

Quick Ship

- Same day shipment on stock units with orders received by 11:00 a.m. CST.

Flexible Heaters

Flexible Shapes and Geometries

Flexible heaters from Watlow are just what the name implies: thin, bendable and shaped to fit your equipment. You can use your imagination to apply heat to the most complex shapes and geometries, without sacrificing efficiency or dependability. With Watlow's customization capabilities, you have the maximum amount of freedom when designing your equipment.

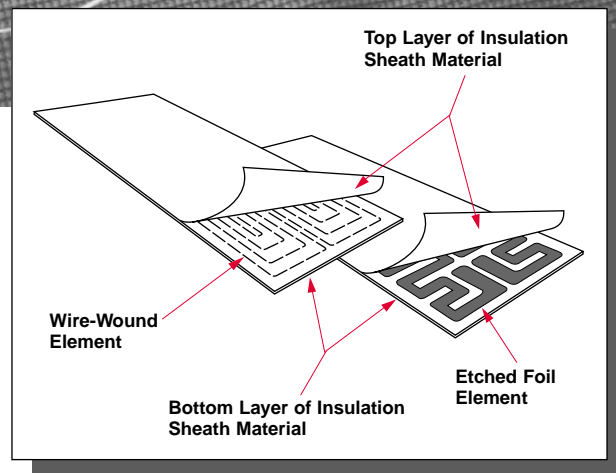
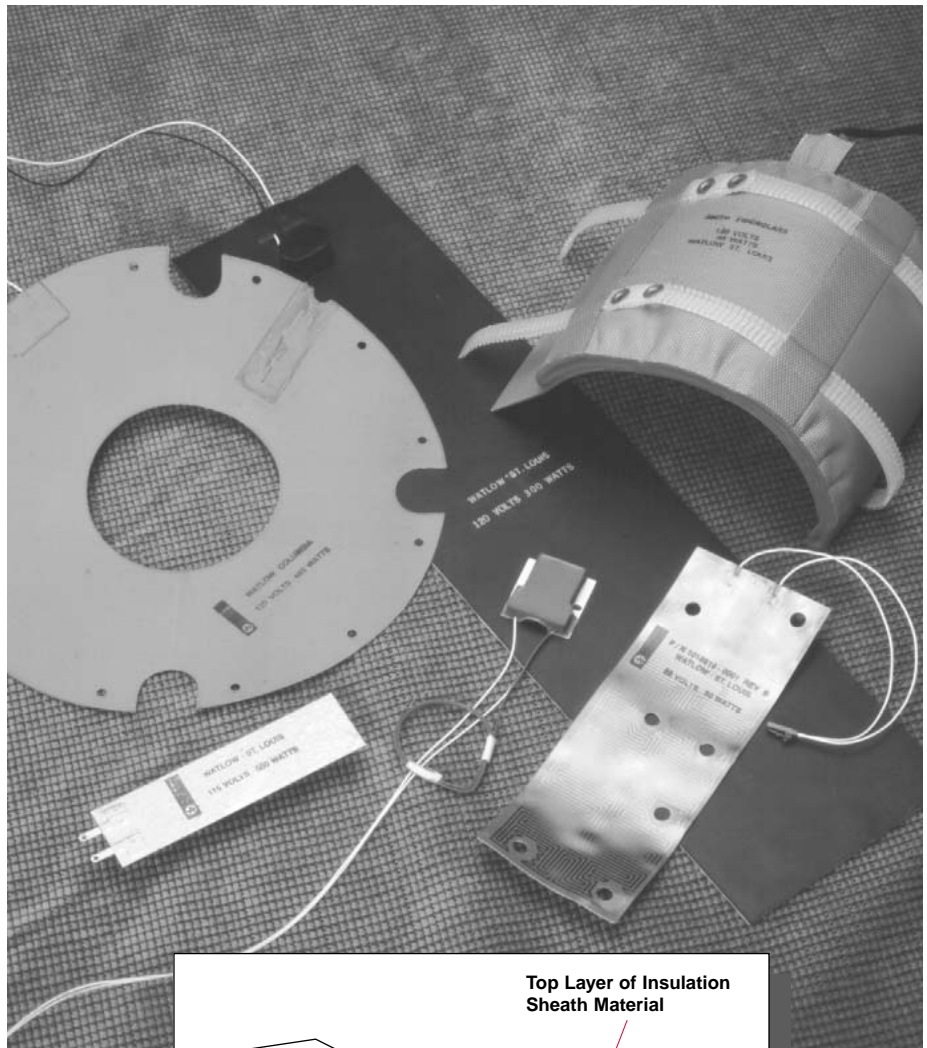
Excellent heat transfer results from the heater's thin design and its direct bonding to the application. Flexible heaters also provide fast heatup and cool down rates, uniform heat distribution and high watt densities.

Features and Benefits

- **Flat geometry** permits holes, notches and unusual shapes.
- **Four material types and two element styles** are available for wider flexibility in meeting your requirements. See next page for performance capabilities.
- **Lightweight construction and low thermal mass** permit use in applications that have limited space or weight requirements.
- **Heating elements** as close as 0.003 inches (0.08 mm) from the heated part respond to controls with faster heat up and cool down.
- **Uniformly spaced element paths**, placed within ¼ inch (6 mm) of the heater perimeter, distribute heat more evenly.

