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# Flexible Heaters



section



## Tempco Flexible Heaters: Silicone Rubber & 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. 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.

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—a desired requirement for applications where precise temperature control is important to the overall quality of the application. Flexible Heaters are not affected by mechanical shock, vibration or repeated flexing and will not stretch or tear over a temperature range of -70°F to +500°F (-56.6°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. This flexibility allows you to design a heating element literally around the shape and size of the system, machine and/or component part.

#### 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.

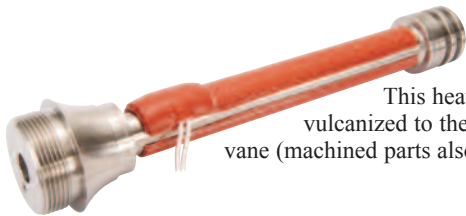
*Tempco's Flexible Heaters offer unlimited design possibilities!*

#### Agency Approvals

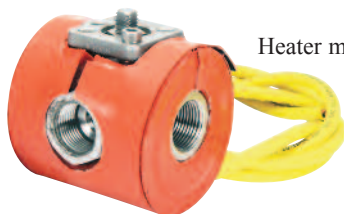


Tempco SHS, DHR & EHR Silicone Rubber Heaters are UL Recognized in the USA and for Canada under UL File Number E65652 (UL499) Component Recognition Program, and CSA Recognized under CSA File Number 043099.

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



This heater, used for freeze protection, is vulcanized to the shaft in the base of a weather vane (machined parts also available from Tempco).

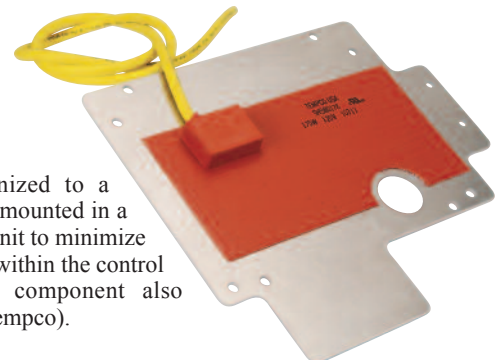


Heater manifold 3D formed for use on a snow making machine.



Heater vulcanized to black anodized aluminum for food-prep station (metal component also supplied by Tempco).

This formed heater is used to remove condensation on a vacuum canister.



Heater vulcanized to a metal plate is mounted in a refrigeration unit to minimize condensation within the control panel (metal component also supplied by Tempco).



## Typical Applications

### Flexible Heater Construction Characteristics

The texture of the fiberglass/silicone material can be “smooth” or “rough”. Smooth silicone tends to be more flexible and stain resistant. Rough silicone has a more durable texture. Standard construction of a plain wire-wound flexible heater is made with rough silicone. Smooth silicone is standard for heaters with PSA, vulcanized to a metal plate or other options or constructions that are deemed necessary by engineering. If smooth silicone is desired, please specify when ordering.

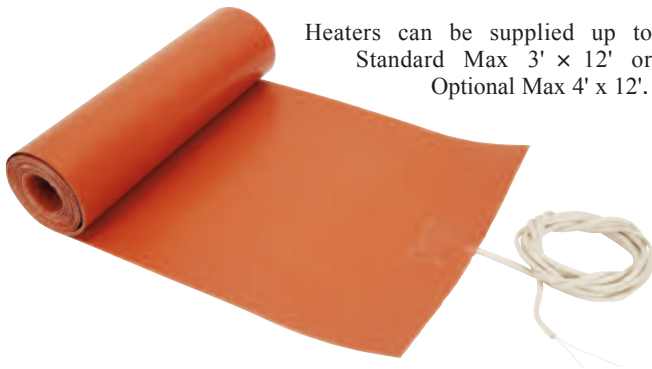
Flexible silicone rubber heaters can be produced using different material thicknesses and texture. Multiple layers can be applied for a thicker heater application. Overlapping the perimeter by 1/2" with the outer layers of a four-layer construction are more “moisture resistant” than standard two-layer construction giving that additional seal around the internal heater. Example: a 10" x 10" heater sandwiched between 11" x 11" outer layers.

The internal heat distribution pattern(s) allows for the heater element wire to be placed as close as 5/32" from the edge 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 are produced in two heating element choices: wire-wound elements and etched foil elements (see page 9-4).

### Typical Applications

- Aerospace
- Air Horns
- Aircraft Comfort Heaters
- Airplane Propeller Repair
- Animal Feeders
- ATM Machines
- Autoclaves
- Automotive
- Battery Heaters
- Computer Memory Planes
- Copy Machines
- Credit Card Scanners
- 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
- Outdoor Antennas
- Packaging Machinery
- Photo Processing
- Recovery Systems
- Refrigeration Equipment
- Security Equipment
- Semiconductor Equipment
- Shoe Machinery
- Turbine Propeller Repair
- Vacuum Chamber
- Vending Machines
- X-Ray Processing

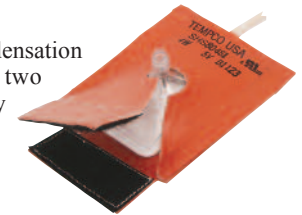


Heaters can be supplied up to  
Standard Max 3' x 12' or  
Optional Max 4' x 12'.



An insulating heater used  
on a compressor pump to  
prevent freezing in Siberia.

Round heater with a center hole used in air horns for motorized vehicles such as Trains, Semi Trucks, or RVs where the leads need to go through the center.



Small heater used to remove condensation in a gas filter is designed with two holes, two slits & Velcro® for easy installation while filter is in use.



Cone heater used on  
a soup dispenser kettle.



Formed heater with six thermocouples for six-zone control used to refurbish airplane propellers by applying heat to cure an epoxy compound that attaches a new nickel lead edge to the propeller blade.



## Flexible Heater Design Guide

### Standard Flexible Heater Specifications

#### SHS Silicone Rubber Heater Specifications

##### Physical Size and Construction Limitations

<b>Maximum Size:</b>	<i>Wire:</i> 36" × 144" (91.4 × 366 cm) <i>Foil:</i> 10" × 22" (25.4 × 56.9 cm)
<b>Dimensional Tolerance:</b>	
<b>Less than 6":</b>	±0.030" (0.76 mm)
<b>6" to 12":</b>	±0.060" (1.52 mm)
<b>Over 12":</b>	±0.125" (3.17 mm)
<b>Nominal Thickness:</b>	<i>Wire:</i> 0.056" (1.42 mm) <i>Foil:</i> 0.030" (0.76 mm)
<b>Available Thickness:</b>	0.018" to 0.112" (0.46 mm to 2.85 mm)
<b>Weight:</b>	7 oz./ft <sup>2</sup> (0.21g/cm <sup>2</sup> )

##### Performance Ratings

<b>Maximum Operating Temperature:</b>	500°F / 260°C Intermittent 392°F / 200°C Continuous
<b>Minimum Operating Temperature:</b>	-70°F / -56.6°C
<b>Physically Resistant To:</b>	Moisture, Ozone, Fungus, Radiation
<b>Agency Approvals:</b>	UL File #E65652 (wire-wound only)

##### Electrical Ratings

<b>Resistance Tolerance:</b>	<i>Wire:</i> +10%, -5% <i>Foil:</i> +10%, -10%
<b>Maximum Operating Voltage:</b>	<i>Wire:</i> 600 VAC <i>Foil:</i> 480 VAC
<b>Dielectric Strength:</b>	1000 VAC
<b>Standard Leads:</b>	10" Teflon® Insulated Stranded Wire

#### SHK Kapton® Heater Specifications

##### Physical Size and Construction Limitations

<b>Maximum Size:</b>	10" × 22" (25.4 × 56.9 cm)
<b>Dimensional Tolerance:</b>	
<b>Less than 6":</b>	±0.030" (0.76 mm)
<b>6" to 12":</b>	±0.060" (1.52 mm)
<b>Over 12":</b>	±0.125" (3.17 mm)
<b>Nominal Thickness:</b>	0.008" (0.20 mm)
<b>Weight:</b>	1.5 oz./ft <sup>2</sup> (0.05g/cm <sup>2</sup> )

##### Performance Ratings

<b>Maximum Operating Temperature:</b>	392°F / 200°C Continuous
<b>Minimum Operating Temperature:</b>	-320°F / -195°C
<b>Physically Resistant To:</b>	Moisture, Ozone, Fungus

##### Electrical Ratings

<b>Resistance Tolerance:</b>	+10%, -10%
<b>Maximum Operating Voltage:</b>	480 Vac
<b>Dielectric Strength:</b>	1000 Vac
<b>Standard Leads:</b>	10" Teflon® Insulated Stranded Wire
<b>Maximum Resistance Density for Heaters with Etched Foil Element:</b>	125 Ω/in <sup>2</sup>



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

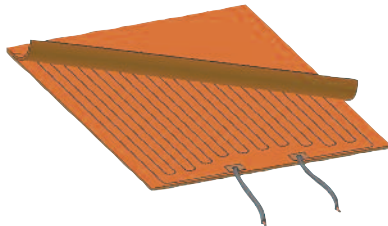
#### Wire-Wound Element Construction ●●●●●●●●●●

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, medium to large size heaters, and to produce prototypes to prove out the design parameters prior to entering into large volume production runs when using etched foil.

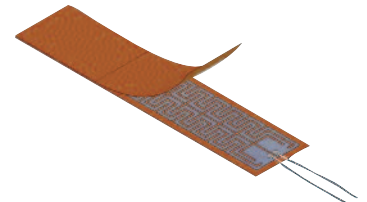


#### Etched Foil Element Construction ●●●●●●●●●●

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. The etched foil process is recommended for small size heaters in large quantities.





### 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" x 12" x 0.5" (3.53 lb.) 200°F (from 70° to 270°F) in 0.5 hours:

$$\text{Watts} = \frac{3.53 \text{ lbs.} \times (0.24 \text{ Btu/lb.}^\circ\text{F}) \times 200^\circ\text{F}}{3.412 \text{ btu/watt hr.} \times 0.5 \text{ hrs.}} = 99 \text{ watts}$$

Add safety margin: 99 W + 25% = 124 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" x 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.

