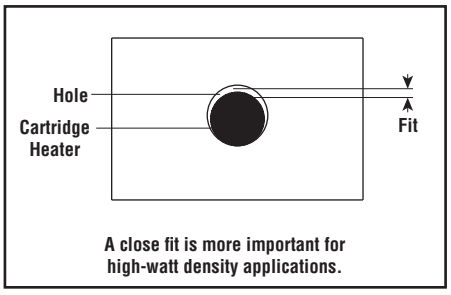
Cartridge Heaters
Application Guidelines

- **Up to 1.297" Dia.**
- **Up to 60" Lengths**
- **Up to 11,500 Watts**
- **120 and 240 Volt**
- **Up to 1400°F Max. Working Temp.**
- **Modification Available to Fit Custom Applications**

Type CIR cartridge heaters are most frequently used for heating metal parts by insertion into drilled holes. For easy installation, the heaters are made slightly undersize relative to their nominal diameter.

Determining Fit — At high watt densities, a close fit is important. The fit is the difference between the minimum diameter of the heater and the maximum diameter of the hole. For example, 1/2" diameter Type CIR cartridge heater is actually 0.498" plus 0.000" minus 0.005". If this heater is placed in a hole which has been drilled and reamed to a diameter of 0.503", then the fit would be 0.01" (0.503" - 0.493" = 0.01").



A close fit is more important for high-watt density applications.

Determining Watt Density — Watt density refers to the heat flow rate or surface loading. It is the number of watts per square inch of heated surface area. For calculation purposes, CIR stock cartridge heaters have 1/4" unheated length at each end. Thus, for a 1/2 x 12" heater rated 1,000 watts, the watt density calculation would be as follows:

$$\text{Watt density} = \frac{W}{\pi \times D \times HL}$$

Where:
W = wattage = 1,000 W
D = diameter = 0.5 in.
HL = heated length = 11.5 in.

$$\text{Watt density} = \frac{1{,}000}{3.14 \times 0.5 \times 11.5} = 55 \text{ W/In}^2$$

Selecting Sizes and Ratings — The calculation of total heat requirements for an application is outlined in the Technical section of this catalog.

Determining, Quantity, Size and Rating — Once total heat requirements are established, the quantity, size and rating of cartridge heaters can be decided. Plan for enough heaters to permit even temperatures through the part during heat-up and operation. The sensor for the temperature control should be placed close to the working surface for accurate control.

Calculate Watt Density and Fit — After the wattage for each heater has been established, the watt density and fit must be calculated. Then, use Graph G-235 to be sure that the watt density is within allowable limits. For example, a 1/2 x 12" CIR heater rated 1000 watts has a watt density of 55 W/in^2. If it were used in a part with an operating temperature of 1000°F with a fit of 0.01", the allowable watt density from the graph would be 90 W/in^2. Thus, the actual watt density of 55 W/in^2 is well below the maximum allowed. A substantial safety margin would exist and high reliability can be expected.

If the heater selected had a watt density higher than that allowed by the graph, consider the following changes.

1. Using more heaters of lower watt density.
2. Using longer or larger diameter heaters.
3. Improving the fit.
4. Reducing heat requirements by reducing heat losses or by allowing for longer heat-up time.

Using the Maximum Allowable Watt Density Graph — This graph is useful for choosing Type CIR cartridge heaters. The curves should be considered as guides and not precise limits.

The graph is based on a 1600°F resistance wire temperature inside the cartridge heater, when the heater is installed in an oxidized mild steel block. Watt density values from the graph should be lowered by about 10% or more when other materials are used which have a lower thermal conductivity or lower emissivity than oxidized mild steel. Contact your Local Chromalox Sales office.

Graph G-235 — Maximum Watt Density vs. Platen Temperature for Various Fits Using Chromalox Type CIR Cartridge Heaters