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# Flexible Heaters

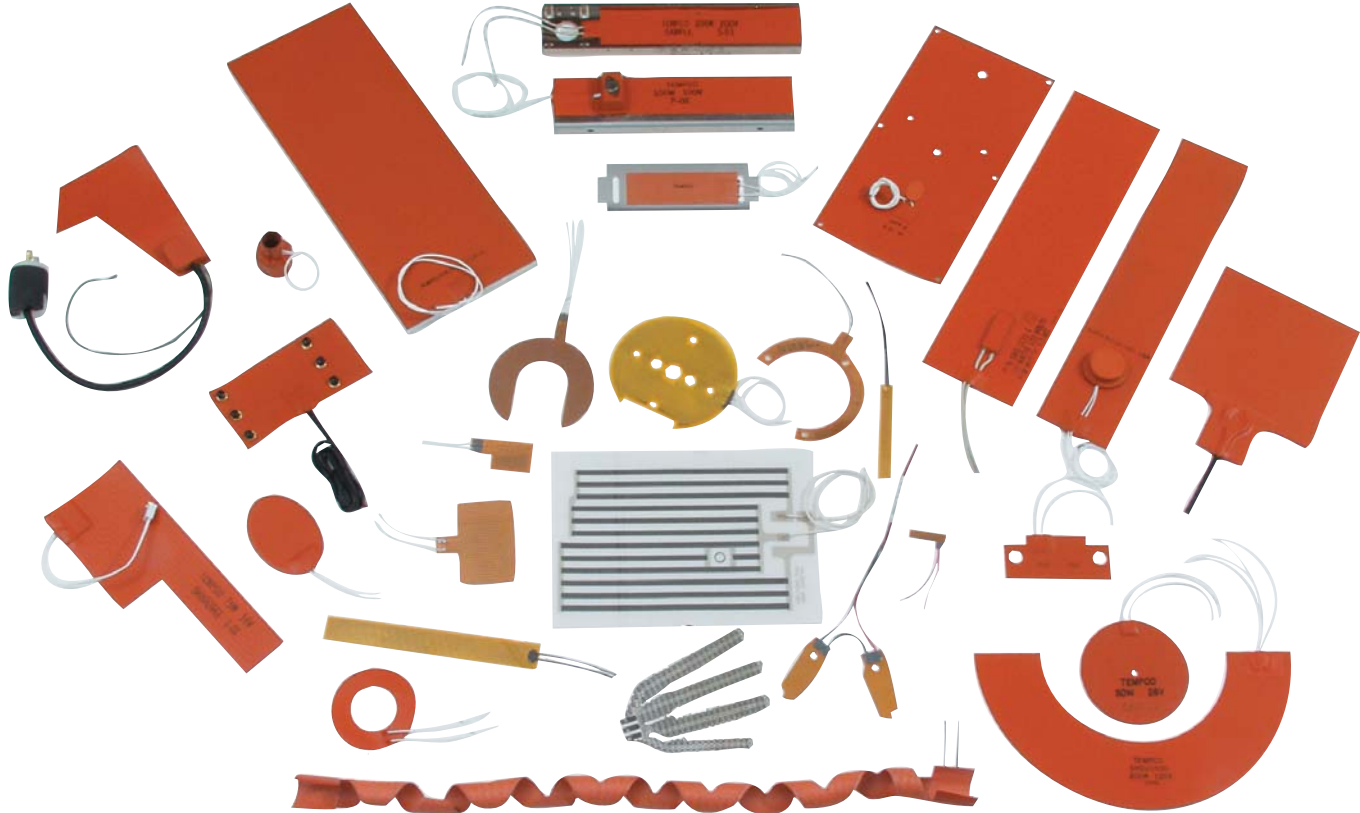
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section





## Flexible Heaters Offer Unlimited Possibilities Silicone Rubber and Kapton®



**The Answer To Hundreds of Unique Heating Applications...**

### Designed for Trouble-Free Performance and Improved Operation Efficiency

Tempco's Flexible Heaters are capable of operating with excellent performance under many adverse conditions, including: moisture, outdoor exposure or ambient temperatures, radiation, ozone, compression set, vacuum, fungus, oils, solvents, and many other chemicals.

Flexible Silicone Rubber and Kapton Heaters also have very good mechanical properties. They are of low mass construction and provide rapid heat-up due to direct bonding to the part. Flexible Heaters are not affected by mechanical shock, vibration or repeated flexing and will not stretch or tear over a temperature range of -392°F to +500°F (-236°C to +260°C).

### Select a Flexible Heater for your specific application...

**Tempco** Flexible Heaters are a reliable and economical heat source capable of providing uniform heat transfer to irregular shaped or flat surfaces including three dimensional geometries, conforming to the part being heated.

#### *Flexible heater use typically falls into the following applications:*

- \* Process Heat
- \* Condensation Protection
- \* Freeze Protection
- \* Composite Bonding

**Tempco's** engineering staff, with many years of experience in heat processing and temperature control, can assist you in designing the right Silicone Rubber or Kapton Flexible Heater for your application.

#### *Tempco's Flexible Heaters offer unlimited design possibilities!*

Agency



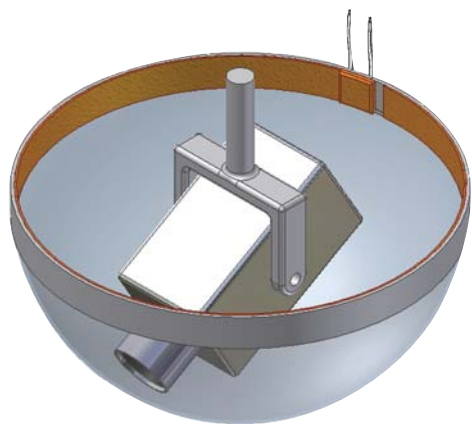
Approvals

Tempco Silicone Rubber Heaters are UL Recognized in the USA and for Canada under UL File Number E65652 (UL499) Component Recognition Program.

*If you require UL/cUL and/or CSA Agency Approval,  
please specify when ordering.*

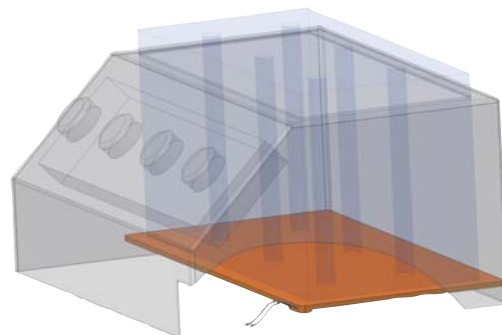


### **Tempco Flexible Heaters — The Answer to Hundreds of Diverse Industrial, Commercial, Military and Scientific Heating Applications . . .**



#### **Security Equipment**

A large manufacturer of surveillance security equipment uses a Tempco Silicone Rubber Heater to prevent condensation on the glass bubble housing. Options include 24 volt power, pressure sensitive adhesive, and Molex® terminations on silicone rubber leads.



#### **Laboratory Equipment**

A leading producer of laboratory equipment uses a Tempco Silicone Rubber Heater in a dry block heater appliance to heat microtubes and test tubes. Options include pressure sensitive adhesive.

**Consult us with your requirements.  
No one can do it better than  
Tempco — let us prove it.**

**Flexible  
Heaters are  
produced  
in-house by a  
team of experts  
for unparalleled quality!**

**SATISFACTION  
GUARANTEED!**



#### **Recovery Systems**

A manufacturer of refrigerant recovery systems uses a Tempco Silicone Rubber Heater Assembly to warm the refrigerant bottle. Options include a pre-set thermostat, thermal fuse, straps and D-rings.



#### **Outdoor Antenna**

A major manufacturer of antenna arrays and systems uses Tempco's Silicone Rubber heaters to freeze-proof large parabolic antennas. Options include: pre-set thermostat and heavy-duty low temperature SJO type power cord.

### **Additional Typical Applications**

- \* Aerospace
- \* Aircraft Comfort Heaters
- \* Animal Feeders
- \* Autoclaves
- \* Automotive
- \* Battery Heaters
- \* Computer Memory Planes
- \* Copy Machines
- \* De-Icing
- \* Drum Heaters
- \* Food Service Equipment
- \* Graphic Arts Equipment
- \* Guidance Systems
- \* Gyroscopes
- \* Heated Presses
- \* Incubators
- \* Laboratory Equipment
- \* Laminators
- \* Liquid Reservoirs
- \* Medical Equipment
- \* Mirror Heaters
- \* Optical Equipment
- \* Packaging Machinery
- \* Photo Processing
- \* Refrigeration Equipment
- \* Semiconductor Equipment
- \* Shoe Machinery
- \* Vacuum Chamber
- \* Vending Machines
- \* X-Ray Processing



### Standard Flexible Heater Specifications

#### Silicone Rubber Heater Specifications

##### Physical Size and Construction Limitations

**Maximum Size:** Wire: 36" × 144" (91.4 × 366 cm)  
Foil: 10" × 22" (25.4 × 56.9 cm)

**Dimensional Tolerance:**  
Less than 6": ±0.030" (0.76 mm)  
6" to 12": ±0.060" (1.52 mm)  
Over 12": ±0.125" (3.17 mm)

**Nominal Thickness:** 0.056" wire (1.42 mm)  
0.030" foil (0.76 mm)

**Thickness Range**  
(Dependent upon Application): 0.018" to 0.070"  
(0.46 mm to 1.78 mm)

**Weight:** 7 oz./ft<sup>2</sup> (0.21g/cm<sup>2</sup>)

##### Performance Ratings

**Maximum Operating Temperature:** 500°F / 260°C Intermittent  
392°F / 200°C Continuous

**Minimum Operating Temperature:** -80°F / -62.2°C

**Physically Resistant To:** Moisture, Ozone, Fungus, Radiation

**Agency Approvals:** UL File #E65652

##### Electrical Ratings

**Resistance Tolerance:** Wire: +10%, -5%  
Foil: +10%, -10%

**Maximum Operating Voltage:** 600 Vac (wire), 480 Vac (foil)

**Dielectric Strength:** 1000 Vac

**Standard Leads:** 10" Teflon® Insulated Stranded Wire

#### Kapton® Heater Specifications

##### Physical Size and Construction Limitations

**Maximum Size:** 10" × 22" (25.4 × 56.9 cm)

**Dimensional Tolerance:**  
Less than 6": ±0.030" (0.76 mm)  
6" to 12": ±0.060" (1.52 mm)  
Over 12": ±0.125" (3.17 mm)

**Nominal Thickness:** 0.006" (0.15 mm)

**Weight:** 1.5 oz./ft<sup>2</sup> (0.05g/cm<sup>2</sup>)

##### Performance Ratings

**Maximum Operating Temperature:** 392°F / 200°C Continuous

**Minimum Operating Temperature:** -320°F / -195°C

**Physically Resistant To:** Moisture, Ozone, Fungus

##### Electrical Ratings

**Resistance Tolerance:** Foil: +10%, -10%

**Maximum Operating Voltage:** 480 Vac

**Dielectric Strength:** 1000 Vac

**Standard Leads:** 10" Teflon® Insulated Stranded Wire

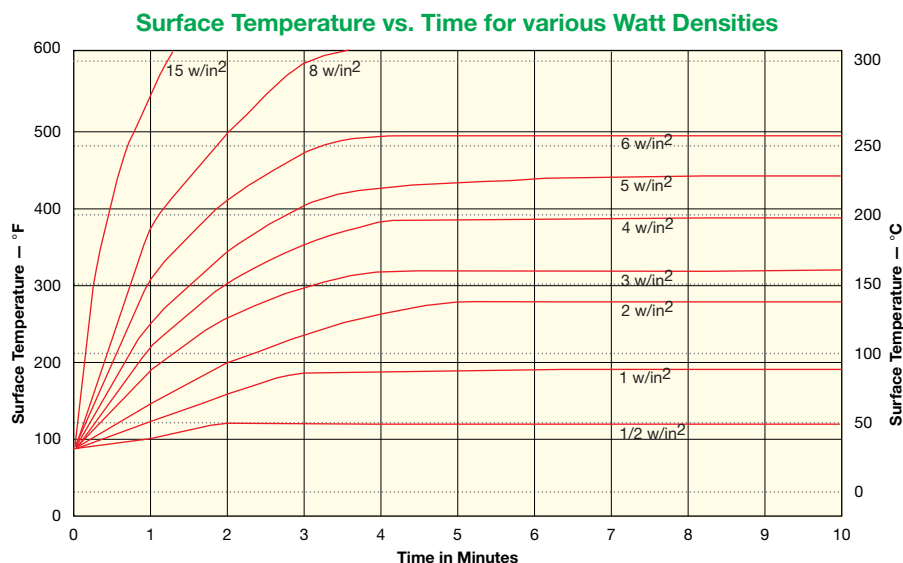


**Note:** Other materials are available, such as neoprene rubber or vinyl plastic. Consult Tempco for more information.

### Silicone Rubber Heater Surface Temperature vs. Watt Density

**Graph** shows the relationship between the maximum surface temperature and the watt density of standard silicone rubber heaters.

The heater was energized in still air without insulation or a load. Using this graph the designer can estimate the maximum temperature the heater can reach compared to the watt density of the heater.







### Flexible Heater Wattage Recommendations

#### Step 1 Determine the Required Wattage

Every process has a unique wattage requirement to heat that particular load up to temperature or to maintain a particular temperature.

If the required heater wattage is not known, estimate the required wattage using the thermodynamic formulas listed in chapter 16, Engineering. A safety factor of 25% additional wattage is recommended to compensate for unknown variables.

#### Example

To raise the temperature of an aluminum plate 6" × 12" × 0.5" (3.53 lb.) 200°F (from 70° to 270°F) in 0.5 hours:

$$\text{Watts} = \frac{3.53 \text{ lbs.} \times (0.24 \text{ Btu/lb.}^\circ\text{F}) \times 200^\circ\text{F}}{3.412 \text{ btu/watt hr.} \times 0.5 \text{ hrs.}} = 108 \text{ watts}$$

Add safety margin 108 W + 25% = 135 watts

#### Step 2 Determine the Heater Size and Watt Density

A flexible heater should use the maximum space available for mounting and heating the process. Factors that affect heater size include the mounting method and watt density.

$$\text{Watt Density} = \frac{\text{Heater Wattage}}{\text{Area of the Heater}}$$

As a general rule, the following can be applied for silicone rubber heaters:

**Low Heat-up:** 2.5 w/in<sup>2</sup>

**Average Heat-up:** 5 w/in<sup>2</sup>

**High Heat-up:** 7.5 w/in<sup>2</sup> and greater

Continuing the aluminum plate example, determine what size the heater should be:

**Silicone Rubber Heater:** 5" × 10" = 50 in<sup>2</sup>

**Watt Density** = 135 watts ÷ 50 in<sup>2</sup> = 2.7 watts/in<sup>2</sup>

Since the watt density falls between 2.5 and 5 w/in<sup>2</sup>, the silicone rubber heater selected should work satisfactorily.

Referring to the chart below for a wire wound silicone rubber heater, pressure sensitive adhesive mounting should work well for this application at the required temperature.

If the calculated watt density is too high, a larger heater will lower the required watt density and still produce the same wattage.