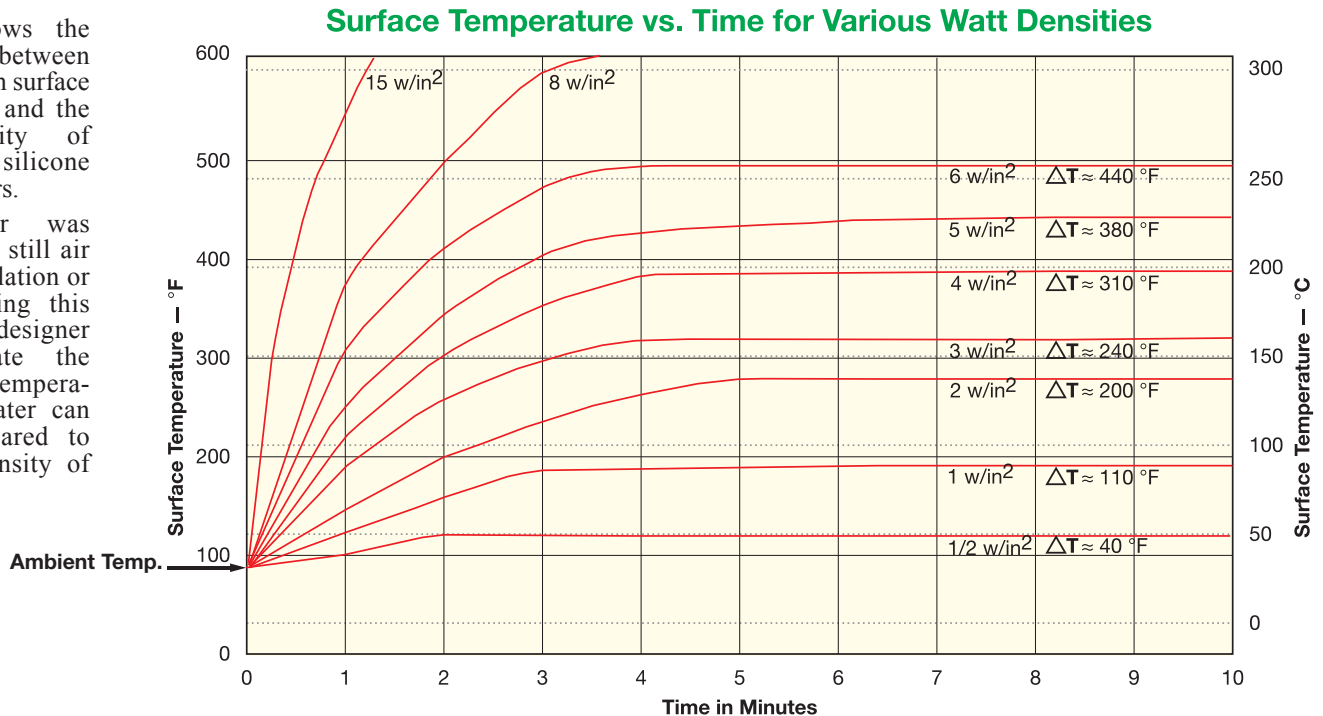
Referring to the chart below for a wire wound silicone rubber heater, pressure sensitive adhesive mounting should work well for this application at the required temperature.

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

### 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.



ΔT = Temperature Rise From Ambient at Specified Watt Densities

**CONTINUED** →



### Flexible Heater Wattage Recommendations

Continued from previous page...

#### Suggested Maximum Watt Density by Heater Type and Mounting Method

Watt Density w/in <sup>2</sup>	Silicone Rubber – Wire Element		Silicone Rubber – Foil Element		Kapton® – Foil Element	
	Vulcanized	PSA	Vulcanized	PSA	Acrylic PSA	Acrylic PSA with 3 mil Aluminum Foil
5	420 to 356°F (216 to 180°C)	350 to 335°F (177 to 168°C)	455 to 419°F (235 to 215°C)	350 to 320°F (177 to 160°C)	212 to 189°F (100 to 87°C)	302 to 275°F (150 to 135°C)
10	356 to 266°F (180 to 130°C)	335 to 248°F (168 to 120°C)	419 to 383°F (215 to 195°C)	320 to 293°F (160 to 145°C)	189 to 163°F (87 to 73°C)	275 to 257°F (135 to 125°C)
15	266 to 158°F (130 to 70°C)	248 to 140°F (120 to 60°C)	383 to 347°F (195 to 175°C)	293 to 266°F (145 to 130°C)	163 to 131°F (73 to 55°C)	257 to 230°F (125 to 110°C)
20	158 to 68°F (70 to 20°C)	140 to 32°F (60 to 0°C)	347 to 311°F (175 to 155°C)	266 to 239°F (130 to 115°C)	131 to -25°F (55 to -32°C)	230 to 194°F (110 to 90°C)
25	68 to -40°F (20 to -40°C)	32 to -49°F (0 to -45°C)	— —	— —	— —	194 to 167°F (90 to 75°C)
30	— —	— —	311 to 257°F (155 to 125°C)	239 to 185°F (115 to 85°C)	— —	167 to 125°F (75 to 52°C)
35	— —	— —	— —	— —	— —	125 to 86°F (52 to 30°C)
40	— —	— —	257 to 185°F (125 to 85°C)	185 to 104°F (85 to 40°C)	— —	86 to -25°F (30 to -32°C)
50	— —	— —	185 to 50°F (85 to 10°C)	104 to -40°F (40 to -40°C)	— —	— —
60	— —	— —	50 to -49°F (10 to -45°C)	-40 to -49°F (-40 to -45°C)	— —	— —



**Note:** Use an appropriate Temperature Controller for the application.

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

Silicone Rubber Heaters listed have 10" Teflon® Insulated Stranded Lead Wires exiting at Location L (see page 9-9).

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

**Silicone Rubber  
Rounds**





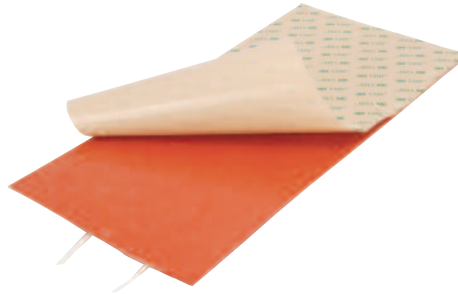
### Stock Square & Rectangular Silicone Rubber Heaters

Standard Smooth Silicone Rubber Heater

Heater with Pressure Sensitive Adhesive (PSA) Backing

Maximum Operating Temperature: 450°F (232°C)

Maximum Operating Temperature: 300°F (149°C)



Use an appropriate method of temperature control to prevent heaters from exceeding maximum operating temperature. Reference Surface Temperature vs. Watt Density graph on page 9-5.



### Stock Silicone Rubber Heaters — Standard Smooth and with Pressure Sensitive Adhesive Backing (PSA)

Silicone Rubber Heaters listed are 120 Volt and have 10" Teflon® Insulated Stranded Lead Wires exiting at Location A (see page 9-9).

Width		Length		Watts	Watt Density w/in <sup>2</sup>	Part Number	
in.	mm	in.	mm			Standard (No PSA)	With PSA Backing
2	51	2	51	10	2.5	SHS80293	SHS80294
2	51	2	51	20	5	SHS80295	SHS80296
3	76	3	76	25	2.5	SHS80297	SHS80298
3	76	3	76	45	5	SHS80299	SHS80300
3	76	3	76	90	10	SHS80301	SHS80302
6	152	6	152	90	2.5	SHS80303	SHS80304
6	152	6	152	180	5	SHS80305	SHS80306
6	152	6	152	360	10	SHS80307	SHS80308
9	229	9	229	200	2.5	SHS80309	SHS80310
9	229	9	229	400	5	SHS80311	SHS80312
9	229	9	229	800	10	SHS80313	SHS80314
10	254	10	254	250	2.5	SHS80315	SHS80316
10	254	10	254	500	5	SHS80317	SHS80318
10	254	10	254	1000	10	SHS80319	SHS80320
12	305	12	305	360	2.5	SHS80321	SHS80322
12	305	12	305	720	5	SHS80323	SHS80324
12	305	12	305	1440	10	SHS80325	SHS80326
1	25	3	76	10	2.5	SHS80327	SHS80328
1	25	3	76	15	5	SHS80329	SHS80330
1	25	3	76	30	10	SHS80331	SHS80332
1	25	6	152	15	2.5	SHS80333	SHS80334
1	25	6	152	30	5	SHS80335	SHS80336
1	25	6	152	60	10	SHS80337	SHS80338
1	25	9	229	25	2.5	SHS80339	SHS80340
1	25	9	229	50	5	SHS80341	SHS80342
1	25	9	229	90	10	SHS80343	SHS80344
1	25	12	305	30	2.5	SHS80345	SHS80346
1	25	12	305	60	5	SHS80347	SHS80348
1	25	12	305	120	10	SHS80349	SHS80350
1	25	18	457	45	2.5	SHS80351	SHS80352
1	25	18	457	90	5	SHS80353	SHS80354
1	25	18	457	180	10	SHS80355	SHS80356
1	25	24	610	60	2.5	SHS80357	SHS80358
1	25	24	610	120	5	SHS80359	SHS80360
1	25	24	610	240	10	SHS80361	SHS80362
1	25	30	762	75	2.5	SHS80363	SHS80364
1	25	30	762	150	5	SHS80365	SHS80366
1	25	30	762	300	10	SHS80367	SHS80368

