MEGAWAT* HIGH DENSITY CARTRIDGE HEATERS

MEGAWAT high-density cartridges are round tubular heaters with electrical terminations on one side. These dependable heaters are made to withstand tough industrial usage. With a tolerance of +/- 0.002" on their outside diameter to secure a tight fit inside receptacle holes, and rock hard compaction of MgO insulation through swaging, these heaters can attain 1500° F sheath temperature.
MEGAWAT cartridges are available with various termination styles and mounting attachments.

- **Construction characteristics**
- **Termination styles**
- **Mounting attachments & installation tips**
- **Optional features**
- **Specifications & watt densities**
- **Operating temperature versus actual temperature of a cartridge heater**

MEGAWAT HIGH DENSITY CARTRIDGE HEATERS

- *Plastic molding*
- *Packaging equipment*
- *Heating tanks*
- *Plastic extruders*
- *Labelling machinery*
- *Gas and liquid heating*

Construction and features

- Up to 200 w/in^2
- Durable construction
- Efficient heat transfer
- Various special features
- CSA and CE certified

In high-density cartridge heaters the resistance wire loops are positioned as close as possible to the outside shell. Because the MgO powder insulation around these loops is compacted by swaging and transformed into a very hard medium, heat transmission is very efficient. **MEGAWAT** cartridges can have up to 200 w/in^2 watt densities.

Cartridges are usually supplied with lead wires. The attachment of the leads to the central pins is done internally, in a 3/8" cold section. In excessively hot applications the length of this cold section could be increased.

To facilitate installation and avoid excessive air pockets, cartridges are made 0.004" less than the nominal size of the receptacle hole with a tolerance of +/- 0.002".

MEGAWAT cartridges can be dual-voltage, three-phase, and/or be supplied with a ground terminal. With ten different termination styles, mounting attachments and various optional features, **MEGAWAT** high-density cartridges are widely used in numerous high temperature applications.

Electrical terminations

High temperature plain leads

A1 Style
High temperature (840° F) fiberglass insulated wire is connected externally to the two solid pins exiting from the cartridge. A silicone impregnated fiberglass jacket insulates the connection.

A2 Style
To provide flexibility at the lead end, high temperature (840° F) leads are connected to the solid pins inside the cartridge.

A3 Style
A bracket having the same diameter as the cartridge provides a 90° exit to the fiberglass insulated high temperature wire. The bracket is potted with high temperature cement (480° F).

Screw terminals

PT Style
For high temperature applications, screw terminals (#10-32 is standard, other sizes are available), are silver-brazed to the 1” extended solid pins of a cartridge. This type of terminals are not recommended for cartridges having less than 1/2” diameter.

Teflon leads

TF Style
Internally connected Teflon leads (480° F), with Teflon plugs, protect the cartridge from contamination. High temperature black epoxy or silicone RTV seals are available too. A minimum cold section of 1” at the lead end is necessary to protect the Teflon leads from high temperature.

Electrical terminations

SS braided leads

K1 Style
High temperature leads (840° F), with flexible abrasion resistant stainless steel braid exiting straight from a cartridge.
An additional 1/4” cold section from the immersed length is allocated to accommodate the stainless steel jacket.

K2 Style
Highly flexible stainless steel braid acts as an abrasion resistant jacket to the high temperature (840° F) leads. This jacket is connected externally to the lateral extension of a 90° bracket. The bracket has the same diameter as the cartridge.

90° bracket and elbow heights*

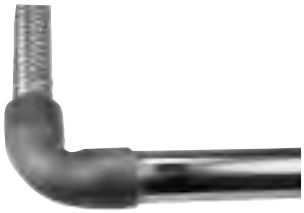
Cartridge OD	Bracket	Elbow
1/4”	3/8”	7/8”
5/16”	3/8”	1”
3/8”	3/8”	1”
1/2”	1/2”	1 3/16”
5/8”	5/8”	1 3/8”
3/4”	5/8”	2”

*Dimensions are subject to change

SS armor cable

X1 Style
High temperature (840° F) lead wires with abrasion and contamination resistant armor cable protection exit straight from a cartridge heater. The armor cable is brazed or crimped to the cartridge. In order to accommodate the armor cable an additional 1/4” cold section is allocated at the lead end.

X2 Style
Protective armor cable, which is silver brazed to the side of a low profile stainless steel bracket, provides right angle transfer to the high temperature leads, when space is limited and elbows cannot be used.



X3 Style
Armor cables are less flexible than stainless steel braids, but provide contamination resistance in addition to superior protection against abrasion. A copper elbow braised to the cartridge externally, provides a 90° transfer.