#### Suggested Maximum Watt Density by Mounting Method — Degrees Fahrenheit

Watt Density w/in <sup>2</sup>	Silicone Rubber – Wire		Silicone Rubber – Foil		Kapton – Foil	
	Vulcanized	PSA	Vulcanized	PSA	Acrylic PSA	Acrylic PSA w/ 3 mil AL Foil
5	420 to 356°F	350 to 335°F	455 to 419°F	350 to 320°F	212 to 189°F	302 to 275°F
10	356 to 266°F	335 to 248°F	419 to 383°F	320 to 293°F	189 to 163°F	275 to 257°F
15	266 to 158°F	248 to 140°F	383 to 347°F	293 to 266°F	163 to 131°F	257 to 230°F
20	158 to 68°F	140 to 32°F	347 to 311°F	266 to 239°F	131 to -25°F	230 to 194°F
25	68 to -40°F	32 to -49°F	—	—	—	194 to 167°F
30	—	—	311 to 257°F	239 to 185°F	—	167 to 125°F
35	—	—	—	—	—	125 to 86°F
40	—	—	257 to 185°F	185 to 104°F	—	86 to -25°F
50	—	—	185 to 50°F	104 to -40°F	—	—
60	—	—	50 to -49°F	-40 to -49°F	—	—

#### Suggested Maximum Watt Density by Mounting Method — Degrees Centigrade

Watt Density w/in <sup>2</sup>	Silicone Rubber – Wire		Silicone Rubber – Foil		Kapton – Foil	
	Vulcanized	PSA	Vulcanized	PSA	Acrylic PSA	Acrylic PSA w/ 3 mil AL Foil
5	216 to 180°C	177 to 168°C	455 to 235°C	177 to 160°C	212 to 100°C	150 to 135°C
10	180 to 130°C	168 to 120°C	235 to 195°C	160 to 145°C	100 to 73°C	135 to 125°C
15	130 to 70°C	120 to 60°C	195 to 175°C	145 to 130°C	73 to 55°C	125 to 110°C
20	70 to 20°C	60 to 0°C	175 to 155°C	130 to 115°C	55 to -32°C	110 to 90°C
25	20 to -40°C	0 to -45°C	—	—	—	90 to 75°C
30	—	—	155 to 125°C	115 to 85°C	—	75 to 52°C
35	—	—	—	—	—	52 to 30°C
40	—	—	125 to 85°C	85 to 40°C	—	30 to -25°C
50	—	—	85 to 10°C	40 to -40°C	—	—
60	—	—	10 to -45°C	-40 to -45°C	—	—

# Flexible Heaters



## Element Types

### Flexible Heater Element Types

**Discover all the new possibilities  
Flexible Heaters have to offer. . .**

Tempco continues its ongoing tradition of leadership and innovation by offering flexible heaters, one of the most diversified types of heating elements in the market today.

Flexible heaters provide a tremendous advantage in design and manufacturing flexibility for applying heat from simple shapes to the most complex geometrical configurations, including three-dimensional.

If the application requires it, flexible heaters can also be vulcanized directly or molded around component parts to maximize heat transfer. This flexibility allows you to design a heating element literally around the shape and size of the system, machine and/or component part.

The low thermal mass of flexible heaters allows their use in applications where the space for placing a heater is limited and weight is a concern.

The internal heat distribution pattern(s) allows for the heater element wire to be placed as close as 5/32" from some of the edges of the flexible heater. The heat pattern can be distributed to accommodate holes or cutouts, or to concentrate the heat in specific sections of the flexible heater as the application dictates.

Flexible heaters provide excellent heat transfer with rapid heat-up and cool-down response to the temperature control — a desired requirement for applications where precise temperature control is important to the overall quality of the application.

Tempco flexible heaters are made in two insulating materials. Silicone Rubber, up to 500°F (260°C), and Kapton®, a lightweight organic polymer film offering dimensional stability, excellent tear resistance and tensile strength, used only for etched foil elements up to 392°F (200°C).

Flexible heaters are produced in two heating element choices: wire-wound elements and etched foil elements.

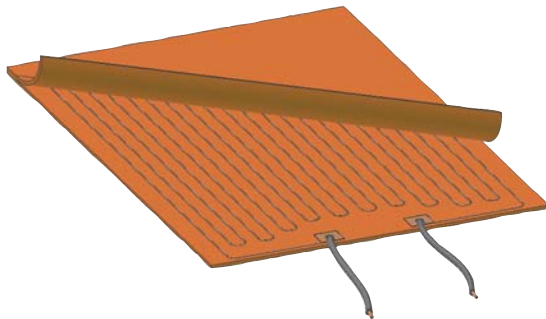
There is a multitude of specialized applications impossible to service with conventional heating elements that are rigid in construction, making Tempco's flexible heaters the obvious and practical solution.



*A vulcanizing press is used to ensure that the silicone rubber heater assembly becomes homogenous.*

*Our capabilities are limited only by your imagination—  
consult us with your requirements.  
We Welcome your Inquiries.*

### Wire-Wound Element Construction • • • • •



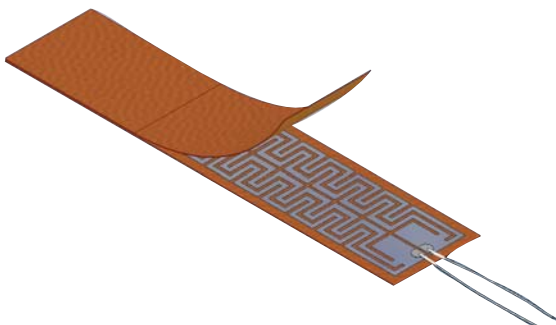
Tempco Silicone Rubber heaters with wire-wound elements provide excellent physical strength capable of withstanding repeated flexing without compromising the life and performance of the heater. They are also very effective for manufacturing geometrically challenged shapes, including three dimensional ones.

The wire-wound element process consists of resistance wire wound on a fiberglass cord for added support and flexibility. The wire-wound element is laid out in a special designed pattern to ensure uniform heat profile and to conform to the size and shape of the silicone rubber heater, avoiding holes and cutouts, or to concentrate the heat profile in a specific section(s) of the heater as the application dictates.

Power lead wires or cord sets are attached to the heater windings with solder and firmly secured in place through a vulcanizing process, ensuring that the assembly becomes homogenous.

The wire-wound process is recommended and preferred for small to medium size quantities or to produce prototypes to prove out the design parameters prior to entering into large volume production runs, when the etched foil element designed will be more cost effective to produce.

### Etched Foil Element Construction • • • • •



Etched Foil Silicone Rubber or Kapton® flexible heaters are made with a thin metal foil (.001"), usually a nickel base alloy, as the resistance element. The resistance pattern to be etched is designed in CAD and transferred to the foil, which is laminated to the insulating substrate. The element/substrate is then processed through an acid spray to produce the desired resistance pattern.

The top layer is then added and vulcanized for silicone rubber or laminated for Kapton® heaters. For silicone rubber heaters, lead wires are then attached to the heater and insulated with additional silicone rubber to complete the heater. For Kapton® heaters, lead wires are attached to the heater and insulated with epoxy cement to complete the heater.

The etched foil heater has exceptional heat transfer compared to wire wound elements, due to its large flat surface area. It can deliver more uniform heat profiles with higher watt densities, providing longer operating heater life. It can also be zoned with distributed wattage or separate heating circuits to compensate for load variations.





### Flexible Heater Lead Location Options

#### Standard Leads — Teflon®

Tempco's standard leads are 10" long, Teflon® insulated, UL 1180, type EE, flexible, stranded, plated copper wire rated for 392°F (200°C) and 300 volts. Stripped: 1/4"

On silicone rubber heaters, the lead connections are insulated with vulcanized silicone rubber, which also acts as a strain relief.

For Kapton® insulated heaters, high temperature epoxy is used to insulate and reinforce the lead connection.

#### Cordset Options

##### HPN Cord and Plug Set

For portable heaters, a neoprene cordset can be vulcanized to the heater. The cord is 18 ga./2-wire (similar to lamp cord). Standard Length: 6 ft. (1.83 M), or custom length as specified. Can be supplied with or without a standard straight blade plug, 120Vac only.

##### SJO Power Cord

For industrial applications, SJO heavy duty power cords can be attached to the heaters in any desired length. Can be supplied with or without a standard straight blade plug, 120 or 240 Vac.

#### Optional Leads — Silicone Rubber

Ensures a moisture seal on the heater. Due to the similarity in material, the heater will fuse to the leads during the vulcanization process. Silicone rubber leads are not as abrasion resistant as Teflon® leads are.

#### Abrasion Protection Options

Various materials can be put over Teflon® or Silicone Rubber leads to provide mechanical or abrasion protection. The leads exit the heater as a single unit.

- **Silicone Rubber/Fiberglass Sleeve** (356°F/180°C)
- **Stainless Steel Overbraid**
- **Heatshrink**

#### Special Leads Options

Special lead types and lengths in many configurations can be done by the expert designers and experienced manufacturers at **Tempco**.

### Flexible Heater Lead End Termination Options

Tempco's standard lead termination is stripped leads — 1/4" (6.3mm). Any type of connector can be attached to the leads to complete the assembly and make wiring into applications quick and easy.

From simple ring crimp connectors to complex male or female crimp pins and housings such as Molex® components, Tempco does it all!

Tempco's expert designers and assemblers can also provide complete wire harnesses if required. Consult Tempco with your requirements.

**Crimp Connectors:** insulated or non-insulated

- Ring Terminal
- Spade Terminal
- 1/4" Female Straight Disconnect
- 1/4" Female Right-Angle Disconnect

**Miniature Connectors:** example – Molex®

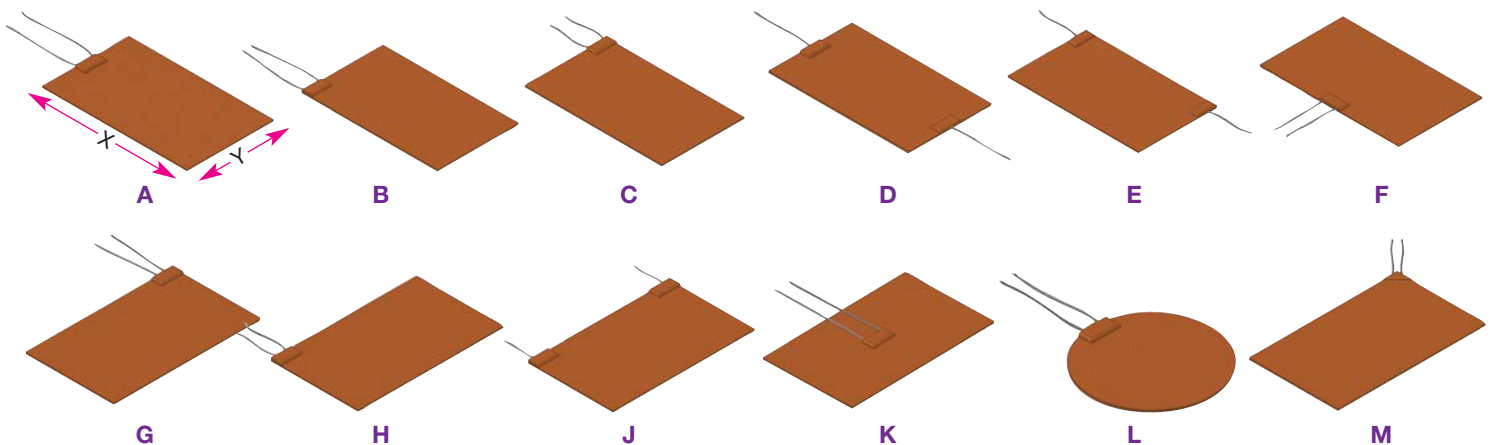
#### Plugs:

- Standard 120 or 240 Vac – straight blade
- Twist locking plugs, 120 to 480 Vac
- Specify NEMA or manufacturer's part number

#### Special Connectors and Plugs:

- Consult Tempco with your requirements.

### Flexible Heater Lead Exit Location Options



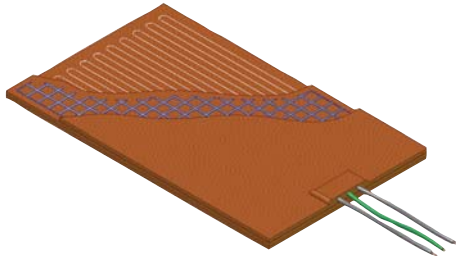
- Note:**
1. Oriented so X is always greater than Y;
  2. Shows lead location by identification letters, A through M
  3. Power leads or cord sets exiting location for shapes other than those shown above, provide sample and/or drawing indicating location.

# Flexible Heaters



## Options for Flexible Heaters

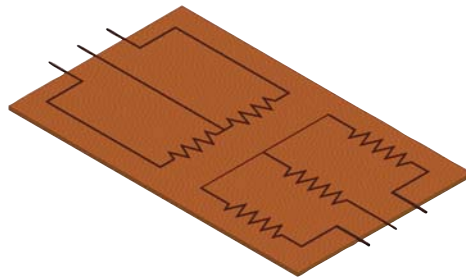
### Flexible Heater Optional Design Features



#### Internal Wire Screen Ground Plane

Some applications may require the heater to be grounded. Due to the fact that the heater sheath is non-conductive, this can only be done artificially. A second layer of insulating material and a conductive grid can be added to the heater. A ground wire will be attached to the grid.

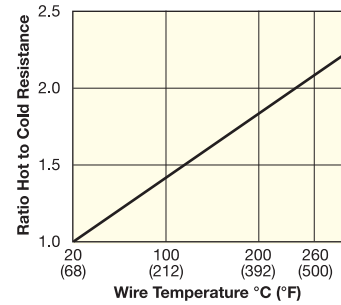
A less expensive alternative for setting up a ground wire, especially for the required ground lead of a cordset, is to have a “flying ground lead” (6" long, green) exit the lead patch for attaching to the metal load surface, effectively grounding the process.



#### Dual Voltage, Zoning and 3-phase

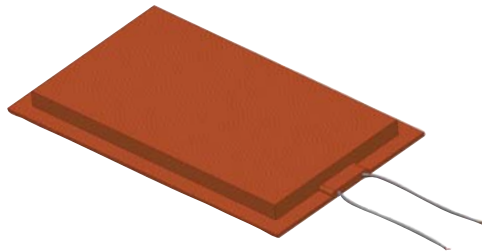
Due to the flexibility in circuit design for flexible heaters, multiple heating circuits can be designed to accommodate dual voltage and multiple zones. On dual voltage heaters, three leads, including a common in a different color, are provided for wiring the heater in series for the higher voltage and parallel for the lower voltage. 120/240 Vac or 240/480 Vac can be specified.

Multiple circuit areas can be zoned to compensate for various heating effects desired. Three-phase circuits can also be designed for large high current applications.



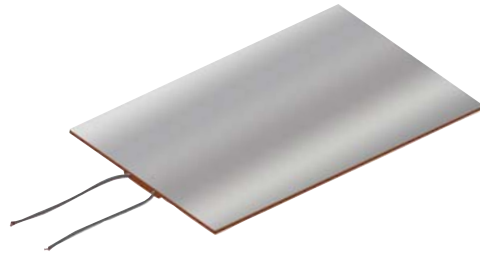
#### Self-Limiting/Self-Regulating Wire Wound Heater

The alloy used for this heaters resistance wire has a high positive temperature coefficient of resistance that allows the heater to reduce power as temperature increases. This self-regulating feature is ideal for many low temperature applications. This feature can also be beneficial when a fast start-up time is required before the heater power levels off to normal operating temperature. See Ratio of Resistance at a given Wire Temperature to Resistance at 20°C (68°F) vs wire temperature chart above.