Width		Length		Watts	Watt Density w/in <sup>2</sup>	Part Number	
in.	mm	in.	mm			Standard (No PSA)	With PSA Backing
1	25	48	1219	120	2.5	SHS80369	SHS80370
1	25	48	1219	240	5	SHS80371	SHS80372
1	25	48	1219	480	10	SHS80373	SHS80374
1	25	60	1524	150	2.5	SHS80375	SHS80376
1	25	60	1524	300	5	SHS80377	SHS80378
1	25	60	1524	600	10	SHS80379	SHS80380
1	25	72	1829	180	2.5	SHS80381	SHS80382
1	25	72	1829	360	5	SHS80383	SHS80384
1	25	72	1829	720	10	SHS80385	SHS80386
2	51	6	152	30	2.5	SHS80387	SHS80388
2	51	6	152	60	5	SHS80389	SHS80390
2	51	6	152	120	10	SHS80391	SHS80392
2	51	9	229	45	2.5	SHS80393	SHS80394
2	51	9	229	90	5	SHS80395	SHS80396
2	51	9	229	180	10	SHS80397	SHS80398
2	51	12	305	60	2.5	SHS80399	SHS80400
2	51	12	305	120	5	SHS80401	SHS80402
2	51	12	305	240	10	SHS80403	SHS80404
3	76	6	152	45	2.5	SHS80405	SHS80406
3	76	6	152	90	5	SHS80407	SHS80408
3	76	6	152	180	10	SHS80409	SHS80410
3	76	9	229	70	2.5	SHS80411	SHS80412
3	76	9	229	140	5	SHS80413	SHS80414
3	76	9	229	280	10	SHS80415	SHS80416
3	76	12	305	90	2.5	SHS80417	SHS80418
3	76	12	305	180	5	SHS80419	SHS80420
3	76	12	305	360	10	SHS80421	SHS80422
6	152	12	305	180	2.5	SHS80423	SHS80424
6	152	12	305	360	5	SHS80425	SHS80426
6	152	12	305	720	10	SHS80427	SHS80428
6	152	24	610	360	2.5	SHS80429	SHS80430
6	152	24	610	720	5	SHS80431	SHS80432
6	152	24	610	1440	10	SHS80433	SHS80434
9	229	12	305	270	2.5	SHS80435	SHS80436
9	229	12	305	540	5	SHS80437	SHS80438
9	229	12	305	1080	10	SHS80439	SHS80440
12	305	24	610	720	2.5	SHS80441	SHS80442
12	305	24	610	1440	5	SHS80443	SHS80444

# Flexible Heaters



## Standard Sizings and Ratings

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



**Kapton  
Rounds**

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	48.54	506.7	393	SHK00115	SHK00127

## KAPTON FLEXIBLE HEATERS



**Kapton  
Squares  
and  
Rectangle**

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

### 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 9-9) and no mounting option.

#### Custom Engineered/Manufactured Heaters

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 Lead End Termination Options

Tempco's standard lead termination is stripped lead ends — 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

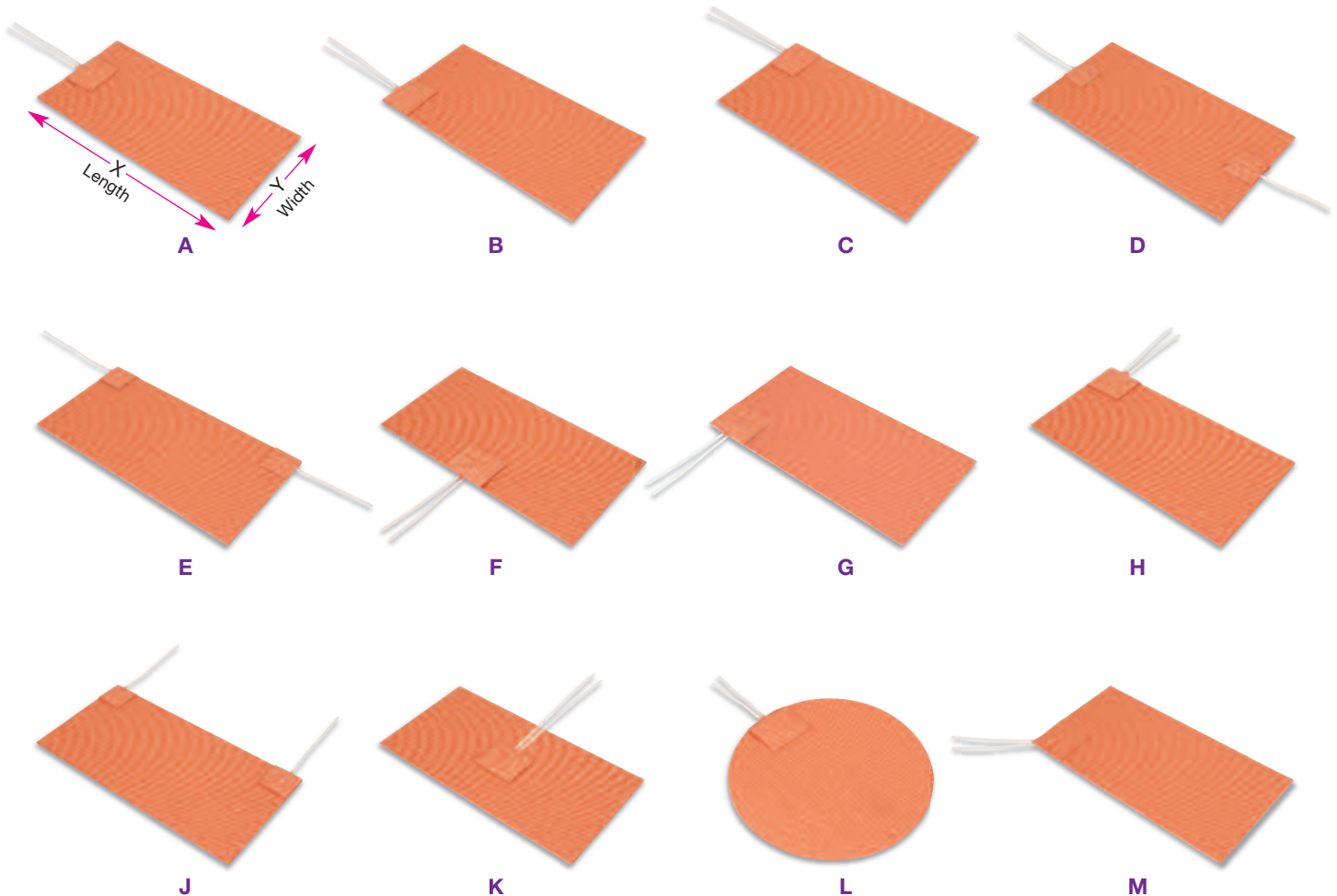
#### Plugs:

- 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



- Notes:**
1. Oriented so X is always greater than Y.
  2. Specify lead exit location using identification letters A through M.
  3. Provide a sample and/or drawing indicating power leads or cord set exit location for shapes other than those shown above.



## Lead and Termination Options

### Flexible Heater Lead Options

#### Standard Leads — Teflon®

Tempco's standard leads are 10" long, Teflon® insulated, flexible, stranded, plated copper wire. Stripped: 1/4"

- UL1180 rated 300V 200°C
- UL1199 rated 600V 200°C

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.



### Optional Leads



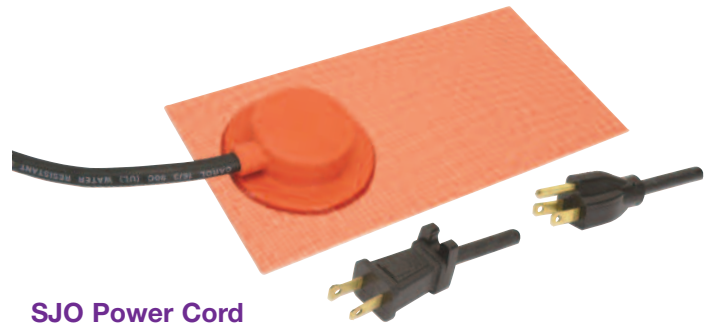
#### HPN Cord

For portable heaters, a two-conductor neoprene cordset can be vulcanized to the heater in any desired length.

#### HPN Cord and Plug Set

A two-conductor neoprene cord and plug set can be vulcanized to the heater. Standard Length: 6 ft. (1.83 M), 7 ft. (2.13M), or custom length as specified. Supplied with standard straight blade ungrounded plug, or grounded plug. 120Vac only.

- 2-Pole 2 wire non-grounding (NEMA 1-15P)
- 2-Pole 3 wire grounding (NEMA 5-15P)



#### SJO Power Cord

For industrial applications, SJO heavy duty power cords can be attached to the heaters in any desired length.

#### SJO Power Cord and Plug Set

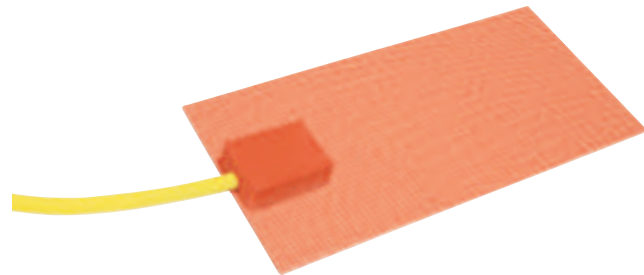
SJO heavy duty power cord and plug set can be attached to the heaters. Standard Length: 6 ft. (1.83 M), or custom length as specified. Supplied with standard straight blade ungrounded plug, or grounded plug. 120Vac only. (For 240Vac see page 15-15 for optional plugs)

- 2-Pole 2 wire non-grounding (NEMA 1-15P)
- 2-Pole 3 wire grounding (NEMA 5-1)



#### Silicone Rubber Leads

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 more flexible, but are not as abrasion resistant as Teflon® leads.



#### Built-Up Molded Lead Exit

Used to encase lead exit and optional snap action thermostat. (See page 9-15 for thermostat specifications) Shown with SJO cord rated -50°C to 105°C.

#### Special Lead Options

Special lead wire types and lengths in many configurations can be done. Consult Tempco.

#### 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 Sleeving (356°F/180°C)
- Heat Shrink Sleeving

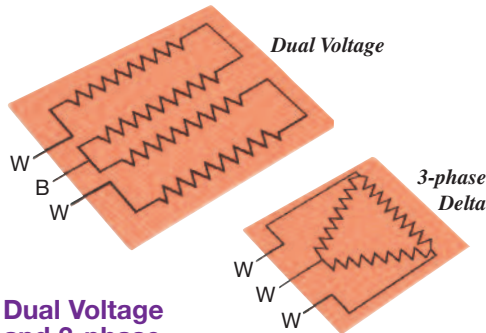
### Flexible Heater Optional Design Features



#### Internal Ground Screen 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 is attached to the grid.

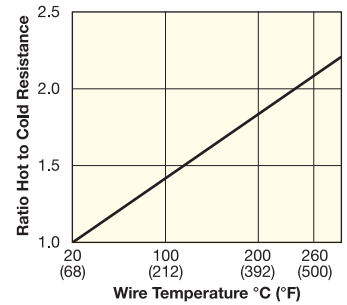
A less expensive alternative for setting up a ground wire, especially for the required ground lead of a cordset, is to have a "flying ground lead" (6" long, green) exit the lead patch for attaching to the metal load surface, effectively grounding the process.



#### Dual Voltage and 3-phase

Due to the flexibility in circuit design for flexible heaters, heating circuits can be designed to accommodate dual voltage. 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. (see page 16-11 for more information)

Three-phase circuits can also be designed for large high-current applications.