Applications

- Medical equipment such as blood analyzers, respiratory therapy units and hydrotherapy baths
- Satellite and communication equipment
- Freeze protection for military hardware, aircraft instrumentation, hydraulic equipment, etc.
- Battery heating
- Semiconductor equipment
- Foodservice equipment
- Any application requiring a flexible shape or design



Flexible Heaters

Flexible Shapes and Geometries

Applications and Technical Data

Four Material Types

Silicone Rubber:

This rugged, moisture- and chemical-resistant material is easily bonded or cemented to parts. Watlow silicone rubber heaters can handle temperatures up to 500°F (260°C). Many styles of these heaters are available with UR®, cUR® and VDE recognition. See [page 171](#) for details.

Kapton®:

A thin, lightweight transparent material from du Pont, Kapton® is designed for extremely precise heating requirements ranging from -319° to 392°F (-195° to 200°C). It is ideal for applications requiring low outgassing in a vacuum, or resistance to radiation, fungus and chemicals. Many custom heaters can be UR® and cUR® recognized.

Neoprene:

Neoprene resists weathering, abrasion and chemicals. It can be used economically in applications to 250°F (120°C), where high watt densities are not needed.

HT Foil:

This mica-insulated, high temperature foil is a semi-rigid heater. Operating temperatures up to 1100°F (595°C) can be achieved.



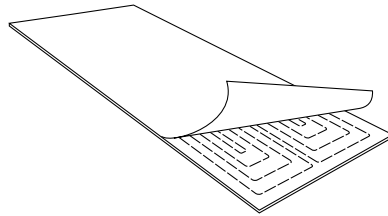
See pages 169 to 182 and 189 to 194 for information on silicone rubber, Kapton®, neoprene, and HT foil heaters.

Two Element Types

Watlow offers both wire-wound and etched foil resistance elements. These element types are available in

most insulating materials, and Watlow can recommend the type best suited to your application.

Wire-Wound Elements

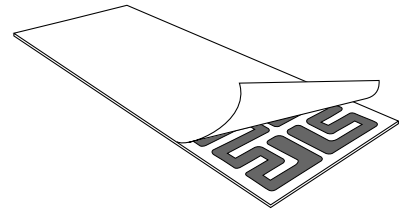


Available on silicone rubber and neoprene heaters, this element style is created by spiraling fine resistance wires around a fiberglass cord. The element is then laid out in a pattern designed specifically for your application. The benefits of wire-wound elements include:

- Excellent physical strength and flexibility; repeated flexing of the heater has no harmful effects on its performance
- Good economy for small production runs
- Conforms readily to curved surfaces, including small radius bends

Drum heaters and conduit bender heaters are typical examples of applications that use the wire-wound method. These heaters are flexed repeatedly during use, but due to their wiring, no internal damage will occur.

Etched Foil Elements



This element type, created by acid etching a circuit in nickel resistance alloy foil, is available in silicone rubber, Kapton® and HT foil heater types. The etched foil element is noted for its excellent circuit pattern repeatability and superior heat transfer, which results from greater area coverage of the element. Other benefits include:

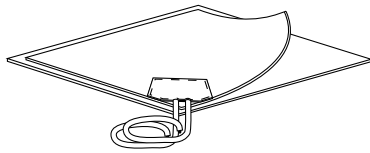
- Delivers more heat and up to twice the watt density of a wire-wound element, providing longer heater life
 - Most economical for large production runs
 - Complex heat distribution patterns can be provided
- The etched foil element style is usually recommended for applications requiring high temperatures or watt densities, or multiple zoning.

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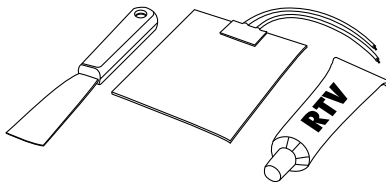
UR® and cUR® are registered trademarks of Underwriter's Laboratories, Inc.

Flexible Heaters

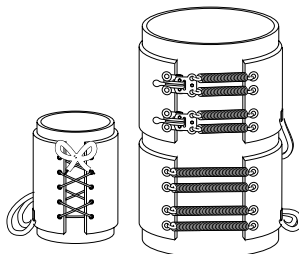
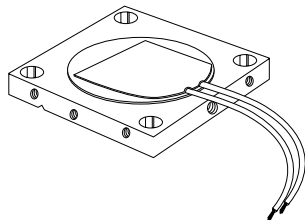
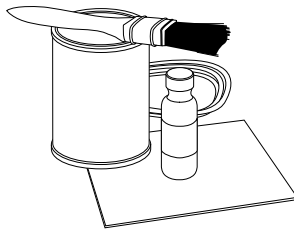
Flexible Shapes and Geometries Options



Note: PSAS maximum six months storage life before heater installation.



Note: Not recommended for Kapton® heaters.



Mounting Methods

Watlow offers various attachment techniques, all designed for fast installation. These include: three types of adhesives; Watlow's special factory vulcanization process; and mechanical fasteners.

Complete installation instructions are available from Watlow. Ask for technical letter #2, silicone rubber heaters.