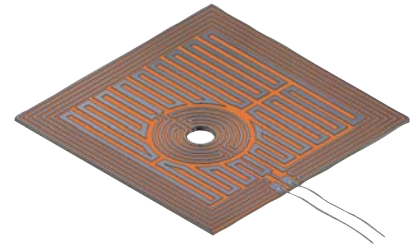
#### Thermal Insulation

To increase heater efficiency, silicone sponge rubber insulation can be bonded to the top side of the heater. Available thicknesses are 1/16", 1/8", 1/4", 3/8" or 1/2".



#### Foil Backing

Aluminum foil can be added to the heater to help dissipate the heat between element runs and eliminate hot spots. Due to the foil, higher watt densities and better temperature uniformity can be attained. The foil would be applied to the back of the heater, on the mounting surface.



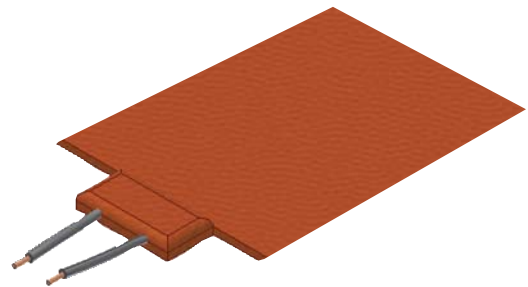
#### Distributed Wattage

In order to compensate for heating losses around the edges or mounting holes, the heating circuit can be designed in a distributed wattage pattern. More wattage can be added to the high loss areas to compensate for the higher losses.



#### Holes and Cutouts

Holes and cutouts in the surface of a silicone rubber or Kapton® heater can generally be placed anywhere in the heater assembly. Holes and cutouts can be used to allow space for bolts, nuts, temperature sensors, brackets, etc. For most holes and cutouts, a detailed drawing will be required for quoting or ordering.



#### Lead Exit Tab

An unheated lead exit tab can be added to the heater for a variety of reasons such as maintaining a rectangular heater with no cold sections or when used in a compression application to remove the lead exit area from between the plates.





### Flexible Heater Installation Methods

#### Flexible Heater Pressure Sensitive Adhesive (PSA)

##### PSA

For ease of attachment specify PSA. Installation is simple: just peel off the protective liner and apply. It will adhere to most clean smooth surfaces. Care must be taken when installing to attain a smooth, consistent, uniform bond to achieve maximum results.

##### Maximum Temperature:

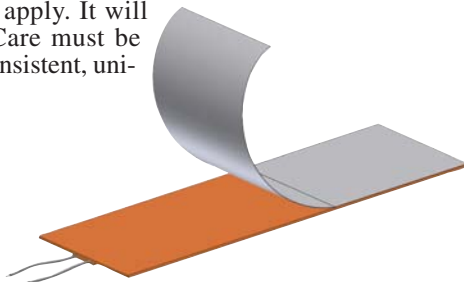
Continuous – 300°F (149°C)  
Intermittent – 500°F (260°C)

##### Recommended Watt Density:

Under 5 W/in<sup>2</sup> (0.78 W/cm<sup>2</sup>)

##### PSA Plus

A layer of aluminum foil is vulcanized to the back of the heater for added heat dissipation prior to the application of PSA.



**Note:** To obtain the expected life of **Silicone Rubber** or **Kapton®** heaters, **care must be taken to mount correctly.**

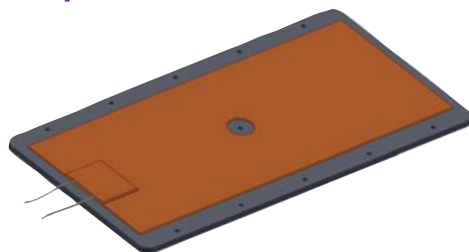
Regardless of the mounting technique used, do not trap any air under the heater; this can cause hot spots and possible premature heater failure. Use a rubber roller over the heater surface to assure good adhesion.

#### Flexible Heater Factory Vulcanizing to Metal Component

##### Factory Vulcanizing

Flexible heaters can be factory vulcanized to plain or black anodized aluminum, Stainless Steel and other metal surfaces for permanent attachment and excellent heat transfer.

The uncured silicone rubber heater is placed on the metal part and placed in the vacuum oven where the heater vulcanizes and adheres to the part in one operation. This procedure forms an extremely strong permanent bond with most metals due to the fact that the silicone rubber flows into and fills the micro structure in the surface of the metal. The metal part can be manufactured by Tempco or supplied by the customer. Consult Tempco for other materials including granite.



#### Flexible Heater Magnetic Mounting

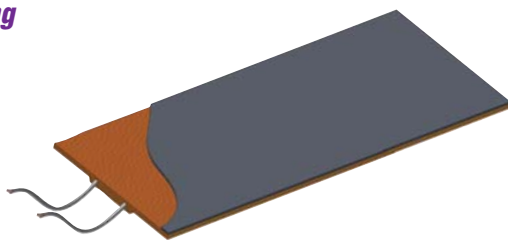
##### Magnetic Mounting

A flexible magnetic material can be attached to the back of a silicone rubber flexible heater. Will adhere to many varieties of steel. Ideal for those situations where you need to “Slap On” some heat! Specify when requesting a quote.

**Maximum Temperature:** 200°F / 93°C

**Maximum Watt Density:** 1 W/in<sup>2</sup> (0.16 W/cm<sup>2</sup>)

**Maximum Width:** 24" (610 mm)



#### Flexible Heater Field Applied Adhesive

##### Field Applied Adhesive

For a field applied permanent bond, a room temperature and ambient humidity curing silicone rubber adhesive is recommended. Tempco offers two types:

Both RTV106 and RTV116 will retain physical and electrical properties up to 500°F (260°C).

When using RTV adhesive, cover the heater completely with a thin layer of RTV, position the heater in place, and use a small roller to remove air bubbles, which could cause hot spots and lead to premature failure of the heater.

**RTV106** — a red paste consistency, high temperature resistant adhesive sealant.

Part Number: **SEA-102-105** 2.8 ounces

**RTV116** — a red, pourable, high temperature resistant adhesive sealant that will flow or self-level on a surface.

Part Number: **SEA-102-102** 9.5 ounces

**CONTINUED**

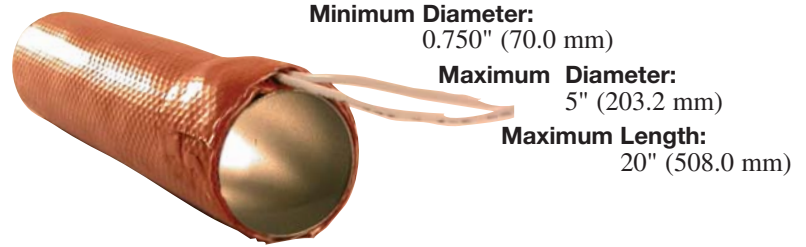
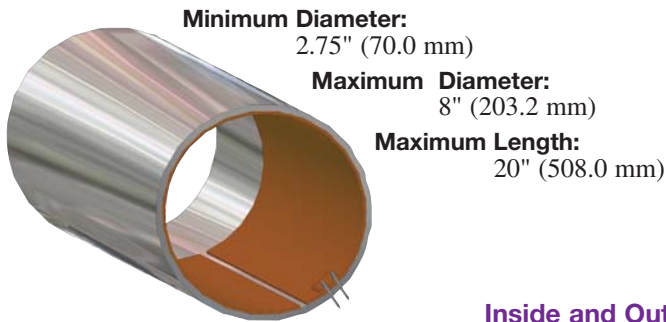


## Installation Methods

### Flexible Heater Installation Methods

Continued from previous page...

#### Diameter Mounting



#### Inside and Outside Diameter Mounting

Tempco has developed the techniques necessary to permanently mount silicone rubber heaters to the inside and outside diameters of pipes and medium size vessels. This technique is particularly useful for heated drums and air or gas heating.

### Flexible Heater Mechanical Fasteners

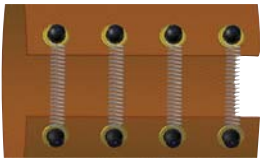
#### Mechanical Fasteners

When flexible heaters must be detachable on cylindrical parts, various methods are used. Various techniques routinely used with leather goods can be used on flexible surface heaters. These would include:

- \* Boot Hooks
- \* Grommets
- \* Snap Fasteners
- \* Boot Hooks and Lacing Cord
- \* Velcro – Hooks and Loops
- \* Boot Hooks and Springs
- \* D-Rings and Straps

*If required consult Tempco for detailed information on mechanical fastener specifications.*

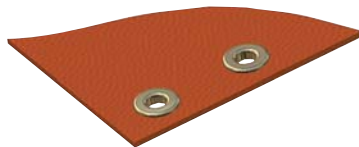
Boot Hooks and Springs



D-Rings and Straps



Grommets



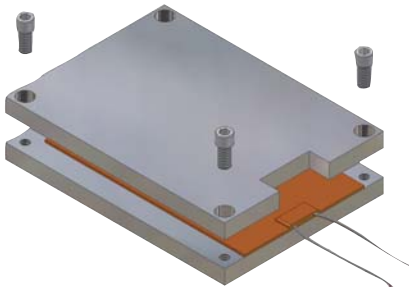
Velcro



#### Clamping

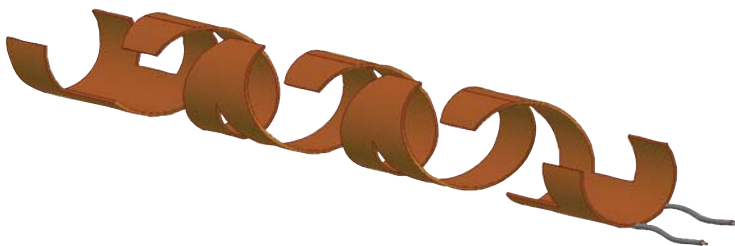
Flexible heaters may be applied by clamping or compression between two rigid materials. The plate surfaces must be ground reasonably smooth. Care must be taken not to damage the heater or pierce the insulation. Mill out an area or cutout in the top plate for the added thickness of the lead exit area.

**Recommended Maximum Pressure:** 40 Psi



**Note:** For added durability, mill out the space for the heater to mount in the same thickness as the heater.

### Flexible Heater Three-Dimensional Configuration



#### Formed 3-D Heaters

Dimensional silicone rubber heaters can be vulcanized to fit a shaped outline. This technique is particularly useful for wrapping SR heaters around pipes or small vessels. Custom tooling or special forms may be required.





### Flexible Heater Temperature Control — Built-in Thermostats

#### Flexible Heater Pre-Set and Adjustable Built-In Thermostats

Pre-set thermostats provide a low cost means of providing built-in control of surface heaters. The thermostat is normally wired directly into the heater. If the current draw of the heater exceeds the rating of the thermostat, external leads are provided.

The thermostats are normally mounted over a heated section to sense the heater's temperature or optionally over a cold section to indirectly sense the temperature of the load. The thermostat is enclosed in a molded silicone rubber housing and permanently attached to the heater.

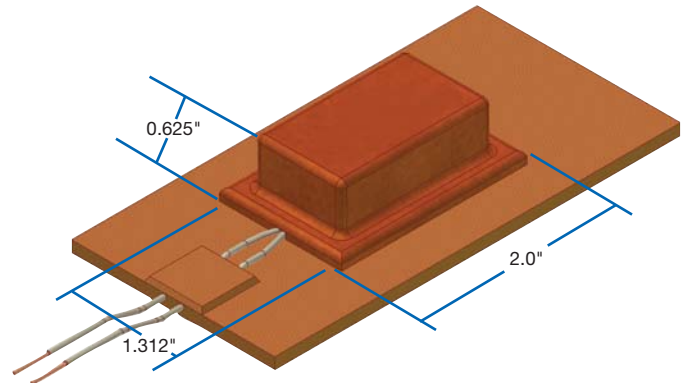
*Specify location and mounting method when ordering.*

#### Snap Action Thermostat

Quick cutout on rise to temperature. The contacts will open on rise when the temperature increases to the snap point of the calibrated bimetal disc.

**Setpoint** (opens): available from 50 to 450°F in 10°F increments  
Most thermostats close 20 to 30°F below setpoint.  
See page 13-65.

**Maximum Electrical Ratings:** 125 Vac, 15 Amp, 1875W  
250 Vac, 10 Amp, 2500W



#### Creep Action Thermostat

Sustained response, and a slow cutout at the trip point. The creep action thermostat has a slow make/slow break action around setpoint.

**Setpoint** (opens): available in a limited selection from  
50 to 300°F in 10°F increments. Consult Tempco.

**Maximum Electrical Ratings:** 120 Vac, 12 Amp, 1440W  
240 Vac, 6 Amp, 1440W

#### Snap Action High Limit Thermostats

A High Limit with a manual reset pushbutton can also be designed in. Specify when requesting a quote.

Note: See pages 13-65 and 13-66 for stock temperature ratings.

#### Adjustable Thermostat

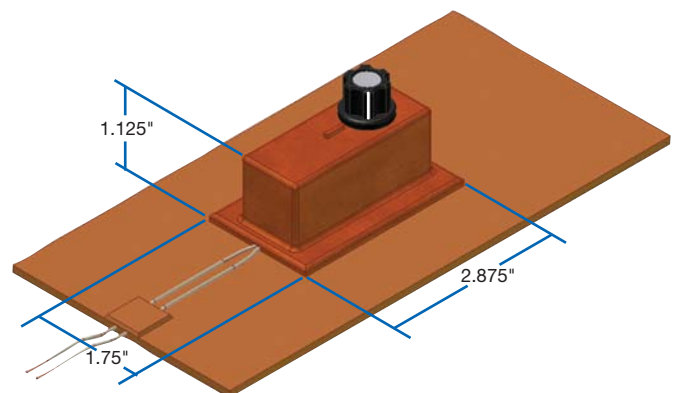
Adjustable thermostats allow the user to set a specific temperature and attain a desired result. The thermostat is encapsulated in a silicone rubber overmold. The adjustment shaft extends through a pre-formed hole. A high temperature knob is included.

**Amps:** 12.5A @ 125V, 6.5 A @ 250V  
**Watts:** 1500W @ 120V, 1560W @ 240V

**Adjustment Ranges Available:**

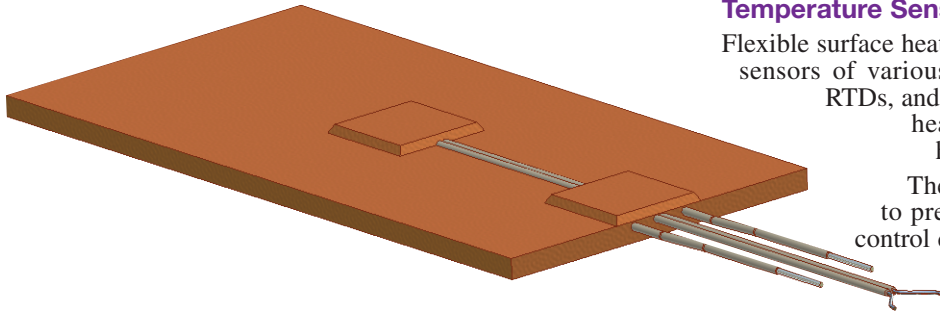
50 to 425°F (10 to 218°C)  
90 to 140°F (32 to 60°C)  
100 to 190°F (38 to 88°C)  
70 to 190°F (21 to 88°C)  
50 to 160°F (10 to 71°C)  
70 to 140°F (21 to 60°C)

**Minimum Width:** 1.75" (44.5 mm)





### Flexible Heater Built-In Temperature Sensors



#### Temperature Sensors

Flexible surface heaters can be manufactured to include temperature sensors of various types. Sensor types include thermocouples, RTDs, and thermistors. The sensors can be mounted on the heater to sense the temperature of the part being heated or the heater surface temperature itself.