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

The alloy used for this heater's 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 Chart for Ratio of Hot to Cold Resistance of the Heater wire at various wire temperatures.



#### Thermal Sponge Insulation and Thermal Conductive Sponge

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".

Thermal Conductive Sponge can be used to transfer heat evenly to various surfaces. Available in 1/8" thickness.



#### Foil Backing

Aluminum foil can be added to the back of 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.



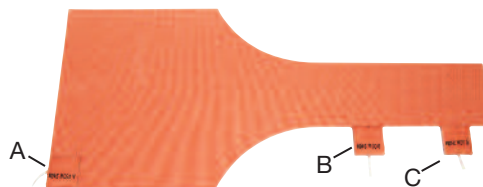
#### Distributed Wattage

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.



#### 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. (Standard 2" x 2")



#### Multiple Zones

Multiple circuit areas can be zoned to compensate for various heating effects desired. In the picture above there are three zones with separate leads (A, B, and C).



#### 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.



## Mounting 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>)



**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.

#### 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.

### Flexible Heater Factory Vulcanizing to Metal Component

#### Factory Vulcanizing

Flexible heaters can be factory vulcanized to bare or anodized aluminum, Stainless Steel, Marble, or other hard 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-102-109** 10.1 ounces  
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





### Flexible Heater Mechanical Fasteners

Various techniques are routinely used when flexible heaters must be detachable from cylindrical parts. The mechanical fastener options include the following:



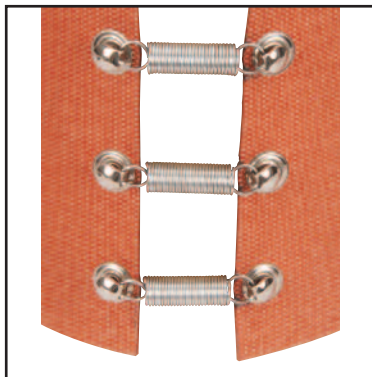
**Heavy Duty D-Rings & 3-Layer Straps**



**Standard D-Rings & 2-Layer Straps**



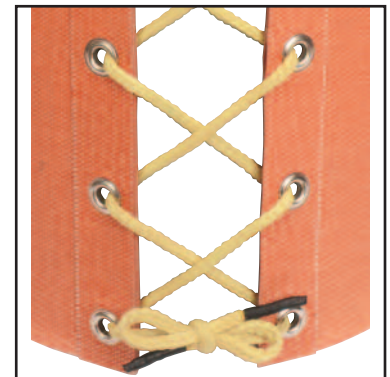
**Velcro® Straps**



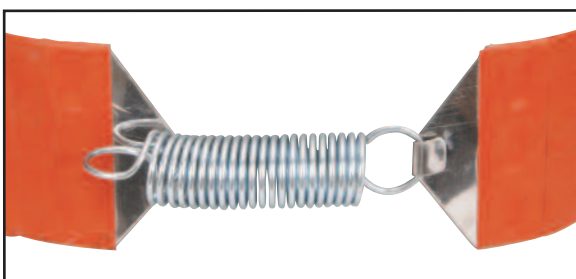
**Boot Hooks & Springs**



**Boot Hooks & Lacing Cord**



**Grommets & Lacing Cord**



**Heavy Duty Spring Clamps**



**Snaps**

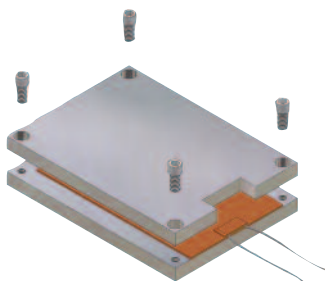
*Consult Tempco for detailed specifications on the mechanical fasteners shown.*

### Flexible Heater Clamping

#### 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.



## Mounting Methods

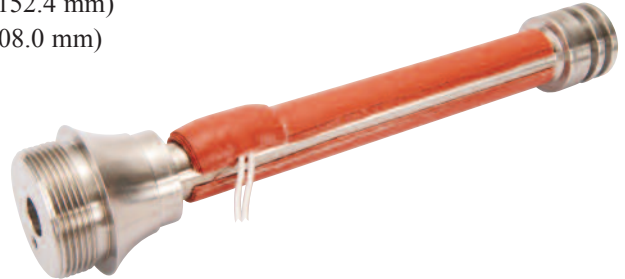
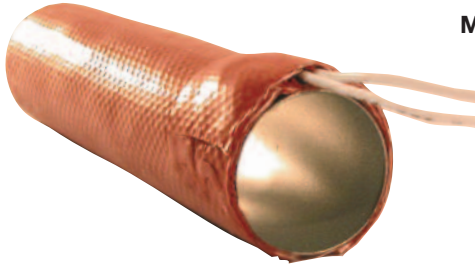
### Outside Diameter Mounting

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

**Minimum Diameter:** 0.5" (12.7 mm)

**Maximum Diameter:** 6" (152.4 mm)

**Maximum Length:** 20" (508.0 mm)

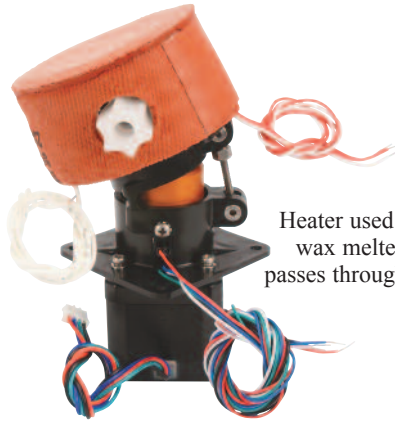


### Flexible Heater Three-Dimensional Configurations

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

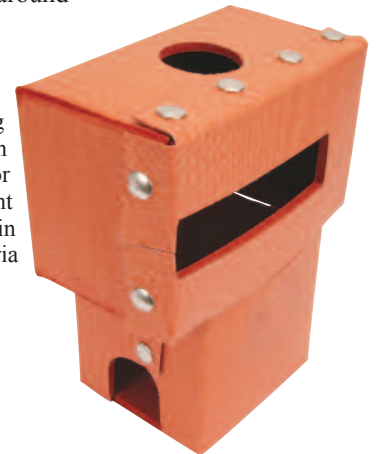


7/8" Hexagon



Heater used to keep wax melted as it passes through a pump

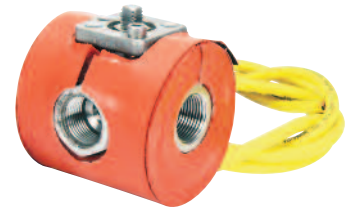
An insulating heater used on a compressor pump to prevent freezing in Siberia



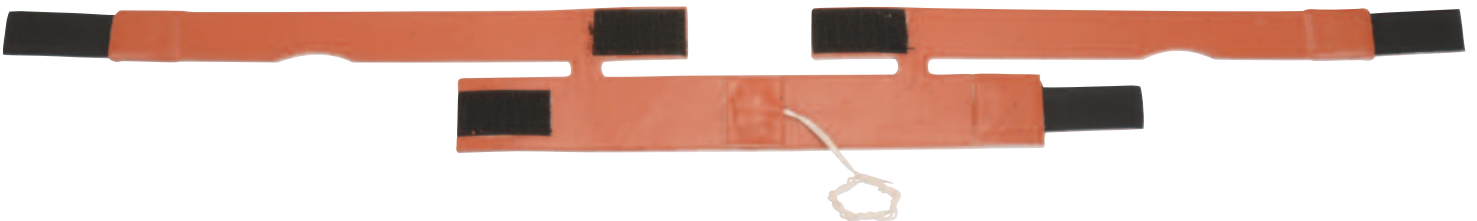
One-Piece Y-Pipe Heater  
(Shown on Pipe at left;  
Shown flat below)



Heater used to remove condensation on a vacuum canister



Heater manifold 3D formed for use on a snow making machine





### Flexible Heater Built-In Temperature Sensors

#### Temperature Sensors

Flexible surface heaters can be manufactured with temperature sensors of various types including thermocouples, RTDs, and thermistors. Thermal fuses can also be incorporated into the design to prevent dangerous temperatures in the event of a control device failure (see page 9-17).

The sensors can be mounted on the heater to sense the temperature of the part being heated or the heater surface temperature itself. 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.)

#### Lead Wire Connectors

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

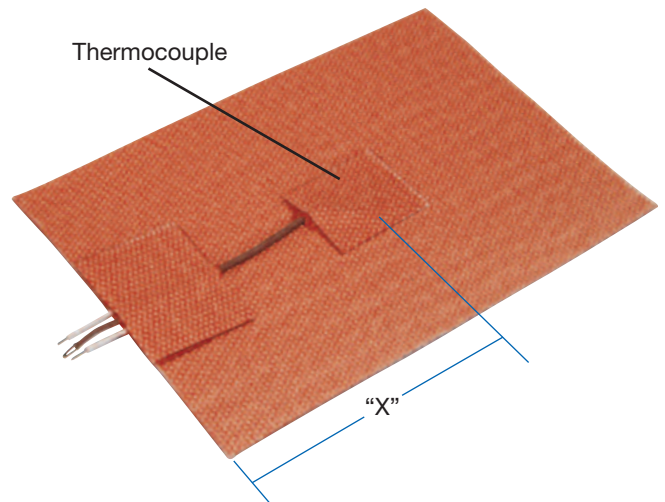
### Sensor Types

#### 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. See page 14-90 for optional plugs.



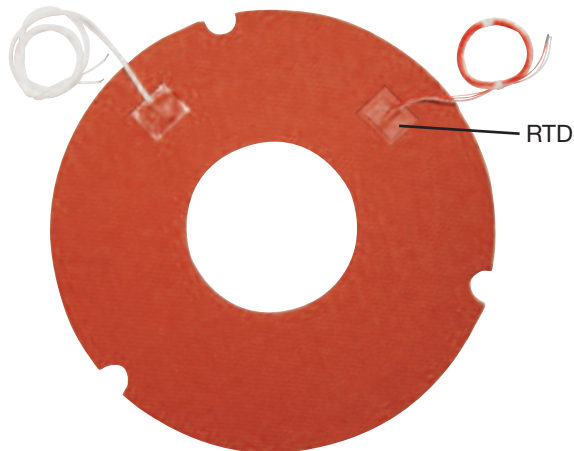
**Note:** Standard length is 10". Specify sensor lead wire length and the distance from where the sensor leads exit the heater to the heater edge (Dimension X) when ordering.