Pressure Sensitive Adhesive Surface (PSAS)

For speed, convenience and economy of installation, specify **PSAS**. Simply peel off the protective backing and roll the heater in place for an even bond to a clean, smooth surface.

Note: PSAS is not recommended for curved surfaces or for heaters rated above 10 W/in² (0.8 W/cm²). It should not be used for applications exceeding 400°F (205°C) on silicone rubber, 300°F (150°C) on Kapton® or 200°F (93°C) for neoprene.

Field Applied Adhesive (RTV)

For a stronger bond, or when long storage is probable, a **room temperature vulcanizing (RTV) silicone adhesive** is available from stock within two days. Watlow offers red RTV for temperatures up to 500°F (260°C). White RTV is available from adhesive suppliers for temperatures up to 400°F (205°C). Watlow's one-

part RTV is self-priming and can be ordered in either 3 oz (90 ml) or 12 oz (355 ml) tubes. For larger heaters requiring longer adhesive working time, two-part RTV kits can be purchased from adhesive suppliers. These kits require primer on the surface prior to application of the adhesive.

Silicone Contact Cement Kit

This two-part adhesive consists of a resin and catalyst which are easily mixed together and applied with a paintbrush. Recommended usage is for field cementing of silicone rubber heaters to customer parts. Available

from stock, the cement kit will handle temperatures to 350°F (175°C). The resin is available in pint or quart containers. To order, specify **silicone contact cement**, and container size.

Factory Bonding

This attachment technique provides a strong, void-free bond for excellent heat transfer and extended heater life. Watlow's expertise in bonding heaters to customer parts has proven extremely successful.

Bonding is recommended for applications that reach maximum temperatures of 500°F (260°C) on silicone rubber and 300°F (150°C) on Kapton®.

Mechanical Fasteners

When a wire-wound flexible heater must be detachable, any type of fastener normally used with fabrics can usually be built into the sheath material of Watlow flexible heaters. The most common types are latch fasteners, boot hooks and

grommets. Other styles include snap fasteners, springs, velcro style fastener strips and lacing cord. The grommets and boot hooks are commonly used with tension springs to compensate for slight variations in part size.

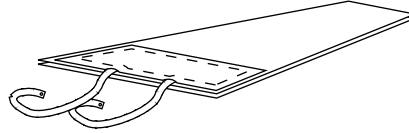
Flexible Heaters

Flexible Shapes and Geometries

Termination Styles

Watlow offers many types of leads and terminations. Leads can project from any position along the perimeter of the unit. **They will be centered on the short side width of rectangular heaters unless specified otherwise.**

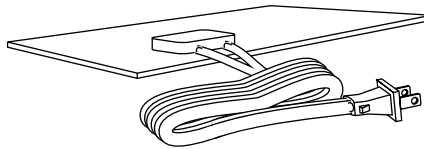
Standard Leads—Type E Teflon®



Leads shown exiting end of heater, centered on short side.

Watlow's standard leads are 12 inches (305 mm) long, white, Teflon® insulated, flexible, plated copper wire. They are rated for 392°F (200°C)/600 volts per MIL-W-16878, Type E. The lead connections on or at the heater are insulated with a cap of sheath material, vulcanized to the heater body. All custom flexible heaters except HT foil will be supplied with this lead type unless otherwise specified.

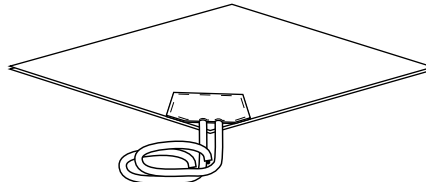
HPN Cord and Plug Set



Molded leads are shown exiting edge of heater. Capped leads are also available.

For removable heaters, a six foot (1.8 m) HPN (neoprene insulated) cord and plug set provides convenience. It is rated for 194°F (90°C)/300V~(ac). HPN cord without a plug is also available in any length.

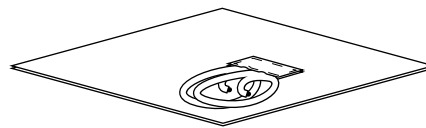
Silicone Insulated Leads



Leads shown exiting corner of heater.

For a better moisture seal, specify UL® silicone insulated lead wires. This lead type is rated for 302°F (150°C)/600V~(ac). Any lead length is available. Note: Silicone rubber heaters are not designed to be waterproof. Excess exposure to moisture may facilitate premature heater failure.

Special Teflon® Leads

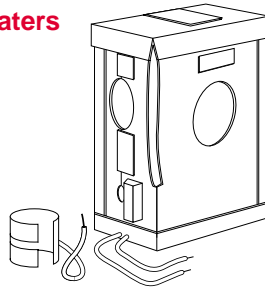


Leads shown exiting middle of heater.

Teflon® leads, UL® style 1180 and cUR® approved, are rated for 392°F (200°C)/300 volts. Any length is available. UL® Teflon® leads are standard on stock rectangles.

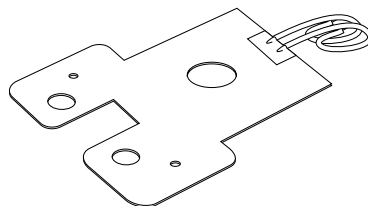
Construction

Formed Heaters



Many three-dimensional shapes, such as cylinders, cones and boxes, can be factory formed. Semi-rigid shapes can be self-gripping to the part. Special tooling may be required for some designs.