Thermal fuses can be incorporated into the design to prevent dangerous temperatures in the event of a control device failure.

#### Thermocouples

Tempco can incorporate common Type J or K thermocouples almost anywhere on the heater surface. Other thermocouple types can also be used. Standard thermocouple temperature ranges apply. Specify when ordering.

#### RTD's

The RTDs used are platinum thin film 100 ohm @ 100°C. The standard curve is 0.00385 TCR / DIN432760. Other common RTD's such as 1000 ohm can also be used. Specify when ordering. The RTD's resistance increases with a rise in temperature and is considered the most accurate and stable sensor.

#### Thermistors

Thermistors are also a resistive-based temperature sensor. They do not generally respond in a linear style and are used in a limited temperature range or at a specific single temperature.

Small bead style thermistors can also be mounted directly on the heater.

The thermistor's response is generally designed directly into the customer's electronic control system. Therefore if a thermistor is required, specify manufacturer, specific model number, type and specifications when requesting a quote. Consult Tempco for more information.

#### Sensor Mounting

For silicone rubber heaters, temperature sensors are mounted to the surface of the heater under a vulcanized patch. For Kapton® heaters the sensor is affixed to the surface with epoxy. The leads are run on the exterior of the heater to avoid heat and mechanical interference with the resistance element inside.

#### Tempco offers three types of sensor mounting:

**Heater Sensing:** The sensor is located over heater wiring to sense the temperature of the heater surface. (Standard)

**Indirect Load Sensing:** A cold section is designed into the resistance element layout for where the sensor is to be located.

**Direct Load Sensing (silicone rubber only):** A hole/window is cut into the bottom layer of the heater so that the sensor is mounted in the "window" under a vulcanized patch, allowing it to be in contact with the load. (Note: higher cost and subject to potential mechanical damage.)

#### Leads

**Standard Type:** Teflon® **Standard Length:** 10 inches

Other types available. Consult Tempco with your requirements. Specify sensor lead length when ordering.

Tempco has the correct tooling to attach many different types of "quick connectors" that are used with sensors. Consult Tempco with your requirements.

### Flexible Heater Built-In Thermal Fusing



**Temperature Range:** 151 to 464°F (66 to 240°C)  
*Single temperature point only, in 10° to 20° steps. Consult Tempco with your requirements.*

Note: See page 13-66 for stock thermal cutoff temperature ratings.

Thermal fuses / cutoffs are used as high limit protection devices to guard the object being heated from dangerous temperatures in the event of a primary control device failure.

The thermal fuse can be mounted using various methods depending on other options. If the heater does not have a thermostat, the thermal fuse would be mounted under the lead exit patch. If used in conjunction with a thermostat, it could be mounted under the thermostat cover.



**Note:** The thermal cutoff is a one-shot, non-resettable component.

**Voltage:** 120/240 Vac

**Maximum Amperage:** 10 Amps, continuous





### Cylindrical Flexible Silicone Rubber Heaters

*Tempco's Silicone Rubber Heaters can be supplied in various configurations to suit many cylindrical heating applications.*



### Silicone Rubber Drum and Pail Heaters

**Flexible drum heaters** can save time by heating stored viscous fluid to a pourable temperature.

The heater is built to be tough, long lasting, and resistant to chemicals. Because few materials stick to its silicone rubber with fiberglass reinforced construction, it is easy to clean. The heater comes with a 6-foot cord and plug (120V only). When not in use, it rolls for convenient storage.

The total wattage (number of heaters) and the material being heated inside of the drum must be considered when determining the actual temperature to which that specific material can be heated.

#### Specifications

- Maximum operating temperature of 425°F (218°C).
- Power cord is 6-foot long, SJO Type 16/3 complete with three-prong plug for 115 VAC models. Plug not included on 230 VAC models.
- Surface grounded electrically with internal metal screen.
- 1250 volts dielectric tested.
- Vulcanized silicone rubber construction resistant to moisture, ozone, fungus, and radiation.

#### Design Features

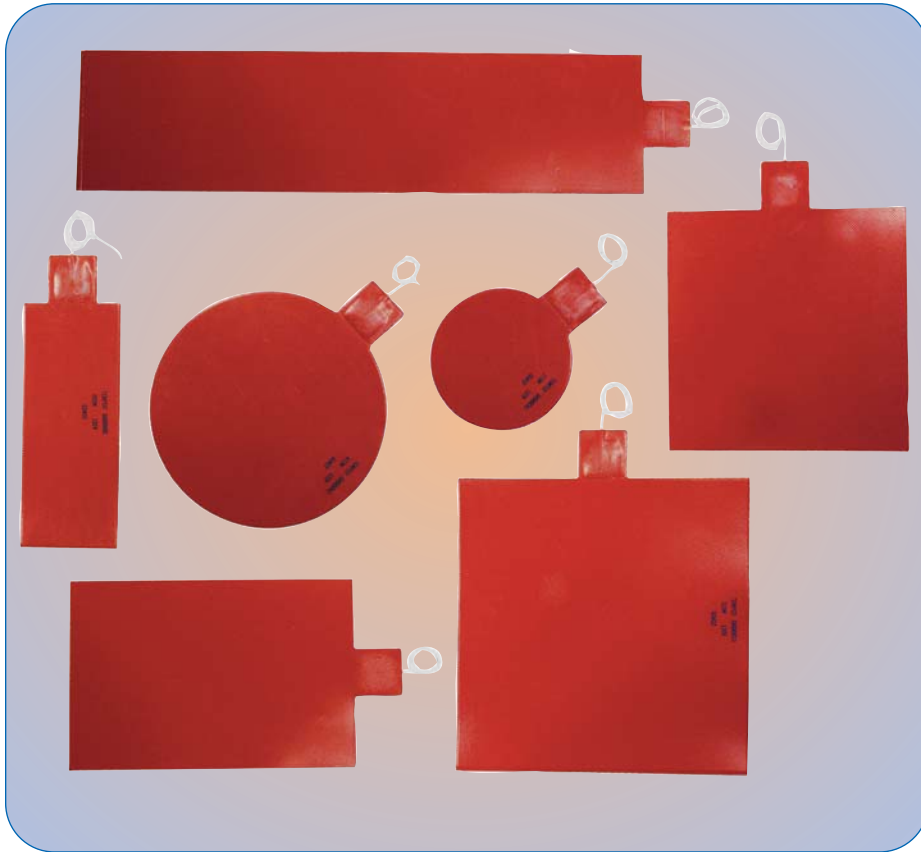
- \* All heaters have a standard width of 3" except 1500W 55 gallon, which are 4"
- \* 120 Volt heaters have a 6-foot cord and plug
- \* 240 Volt heaters have a 6-foot cord —NO PLUG
- \* B200 type thermostat used



For complete information on Tempco's Silicone Rubber **DRUM** Heaters, see page 11-71.



### Composite Curing Flexible Heater Blankets



#### Design Features

- \* *Maximum Temperature: 500°F/260°C intermittent  
450°F/232°C continuous*
- \* *Material: Fiberglass reinforced Silicone Rubber*
- \* *Smooth bottom layer for contact with the composite under cure*
- \* *External Lead Exit Tab, 2" x 2" maximizes heating area and uniformity*
- \* *Lead wire: Teflon®, 5 ft. length, 400°F/200°C, 600V*
- \* *Composite Industry Watt Density Standard of 5 watts/in<sup>2</sup>*
- \* *Available Voltage: 120 Vac or 240 Vac*
- \* *Meets Composite Industry uniformity standard of  $\pm 10^\circ\text{F}$*
- \* *Each heater blanket has a serial number for traceability*
- \* *Heat Mapping Certification available*
- \* *Made to Order:*
  - Maximum Width: 36" (914mm)*
  - Maximum Length: 120" (3048mm)*
  - Maximum Diameter: 32" (813mm)*
- \* *UL recognized*

**Specialized Silicone Rubber Heater Blankets** are used in the composite industry to bond and cure composite structures using vacuum bagging techniques which have become standard in the industry.

Tempco's composite bonding and curing heater blankets are designed with the field technician in mind with an extra strong strain relief, and even heat distribution to produce the best possible cure or bond.

Temperature uniformity is optimized for even heating through computer designed resistance elements. Circuit spacing is maintained at 1/4" for larger heater blankets or less on smaller heaters. This technique guarantees a  $\pm 10^\circ\text{F}$  ( $\pm 5.5^\circ\text{C}$ ) temperature uniformity across the heater blanket.

The lead wires exit the heater through an unheated 2" x 2" lead exit tab. This allows the overall heater surface to be heated while maintaining a separate unheated section for the transition from resistance element to the leads and a solid strain relief.

Tempco's Composite Curing Heater Blankets emphasize strength, durability, flexibility and overall temperature uniformity.

#### Typical Industries

- \* *Aerospace/Aircraft  
Repair  
Manufacturing*
- \* *Marine/Boats  
Repair  
Manufacturing*
- \* *All composite, metal bonding,  
curing applications*

#### Thermal Mapping

It is a known fact in the composite repair industry that the quality of the overall repair often relates directly to the quality of the cure. The cure in turn is directly affected by the temperature uniformity of the heat blanket.

Thermal/heat mapping certification of the heater blanket is rapidly becoming the standard operating procedure for many repair facilities to optimize the cure process.

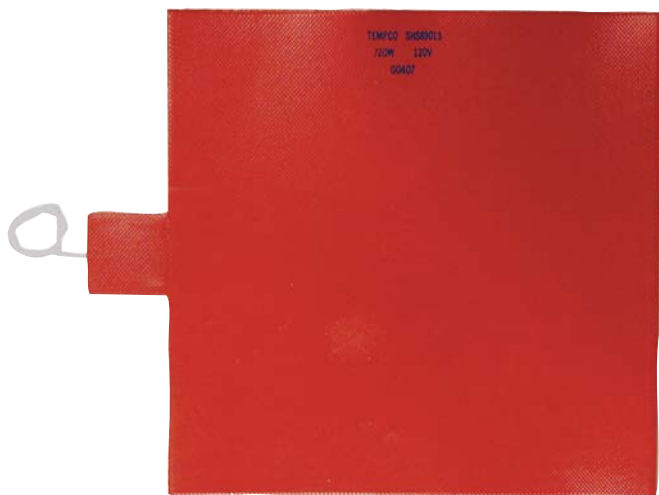
As an added value service, Tempco can certify that the heat blanket you order follows the guidelines established by the Commercial Aircraft Composite Repair Committee (CACRC), SAE document ARP 5144 Section 7, which states specific recommendations for the "...handling, maintenance and thermal testing of heat blankets..." The heater blanket certification also meets the requirements of Boeing document D6-56 273 "Qualification of Heat Blankets for Hot Bonding Composites."



### Composite Curing Flexible Heater Blankets

#### Standard (Non-Stock) Flexible Heater Blankets

inches		mm		Watts	Voltage	
L	W	L	W		120	240
4	10	102	254	200	SHS89001	SHS89021
6	6	152	152	180	SHS89002	SHS89022
6	8	152	203	240	SHS89003	SHS89023
6	10	152	254	300	SHS89004	SHS89024
6	20	152	508	600	SHS89005	SHS89025
6	24	152	610	720	SHS89006	SHS89026
6	36	152	914	1080	SHS89007	SHS89027
8	8	203	203	320	SHS89008	SHS89028
8	12	203	305	480	SHS89009	SHS89029
10	10	254	254	500	SHS89010	SHS89030
10	12	254	305	600	SHS89011	SHS89031
10	18	254	457	900	SHS89012	SHS89032
12	12	305	305	720	SHS89013	SHS89033
12	18	305	457	1080	SHS89014	SHS89034
12	24	305	610	1440	SHS89015	SHS89035
15	15	381	381	1125	SHS89016	SHS89036
15	18	381	457	1350	SHS89017	SHS89037
18	18	457	457	1620	SHS89018	SHS89038
18	24	457	610	2160	SHS89019	SHS89039
24	24	610	610	2880	SHS89020	SHS89040



#### Standard (Non-Stock) Round Flexible Heater Blankets

Diameter		Watts	Voltage	
inches	mm		120	240
6	152	170	SHS89041	SHS89044
10	254	470	SHS89042	SHS89045
15	381	1055	SHS89043	SHS89046



**Note:** Round heaters have a higher watt density than listed rectangular sizes, and provide an additional 20% of surface heat.

#### Ordering Information

##### Catalog Heaters

Choose from the table of standard sizes of Composite Curing Heater Blankets in rectangular and round shapes.

The heaters listed are 5 W/in<sup>2</sup>. Standard configuration includes 5-ft. Teflon® leads, exit style A or L . (see page 9-7) and all standard design features.

##### Custom Engineered/Manufactured Heaters

For those special situations that require a custom manufactured heater blanket, **TEMPCO** can design a heater with curves, cutouts, holes or unique shapes.

**Standard lead time is 2 to 3 weeks.**

**Please Specify** the following:

- ☐ Diameter
- ☐ Wattage and Voltage
- ☐ Lead Type
- ☐ Sensors or Thermostats
- ☐ Special Features or Cutouts
- ☐ Lead Location



# Flexible Heaters

## PVC Pipe Bending & Enclosure Heaters



### PVC Pipe/Conduit Bending Heaters

**Tempco's PVC Pipe/Conduit Bending Heater Assembly** makes it easy to form PVC plastic pipe and conduit at the job site.

To bend the PVC pipe/conduit, just wrap the heater assembly around the pipe at the location desired and plug it in. In 4 to 18 minutes, depending on pipe size, it will be soft enough to bend by hand to the desired radius or shape.

This heavy duty assembly, made from our proven wire wound silicone rubber heater technology, will provide hundreds of hours of use.

#### Design Features

- \* Built-in thermostat limits temperature to 250°F (121°C)
- \* Standard Voltage is 120 Vac
- \* 6-ft. plug and cordset standard

*Available from Stock*

For same-day shipping when  
**ORDERED BY 2 PM CST**



**Stock PVC Pipe Bending Heaters**

Pipe Diameter	Length	Watts	Volts	Warm-Up Time	Part Number
1/2" to 1-1/2"	12"	180	120	4 – 10 minutes	SHS01210
2" to 4"	25"	950	120	7 – 18 minutes	SHS01222

### EHR — Silicone Rubber Enclosure Heater

#### Design Features

- \* Choose Either an Integrated or Remote Thermostat
- \* Custom Design and Alternate Thermostat Settings Available
- \* Heater Vulcanized to an Aluminum Mounting Plate for Easy Installation
- \* 120V Standard; Custom Voltages Available upon Request
- \* 48" Teflon® Leads Standard
- \* Dimensions Listed are for Heater and Bracket; Actual Heater Width is 1/2" Less.
- \* Safe to Operate, No Exposed Electrical Connections



**EHR — Silicone Rubber Heaters** are designed for easy installation and safe operation. These rectangular shaped wire wound Silicone Rubber Heaters are vulcanized to an aluminum mounting plate with mounting holes. They provide superior protection for enclosures of all types against condensation, humidity and freezing.

