Flexible Heater Wattage Recommendations

Step 1 Determine the Required Wattage

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

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

Example

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

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

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/in²

Average Heat-Up: 5 w/in²

High Heat-Up: 7.5 w/in² and greater

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

Silicone Rubber Heater: 5" × 10" = 50 in²

Watt Density = 135 watts ÷ 50 in² = 2.7 watts/in²

Since the watt density falls between 2.5 and 5 w/in², 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.

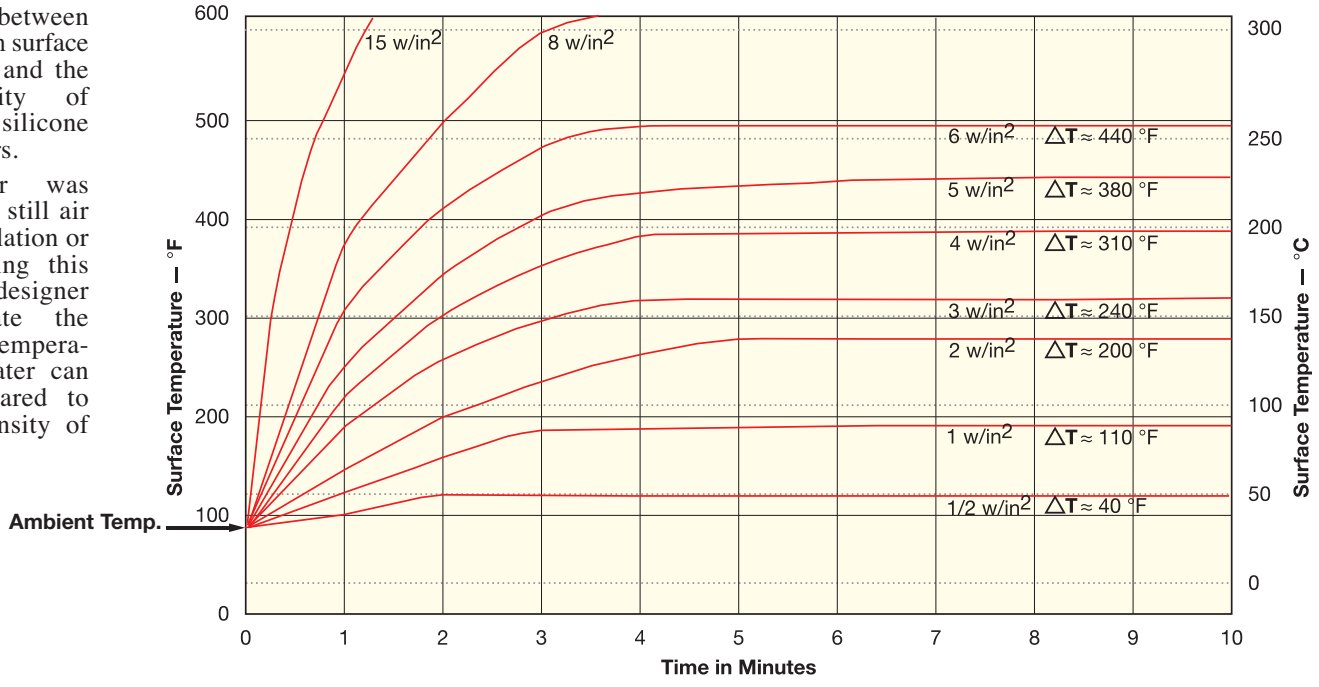
If the calculated watt density is too high, a larger heater will lower the required watt density and still produce the same wattage.

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.

Surface Temperature vs. Time for Various Watt Densities



△T = Temperature Rise From Ambient at Specified Watt Densities

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Flexible Heater Wattage Recommendations

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Suggested Maximum Watt Density by Heater Type and Mounting Method

Watt Density w/in²	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.	Diameter mm	Area in²	Area cm²	Watts	Wire Construction 120V	Wire Construction 240V	Foil Construction 120V	Foil Construction 240V
3.0	76	7.07	45.6	35	SHS00201	—	—	—
3.5	89	9.62	62.1	48	SHS00202	—	SHS00241	—
4.0	102	12.57	81.1	63	SHS00203	SHS00222	SHS00242	—
4.5	114	15.90	102.6	80	SHS00204	SHS00223	SHS00243	SHS00261
5.0	127	19.63	126.6	98	SHS00205	SHS00224	SHS00244	SHS00262
5.5	140	23.76	153.3	119	SHS00206	SHS00225	SHS00245	SHS00263
6.0	152	28.27	182.4	141	SHS00207	SHS00226	SHS00246	SHS00264
6.5	165	33.18	214.1	166	SHS00208	SHS00227	SHS00247	SHS00265
7.0	178	38.48	248.3	192	SHS00209	SHS00228	SHS00248	SHS00266
7.5	191	44.18	285.0	221	SHS00210	SHS00229	SHS00249	SHS00267
8.0	203	50.26	324.3	250	SHS00211	SHS00230	SHS00250	SHS00268
8.5	216	56.74	366.1	284	SHS00212	SHS00231	SHS00251	SHS00269
9.0	229	63.62	410.4	318	SHS00213	SHS00232	SHS00252	SHS00270
9.5	241	70.88	457.3	354	SHS00214	SHS00233	SHS00253	SHS00271
10.0	254	78.54	506.7	393	SHS00215	SHS00234	SHS00254	SHS00272
10.5	267	86.59	558.7	430	SHS00216	SHS00235	SHS00255	SHS00273
11.0	279	95.03	613.2	480	SHS00217	SHS00236	SHS00256	SHS00274
11.5	292	103.87	670.2	520	SHS00218	SHS00237	SHS00257	SHS00275
12.0	305	113.10	729.7	570	SHS00219	SHS00238	SHS00258	SHS00276
15.0	381	176.72	1140.2	880	SHS00220	SHS00239	SHS00259	SHS00277
20.0	508	314.16	2027.0	1570	SHS00221	SHS00240	SHS00260	SHS00278

Silicone Rubber Rounds