Holes, Cutouts and Notches



Watlow can provide flexible heaters with special holes, cutouts and notches in nearly any position required for your design. The resistance element can be brought to within 1/8 inch (3 mm) of all edges. Standard spacing is 1/4 inch (6 mm) from all edges.

Teflon® is a registered trademark of E.I. du Pont de Nemours & Company.

Flexible Heaters

Flexible Shapes and Geometries

Temperature Sensors

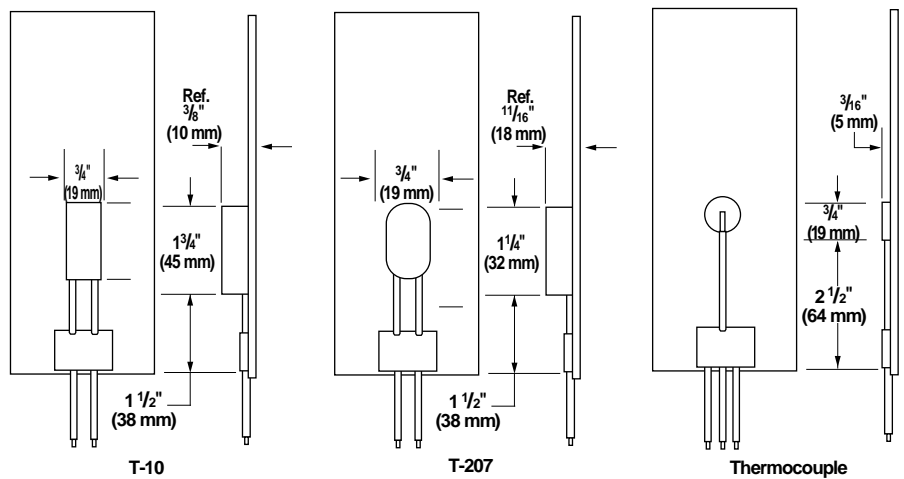
Watlow offers several styles of sensors for use with flexible heaters. These sensors are available as preset or adjustable thermostats, thermocouples, thermistors, RTDs or thermal fuses. They can be integrally mounted (encapsulated in silicone rubber) to sense the temperature of either the part or the heater sheath. The thermostats can also be ordered separate from the heater, allowing direct control of your process temperature, if desired.

Pre-Set Thermostats

Several styles of non-adjustable, pre-set thermostats are available from Watlow. Thermostats separate from the heater are encapsulated in silicone rubber, and are available with standard 12 inch (305 mm) leads unless otherwise specified.

Thermocouples, thermistors, RTDs and thermal fuses are usually mounted to the heater under a vulcanized protective cap of silicone rubber sheath material. This drawing shows a typical mounting style for a thermocouple.

Note: Precise part temperature control with preset thermostats requires prototyping and field testing.



Pre-Set Thermostats (Non-Adjustable)

Thermostat Model	Maximum Watts	Volts AC	Temperature Settings Available °F (°C)	Agency Approvals		
				UR	cUR	VDE
T-10	600/960	120/240	125-300±10 (50-149±5)	yes	yes	yes
T-207	1500	120/240	40/55±8 (4/13±4.4)	yes	yes	yes
	1500	120/240	60/75±8 (16/24±4.4)	yes	yes	yes
	1500	120/240	95/110±8 (35/43±4.4)	yes	yes	yes
	1500	120/240	145/160±8 (63/71±4.4)	yes	yes	yes

Notes:

- When ordering a pre-set thermostat separate from the heater, simply add the prefix **S** to the model number. (Example: ST-10) See next page.
- Snap action preset temperatures on the T-207 are close/open settings.
- T-10 thermostats are manufactured for specific preset temperatures. Available in 25°F increments.
- Other temperature ranges and voltages are available on special order. Minimum quantities apply, so consult factory before ordering.

Adjustable Thermostats

The B-200 thermostat features a maximum rating of 1500 watts at 120/240V~(ac). The following temperature ranges are available:

- Model B-200-2:
100° to 500°F (40° to 260°C)

- Model B-200-3:
25° to 330°F (-5° to 165°C)

The B-200 thermostat can be integrally mounted to the heater with a bonded protective cap of silicone rubber sheath material.

Flexible Heaters

Flexible Shapes and Geometries

Temperature Sensors

Continued



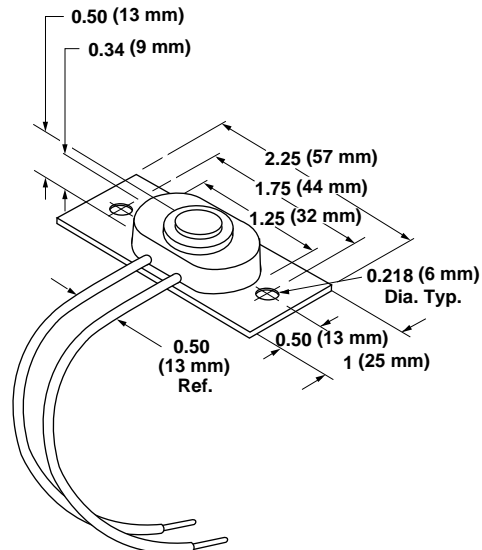
Separate Heater Accessories Available From Stock