#### RTDs (2- or 3-wire)

The RTDs used are platinum thin film 100 ohm @ 100°C. The standard curve is 0.00385 TCR / DIN432760. Other common RTDs such as 1000 ohm can also be used. Specify when ordering.

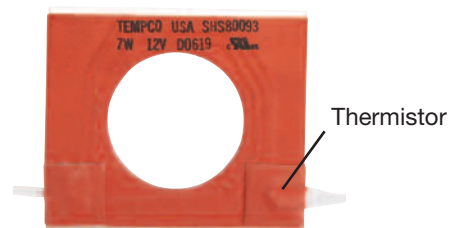
The RTD's resistance increases with a rise in temperature and is considered the most accurate and stable sensor.



#### 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 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.





### Flexible Heater 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, the voltage is over 250V, has a Dual Voltage Design, or is 3-ph, separate leads on the thermostat will be supplied for use with a separate (remote) relay to control the heater (see pages 13-94, 95, 96).

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 type and location when ordering.**



**Note:** If heater amps exceed thermostat electrical ratings, separate leads will be provided for use with a relay (see pages 13-94 through 13-96).

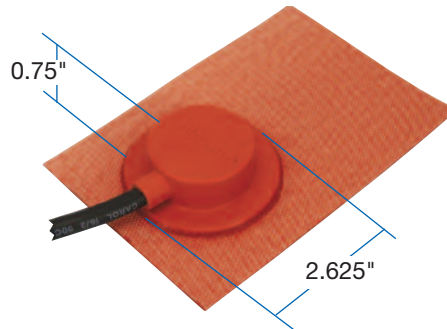
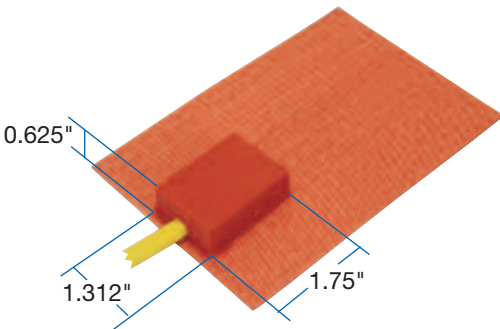
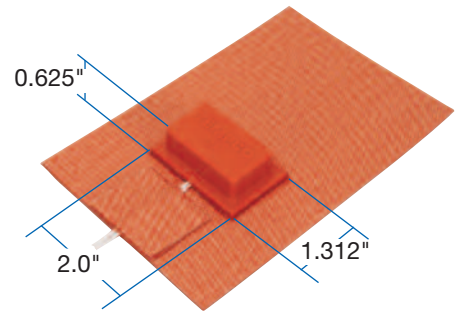
#### Snap Action Thermostat – Automatic Reset

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 13-82)

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

**Minimum Heater Width:** 1.312"



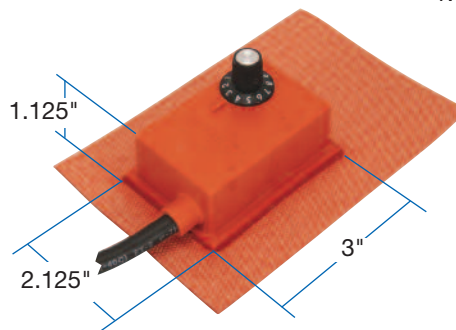
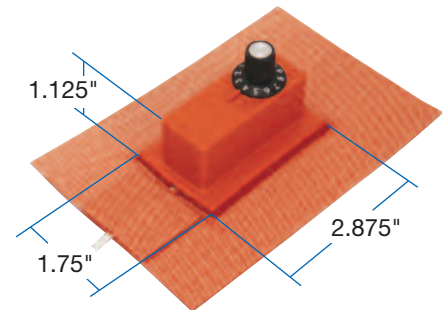
#### Adjustable Thermostat

Adjustable thermostats allow the user to dial-in a specific temperature and attain a desired result. The thermostat is enclosed in a molded silicone rubber housing and permanently attached to the heater. 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 Heater Width:** 1.75" (44.5 mm)







### Flexible Heater Built-In Thermostats

#### Snap Action High Limit Thermostats – Manual Reset

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

**NOTE:** See page 13-83 for stock temperature ratings.

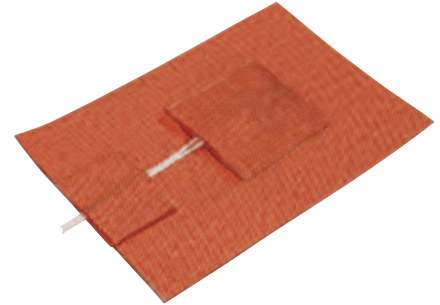


#### Creep Action Thermostat

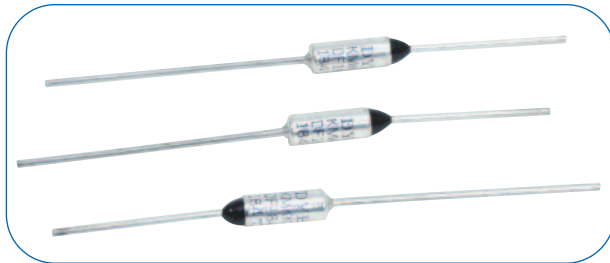
Sustained response, and a slow cutout at the trip point. The creep action thermostat has a slow make/slow break action around setpoint.

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

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



### 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 13-84 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.

**Voltage:** 120/240 Vac

**Maximum Amperage:** 10 Amps, continuous



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

### 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.

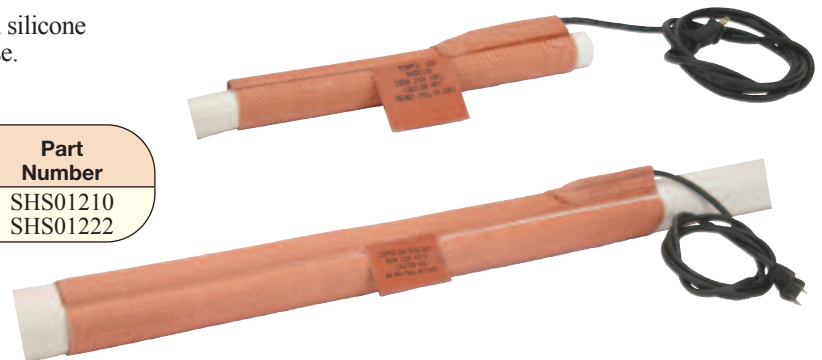
This heavy-duty assembly, made from our proven wire-wound silicone rubber heater technology, will provide hundreds of hours of use.

#### Design Features

- \* Built-in thermostat limits temperature to 194°F (90°C)
- \* Standard Voltage is 120 Vac
- \* 6-ft. plug and cordset standard

#### Stock PVC Pipe Bending Heaters

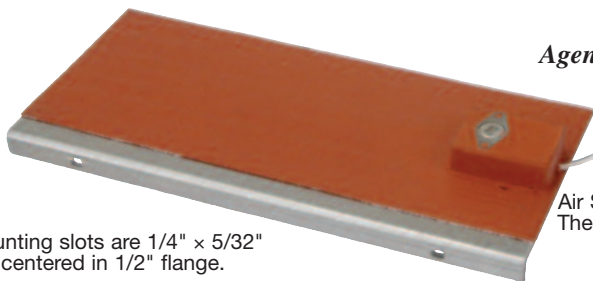
Pipe Diameter	Length	Watts	Volts	Warm-Up Time	Part Number
1/2" to 1-1/2"	12"	180	120	4 – 10 minutes	SHS01210
2" to 4"	20"	950	120	7 – 18 minutes	SHS01222





## Enclosure Heaters

### EHR — Silicone Rubber Enclosure Heater



Mounting slots are 1/4" x 5/32" centered in 1/2" flange.

Agency Approval: US

Built-in Air Sensing Thermostat



#### Design Features

- \* Available with or without an Integrated Thermostat (See EHA below for Remote Thermostats)
- \* 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

#### Standard (Non-Stock) Silicone Rubber Enclosure Heaters

Width	Length	Mounting Center	Watts	Volts	Lead Length	Thermostat (°F)		Part Number
						Opens	Closes	
2½	5	3	25	120	48	—	—	EHR00001
2½	5	3	25	120	48	60	40	EHR00002
2½	5	3	35	120	48	—	—	EHR00003
2½	5	3	50	24	48	—	—	EHR00039
2½	5	3	50	120	48	—	—	EHR00004
2½	5	3	50	120	48	60	40	EHR00005
2½	6	4	60	120	48	—	—	EHR00006
2½	6	4	60	120	48	60	40	EHR00007
2½	6	4	60	120	48	140	110	EHR00008
2½	6	4	60	120	48	180	150	EHR00009
2½	10	7	70	120	48	—	—	EHR00010
2½	10	7	100	12	48	—	—	EHR00049
2½	10	7	100	120	48	—	—	EHR00011
2½	10	7	100	120	48	60	40	EHR00012
2½	10	7	100	230	48	60	40	EHR00028
2½	12	9	80	240	48	60	40	EHR00032
2½	12	9	120	120	48	—	—	EHR00013
2½	12	9	120	120	48	60	40	EHR00014
2½	12	9	120	120	48	140	110	EHR00015
2½	12	9	120	120	48	180	150	EHR00016
2½	12	9	120	240	48	60	40	EHR00034
4½	10	7	140	120	48	—	—	EHR00017
4½	10	7	250	120	48	—	—	EHR00018
4½	10	7	250	120	48	60	40	EHR00019
4½	10	7	250	240	48	140	110	EHR00044

**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.

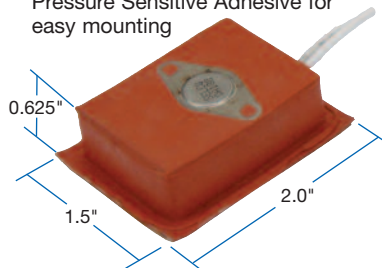
It is recommended that the enclosure heater be used with a thermostat either built in or mounted remotely to limit the maximum temperature reached and conserve energy. The suggested mounting method is at the bottom of the enclosure, mounted vertically. If a remote mounted thermostat is preferred, mount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

### EHA — Remote Thermostats for Enclosure Heaters

#### Design Features

- \* Standard 16ga Teflon® lead length: 48"
- \* Can easily be located anywhere in the enclosure using the pressure sensitive adhesive.
- \* Any standard thermostat can be used (see page 13-82 for available ranges)
- \* Silicone rubber base and enclosure
- \* Ratings: 10A/250 Vac, 15A/120 Vac

Pressure Sensitive Adhesive for easy mounting



EHA00005 D-ring and strap mounting thermostat. Can be applied to sense the air around an object or an object directly.