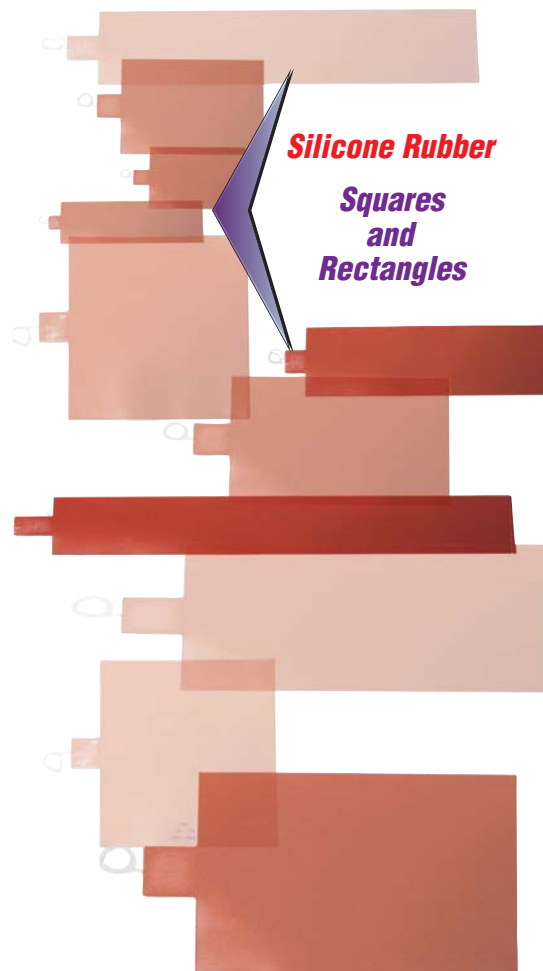
It is recommended that the enclosure heater be used with a thermostat either built in or mounted remotely to limit the maximum temperature reached and conserve energy. The suggested mounting method is at the bottom of the enclosure, mounted vertically. If a remote mounted thermostat is preferred, mount the heater on the bottom of the enclosure and the thermostat in the middle of the enclosure.

For complete information  
on Tempco's Silicone Rubber  
**ENCLOSURE** Heaters,  
see page 11-65.

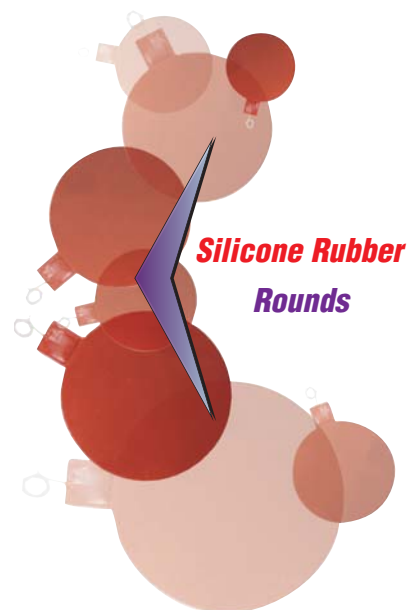


### Silicone Rubber Standard (Non-Stock) Sizes and Ratings

Width		Length		Watts	Wire Construction		Foil Construction	
in.	mm	in.	mm		120V	240V	120V	240V
1	25	8	203	40	SHS00001	—	SHS00080	—
1	25	12	305	60	SHS00002	SHS00041	SHS00081	SHS00101
1	25	24	610	120	SHS00003	SHS00042	—	—
1	25	48	1219	240	SHS00004	SHS00043	—	—
2	51	2	51	20	SHS00005	SHS00044	SHS00082	SHS00102
2	51	4	102	40	SHS00006	SHS00045	SHS00083	SHS00103
2	51	8	203	80	SHS00007	SHS00046	SHS00084	SHS00104
2	51	12	305	120	SHS00008	SHS00047	SHS00085	SHS00105
2	51	24	610	240	SHS00009	SHS00048	—	—
2	51	48	1219	480	SHS00010	SHS00049	—	—
3	76	4	102	60	SHS00011	SHS00050	SHS00086	SHS00106
3	76	8	203	120	SHS00012	SHS00051	SHS00087	SHS00107
3	76	12	305	180	SHS00013	SHS00052	SHS00088	SHS00108
3	76	24	610	360	SHS00014	SHS00053	—	—
3	76	48	1219	720	SHS00015	SHS00054	—	—
4	102	4	102	80	SHS00016	SHS00055	SHS00089	SHS00109
4	102	8	203	160	SHS00017	SHS00056	SHS00090	SHS00110
4	102	12	305	240	SHS00018	SHS00057	SHS00091	SHS00111
4	102	24	610	480	SHS00019	SHS00058	—	—
4	102	48	1219	960	SHS00020	SHS00059	—	—
5	127	6	152	150	SHS00021	SHS00060	SHS00092	SHS00112
5	127	10	254	250	SHS00022	SHS00061	SHS00093	SHS00113
5	127	12	305	300	SHS00023	SHS00062	SHS00094	SHS00114
5	127	24	610	600	SHS00024	SHS00063	—	—
5	127	48	1219	1200	SHS00025	SHS00064	—	—
6	152	6	152	180	SHS00026	SHS00065	SHS00095	SHS00115
6	152	10	254	300	SHS00027	SHS00066	SHS00096	SHS00116
6	152	12	305	360	SHS00028	SHS00067	SHS00097	SHS00117
6	152	24	610	720	SHS00029	SHS00068	—	—
6	152	48	1219	1440	SHS00030	SHS00069	—	—
8	203	8	203	320	SHS00031	SHS00070	SHS00098	SHS00118
8	203	12	305	480	SHS00032	SHS00071	SHS00099	SHS00119
8	203	24	610	960	SHS00033	SHS00072	—	—
8	203	48	1219	1920	SHS00034	SHS00073	—	—
10	254	10	254	500	SHS00035	SHS00074	SHS00100	SHS00120
10	254	24	610	1200	SHS00036	SHS00075	—	—
10	254	48	1219	2400	SHS00037	SHS00076	—	—
12	305	12	305	720	SHS00038	SHS00077	—	—
12	305	24	610	1440	SHS00039	SHS00078	—	—
12	305	48	1219	2880	SHS00040	SHS00079	—	—



Diameter		Area		Watts	Wire Construction		Foil Construction	
in.	mm	in <sup>2</sup>	cm <sup>2</sup>		120V	240V	120V	240V
3.0	76	7.07	45.6	35	SHS00201	—	—	—
3.5	89	9.62	62.1	48	SHS00202	—	SHS00241	—
4.0	102	12.57	81.1	63	SHS00203	SHS00222	SHS00242	—
4.5	114	15.90	102.6	80	SHS00204	SHS00223	SHS00243	SHS00261
5.0	127	19.63	126.6	98	SHS00205	SHS00224	SHS00244	SHS00262
5.5	140	23.76	153.3	119	SHS00206	SHS00225	SHS00245	SHS00263
6.0	152	28.27	182.4	141	SHS00207	SHS00226	SHS00246	SHS00264
6.5	165	33.18	214.1	166	SHS00208	SHS00227	SHS00247	SHS00265
7.0	178	38.48	248.3	192	SHS00209	SHS00228	SHS00248	SHS00266
7.5	191	44.18	285.0	221	SHS00210	SHS00229	SHS00249	SHS00267
8.0	203	50.26	324.3	250	SHS00211	SHS00230	SHS00250	SHS00268
8.5	216	56.74	366.1	284	SHS00212	SHS00231	SHS00251	SHS00269
9.0	229	63.62	410.4	318	SHS00213	SHS00232	SHS00252	SHS00270
9.5	241	70.88	457.3	354	SHS00214	SHS00233	SHS00253	SHS00271
10.0	254	78.54	506.7	393	SHS00215	SHS00234	SHS00254	SHS00272
10.5	267	86.59	558.7	430	SHS00216	SHS00235	SHS00255	SHS00273
11.0	279	95.03	613.2	480	SHS00217	SHS00236	SHS00256	SHS00274
11.5	292	103.87	670.2	520	SHS00218	SHS00237	SHS00257	SHS00275
12.0	305	113.10	729.7	570	SHS00219	SHS00238	SHS00258	SHS00276
15.0	381	176.72	1140.2	880	SHS00220	SHS00239	SHS00259	SHS00277
20.0	508	314.16	2027.0	1570	SHS00221	SHS00240	SHS00260	SHS00278

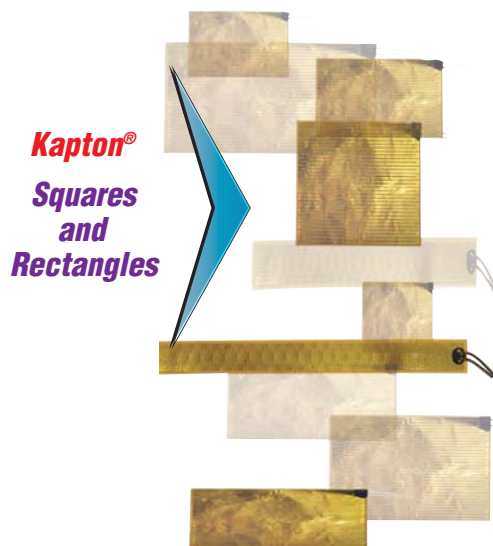


# Flexible Heaters



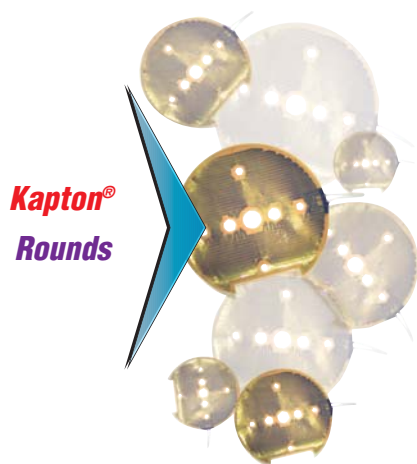
## Kapton® — Common Sizes

### Kapton Standard (Non-Stock) Sizes and Ratings



Width		Length		Watts	Part Number	
in.	mm	in.	mm		120V	240V
1	25	8	203	40	SHK00001	—
1	25	12	305	60	SHK00002	SHK00022
2	51	2	51	20	—	SHK00023
2	51	4	102	40	SHK00004	SHK00024
2	51	8	203	80	SHK00005	SHK00025
2	51	12	305	120	SHK00006	SHK00026
3	76	4	102	60	SHK00007	SHK00027
3	76	8	203	120	SHK00008	SHK00028
3	76	12	305	180	SHK00009	SHK00029
4	102	4	102	80	SHK00010	SHK00030
4	102	8	203	160	SHK00011	SHK00031
4	102	12	305	240	SHK00012	SHK00032
5	127	6	152	150	SHK00013	SHK00033
5	127	10	254	250	SHK00014	SHK00034
5	127	12	305	300	SHK00015	SHK00035
6	152	6	152	180	SHK00016	SHK00036
6	152	10	254	300	SHK00017	SHK00037
6	152	12	305	360	SHK00018	SHK00038
8	203	8	203	320	SHK00019	SHK00039
8	203	12	305	480	SHK00020	SHK00040
10	254	10	254	500	SHK00021	SHK00041

## KAPTON® FLEXIBLE HEATERS



Diameter		Area		Watts	Part number	
in.	mm	in <sup>2</sup>	cm <sup>2</sup>		120V	240V
3.0	76	7.07	45.6	35	SHK00101	—
3.5	89	9.62	62.1	48	SHK00102	—
4.0	102	12.57	81.1	63	SHK00103	—
4.5	114	15.90	102.6	80	SHK00104	SHK00116
5.0	127	19.63	126.6	98	SHK00105	SHK00117
5.5	140	23.76	153.3	119	SHK00106	SHK00118
6.0	152	28.27	182.4	141	SHK00107	SHK00119
6.5	165	33.18	214.1	166	SHK00108	SHK00120
7.0	178	38.48	248.3	192	SHK00109	SHK00121
7.5	190	44.18	285.0	221	SHK00110	SHK00122
8.0	203	50.26	324.3	250	SHK00111	SHK00123
8.5	216	56.74	366.1	284	SHK00112	SHK00124
9.0	229	63.62	410.4	318	SHK00113	SHK00125
9.5	241	70.88	457.3	354	SHK00114	SHK00126
10.0	254	78.54	506.7	393	SHK00115	SHK00127

### Ordering Information

#### Catalog Heaters

Chose from the tables of common sizes of Silicone Rubber and Kapton® in round or rectangular shapes.

The heaters listed are 5 W/in<sup>2</sup>. Standard configuration includes 10" Teflon® leads, exit style A or L (see page 9-7) and no mounting option.

#### Custom Engineered/Manufactured Heaters

Understanding that an electric heater can be very application specific, for sizes and ratings not listed, **TEMPCO** will design and manufacture a Flexible Surface Heater to meet your requirements. **Standard lead time is 4 to 5 weeks.**

**Please Specify** the following:

- ☐ Diameter
- ☐ Wattage and Voltage
- ☐ Lead Type
- ☐ Sensors or Thermostats
- ☐ Special Features or Cutouts
- ☐ Lead Location





### Flexible Heater Quote Request

Made-To-Order Quote Request Form — Copy and Fax us your requirements.

Customer Drawing

Name \_\_\_\_\_  
Company \_\_\_\_\_  
Address \_\_\_\_\_  
\_\_\_\_\_  
Phone \_\_\_\_\_ Fax \_\_\_\_\_  
E-mail \_\_\_\_\_

#### Application Information

Describe in Detail \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Maximum Load Temperature \_\_\_\_\_  
Ambient Temperature \_\_\_\_\_  
Quantity \_\_\_\_\_

#### Specifications

Insulation Material: Silicone Rubber \_\_\_\_\_ Kapton® \_\_\_\_\_  
Resistance Style: Wire \_\_\_\_\_ Foil \_\_\_\_\_ Thk. Film \_\_\_\_\_  
Length \_\_\_\_\_ Width \_\_\_\_\_ Diameter \_\_\_\_\_  
Watts \_\_\_\_\_ Volts \_\_\_\_\_  
UL \_\_\_\_\_ cUL \_\_\_\_\_ CSA \_\_\_\_\_  
Lead Length (10" standard) \_\_\_\_\_  
Insulation (Teflon® standard) \_\_\_\_\_  
Lead Location (Indicate code & on sketch) \_\_\_\_\_  
Options (holes, cutouts, etc. — describe & indicate on sketch) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Maximum Thickness \_\_\_\_\_  
(if applicable, except for lead exit) \_\_\_\_\_  
\_\_\_\_\_  
Notes \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

#### Controls and Sensors

Thermostat: Pre-set Type \_\_\_\_\_  
Temperature Setting (Opens) \_\_\_\_\_  
Adjustable (Range 50-450°F) \_\_\_\_\_  
Mounting: Heater Sensing (Standard) \_\_\_\_\_  
Load Sensing \_\_\_\_\_  
Location (Describe & indicate on sketch) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Thermocouple: Type (J, K or other) \_\_\_\_\_  
RTD (DIN 100 ohm) \_\_\_\_\_ Other \_\_\_\_\_  
Thermistor (Indicate manufacturer part #, calibration  
curve/spec & useful range) \_\_\_\_\_

#### Sensor Mounting:

Heater Sensing (Standard) \_\_\_\_\_  
Load Sensing \_\_\_\_\_  
Location (Describe & indicate on sketch) \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Sensor Lead Length (10" standard) \_\_\_\_\_  
Sensor Insulation (Teflon® standard) \_\_\_\_\_ Fiberglass \_\_\_\_\_  
Options \_\_\_\_\_

#### Mounting

None \_\_\_\_\_  
Pressure Sensitive Adhesive (PSA) \_\_\_\_\_  
Boot Hooks & Springs \_\_\_\_\_ Quantity \_\_\_\_\_  
Eyelets/Grommets \_\_\_\_\_ Quantity \_\_\_\_\_  
Lacing Cord \_\_\_\_\_ Length \_\_\_\_\_  
Straps & Velcro \_\_\_\_\_ Strap Length \_\_\_\_\_ Quantity \_\_\_\_\_  
Straps & D-Rings \_\_\_\_\_ Strap Length \_\_\_\_\_ Quantity \_\_\_\_\_  
Factory Vulcanizing \_\_\_\_\_ Description \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Sponge Insulation \_\_\_\_\_ Thickness \_\_\_\_\_  
Describe in Detail \_\_\_\_\_  
\_\_\_\_\_



## Thick Film

### Printed Thick Film Heating Elements

Tempco's flexible **Thick Film Heating Elements** offer a wide range of design options for OEM applications. By utilizing printed thick film technology, the heaters can more efficiently spread the heat across the surface, and are more cost effective systems when compared to comparable etched foil or wire elements.