Pre-Set Thermostats Separate From Heater

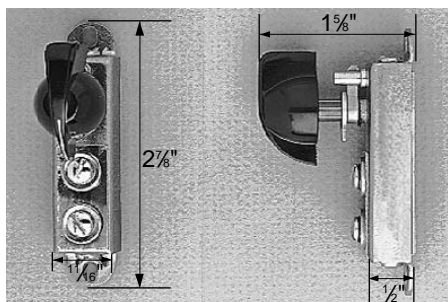
These are offered to allow direct control of your process temperature, so you're not limited to controlling only the heater temperature when using stock heaters. Pre-set thermostats are encapsulated in silicone rubber with standard 12 inch leads.

The same temperature ranges, ratings and sizes are available on these thermostats. When ordering, add "S" prefix to the model number to indicate "separate" item. (Examples: ST-10 and ST-207)

Standard leads are 12 inch (305 mm) 18 ga. UL1180 black leads.



Notes: For direct control of air temperature as is required in enclosure heating applications, specify thermostat model number ST-207E. This is a modified ST-207 mounted on 1/2 inch thick G-10 circuit board with the thermostat's metal cap exposed to sense air temperature.



B-200

Adjustable Thermostats Separate From Heater

The Model B-200 adjustable thermostat can be ordered as a separate item. The same model numbers and temperature ranges

indicated under *Adjustable Thermostats* are available. When ordering, simply note that you want the **B-200 separate** from the heater.

Quick Ship

- Same day shipment on stock units with orders received by 11:00 a.m.

Flexible Heaters

Silicone Rubber

Rugged, yet thin, lightweight and flexible ... the use of Watlow silicone rubber heaters is limited only by your imagination. With these heaters, you can put the heat where it's needed and, in the process, improve heat transfer, speed warm-ups and decrease wattage requirements.

Fiberglass-reinforced silicone rubber gives your heater dimensional stability without sacrificing flexibility. Because very little material separates the element from the part, heat transfer is rapid and efficient.

Performance Capabilities

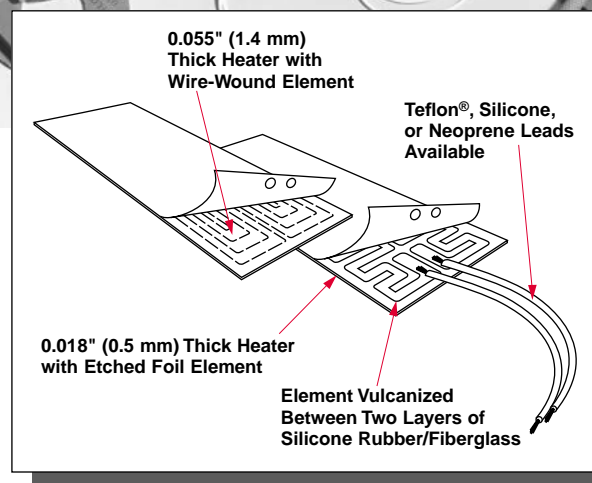
- Operating temperatures to 500°F (260°C)
- Watt densities to 80 W/in² (12.5 W/cm²) dependent upon application temperature
- 0.055 inch (1.4 mm) thick with a wire-wound element; only 0.018 inch (0.5 mm) with an etched foil element

Features and Benefits

- **Designed in the exact shape and size**, including 3-D geometries, to conform to your equipment.
- **More than 80 designs** available immediately from stock.
- **UR®, cUR® and VDE** recognitions are available on many designs.
- **Moisture and chemical-resistant** silicone rubber material provides longer heater life.
- **Easy to bond or attach** to your part through the use of vulcanizing, adhesives, or fasteners.

Applications

- Freeze protection and condensation prevention for many types of instrumentation and equipment
- Medical equipment such as blood analyzers, test tube heaters, etc.
- Computer peripherals such as laser printers
- Curing of plastic laminates
- Photo processing equipment



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UR® and cUR® are registered trademarks of Underwriter's Laboratories, Inc.

