Cartridge Heaters
Application & Installation Recommendations

Applications

Application at High Watt Densities —
Type CIR cartridge heaters are designed and manufactured to provide watt density capabilities second to none. To obtain best life at the highest watt densities allowed per Curve G-235 in the Application Guidelines, close attention to application details is suggested.

A. For closest fit and best heat transfer, holes should be drilled and reamed, rather than just drilled to final diameter with a general-purpose drill.

B. The sensor for the temperature control should be placed between the working surface of the part and the heaters. The temperature of the part approximately 1/2" away from the heaters is used in selecting maximum allowable watt density from the graph.

C. Control of power is an important consideration in high watt density applications. On/Off control is frequently utilized, but it can cause wide excursions in the temperature of the heater and working parts. SCR power controls are valuable in extending the life of high watt density heaters, since they effectively eliminate on-off cycling.

Application at Medium Watt Densities —
Curve G-235 in the Application Guidelines shows maximum allowable watt density for various fits and operating temperatures. The vast majority of applications do not require maximum W/In², however. Use a watt density only as high as you need. Take advantage of the safety margin provided by using ratings less than the maximum allowed. Select and space heaters for most even heat pattern requirements and therefore lower wattage rating is calculated. Heaters of the correct wattage rating are then ordered for the application conditions result in continual lead flexing and therefore lower wattage rating is suggested.

Testing Recommendations — Testing under simulated operating conditions is suggested when equipment manufacturers design new products. Cartridge heaters of the appropriate physical size are operated on a variable transformer until the heat output is at the proper level. Then, voltage and current measurements are taken and required wattage rating is calculated. Heaters of the correct wattage rating are then ordered for the designed product.

Installation Recommendations

1. On moving machinery, anchor the leads securely. As little movement as possible should be allowed close to where the leads emerge from the heater. A loop in the lead wire will frequently extend lead life. If application conditions result in continual lead flexing, terminate the cartridge heater leads at a terminal block which moves with the heated assembly. Flexing is transferred to the extension leads which can be economically replaced.

2. For rapidly vibrating equipment, employ the terminal block described above. Keep leads from heater to block short and well supported to prevent lead movement due to vibration.

3. Protect leads from spray, oil and abrasion. Contaminating liquids and vapors can enter unsealed cartridge heaters and cause insulation breakdown.

4. Avoid tape on leads where they emerge from the cartridge heater. The adhesive on some tapes can enter the heater and turn to carbon which is electrically conductive. Where glass tape cannot be avoided, a tape with a silicone based adhesive is suggested.

5. Design the installation so that the leads are in an ambient temperature which doesn’t exceed the rating on the lead insulation (482°F for standard leads). Where temperatures require it, use nickel or nickel-plated copper wire with fluoropolymer insulation, silicone impregnated Fiberglas® or Rockbestos® insulation to extend leads.

6. Graphite and other lubricants to help insert the cartridge heater into the hole are generally not recommended. These are electrically conductive and can get on the lead end of the heater unless extra care is taken. Use Chromalox heat transfer and release coating.

7. As operating temperatures rise, thermal insulation on the heated part becomes more desirable to conserve heat. Thermal insulation results in lower wattage requirements and therefore lower watt density on the heaters. Other benefits are more even work temperatures and greater operator safety and comfort.

8. Leads must not extend into the hole containing the cartridge heater. Generally, the lead end of the heater sheath should be flush with the surface of hole or extended by 1/16 inch.
Cartridge Heaters

Modifications & Options

Cartridge heaters can be easily specified to meet the demands of special applications. Simply select from a variety of standard options and features to customize the heater to your specific needs. For customized engineering or alternative options, contact your Chromalox sales representative for fast turnaround on your specifications.

- Leadwire Types
- End Seal Options
- Lead Options
- Mounting Options
- Built-In Thermocouple

Leadwire Types

<table>
<thead>
<tr>
<th>Description</th>
<th>Volts</th>
<th>Operating Temperature (°F) (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mica Fiberglass® Insulation</td>
<td>300V Standard 600V</td>
<td>842 450</td>
</tr>
<tr>
<td>Fluoropolymer</td>
<td>300V 600V</td>
<td>392 200</td>
</tr>
</tbody>
</table>

Seal Options

<table>
<thead>
<tr>
<th>Type</th>
<th>Description/Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epoxy</td>
<td>Epoxy seal available on above leads by voiding end of sheath and filling with epoxy to provide a moisture barrier.</td>
</tr>
<tr>
<td>Fluoropolymer</td>
<td>A swaged-in seal that provides additional moisture resistance.</td>
</tr>
<tr>
<td>RTV</td>
<td>For applications where a moisture barrier is required.</td>
</tr>
<tr>
<td>Hermetic</td>
<td>Ceramic-to-metal seal is good for element temperatures up to 1000°F. Specify heater length beyond the seal. Metal portion of the seal overlaps the heater sheath by 3/16&quot;. For washdown conditions.</td>
</tr>
</tbody>
</table>

End Seal Options

- **Hermetic Seal**

  Ceramic-to-metal seal is good for element temperatures up to 1000°F. Specify heater length beyond the seal. Metal portion of the seal overlaps the heater sheath by 3/16". For washdown conditions.

  ![Hermetic Seal](image)

- **Flux Seal**

  Ceramic-to-metal seal with additional moisture resistance.

  ![Flux Seal](image)

Lead Options (cont’d.)

Flexible Stainless Steel Conduit

Flexible Stainless Steel Conduit provides leadwire protection from abrasion and sharp edges, and facilitates easier handling in harsh environments. Available in both straight and right angle configurations.