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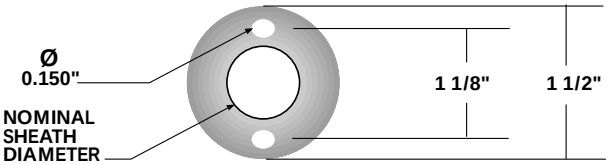
Mounting attachments



Heater Diameter	NPT Size
1/4“	1/8” - 27
3/8“	1/4” - 18
1/2“	3/8” - 18
5/8“	1/2” - 14
3/4“	3/4” - 14

FL Style

Flange mounting attachements secure the cartridge firmly in place in applications where there is excessive vibration. 1 1/2” diameter is the standard flange size. Flanges with smaller diameters are generally used as stop rings.

IM Style

The conical thread of NPT fittings (single or double ended), allow for simultaneous threading and sealing. Brass or stainless steel fittings can be brazed on the lead end of a cartridge heater.

Selection & installation tips

- Cartridges should have a tight fit in the receptacle hole. Drilling and reaming to the next standard size and using a larger cartridge could solve the problem of loose or worn-out holes.
- Lead wires should be kept away from abrasion, and should not be exposed to temperatures above 840°F.
- Stocked cartridge heaters, which have been exposed to air and moisture for a long period of time, should be energized on a low voltage prior to usage, in order to eliminate possible moisture contamination. It is always preferable to stock cartridges in sealed bags.
- Cartridges should be immersed completely inside the receptacle hole. Proper mounting attachments can prevent their edging out by vibration. If it is necessary to have an exposed section, that part should be unheated.
- Receptacle holes should be properly cleaned prior to the installation of a cartridge.
- When designing molds, it is recommended to make the receptacle cavities such that they will accommodate cartridge heaters completely and all-the-way-through. This will later facilitate the removal of the heaters.
- Watt densities should be kept within the safe range. This can be done by using either larger cartridges or as many as it is reasonably possible.
- To prevent short cycling, the wattage of a cartridge should be close to the wattage required by that specific application.

Optional Features

Built-in thermocouples

One optional feature on **MEGAWAT** cartridges is built-in thermocouples. These could be type "J" or "K", grounded or ungrounded, and attached either at the disc end or the middle of the cartridge.

Graphite coating

To facilitate their installation and removal, cartridges could be coated with a graphite-like substance. This solid lubricant doesn't increase the outside diameter, and is suitable for temperatures up to 750° F.

Moisture and contamination proofing

To protect cartridge heaters against moisture and contamination, Teflon lead wires are used and the lead end is sealed using Epoxy, RTV silicone or Teflon. The temperature limitation is 480° F.

Distributed wattage

In applications such as sealing bars or rubber molds, the two ends of a cartridge heater are usually colder than the middle. To overcome this inconsistency and have a uniformly distributed heat source, cartridges could be made to have higher wattages at the ends. 35/30/35 is a common wattage distribution.

Center-less grinding

In applications where superior heat transfer is required, the tolerance on the outside diameter could be improved to +/-0.001" by center-less grinding.