Flexible Heaters

Silicone Rubber

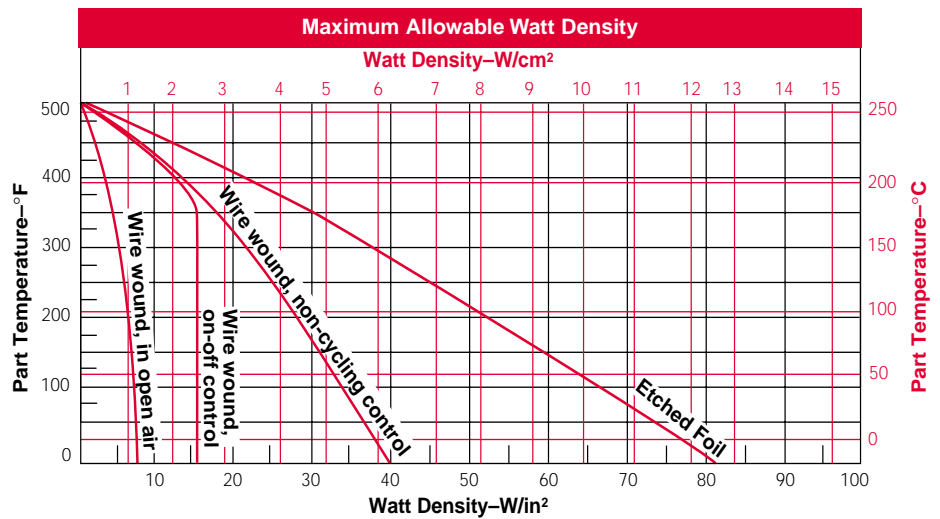
Applications and Technical Data

Determining Watt Density

The *Maximum Allowable Watt Density* graph illustrates the maximum recommended heater watt density at various metal part or ambient air temperatures. However, it does not indicate the watt density necessary to achieve a given part temperature. See the *Surface Temperature vs. Time* graph on the next page for assistance with those calculations. When using this graph, remember:

- Part temperature is measured at the point where the heater contacts the metal part.
- Thermostats and on-off controls are typically bimetal or capillary bulb.
- Non-cycling controls are typically solid state, time-proportioning or SCR temperature controllers.
- Watt density values should be derated by one third if insulation is used.
- UL® recognition temperature limits are not detailed.
- Consult Watlow before doing any of the following: selecting high watt density etched-foil elements, or operating heaters with back side insulation or non-metallic parts, which are poor thermal conductors.

Example: A wire-wound heater with non-cycling control at a part temperature of 250°F (120°C) can be rated at 24 W/in² (3.7 W/cm²) maximum. An etched foil heater under the same conditions can be rated at 45 W/in² (7 W/cm²) maximum.



Standard Silicone Rubber Specifications

Maximum width x maximum length:

- Wire wound: 36 x 120 inches (915 mm x 3050 mm)
- Etched foil: 20 x 30 inches (510 mm x 760 mm)

Thickness (standard):

- Wire wound: 0.055 inch (1.4 mm)
- Etched foil: 0.018 inch (0.5 mm)

Weight (standard):

- Wire wound: 8 oz./ft² (0.24 g/cm²)
- Etched foil: 3 oz./ft² (0.09 g/cm²)

Maximum operating temperature: 500°F (260°C)

Maximum temperature for UL® recognition: 428°F (220°C)

Minimum ambient temperature: -80°F (-62°C)

Maximum voltage: 600V~(ac)

Maximum wattage: See watt density graph

Lead size: Sized to load

Lead length: 12 + 1 ½ - ½ inches (305 mm + 40 mm - 15 mm)

Wattage tolerance:

- Wire: ±5 percent
- Foil: +5 percent -10 percent

Dimensional tolerances:

- 0 to 6 inches (0 to 150 mm): ±¹/₁₆ inch (1.6 mm)
- 6 to 18 inches (150 to 455 mm): ±¹/₈ inch (3.2 mm)
- 18 to 36 inches (455 mm to 915 mm): ±³/₁₆ inch (4.8 mm)
- Over 36 inches (915 mm): ±1 percent

Government Supply Code Number

Cage code = 78056

UL® is registered trademark of Underwriter's Laboratories, Inc.

Flexible Heaters

Silicone Rubber

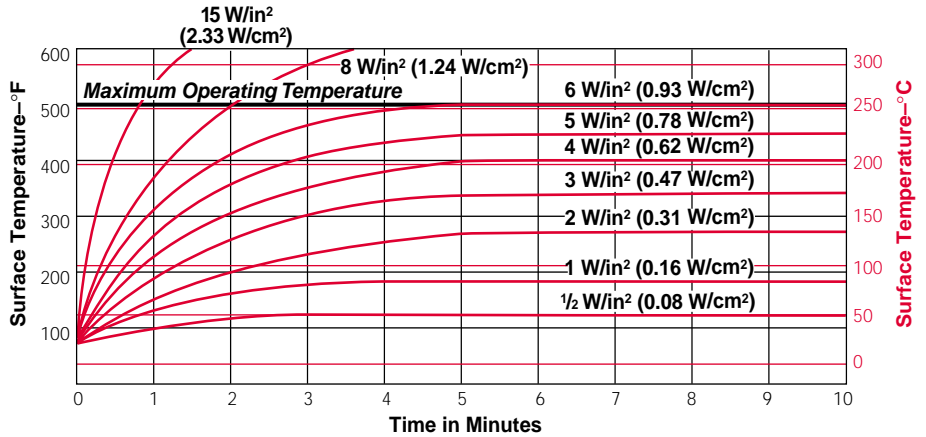
Applications and Technical Data

Continued

Surface Temperature vs. Time

This graph illustrates the surface temperature a silicone rubber heater will reach when the heater is uninsulated and is suspended

vertically in 70°F (20°C) still air. This data is based on 0.055 inch (1.4 mm) thick standard construction and is offered as a reference tool.



UR®, cUR® and VDE Recognition for Silicone Rubber Heaters

Watlow frequently works with customers requiring agency approvals such as UR®, cUR® and VDE. Many stock silicone rubber heaters are available with one or more of these certifications.

Watlow's technical letter #3, flexible heaters, provides in-depth information on agency approvals.