![Flexible Stainless Steel Conduit](image)

End Seal Temperature Limits

<table>
<thead>
<tr>
<th>Description</th>
<th>Operating Temperature (°F) (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Set Cement Standard</td>
<td>1000 538</td>
</tr>
<tr>
<td>Epoxy Seal</td>
<td>194 90</td>
</tr>
<tr>
<td>Fluoropolymer Seal</td>
<td>392 200</td>
</tr>
<tr>
<td>RTV Seal</td>
<td>284 140 392 200</td>
</tr>
<tr>
<td>Hermetic Seal</td>
<td>1000 538</td>
</tr>
</tbody>
</table>

Strain Relief

Strain Relief supports leads to reduce bending, crimping and breakage.

![Strain Relief](image)

Protective Spring

Available in both straight and right angle configurations, the Protective Spring gives strong, yet flexible leadwire protection from bending, fatigue and flexing.

![Protective Spring](image)
Components

Cartridge Heaters

Modifications & Options (cont’d.)

**Lead Options (cont’d.)**

**Metal Braid**

Stainless Steel metal braid protects leadwire from abrasion and sharp edges, yet maintains flexibility and ease of installation. Metal braid is available in both straight and right angle configurations.

**Ceramic Beads**

Ceramic Bead insulation can be specified to protect leadwires from high ambient temperatures up to 1200°F (649°C). To order, specify ceramic beads length and additional lead length.

**Threaded Post Terminals**

Post Terminals provide a strong, secure connection to buss bars or ring/fork connectors. Available only on 5/8 and 3/4” diameter heaters.

**Mounting Options**

**Threaded Fittings**

Threaded fittings allow the heater to be easily installed into a threaded hole for immersion applications. Available with single or double threaded fittings. The fitting overlaps the cartridge heater sheath by 1/4”. Specify “brass” or “stainless steel” threaded fitting.

**Threaded Fitting Sizes**

<table>
<thead>
<tr>
<th>Nom. Heater Diameter (in.)</th>
<th>NPT Size (in.)</th>
<th>Hex Size (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
<td>1/8 - 27</td>
<td>7/16</td>
</tr>
<tr>
<td>3/8</td>
<td>1/4 - 16</td>
<td>9/16</td>
</tr>
<tr>
<td>1/2</td>
<td>3/8 - 14</td>
<td>11/16</td>
</tr>
<tr>
<td>5/8</td>
<td>1/2 - 14</td>
<td>7/8</td>
</tr>
<tr>
<td>3/4</td>
<td>3/4 - 14</td>
<td>1-1/16</td>
</tr>
</tbody>
</table>

**Mounting Flange**

The mounting flange option allows for easy mounting and specific positioning of the heater within an application.

**Wire Pull**

The Wire Pull assists in heater removal.
Components

Cartridge Heaters

Thermocouple Leadwire

- Process Temperature Control
- Protection from Overheating and Temperature Burnout
- Type J or K

In some applications, the heating element temperature is closely related to the temperature of the platen or mold it is heating. Chromalox Cartridge heaters with built-in thermocouples allow you to precisely measure the temperature at the ideal measurement point within the cartridge heater, and control the internal heater temperature to more closely maintain the optimum process temperature. Longer heater life and increased heat transfer efficiency may be achieved by precisely controlling the heater temperature.

Built-In Thermocouple Cartridge Heaters are available in three styles, each designed for specific application needs.

Thermocouple Cartridge Styles

**Code T1**

Thermocouple (T/C) junction is located in the center of the core and at any point along the length. The T/C is not grounded. Style T1 is used as an overtemperature control or for burnout protection. It can also be used for process temperature control.

**Code T2**

T/C junction is located at most any point (specify location) along the length of the heater and grounded against the sheath. A 1/2" unheated section must be allowed for the T/C to clear the resistance wire.

Style T2 is used to control process temperature. T/C should be placed along the length of the heater in the most suitable position to control the temperature of the mold or platen being heated.

**Code T3**

T/C junction is embedded in the end disc. The T/C is grounded.

Style T3 is used when the process temperature at the end of the cartridge heater is critical. In applications where the product flows past the heater end, such as plastic molding, this thermocouple style allows the cartridge end temperature to be closely controlled.

**Thermocouples**

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>(°F)</th>
<th>(°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type J</td>
<td>100 - 1400</td>
<td>38 - 760</td>
<td></td>
</tr>
<tr>
<td>Type K</td>
<td>100 - 2300</td>
<td>38 - 1260</td>
<td></td>
</tr>
</tbody>
</table>

Diameters: 3/8, 1/2, 5/8, 3/4"

Leadwire Length: Standard 14 inches, Maximum length available 36 inches

HTRC — Chromalox Heat Transfer and Release Coating (Patented)

Chromalox HTRC is used for improving heat transfer and release in the following applications.

- Cartridge units in drilled holes.
- Tubular units in drilled holes, grooves or clamp-on surfaces.
- Strip and Ring heaters in grooves or clamped on to rough surfaces.

Laboratory tests have demonstrated that in high temperature applications, improved heat transfer can lower the internal wire temperature to provide up to 100% improvement in heater life. Chromalox HTRC is recommended for use in the above applications where sheath temperature of the heater is expected to exceed 750°F.

HTRC has an excellent heat transfer coefficient approaching that of aluminum. Shelf life greater than one year.

- PCN 014293 - 4 oz.
- Max. Temp. -1800°F

Chromalox®