The design incorporates printed thick film technology as the active heat source. The ink can be designed in various patterns and densities, concentrating power exactly where it is needed. The element traces can be widened or narrowed to allow for cutouts and holes.



**PRINTED THICK FILM TECHNOLOGY**  **Efficient • Cost Effective • Custom Designed**

#### Construction

Conductive and resistive inks are printed on a film substrate layer, and then covered with another film layer laminated together with pressure sensitive adhesive (PSA). Typically, the film layers are .005" thick thermoplastic or thermoset polymers, like polyester (up to 105°C) or polyimide (up to 180°C), that exhibit good thermal conductivity while serving as electrical insulators. An additional layer of PSA can be added to the bottom of the assembly so the element can be bonded directly to the surface to be heated, ensuring excellent thermal transfer.

#### Cooler Operating Temperature

By spreading the heat trace over a larger percentage of the surface of the element, a Tempco element will also operate at a cooler operating temperature due to the lower watt density in a given area. Low thermal mass also allows the heat to be transferred more quickly to the surface to be heated. Both characteristics enhance the safety and overall life of the element.

#### Resistive Inks

The elements, due to the resistive inks used, exhibit a slight PTC effect, or positive temperature coefficient. As the temperature of the elements increase, the resistance also increases, lowering current draw and wattage output. This further enhances the safety of the element, and allows for full power when needed at cooler temperatures, while conserving energy consumption at higher temperatures.

#### Typical Applications

- \* Blanket Heaters for Battery Back-Up Systems
- \* Video Camera Lens Defoggers
- \* Outdoor Enclosure Warmers
- \* Fluorescent Bulb Starters
- \* Clear LCD Heaters
- \* Packaging/Sealing Bar Element
- \* Medical Equipment
- \* Food Service Equipment
- \* Mirror Heater/Defoggers

#### Controls and Sensors

More exacting control is available for the heaters as well. Thermostats and temperature sensors can be mounted directly on the heaters for direct temperature control. Thermal fuses/TCO's are available for overtemperature/runaway condition protection.



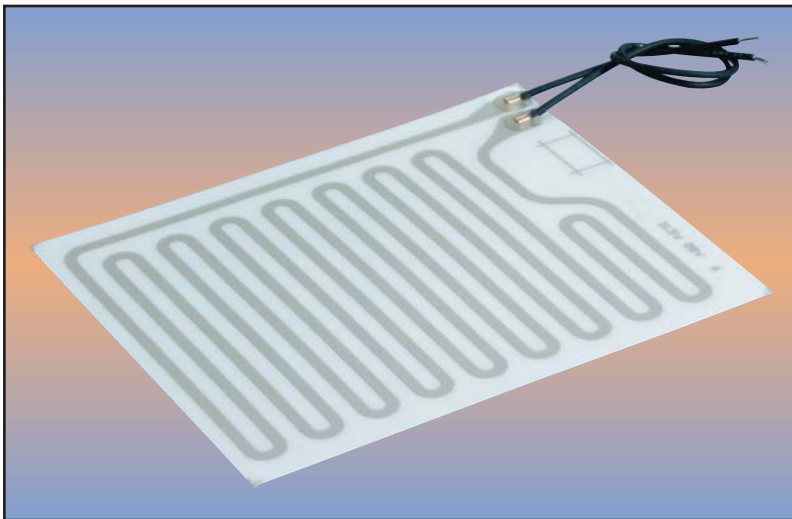
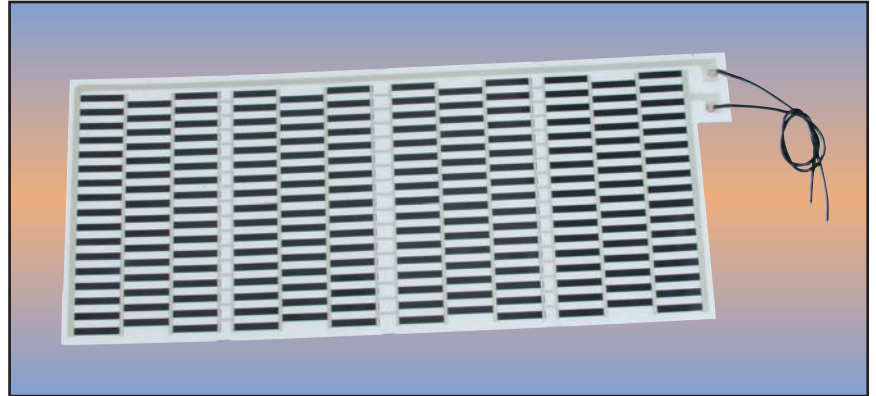
The elements can be designed for either AC or DC variable input voltages up to 277 VAC, with UL/CSA recognized component watt densities of up to 25 W/sq. in. The technology lends itself well to both small and large designs, with current products ranging from 5/8" x 1-1/4" to 24" x 98". Round, oval and other non-linear shapes and designs are easily accommodated. Elements can also be pre-creased to allow elements to be wrapped around the surface to be heated, minimizing concerns about film memory and potential delamination.



### Printed Thick Film Heating Elements

#### Rigidity or Abrasion Resistance

Various laminates, such as foam, mica, FR-4 board and metal can be applied to further enhance thermal efficiency and add rigidity or abrasion resistance where needed.



Tempco's printed thick film heaters offer a cost effective and thermally efficient method of delivering heat to your product. The element's adaptability to the many challenges of effectively delivering heat make it an ideal solution for many thermal problems.

#### Ordering Information

##### Custom Engineered / Manufactured Heaters

Understanding that an electric heater can be application specific, Tempco will design and manufacture a Thick Film Heater to meet your requirements. Copy the form on page 9-19, fill it out, and fax it in to Tempco to receive a quote.

#### Specifications

**Maximum Temperature:** 900°F (482°C)

#### Substrate Materials — Maximum Ratings

**Polyester:** 221°F / 105°C

**Polyethylene:** 221°F / 105°C

**Polyvinyl Chloride (PVC):** 221°F / 105°C

**Thermoset Laminate:** 284°F / 140°C

**Polyethylene Napthalate (PEN):** 320°F / 160°C

**Polyimide (Kapton®):** 392°F / 200°C

**Silicone Rubber:** 392°F / 200°C

#### Pressure Sensitive Adhesives — Maximum Ratings

**Acrylic:** 221°F / 105°C

**High Temperature Acrylic:** 300°F / 149°C

**Silicone:** 392°F / 200°C

#### Dimensional Limits

**Minimum Width:** 0.25" (6mm)

**Maximum Length:** 30" (508mm)

#### Dielectric Strength

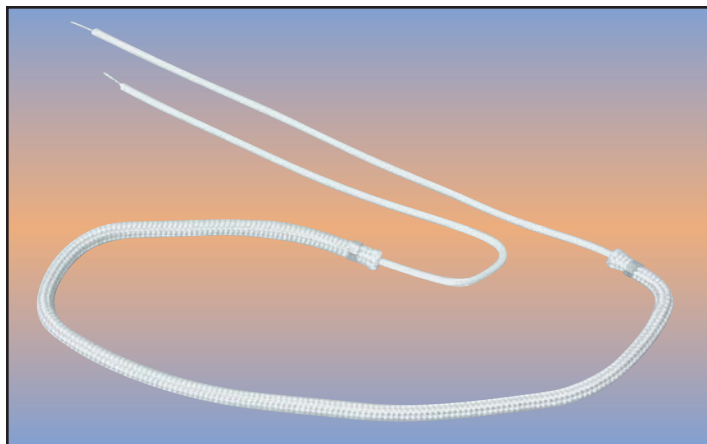
Each element is 100% tested to the greater of 1500Vac or the typical approval agency recommendation of 2× input voltage plus 1000 volts for dielectric integrity.





## Rope Heaters

### RHR Series — Fiberglass Insulated Rope Heater



#### Typical Applications

- \* Appliances
- \* Incubators
- \* Laboratory Beakers
- \* Blueprint Machine Drier Units
- \* Heat Tracing for Pipes or Tubes
- \* Valves or Union

Tempco's **Rope Heaters** are made from the highest quality materials and are designed to last longer than rope heaters from other manufacturers.

A resistive alloy element is helically wound around a fiberglass core and covered with a layer of fiberglass sleeving. Fiberglass leads are crimped onto the resistance wire and covered by the fiberglass sleeving. Retention crimps hold the assembly together.

They are used where a low cost, economical heat source is required.

#### Single Element — Lead from both ends



#### Specifications

**Maximum Temperature:** 900°F (482°C)

**Maximum Length:** 300" (7620 mm)

**Nominal Diameter:** 120V: 0.165" (4.2 mm)  
240V: 0.180" (4.6 mm)

**Maximum Recommended Wattage:** 5W/linear inch  
Some applications can go higher; consult Tempco.

**Wattage Tolerance:** +5%, -10%

**Resistance Tolerance:** +10%, -5%

**Standard Leads:** 10" Fiberglass, 450°C (842°F)

#### Structure

1. Flexible woven fiberglass sleeving
2. High grade resistance wire element wound on a fiberglass core.
3. Retention crimp
4. High temperature fiberglass leads

#### Double Element — Leads from single end



#### Specifications

**Maximum Temperature:** 900°F (482°C)

**Maximum Length:** 150" (3810 mm)

**Nominal Diameter:** 120V or 240V: 0.300" (7.62 mm)

**Maximum Recommended Wattage:** 8W/linear inch  
Some applications can go higher; consult Tempco.

**Wattage Tolerance:** +5%, -10%

**Resistance Tolerance:** +10%, -5%

**Standard Leads:** 10" Fiberglass, 450°C (842°F)

#### Structure

1. External flexible woven fiberglass sleeving
2. Internal flexible woven fiberglass sleeving
3. High grade resistance wire element wound on a fiberglass core
4. Retention crimp
5. High temperature fiberglass leads



### RHR Series — Fiberglass Insulated Rope Heater

#### AVAILABLE OPTIONAL SPECIALTY SHEATH MATERIALS

##### High Temperature Fiberglass Rope Heater

The high temperature version uses a higher temperature rated sleeving. Internal construction is identical to the single or double element rope heater except for the use of a higher rated fiberglass sleeving.

**Maximum Temperature:** 1200°F (649°C)

**Maximum Length:** 300" (7620 mm)

**Nominal Diameter:** 120V: 0.165" (4.2 mm)  
240V: 0.180" (4.6 mm)

**Maximum Recommended Wattage:** 7 W/linear inch  
Some applications can go higher; consult Tempco.

**Wattage Tolerance:** + 5%, - 10%

**Resistance Tolerance:** + 10%, - 5%

**Standard Leads:** 10" fiberglass, 450°C (842°F)

##### High Temperature Flexible Metal Sheathed Rope Heater

This version uses Stainless Steel sleeving over ceramic bead insulators around the resistance element for high temperature, corrosive environments.

**Maximum Temperature:** 1300°F (704°C)

**Maximum Length:** 120" (3048 mm)

**Nominal Diameter:** .250" (6.4 mm)

**Maximum Recommended Wattage:** 10 W/linear inch  
Some applications can go higher; consult Tempco.

**Wattage Tolerance:** + 5%, - 10%

**Resistance Tolerance:** + 10%, - 5%

**Standard Leads:** 10" fiberglass w/stainless steel over braid, 450°C (842°F)

##### Silicone Rubber Insulated Rope Heater

The silicone rubber insulated version is designed to withstand wet or moist applications. Internal construction is identical to the single element rope heater except for the use of a silicone rubber sleeving.

**Maximum Temperature:** 325°F (163°C)

**Maximum Length:** 300" (7620 mm)

**Nominal Diameter:** .165" (4.2 mm)

**Maximum Recommended Wattage:** 3 W/linear inch  
Some applications can go higher; consult Tempco.

**Wattage Tolerance:** + 5%, - 10%

**Resistance Tolerance:** + 10%, - 5%

**Standard Leads:** 10" silicone rubber

#### Options — Lead End Connections

##### Type RT

Ring Terminal



##### Type ST

Spade Terminal



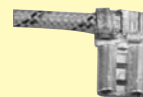
##### Type QTA

1/4" Female Straight Quick Disconnect



##### Type QTB

1/4" Female Right-Angle Quick Disconnect



Various types of crimp terminals can be attached to the heater leads to make wiring into applications quick and easy.

Insulated and non-insulated types are available. *Specify* insulation type and size (#6, #8, or #10) when ordering. Consult Tempco with your requirements.

#### Ordering Information

##### Custom Engineered/Manufactured Rope Heaters

Understanding that an electric heater can be very application specific, **TEMPCO** will design and manufacture a Rope Heater to meet your requirements.

**Standard lead time is 3 weeks.**

**Please Specify** the following:

- |  |  |   |
|--|--|---|
| <input type="checkbox"/> Quantity            | <input type="checkbox"/> Heated Length | <input type="checkbox"/> Lead Material              |
| <input type="checkbox"/> External Insulation | <input type="checkbox"/> Watts         | <input type="checkbox"/> Lead Length                |
| <input type="checkbox"/> Overall Length      | <input type="checkbox"/> Volts         | <input type="checkbox"/> Optional Lead Terminations |



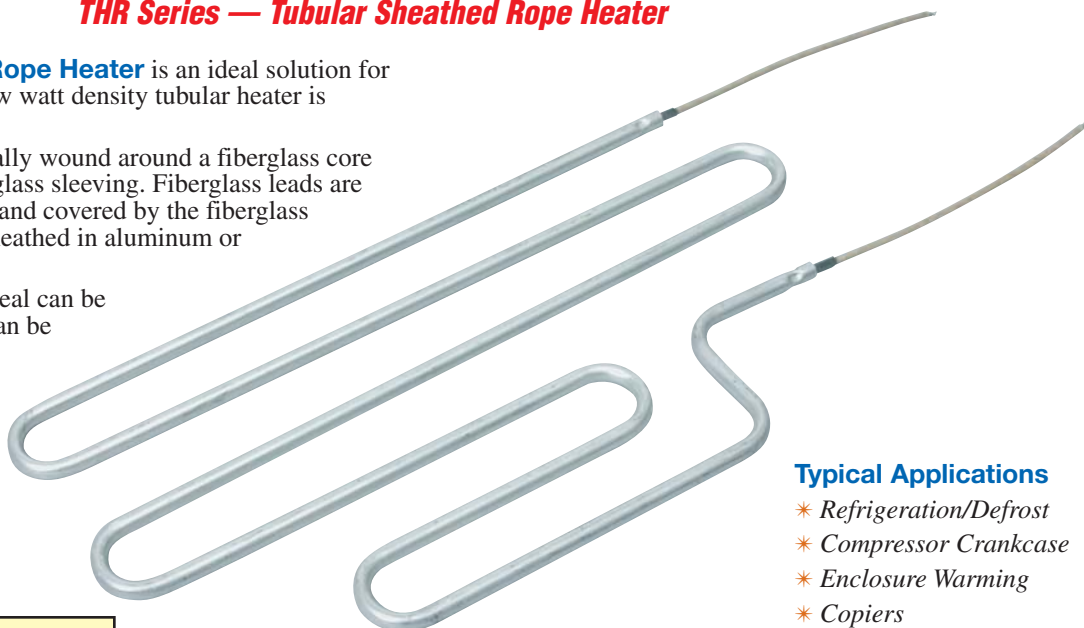
## Rope Heaters

### THR Series — Tubular Sheathed Rope Heater

Tempco's **Tubular Sheathed Rope Heater** is an ideal solution for applications where a low cost, low watt density tubular heater is required.