UL® Component Recognition (UR)

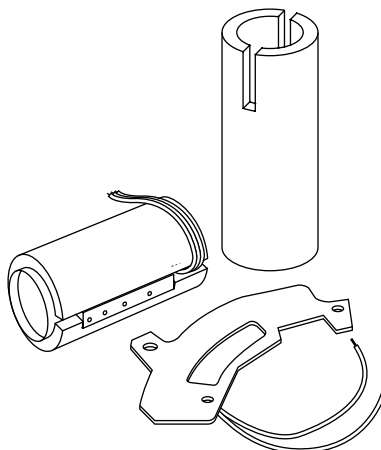
of factory-bonded heaters is available up to 392°F (200°C), and for customer installed heaters up to 428°F (220°C) (UL File No. E52951). For Canadian recognition Watlow offers **cUR Recognized®** silicone rubber heaters under UL File #E52951. Several constructions are available with ratings to 600V~(ac) and 428°F (220°C) maximum surface temperature. Consult the factory for further information.

VDE Approval is available on several constructions of both wire-wound (File No. 62533) and etched foil (File No. 62535) silicone rubber heaters. The maximum ratings are 440V~(ac) and 428°F (220°C) surface temperature. Under VDE guidelines, minimum installed bend radius is 1/8 inch (3 mm) for etched foil and 1/4 inch (6 mm) for wire wound. VDE also states that the user is responsible for the safe application, installation and wiring of the heaters. Maximum working temperature must be maintained by an appropriate temperature control.

Options

Watlow offers a variety of options such as attachment techniques, thermostats, special leads, holes and cutouts and three-dimensional shapes. These are all described in the introduction to flexible heaters section. In addition, the following option is available only on silicone rubber heaters.

Thermal Insulation



To increase the heating efficiency of your application, silicone rubber heaters can be thermally insulated with silicone sponge rubber, bonded to one side in the following thicknesses: 1/16, 1/8, 1/4, 3/8 or 1/2 inch (1.6, 3, 6, 10 or 13 mm). Heaters with thermal insulation are still quite flexible.

An aluminized surface can be added to the back of the heater to reduce radiated heat losses. This aluminized surface, called "Low Loss Treatment," adds very little to the unit thickness and maintains a very clean appearance.



See pages 165 to 168 for more information on options.

Flexible Heaters

F.O.B.: Columbia, Missouri

Silicone Rubber

Wire-Wound Element

Width in (mm)	Length in (mm)	Watts	Availability	120V~(ac) Code No.	240V~(ac) Code No.
1 (25)	2 (50)	10	Stock	010020C1	
	3 (75)	15	Stock	010030C1	
	4 (100)	20	Stock	010040C1	
	5 (125)	25	Stock	010050C1	
	5 (125)	25	Stock		010050C2
	10 (255)	50	Stock	010100C1	
	10 (255)	50	Stock		010100C2
	15 (380)	75	Stock	010150C1	
	15 (380)	75	Stock		010150C2
	20 (510)	100	Stock	010200C1	
	20 (510)	100	Stock		010200C2
	25 (635)	125	Stock	010250C1	
	30 (760)	150	Stock	010300C1	
	35 (890)	175	Stock	010350C1	
	40 (1015)	200	Stock	010400C1	
80 (2030)	400	Stock	010800C1		
120 (3050)	600	Stock	010F10C1 ^①		
2 (50)	2 (50)	20	Stock	020020C1	
	5 (125)	50	Stock	020050C1	
	5 (125)	50	Stock		020050C2
	10 (255)	100	Stock	020100C1	
	10 (255)	100	Stock		020100C2
	15 (380)	150	Stock	020150C1	
	15 (380)	150	Stock		020150C2
	20 (510)	200	Stock	020200C1	
	20 (510)	200	Stock		020200C2
	25 (635)	250	Stock	020250C1	
	30 (760)	300	Stock	020300C1	
	35 (890)	350	Stock	020350C1	
	40 (1015)	400	Stock	020400C1	

CONTINUED 

① 010F10C1 - F = feet (i.e. 10 feet = 120 inches)

Approx. net weight: 8 ounces/ft² (0.24 g/cm²). Standard thickness: 0.055 inch. Standard lead length: 12 inches UL 1180 Te on[®].

Silicone rubber wire-wound elements rated at 5 W/in².

UL[®] Component Recognition (UR[®]).

How to Order

To order stock silicone rubber heaters, specify the Watlow code number and the quantity. To order a heater with options, specify the code number, quantity and options desired (**see page 165**). Consult Watlow before combining options.

Made-to-Order: Consult factory.

For **made-to-order** units, Watlow will need the following application information from you:

- Size (dimensions)
- Voltage
- Wattage/watt density
- Operating temperature
- Options (leads, thermostats, attachment techniques, etc.)
- Will heater be subject to flexing?
- Element type, if you have a preference
- Agency approvals
- Quantity

Availability

Stock: Same day shipment of orders received by 11:00 a.m. CST.

Stock with Options: Shipment in 1-3 working days or less. Not all options are available with stock heaters.