Zones and cold sections

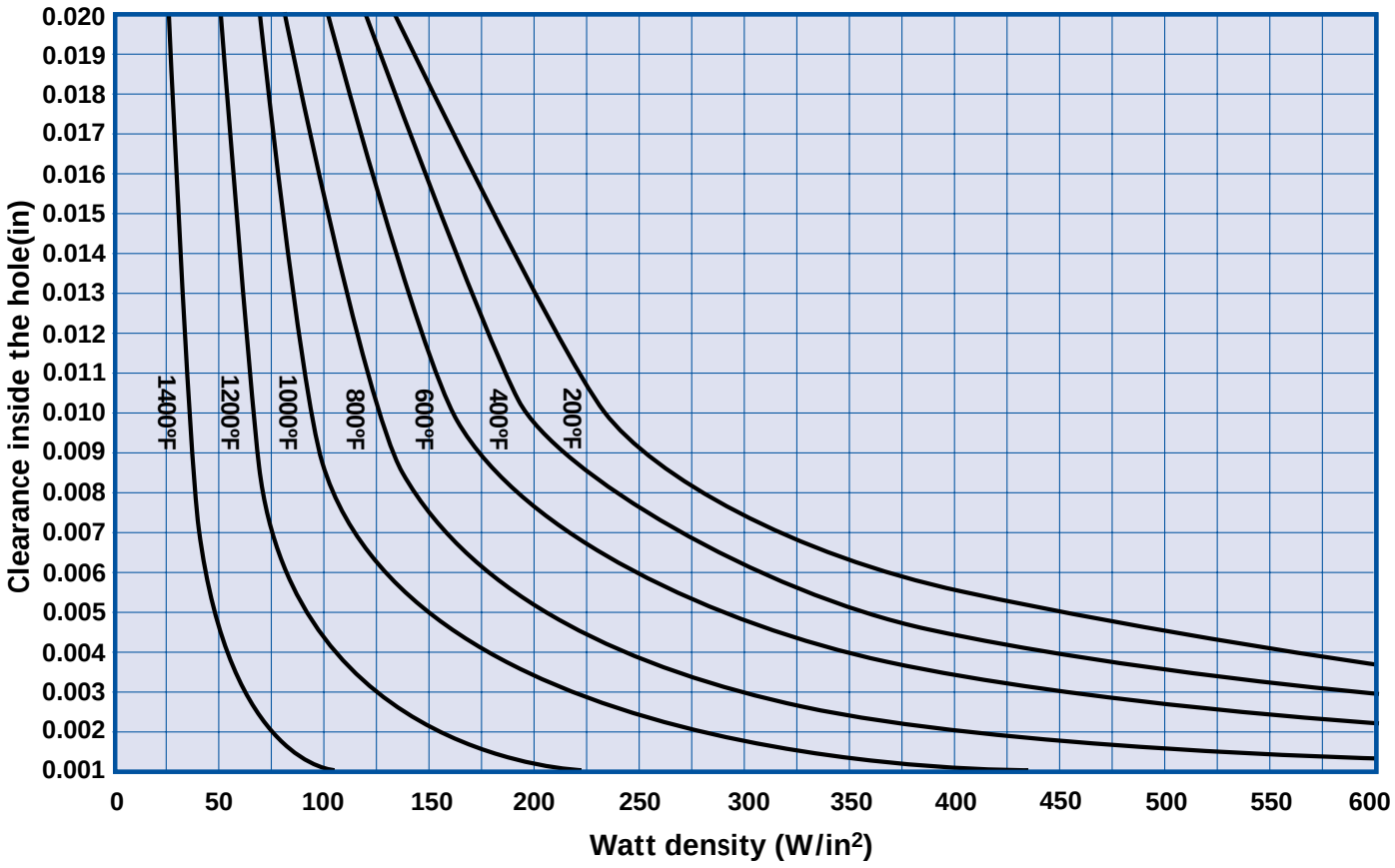
We can also manufacture cartridges with cold sections and separate zones that can be controlled independently.

MEGAWAT HIGH DENSITY CARTRIDGE HEATERS

Cartridge heater specifications

DIAMETER (NOM)	1/4	5/16	3/8	1/2	5/8	3/4	1
DIAMETER (ACTUAL)	0.246	0.310	0.371	0.496	0.621	0.746	0.996
MAX LENGTH	36”	36”	72”	96”	96”	96”	96”
MAX VOLTAGE (CSA)	240V	240V	480V	480V	480V	480V	480V
MAX VOLTAGE	250V	250V	600V	600V	600V	600V	600V
MAX WATTAGE AT 240V	1200W	1300W	2000W	3000W	5300W	5300W	5300W
WATTAGE TOLERANCE	+5%-10%						
DIAMETER TOLERANCE	+/-0.002”						
LENGTH TOLERANCE	+/-2% OF LENGTH						
CAMBER TOLERANCE	0.010” PER FT UP TO 12in						
	0.018” PER FT ABOVE 12in						

Recommended Watt densities to heat mild steel



Operating temperature versus actual temperature of cartridge

MEGAWAT cartridge heaters are designed to withstand a sheath temperature of up to 1500° F. The recommended maximum operating temperatures for different applications are much less than that. There are many factors that have a direct effect on the lag between the actual sheath temperature of a cartridge heater and the monitored temperature of a material during the heat-up cycle. In some cases, this temperature lag is so significant that the cartridge will reach its elevated critical temperature even when the surrounding material is monitored to have a relatively much lower temperature level. The most common factors that contribute to the degree of temperature difference are the following:

- **Thermal conductivity of the material being heated**
- **The cartridge sheath watt density**
- **The tightness of the cartridge inside the hole**
- **The location of the monitoring sensor**
- **The alloy of the cartridge sheath material**
- **Contamination around the cartridge heater**

These factors should be taken into consideration while selecting a cartridge for a specific application. One common practice is to use stainless steel cartridge sheathes for temperatures up to 1000° F and Incoloy sheathes for temperatures up to 1400° F.

Another design consideration related to the operating temperature is the electrical termination of a cartridge. Teflon and TGGT leads have 480° F rating while MGT wires can withstand up to 840° F. When cartridges are used at relatively high temperatures, the terminals selected should be either different than the common high temperature lead wires or the design should be done such that the temperature around the lead wires (whether the leads are connected internally or externally to the cartridge) is maintained at a temperature level lower than the critical temperature limit of the lead wire.