A resistive alloy element is helically wound around a fiberglass core and covered with a layer of fiberglass sleeving. Fiberglass leads are crimped onto the resistance wire and covered by the fiberglass sleeving. The assembly is then sheathed in aluminum or stainless steel tubing.

For wet or moist applications, a seal can be added to the tubing. The heater can be formed to any shape standard tubular elements can be formed to. (see page 10-8 for standard configurations). Distributed wattage heaters can be manufactured to compensate for special heat losses.



#### Typical Applications

- \* Refrigeration/Defrost
- \* Compressor Crankcase
- \* Enclosure Warming
- \* Copiers
- \* Blueprint Machines

#### Options — Lead End Connections

##### Type RT

Ring Terminal



##### Type ST

Spade Terminal



##### Type QTA

1/4" Female Straight Quick Disconnect



##### Type QTB

1/4" Female Right-Angle Quick Disconnect



Various types of crimp terminals can be attached to the heater leads to make wiring into applications quick and easy.

Insulated and non-insulated types are available. *Specify* insulation type and size (#6, #8, or #10) when ordering. Consult Tempco with your requirements.

#### Specifications

**Standard Diameters:** .250" (6.4 mm), .375" (9.5 mm)

**Minimum Forming Radius:** 0.5" (12.7 mm) – .250" Dia., 1.0" (25.4 mm) – .375" Dia.

**Maximum Recommended Wattage:** 5 W/linear in. (.250" Dia.)  
8 W/linear in. (.375" Dia.)

**Maximum Temperature:** Aluminum 550°F (287.8°C)  
Stainless Steel 750°F (398.9°C)

**Maximum Length:** 150" (3810 mm)

**Nominal Diameter:** .300" (7.62 mm) 120V or 240V

**Maximum Recommended Wattage:** 8 W/linear inch  
Some applications can go higher; consult Tempco.

**Voltage:** 120 and 240VAC Standard

**Wattage Tolerance:** +5%, -10%

**Resistance Tolerance:** +10%, -5%

**Standard Leads:** 10" Fiberglass, 450°C (842°F)

#### Ordering Information

**Custom  
Engineered/Manufactured  
Tubular Sheathed Rope Heaters**

Understanding that an electric heater can be very application specific, **TEMPCO** will design and manufacture a Tubular Sheathed Rope Heater to meet your requirements.  
**Standard lead time is 3 weeks.**

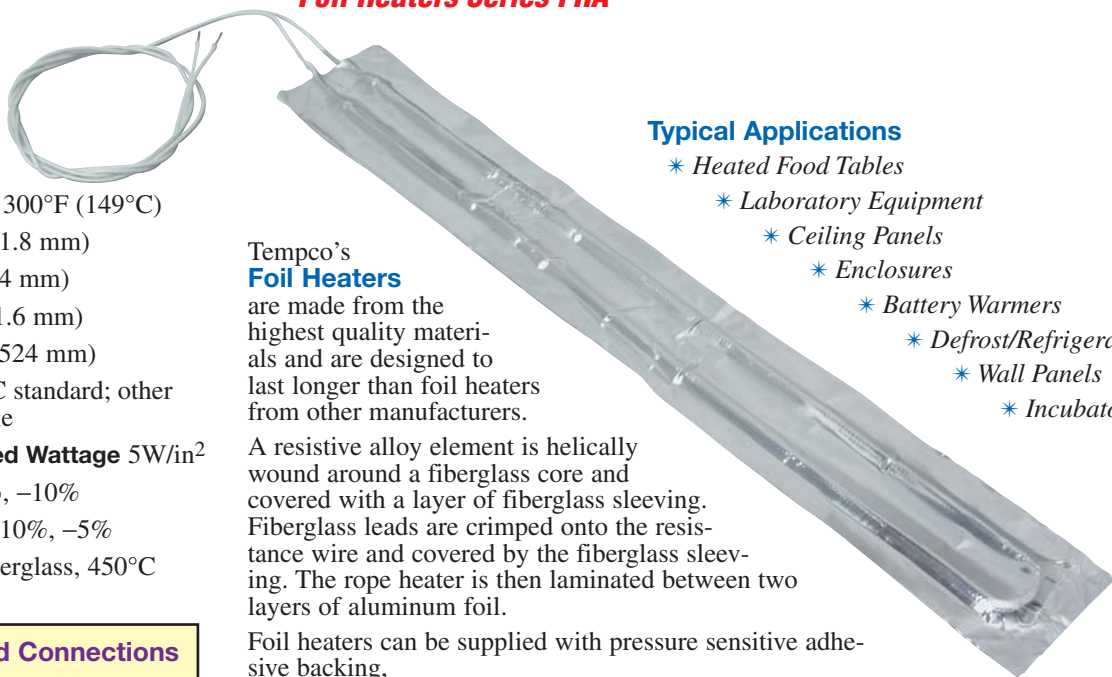
**Please Specify** the following:

- |                                   |  |   |
|-----------------------------------|--|---|
| <input type="checkbox"/> Quantity | <input type="checkbox"/> Watts           | <input type="checkbox"/> Lead Length                |
| <input type="checkbox"/> Length   | <input type="checkbox"/> Volts           | <input type="checkbox"/> Optional Lead Terminations |
| <input type="checkbox"/> Diameter | <input type="checkbox"/> Sheath Material | <input type="checkbox"/> Bend Configuration         |





### Foil Heaters Series FHA



#### Specifications

**Maximum Temperature:** 300°F (149°C)  
**Minimum Width** 1.25" (31.8 mm)  
**Maximum Width** 36" (914 mm)  
**Minimum Length** 4" (101.6 mm)  
**Maximum Length** 60" (1524 mm)  
**Voltage:** 120 and 240VAC standard; other voltages available  
**Maximum Recommended Wattage** 5W/in<sup>2</sup>  
**Wattage Tolerance:** +5%, -10%  
**Resistance Tolerance:** +10%, -5%  
**Standard Leads:** 10" Fiberglass, 450°C

#### Typical Applications

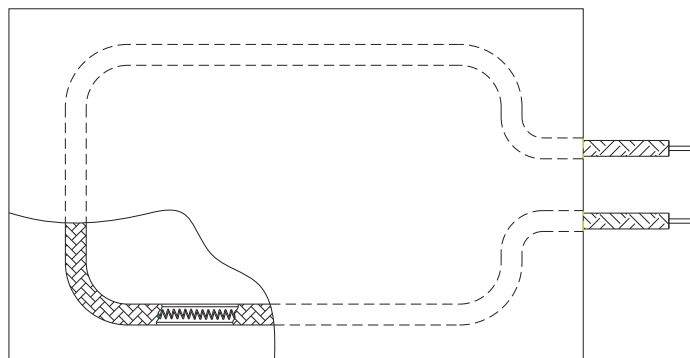
- \* Heated Food Tables
- \* Laboratory Equipment
- \* Ceiling Panels
- \* Enclosures
- \* Battery Warmers
- \* Defrost/Refrigeration
- \* Wall Panels
- \* Incubators

#### Tempco's Foil Heaters

are made from the highest quality materials and are designed to last longer than foil heaters from other manufacturers.

A resistive alloy element is helically wound around a fiberglass core and covered with a layer of fiberglass sleeving. Fiberglass leads are crimped onto the resistance wire and covered by the fiberglass sleeving. The rope heater is then laminated between two layers of aluminum foil.

Foil heaters can be supplied with pressure sensitive adhesive backing, thermostats, holes, cutouts, or thermostats. They are used where a low cost, economical heat source for area or surface heating is required.



#### Options — Lead End Connections

##### Type RT

Ring Terminal



##### Type ST

Spade Terminal



##### Type QTA

1/4" Female Straight Quick Disconnect



##### Type QTB

1/4" Female Right-Angle Quick Disconnect



Various types of crimp terminals can be attached to the heater leads to make wiring into applications quick and easy.

Insulated and non-insulated types are available. **Specify** insulation type and size (#6, #8, or #10) when ordering. Consult Tempco with your requirements.

#### Structure

1. Aluminum foil
2. Flexible woven fiberglass sleeving
3. High grade resistance wire element wound on a fiberglass core.
4. High temperature fiberglass leads

#### Ordering Information

**Custom  
Engineered/Manufactured  
Foil Heaters**

Understanding that an electric heater can be very application specific, **TEMPCO** will design and manufacture a Foil Heater to meet your requirements.

**Standard lead time is 3 weeks.**

**Please Specify** the following:

- |                                   |  |   |
|-----------------------------------|--|---|
| <input type="checkbox"/> Quantity | <input type="checkbox"/> Watts         | <input type="checkbox"/> Lead Length                |
| <input type="checkbox"/> Length   | <input type="checkbox"/> Volts         | <input type="checkbox"/> Optional Lead Terminations |
| <input type="checkbox"/> Width    | <input type="checkbox"/> Lead Material | <input type="checkbox"/> Special Requirements       |

# Flexible Heaters



## Adhesive Backed Heating Tape

### Electrical Resistance Heating Tape — Adhesive Backed

#### Designed For High Heat Transfer

All electrical resistance elements create heat, but some systems are better at transferring this energy. The secret to this heating tape is in its thermally conductive adhesive and its outer reflective sheath.

The adhesive surrounds the resistance wire and transfers the thermal energy directly to the surface of the load. The resistance wire itself has a back and forth kink that acts as a spring to absorb expansion and contraction.

The outer aluminum sheath spreads heat evenly over the entire surface of the tape and also reflects heat back onto the load.

The end result is a highly efficient heating source with maximum heat being transferred to the desired material.



#### Typical Applications

- \* Cylinder wrap ideal for tubes, pipes or vessels.
- \* Placed directly on PVC, PTFE plastic pipe without the need for other material.
- \* Excellent for prototype engineering, placing heat exactly where it is needed.
- \* Even heating throughout the length of a heated hose for hot wax handling, food processing, hot melt and other plastic processing.
- \* De-fogging, de-icing, fuel line warming.
- \* Acrylic product approved by NASA for space flight.
- \* Acrylic low outgassing perfect for vacuum applications.

#### Product Types

**4 Conductor Tape** 1/2" (12.7 mm) wide; has the highest watt density and the most variety of resistances. It can have leads at one end in the case of a series connection or a series/parallel connection, or leads at either end in a parallel connection.

The tightest wrap this tape can achieve is on a 1/4" (6.3 mm) O.D. surface. A smaller tube should be wrapped with 1/4" (6.3 mm) or 1/6" (4.2 mm) tape.

**2 Conductor Tape** 1/4" (6.3 mm) wide; has leads on one end in the series connection, and leads at both ends for parallel connections. This tape will wrap down to 1/8" (3.17 mm) O.D.

**1 Conductor Tape** 1/6" (4.2 mm) wide; can wrap down to .060" (1.52 mm) O.D. A lead will be present at both ends.

Typical finished assembly with leads.



#### ADHESIVE SPECIFICATIONS

	Silicone	Acrylic
Operating Temperature Range	-100°C to 250°C -148°F to 482°F	-100°C to 180°C -148°F to 356°F
Outgassing... TML/VCM	1.047%/ .322%	.264%/ .000%
Adhesion to Etched Aluminum (oz/inch width)	28 @ +125°C 450 @ -100°C	29 @ +125°C 50 @ -100°C
Overall Thickness Applied	.025" (.63 mm)	.028" (.71 mm)
Dielectric Strength	600 Vdc	600 Vdc

#### General Purpose Wattage Calculations for Tube and Pipe Heating

$$T_p = P \times L \times \Delta T$$

**T<sub>p</sub>** = Total Watts Required

**P** = Watts per lineal foot of tube per °F temp. rise (see chart below)

**L** = Length of tube in feet

**ΔT** = Temperature rise, °F above ambient

**To Find P:** Look at the intersection of Tube O.D. and Insulation thickness.

Insulation Thickness	Tube Outside Diameter			
	1/4"	1/2"	1"	2"
Bare	.10	.13	.21	.40
1/2"	.07	.09	.13	.20
1"	—	.05	.08	.11



**Note:** This is for estimating power requirements only. Confirmation by prototype testing is recommended.

• If the temperature rise is over 100 degrees, increase the wattage by 10%.

• For rapid start-up and to allow for colder material entering the hose, increase the wattage by 25% and use a temperature controller with a temperature sensor.

**Warning !!** This product is essentially resistance wire mounted in an adhesive tape and must be designed as a heater prior to purchase.



### Electrical Resistance Heating Tape — Adhesive Backed

#### Engineering Example

A 10 ft. stainless steel braided hose, 1/2" O.D., needs to be heated to 400°F from 70°F. Insulation: 1/2". The voltage is 220V.

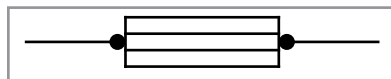
- Determine the Length.** To cover the hose completely would take  $\pi \times 1/2" \times 120" = 188$  sq. in. A 12" length of 1/2" tape would cover 6 sq. in. of hose; therefore, 31 ft. of 1/2" tape would completely cover the hose, spiral wrapped edge to edge.
- Determine the Watts.** Total Power ( $T_p$ ) =  $P \times L \times \Delta T$   
From the chart,  $P = .09$  for a 1/2" hose with 1/2" insulation, therefore  
 $T_p = .09 \times 10 \text{ ft.} \times (400-70) = 297$  Watts. For rapid start-up and to compensate for colder material flowing through the hose, increase the wattage by 25% to 400W.
- Calculate the Ohms per Foot.** The ohms/ft. =  $E^2 \div (T_p \times L)$   
Therefore ohms/ft. =  $220^2 \div (400W \times 31 \text{ ft.}) = 3.9$  ohms per ft.
- Calculate the Watts per Foot.** The Watts per ft. =  $T_p \div L$   
Therefore the watts/ft. =  $400 \text{ watts} \div 31 \text{ ft.} = 12.9$  watts/ft.
- Choose Heat Tape Material from the Table.** From the table, the FTP00035, 1/2" tape with four conductors and silicone adhesive in the parallel/series connection at 4.0 ohm/ft. would fill the requirements. The required 12.9 watts/ft. is well under the maximum rating of 62 watts/ft.