#### Ordering Information

Select a **Remote Thermostat** from the list at right.

#### Custom Engineered/Manufactured Remote Thermostats

**Standard lead time is 3 weeks. Please Specify** the following:

- Range:** Select from the list of thermostats on page 13-82
- Lead Length:** Specify any special lead length you require.

#### Stock EHA Remote Thermostats

Opens °F	Closes °F	Part Number	
		PSA	D-ring & Strap
60±5	40±7	EHA00001	EHA00005
140±5	110±10	EHA00002	—
180±5	150±10	EHA00003	—



### Composite Curing Flexible Heater Blankets

**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.

#### 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**

#### 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.



#### Typical Applications

- ➔ **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."

#### 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

# Flexible Heaters



## Silicone Rubber Drum Heaters

### Silicone Rubber Drum and Pail Heaters

#### Design Features

- \* Maximum operating temperature of 425°F (218°C).
- \* Power cord is 6-foot long, SJO Type 16/3 complete with three-prong plug for 120 VAC models. Plugs are not included on 240 VAC models but are available (see page 15-15).
- \* Surface grounded electrically with internal ground screen.
- \* 1250 volts dielectric tested.
- \* Vulcanized silicone rubber construction resistant to moisture, ozone, fungus, and radiation.
- \* Adjustable thermostat, see page 9-16 for specifications.

- Built tough
- Resistant to chemicals
- Ratings for Metal and Plastic Drums and Pails
- Easy to clean
- Stock to 2-week lead time

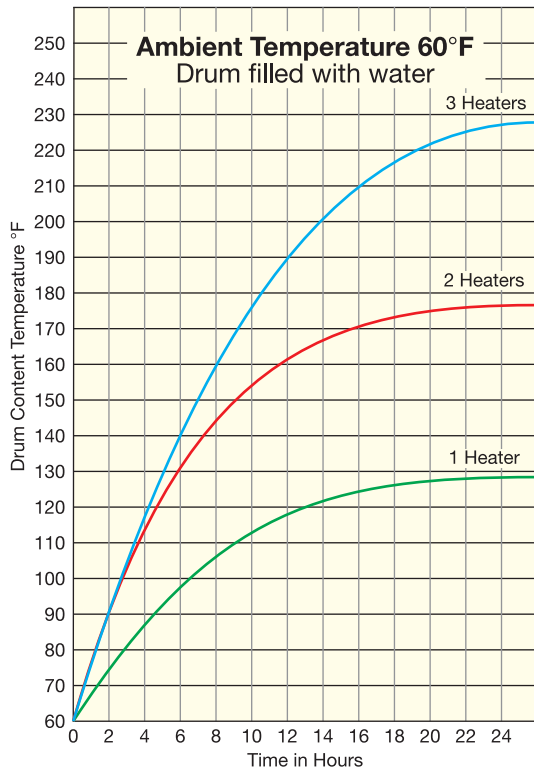
Agency Approval: (See page 9-2 for details)



Tempco 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.



**Note:** Metal Jacketed Drum Heaters and heated Drum Dollies can be found on page 11-122, Drum Immersion Heaters on page 11-123, and Drum Blanket Heaters on page 11-124.

### Standard (Non-Stock) and Stock Drum Heaters for Metal Drums

Stock Items Are Shown In **RED**

Drum Size	Drum Dia.	Heater Width	Heater Length	Watts	Part Number		Thermostat
					120V	240V	
5 Gal.	11.5	3"	31"	300	<b>DHR00150</b>	<b>DHR01010</b>	50-425°F
15 Gal.	13.5	3"	38"	500	<b>DHR00110</b>	DHR00130	50-425°F
30 Gal.	18	3"	52"	750	<b>DHR00070</b>	DHR00090	50-425°F
55 Gal.	22.5	3"	64"	1000	<b>DHR00020</b>	<b>DHR00040</b>	50-425°F
5 Gal.	11.5	3"	31"	300	DHR00140	DHR01041	No
15 Gal.	13.5	3"	38"	500	DHR00100	DHR00120	No
30 Gal.	18	3"	52"	750	DHR00060	DHR00080	No
55 Gal.	22.5	3"	64"	1000	<b>DHR00010</b>	<b>DHR00030</b>	No
5 Gal.	11.5	4"	31"	550	DHR01014	DHR01018	50-425°F
15 Gal.	13.5	4"	38"	700	DHR01013	DHR01017	50-425°F
30 Gal.	18	4"	52"	1000	DHR01012	DHR01016	50-425°F
55 Gal.	22.5	4"	64"	1500	<b>DHR00050</b>	<b>DHR00055</b>	50-425°F
5 Gal.	11.5	9.5"	31"	1000	DHR01023	DHR01047	70-190°F
15 Gal.	13.5	9.5"	38"	1000	DHR01024	DHR01046	70-190°F
55 Gal.	22.5	9.5"	64"	1500	<b>DHR01025</b>	DHR01045	70-190°F

### Standard (Non-Stock) and Stock Drum Heaters for Plastic Pails

Stock Items Are Shown In **RED**

Drum Size	Drum Dia.	Heater Width	Heater Length	Watts	Part Number		Thermostat
					120V	240V	
5 Gal.	11.5	4"	31"	150	DHR01034	DHR01044	50-160°F
15 Gal.	13.5	4"	38"	200	DHR01035	DHR01036	50-160°F
30 Gal.	18	4"	52"	250	DHR01037	DHR01038	50-160°F
55 Gal.	22.5	4"	64"	300	<b>DHR01033</b>	<b>DHR01039</b>	50-160°F
5 Gal.	11.5	9.5"	31"	300	DHR01027	DHR01043	70-140°F
55 Gal.	22.5	9.5"	64"	750	<b>DHR01026</b>	DHR01042	70-140°F

Standard lead time is Stock to 2 weeks.

View Product Inventory @ [www.tempco.com](http://www.tempco.com)



### Hazardous Area Rated Silicone Rubber Drum Heaters

#### Design Features

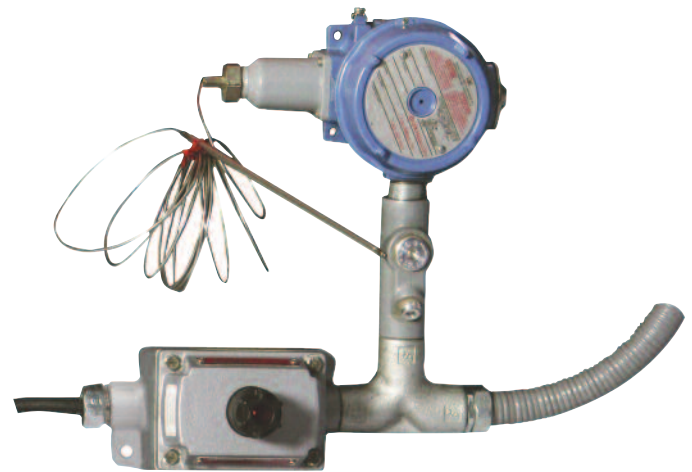
- \* Dual setpoint NEMA 7 temperature controller connected to a high temperature limit indicator light
- \* Extra wide 8" coverage area
- \* Exceptional durability and flexibility
- \* Grounded heating element meets NEC 427.23
- \* Designed for metal drums



#### Hazardous Area Rated

Class I Division 2:  
Groups A, B, C and D

Class II Division 2:  
Groups F and G



NEMA 7 Thermostat Control Assembly with High Limit Indicator Lamp

### Specifications

#### Physical Description

Heating element is laminated between two layers of 23 mil and two layers of 25 mil fiberglass reinforced silicone rubber.

**Power Density:** 2.5W/sq.in.

**Nominal Silicone Rubber Density:** 26 oz/sq.yd.

#### Electrical Ratings

**Wiring from Drum Heater to Controller:** 6 ft. liquid-tight conduit

**Line Cord from Controller Assembly:** 6 ft. industrial power cord

**Line Cord Termination:** 120V – Hazardous area rated 5-15P plug  
240V – No plug, flying leads

#### Thermostat

##### High Limit Thermostat:

- Designed to keep blanket below NEC article 500-T rating:

T Rating	NEC Temperature	Actual High Limit
T3	392°F (200°C)	292°F (145°C)
T4A	248°F (120°C)	158°F (70°C)

- High limit red indicator lamp
- Attached adjustable dual setpoint thermostat NEMA 7 temperature controller. Moisture and chemical resistant.

**Thermostat Range:** 25°-325°F/-4°-163°C, dual scale limited by the "T Rating"

### Ordering Information

Select the part number of the hazardous area silicone rubber drum heater that matches your requirements.

**Standard lead time is 4 weeks.**

### Standard Hazardous Area Rated Drum Heaters

Drum Size Gallons	Drum Dia. in.	Heater Width in.	Heater Length in.	Wattage	Part Number		T-Rating
					120VAC	240VAC	
30	18.6	8	58.5	1000	DHX00101	DHX00201	T-3
55	22.3	8	70.0	1300	DHX00102	DHX00202	T-3
30	18.6	8	58.5	1000	DHX00103	DHX00203	T-4A
55	22.3	8	70.0	1300	DHX00104	DHX00204	T-4A



## Quote Request

### Flexible Heater Quote Request

Made-To-Order Quote Request Form – Copy and Fax (630-350-0232) 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 from page 9-9 & 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 \_\_\_\_\_  
\_\_\_\_\_



### FHA Rope Foil Heaters Series



#### Typical Applications

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

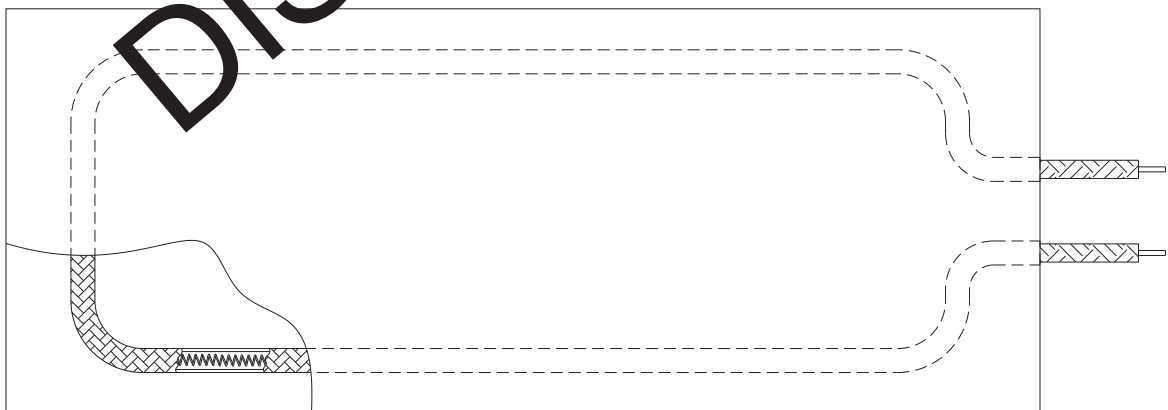
#### Specifications

- 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

Tempco's **Rope 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, or cutouts. They are used where a low cost, economical heat source for area or surface heating is required.