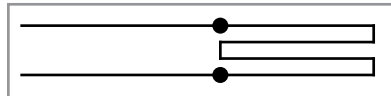
Bulk roll of Heat Tape

#### CHART NOTES

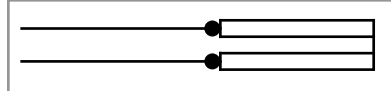
- Ohms per foot with all conductors in a *parallel connection*.



- Ohms per foot with all conductors in a *series connection*.



- Ohms per foot with all conductors in a *parallel pair-series connection*.



determine 1-wire or 2-wire, refer to the number of wires being terminated at the end of the heater. For example, to complete the heater in a parallel connection, (two) 1-wire terminal kits would be required because one lead exits from each end of the heater assembly. The "solderless crimps" are used to complete the non-lead end of the heater. The Heat Transfer Tape is used to provide additional adhesion, placed over the heating tape.

#### Heating Tape — Ohms-per-foot Table

Width		1/8" (4.2 mm)		1/4" (6.3 mm)		1/2" (12.7 mm)			
Number of Conductors		1 conductor		2 conductors		4 conductors			
Part Number		Max.		Ohms/ft.		Ohms/ft.		Ohms/ft.	
50 ft. roll	100 ft. roll	Ohms/ft.	Watts/ft.	(1)	(2)	(1)	(3)	(2)	Watts/ft.
FTP0001	FTP1001	1.9	25	.9	3.8	.5	1.9	7.6	70
FTP0002	FTP1002	3.2	25	1.6	6.4	.8	3.2	12.8	70
FTP0003	FTP1003	4.0	23	2.0	8.0	1.0	4.0	16.0	62
FTP0004	FTP1004	4.9	20	2.4	9.8	1.2	4.9	19.6	52
FTP0005	FTP1005	7.0	25	3.5	14.0	1.7	7.0	28.0	70
FTP0006	FTP1006	8.8	23	4.4	17.6	2.2	8.8	35.2	62
FTP0007	FTP1007	10.8	20	5.4	21.6	2.7	10.8	43.2	52
FTP0008	FTP1008	13.2	20	6.6	26.4	3.3	13.2	52.8	52
FTP0009	FTP1009	21.3	13	10.6	42.6	5.3	21.3	85.2	32
FTP0010	FTP1010	26.8	10	13.4	53.6	6.7	26.8	107.2	25

Terminal kits are required to terminate the bulk tape into a finished heater assembly. To

#### Accessories

**Terminal Kit for 1-wire 2-wire**  
**Additional solderless crimps**  
**Aluminum/Silicone Heat Transfer Tape**

**16-20 Ga.** FTP00911 FTP00912 FTP00920  
**22-26 Ga.** FTP00913 FTP00914 FTP00921  
**3/4" x 27 ft.** FTP00930  
**1-1/4" x 27 ft.** FTP00931

#### Ordering Information

##### Bulk Heat Tape

Heat Tape can be ordered in **bulk in 50 or 100 ft. rolls** or in custom assemblies. The part number for each item is completed by filling in the ☐ with a number from the following table to detail adhesive type and tape width:

- 1—silicone, 1/8" wide (1 cond.) 2—acrylic, 1/8" wide (1 cond.)  
3—silicone, 1/4" wide (2 cond.) 4—acrylic, 1/4" wide (2 cond.)  
5—silicone, 1/2" wide (4 cond.) 6—acrylic, 1/2" wide (4 cond.)

##### Custom Engineered/Manufactured Heaters

Understanding that an electric heater can be very application specific, for sizes and ratings not listed, **TEMPCO** will design and manufacture custom Heating Tape assemblies to meet your requirements — ready to install.  
**Standard lead time is 4 to 5 weeks.**

For a quote, **Please Specify** the following:

- ☐ Application Information ☐ Wattage Requirements  
☐ Lead Information



# Flexible Heaters



## High Temperature Heating Tape

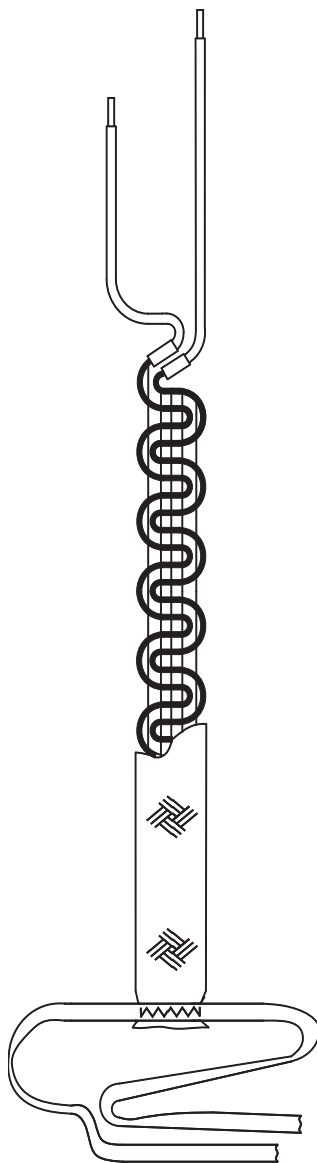
### Flexible Heating Tape — Duo-Tape®

#### Design Features:

- \* 1400°F (760°C) temperature rating
- \* 2 ft. (610 mm) long high temperature lead wires on one end
- \* Highly flexible & rugged, knitted design
- \* High, medium and low watt density designs
- \* Constant wattage (min. ohm change cold to hot)

#### Typical Applications:

- \* Laboratory, general application
- \* Research and Development
- \* Pilot plant research heaters
- \* High temperature hose heating
- \* Industrial applications, anywhere high temperature and flexibility are required (non-hazardous and dry locations only)



#### Tempco Heating Tapes

We provide high temperature, flexible electric heating elements. They were developed to offer the unique convenience of wrap-on heat for tubing, laboratory apparatus or any dry environment application where flexible surface spot heat is required.

Heating tapes are offered in many standard sizes, having watt densities from 3.25 to 13 watts per square inch, and temperature ratings to 1400°F (760°C).

#### CONSTRUCTION

The construction begins with bundled, fine strand resistance wire, 37 to 40 gauge, covered with a minimum of 2 layers of high temperature braided AMOX yarn. The insulated resistance wire is then knitted into a serpentine configuration, forming a flat tape. Once the lead wires are attached, most tapes have an additional braided, dielectric protection layer of AMOX yarn for use on conductive (metal) surfaces.

#### DURABILITY FEATURE

Unlike other straight element heating wires and tapes, knitting allows for cushioning during heating and cooling. The element expands in all directions rather than one, virtually eliminating “thermal growth.” In addition, knitting prevents the tape from tensile stress when stretched (a typical problem of elements applied to flexible hoses).

#### LOW WATT DENSITY, WELL DISTRIBUTED HEAT FEATURE

Knitting allows dense distribution of wire per unit length of tape. This feature provides longer life resulting from lower watts per inch of wire. (A typical 1-inch-wide tape may contain 10 inches (25.4 cm) of wire element.)

#### DUO-TAPE®

Duo-Tape® is a breakthrough design innovation that allows two wires to be knitted side by side. The advantage is that the lead wires may be attached on the same end rather than opposite ends. The balance of the tape is constructed the same as the other single wire tapes.

#### OPTIONS

- 1. Plug** A 120V plug can be ordered on indicated heaters only as a custom assembly. Since the leads of the Duo-Tape® are on one end, the plug is a single molded unit.
- 2. Lead Wire** Standard lead wire length is 2 ft. (61 cm)



**Note:** When a plug is requested, lead wire length may be 2 ft. or shorter. Optional lengths may be ordered to 8 ft. For special length, width, watts or volts—contact **Tempco**.



### Flexible Heating Tape — Duo-Tape®

#### Duo-Tape® Standard (Non-Stock) Sizes and Ratings

Part Numbers in table are for heaters without plugs.

Plugs are available for 120V heaters only.

Watt Density	Size	Watts	Part Number	
			120V	240V
13.00 W/in <sup>2</sup>  2.0 W/cm <sup>2</sup>	½" × 2'	156	FTF00101	FTF00107
	½" × 4'	312	FTF00102	FTF00108
	½" × 6'	468	FTF00103	FTF00109
	½" × 8'	624	FTF00104	FTF00110
	½" × 10'	780	—	FTF00111
	½" × 12'	936	—	FTF00112
	½" × 16'	1248	—	FTF00113
	1" × 2'	312	FTF00105	FTF00114
	1" × 4'	624	FTF00106	FTF00115
	1" × 6'	936	—	FTF00116
8.67 W/in <sup>2</sup>  1.3 W/cm <sup>2</sup>	1" × 8'	1248	—	FTF00117
	½" × 2'	104	FTF00118	—
	½" × 4'	208	FTF00119	FTF00125
	½" × 6'	312	FTF00120	FTF00126
	½" × 8'	416	FTF00121	FTF00127
	½" × 10'	520	FTF00122	FTF00128
	½" × 12'	624	—	FTF00129
	½" × 16'	832	—	FTF00130
	1" × 2'	208	FTF00123	FTF00131
	1" × 4'	416	FTF00124	FTF00132
3.25 W/in <sup>2</sup>  .50 W/cm <sup>2</sup>	1" × 6'	624	—	FTF00133
	1" × 8'	832	—	FTF00134
	1" × 10'	986	—	FTF00135
	½" × 2'	39	FTF00136	—
	½" × 4'	78	FTF00137	FTF00147
	½" × 6'	117	FTF00138	FTF00148
	½" × 8'	156	FTF00139	FTF00149
	½" × 10'	195	FTF00140	FTF00150
	½" × 12'	234	FTF00141	FTF00151
	½" × 16'	312	FTF00142	FTF00152
	1" × 2'	78	FTF00143	FTF00153
	1" × 4'	156	FTF00144	FTF00154
	1" × 6'	234	FTF00145	FTF00155
	1" × 8'	312	FTF00146	FTF00156
	1" × 10'	385	—	FTF00157
	1" × 12'	468	—	FTF00158
	1" × 16'	624	—	FTF00159



Typical Duo-Tape® assembly including ties



Example of internal construction before covering

### Ordering Information

#### Standard Heaters

Choose the Duo-Tape® Heater from the above table that meets your needs. Specify Part Number.

#### Custom Engineered/Manufactured Heaters

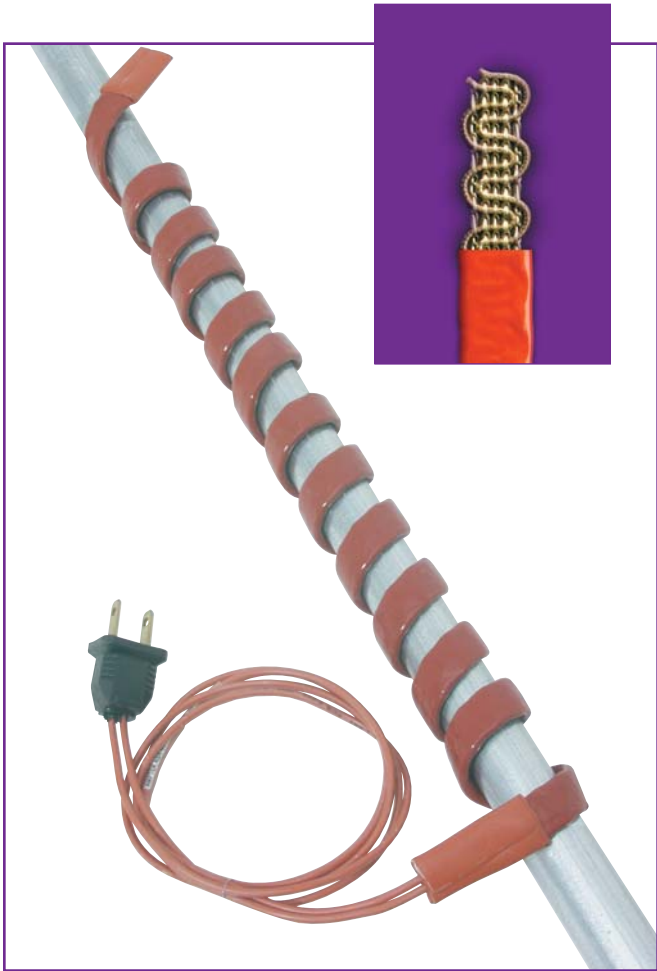
Understanding that an electric heater can be very application specific, for sizes and ratings not listed, **Tempco** will design and manufacture a Duo-Tape® Heater to meet your requirements. **Standard lead time is 2 to 3 weeks.**

**Please Specify** the following:

- ☐ Application
- ☐ Length
- ☐ Wattage
- ☐ Voltage
- ☐ Termination
- ☐ Leads
- ☐ Crimp Connectors



### Duo-Tape® — Silicone Rubber Insulated Flexible Heating Tapes



The same proven internal design of all Duo-Tapes® of knitted Amox yarn over serpentine resistance is used. The heavy silicone rubber extruded outer cover provides abrasion and dielectric protection for the heating element.

**Silicone Rubber Duo-Tapes** may be used on conductive surfaces, and in applications where moisture, chemical and abrasion resistance is required.

#### Design Features:

- \* 400°F (204°C) temperature rating, non-energized exposure to 500°F (2608C)
- \* 2 ft. (610 mm), 16 gauge, 600 VAC silicone rubber insulated leads
- \* Vulcanized fiber reinforced silicone rubber end cap
- \* Standard low watt density of 4.3 w/inch<sup>2</sup>
- \* All standard 120Volt units are provided with plug
- \* Multi strand wire element for maximum flexibility
- \* Highly flexible and durable design

#### Standard Sizes — with 2 ft. leads, 120V only with plug

Watt Density	Size		Watts	Part Number	
	US	Metric(CM)		120V	240V
4.3 W/in <sup>2</sup>  0.67 W/cm <sup>2</sup>	.5" × 2 ft.	1.3 × 60	52	FTF20001	—
	.5" × 4 ft.	1.3 × 120	104	FTF20002	FTF20022
	.5" × 6 ft.	1.3 × 180	156	FTF20003	FTF20023
	.5" × 8 ft.	1.3 × 240	208	FTF20004	FTF20024
	.5" × 10 ft.	1.3 × 300	260	FTF20005	FTF20025
	.5" × 12 ft.	1.3 × 360	312	FTF20006	FTF20026
	.5" × 14 ft.	1.3 × 420	364	FTF20007	FTF20027
	.5" × 16 ft.	1.3 × 480	416	FTF20008	FTF20028
	.5" × 18 ft.	1.3 × 540	468	FTF20009	FTF20029
	.5" × 20 ft.	1.3 × 600	520	FTF20010	FTF20030
	.5" × 24 ft.	1.3 × 720	624	FTF20011	FTF20031
	1" × 2 ft.	2.5 × 060	104	FTF20012	FTF20032
	1" × 4 ft.	2.5 × 120	208	FTF20013	FTF20033
	1" × 6 ft.	2.5 × 180	312	FTF20014	FTF20034
	1" × 8 ft.	2.5 × 240	416	FTF20015	FTF20035
	1" × 10 ft.	2.5 × 300	520	FTF20016	FTF20036
	1" × 12 ft.	2.5 × 360	624	FTF20017	FTF20037
	1" × 14 ft.	2.5 × 420	728	FTF20018	FTF20038
	1" × 16 ft.	2.5 × 480	832	FTF20019	FTF20039
	1" × 18 ft.	2.5 × 540	936	FTF20020	FTF20040
	1" × 20 ft.	2.5 × 600	1040	FTF20021	FTF20041