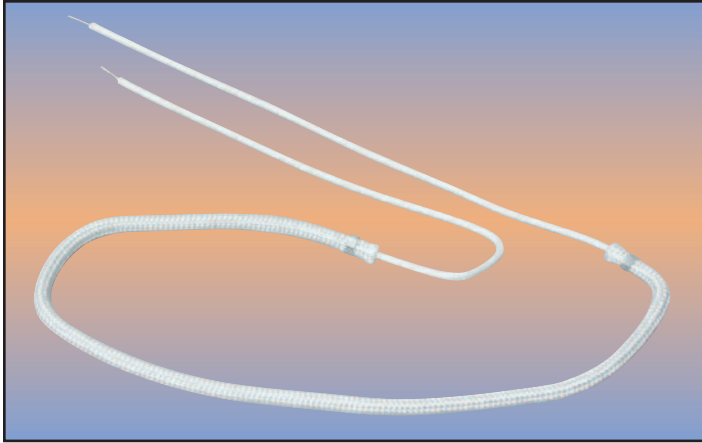
#### Structure

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



## Rope Heaters

### RHR Series — Fiberglass Insulated Rope Heater



#### Typical Applications

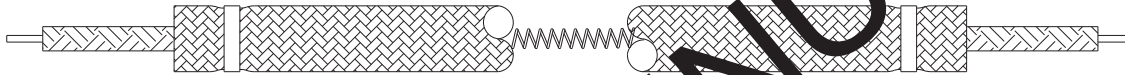
- Appliances
- Incubators
- Laboratory Beakers
- Blueprint Machine Drier Units
- Heat Tracing for Pipes or Tubes
- Valves or Union

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" SS braid over 12" fiberglass leads, 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:** .16" (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%

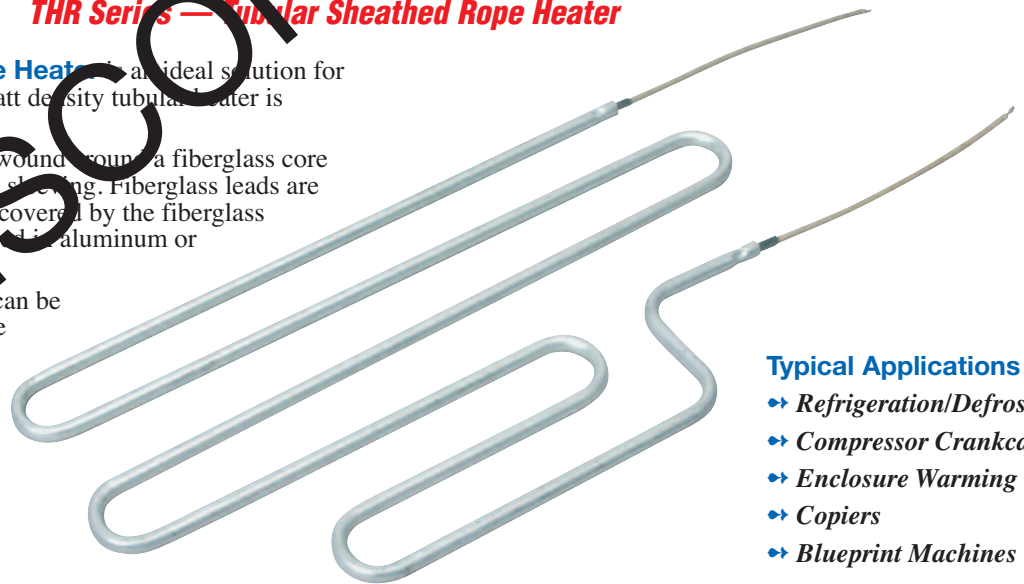
**Standard Leads:** 10" silicone rubber

### 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 10-9 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

##### 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)



## Adhesive Backed Heating Tape

### Electrical Resistance Heating Tape — Adhesive Backed

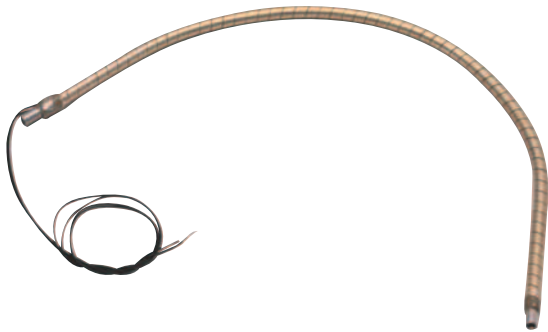
#### Designed For High Heat Transfer

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.

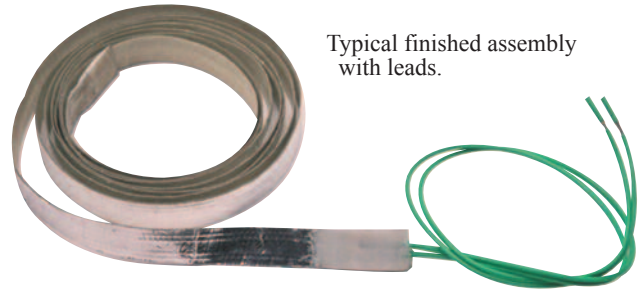
#### Product Types

**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
<b>Operating Temperature Range</b>	-100°C to 250°C -148°F to 482°F	-100°C to 180°C -148°F to 356°F
<b>Outgassing... TML/VCM</b>	1.047%/.322%	.264%/.000%
<b>Adhesion to Etched Aluminum (oz/inch width)</b>	28 @ +125°C 450 @ -100°C	29 @ +125°C 50 @ -100°C
<b>Overall Thickness Applied</b>	.025" (.63 mm)	.028" (.71 mm)
<b>Dielectric Strength</b>	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 !!** FTP Heat Tape is essentially resistance wire in a mountable high temperature adhesive backed tape. In order to be used properly, the heater design must be done and the math worked out, following the example provided.



### 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.

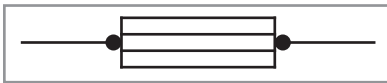


Bulk roll of Heat Tape

#### CHART NOTES

##### Resistance Wiring

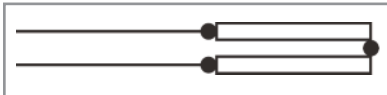
**Type 1.** Ohms per foot, with all conductors in a *Parallel Connection*.



**Type 2.** Ohms per foot, with all conductors in a *Series Connection*.



**Type 3.** Ohms per foot, with all conductors in a *Parallel - Series Pair Connection*.



#### Max. Watts/ft. in Ohms-Per-Foot Table

The maximum wattage per lineal foot is when the heat tape is applied to a metal heat sink at room temperature. Reduce these ratings linearly to zero watts output at 500°F. Adhesion to heat sink along entire length is important to prevent burnout when tape is used near maximum wattage rating.

**Example:** A tape that is 70W/ft. maximum watt density at 74°F, would derate to about 35W/ft. maximum watt density at 250°F.

#### 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. see notes		Ohms/ft. see notes				
50 ft. roll	100 ft. roll	Ohms/ft.	Watts/ft.	(1)	(2)	Max. Watts/ft.	(1)	(2)	Max. Watts/ft.	
FTP0001 <input type="checkbox"/>	FTP1001 <input type="checkbox"/>	1.9	25	.9	3.8	40	.5	1.9	7.6	70
FTP0002 <input type="checkbox"/>	FTP1002 <input type="checkbox"/>	3.2	25	1.6	6.4	40	.8	3.2	12.8	70
FTP0003 <input type="checkbox"/>	FTP1003 <input type="checkbox"/>	4.0	23	2.0	8.0	35	1.0	4.0	16.0	62
FTP0004 <input type="checkbox"/>	FTP1004 <input type="checkbox"/>	4.9	20	2.4	9.8	30	1.2	4.9	19.6	52
FTP0005 <input type="checkbox"/>	FTP1005 <input type="checkbox"/>	7.0	25	3.5	14.0	40	1.7	7.0	28.0	70
FTP0006 <input type="checkbox"/>	FTP1006 <input type="checkbox"/>	8.8	23	4.4	17.6	35	2.2	8.8	35.2	62
FTP0007 <input type="checkbox"/>	FTP1007 <input type="checkbox"/>	10.8	20	5.4	21.6	30	2.7	10.8	43.2	52
FTP0008 <input type="checkbox"/>	FTP1008 <input type="checkbox"/>	13.2	20	6.6	26.4	30	3.3	13.2	52.8	52
FTP0009 <input type="checkbox"/>	FTP1009 <input type="checkbox"/>	21.3	13	10.6	42.6	20	5.3	21.3	85.2	32
FTP0010 <input type="checkbox"/>	FTP1010 <input type="checkbox"/>	26.8	10	13.4	53.6	16	6.7	26.8	107.2	25

#### Accessories

	16-20 Ga.	22-26 Ga.
<b>Terminal Kit for 1-wire</b>	FTP00911	FTP00913
<b>Terminal Kit for 2-wire</b>	FTP00912	FTP00914
<b>Additional solderless crimps</b>	FTP00920	FTP00921
<b>Aluminum/Silicone Heat Transfer Tape</b>	3/4" x 27 ft. FTP00930	1-1/4" x 27 ft. FTP00931

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

#### 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, 1/6" wide (1 cond.) | 2—acrylic, 1/6" 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

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

- Application Information    Wattage Requirements    Lead Information:

# Flexible Heaters



## High Temperature Heating Tape

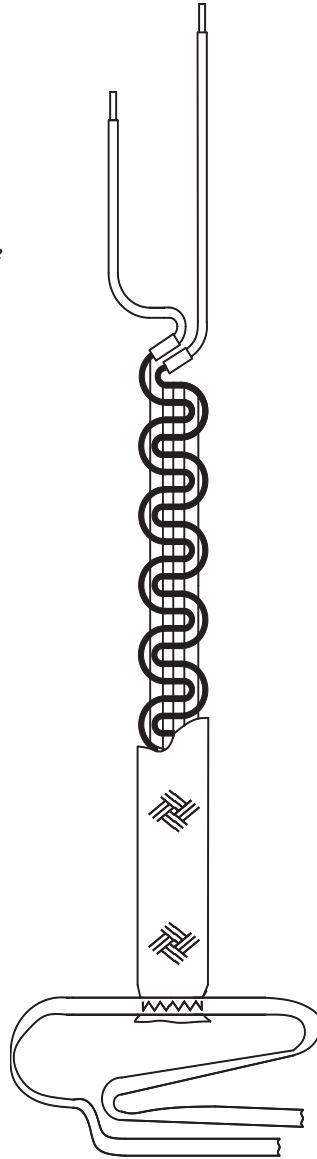
### Flexible Heating Tape — Duo-Tape®

#### 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.

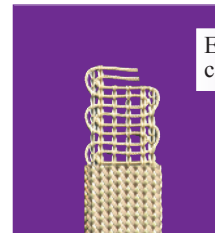
Watt Density	Size	Watts	Part Number	
			120V	240V
13.00 W/in <sup>2</sup>  2.0 W/cm <sup>2</sup>	½" × 2'	156	FTF00101	FTF00107
	½" × 4'	312	FTF00102	FTF00108
	½" × 6'	468	FTF00103	FTF00109
	½" × 8'	624	FTF00104	FTF00110
	½" × 10'	780	—	FTF00111
	½" × 12'	936	—	FTF00112
	½" × 16'	1248	—	FTF00113
	1" × 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>	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
	1" × 6'	624	—	FTF00133
3.25 W/in <sup>2</sup>  .50 W/cm <sup>2</sup>	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	



Flexible Heating Tape Duo-Tape



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

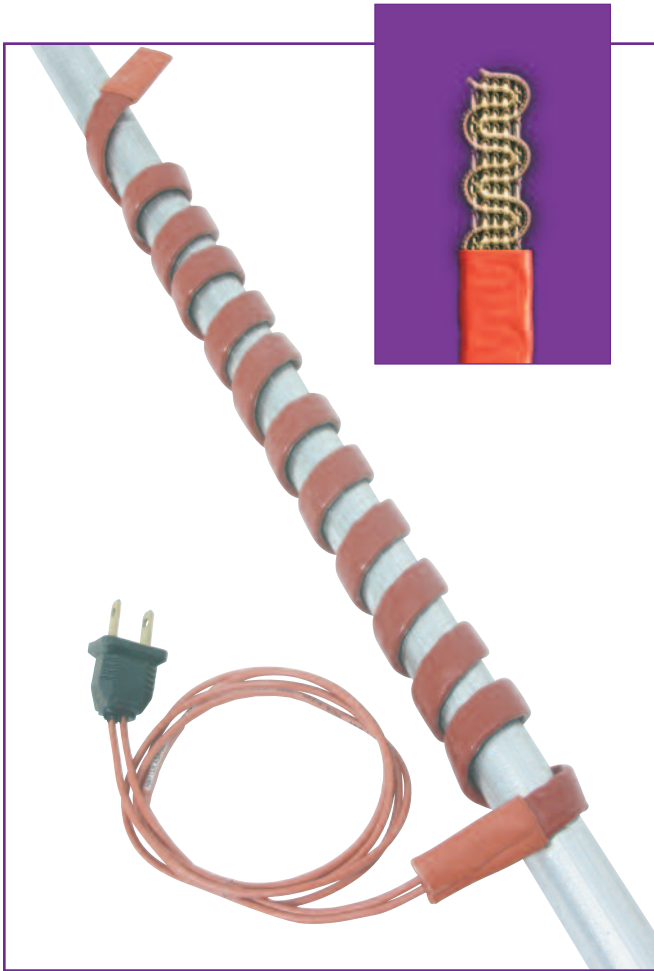
An electric heater can be very application specific; for sizes and ratings not listed, **Tempco** will design and manufacture a Duo-Tape Heater to meet your requirements. **Standard lead time is 2 to 3 weeks.**

**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.

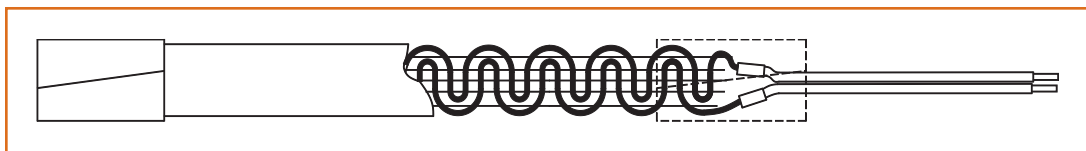
**Silicone Rubber Duo-Tapes** may be used on conductive surfaces, and in applications where moisture, chemical and abrasion resistance is required.

#### Design Features:

- \* 400°F (204°C) temperature rating, non-energized exposure to 500°F (260°C)
- \* 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 120 Volt 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>	.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
0.67 W/cm <sup>2</sup>	.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	





### Silicone Rubber Heating Tapes with Thermostat or Time Percentage Control



#### FTF3 with Adjustable Thermostat Control

\* Adjustable Thermostat: 50°F to 425°F (10°C to 218°C)

**NOTE:** The heat sensing plate on the bottom of the thermostat enclosure must make firm contact with the load being sensed.

#### Design Features:

- \* Maximum exposure temperature: 450°F (232°C)
- \* Moisture and chemical resistant silicone rubber extruded outer sheath
- \* Fiberglass reinforced serpentine-wound stranded heating element
- \* Rapid heat-up and thermal response
- \* Power density: 6.0 watts/inch<sup>2</sup>
- \* 6 foot (2 m) long power cord with  
120VAC: standard 2-prong NEMA 1-15 plug  
240VAC: bare wire connection
- \* Suitable for electrically conductive surfaces

#### FTF4 with Time Percentage Control

\* Easily adjust percentage of time heater is on and off: 0 to 100%

**NOTE:** The time percentage control varies the length of time the heater is on vs. off heating mode. The controller does not use a temperature sensor and therefore requires occasional supervision under changing load conditions.

#### Typical Applications

- ↔ Valves
- ↔ Pipes
- ↔ Bearings
- ↔ Pumps
- ↔ Gas Tubing
- ↔ Filter Housings
- ↔ Actuators
- ↔ De-icing

Width		Length		Watts	Part Number - Thermostat		Part Number - %Control	
in	mm	in	mm		120V	240V	120V	240V
0.5	13	24	610	72	FTF30001	FTF30021	FTF40001	FTF40021
0.5	13	48	1220	144	FTF30002	FTF30022	FTF40002	FTF40022
0.5	13	72	1830	216	FTF30003	FTF30023	FTF40003	FTF40023
0.5	13	96	2440	288	FTF30004	FTF30024	FTF40004	FTF40024
0.5	13	120	3050	360	FTF30005	FTF30025	FTF40005	FTF40025
1.0	25	24	610	144	FTF30006	FTF30026	FTF40006	FTF40026
1.0	25	48	1220	288	FTF30007	FTF30027	FTF40007	FTF40027
1.0	25	72	1830	432	FTF30008	FTF30028	FTF40008	FTF40028
1.0	25	96	2440	576	FTF30009	FTF30029	FTF40009	FTF40029
1.0	25	120	3050	720	FTF30010	FTF30030	FTF40010	FTF40030
2.0	51	24	610	288	FTF30011	FTF30031	FTF40011	FTF40031
2.0	51	48	1220	576	FTF30012	FTF30032	FTF40012	FTF40032
2.0	51	72	1830	864	FTF30013	FTF30033	FTF40013	FTF40033
2.0	51	96	2440	1152	FTF30014	FTF30034	FTF40014	FTF40034
2.0	51	120	3050	1440	FTF30015	FTF30035	FTF40015	FTF40035
3.0	76	24	610	432	FTF30016	FTF30036	FTF40016	FTF40036
3.0	76	48	1220	864	FTF30017	FTF30037	FTF40017	FTF40037
3.0	76	72	1830	1296	FTF30018	FTF30038	FTF40018	FTF40038
3.0	76	96	2440	1440*	FTF30019	FTF30039	FTF40019	FTF40039
3.0	76	120	3050	1440*	FTF30020	—	FTF40020	—
3.0	76	120	3050	1800*	—	FTF30040	—	FTF40040

The FTF3 thermostats shown have a °F temperature label. For a °C temperature label, consult Tempco.

\*Derated watt density due to maximum current limits



## 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 etched foil or wire elements.

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.

#### 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, as compared to wire wound elements, a Tempco thick film element will operate at a cooler operating temperature due to the lower watt density in a given area. The low thermal mass of the heater allows the heat to be transferred more quickly to the surface to be heated.

#### 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/TCOs are available for overtemperature/runaway condition protection.

#### 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*



#### Specifications

**Overall 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 Naphthalate (PEN):** 320°F / 160°C

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

**Silicone Rubber:** 392°F / 200°C

#### Pressure Sensitive Adhesive

**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)

Heaters can be manufactured that have a length much greater than the width. Up to 24" x 98" have been made.

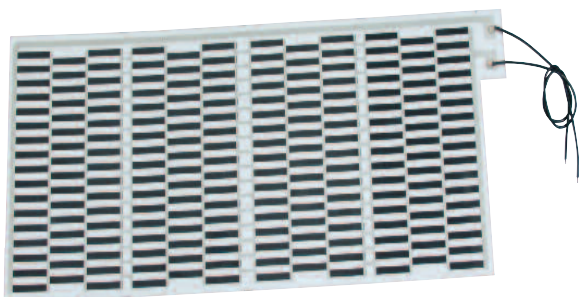
#### Electrical

**Voltage:** Up to 277 VAC or VDC

**Watt Density:** Standard, up to 25 w/in<sup>2</sup>.

Can go higher under certain conditions.  
Consult Tempco with your requirements.

**Dielectric Strength:** 1500 VAC



#### 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 9-22, fill it out, and fax it to Tempco to receive a quote.