Flexible Heaters

Silicone Rubber Wire-Wound Element

Width in (mm)	Length in (mm)	Watts	Availability	120V~(ac) Code No.	240V~(ac) Code No.
3 (75)	3 (75)	45	Stock	030030C1	
	5 (125)	75	Stock	030050C1	
	5 (125)	75	Stock		030050C2
	10 (255)	150	Stock	030100C1	
	10 (255)	150	Stock		030100C2
	15 (380)	225	Stock	030150C1	
	15 (380)	225	Stock		030150C2
	20 (510)	300	Stock	030200C1	
	20 (510)	300	Stock		030200C2
	25 (635)	375	Stock	030250C1	
	30 (760)	450	Stock	030300C1	
	35 (890)	525	Stock	030350C1	
	40 (1015)	600	Stock	030400C1	
4 (100)	4 (100)	80	Stock	040040C1	
	5 (125)	100	Stock	040050C1	
	5 (125)	100	Stock		040050C2
	10 (255)	200	Stock	040100C1	
	10 (255)	200	Stock		040100C2
	15 (380)	300	Stock	040150C1	
	15 (380)	300	Stock		040150C2
	20 (510)	400	Stock	040200C1	
	20 (510)	400	Stock		040200C2
	25 (635)	500	Stock	040250C1	
	30 (760)	600	Stock	040300C1	
	35 (890)	700	Stock	040350C1	
	40 (1015)	800	Stock	040400C1	
5 (125)	5 (125)	125	Stock	050050C1	
	5 (125)	125	Stock		050050C2
	10 (255)	250	Stock	050100C1	
	10 (255)	250	Stock		050100C2
	15 (380)	375	Stock	050150C1	
	15 (380)	375	Stock		050150C2
	20 (510)	500	Stock	050200C1	
	20 (510)	500	Stock		050200C2
	25 (635)	625	Stock	050250C1	
	30 (760)	750	Stock	050300C1	
35 (890)	875	Stock	050350C1		
40 (1015)	1000	Stock	050400C1		
6 (150)	5 (125)	150	Stock	060050C1	
	5 (125)	150	Stock		060050C2
	10 (255)	300	Stock	060100C1	
	10 (255)	300	Stock		060100C2
	15 (380)	450	Stock	060150C1	
	15 (380)	450	Stock		060150C2
	20 (510)	600	Stock	060200C1	
	20 (510)	600	Stock		060200C2
	25 (635)	750	Stock	060250C1	
	30 (760)	900	Stock	060300C1	
35 (889)	1050	Stock	060350C1		
40 (1016)	1200	Stock	060400C1		

Approx. net weight: 8 ounces/ft² (0.24 g/cm²). Standard thickness: 0.055 inch. Standard lead length: 12 inches UL 1180 Te on®.
Silicone rubber wire-wound elements rated at 5 W/in². UL® Component Recognition (UR®).

Flexible Heaters

Silicone Rubber

Wire-Wound Stock Heater Coding Configured Options

How to order

To order, complete the code number with the information below:

Wire wound (p. 172-173)

0 - - - - -

Modification Options	
0	= None
A	= PSAS Bottom
B	= PSAS Top
E	= With Plate. Heater on Side Opposite Flange
F	= With Plate. Heater on Flange Side
G	= Flaps + Grommets
H	= Flaps + Boot Hooks
J	= Flaps + Latch Fasteners
K	= PSAS and Low Loss
L	= Low Loss
M	= Low Loss + Flaps + Grommets
N	= Low Loss + Flaps + Boot Hooks
P	= Low Loss + Flaps + Latch Fasteners
R	= 1/16 inch Sponge
S	= 1/8 inch Sponge
T	= 1/4 inch Sponge
U	= 3/8 inch Sponge
V	= 1/2 inch Sponge
W	= PSAS + 1/16 inch Sponge
Y	= PSAS + 1/8 inch Sponge
1	= PSAS + 1/4 inch Sponge
2	= PSAS + 3/8 inch Sponge
3	= PSAS + 1/2 inch Sponge
4	= Tip Plugs
6	= Tip Plugs/PSAS

• Heaters with caps must be minimum 10 inches long.

Sensors		
Type	LOC	WIR
0	= None	
L	= T10 STD	STD
M	= T10 STD	ALT
N	= T10 ALT	STD
P	= T10 ALT	ALT
R	= T207 STD	STD
S	= T207 STD	ALT
T	= T207 ALT	STD
U	= T207 ALT	ALT
V	= T207E on heater	STD
W	= T207E Remote	STD
Y	= B200 STD	STD
1	= B200 STD	ALT
2	= B200 ALT	STD
3	= B200 ALT	ALT
4	= JSTD STD	STD
6	= JALT STD	STD
7	= KSTD STD	STD

• For thermostats, standard location is as shown in catalog; standard wiring is integral or series with the heater; alternate location is rotated parallel with heater width; alternate wiring is separate leads for pilot control.

• For thermocouples, J standard is Te on[®] insulation; J alternate is berglass insulation; K standard is berglass insulation.

T10 Set °F*	
0	= None
A	= 125
B	= 150
E	= 175
F	= 200
G	= 225
H	= 250
J	= 275
K	= 300

T207 Set °F*	
0	= None
1	= 40/55
2	= 60/75
3	= 95/110
4	= 145/1600

B200 Set °F*	
0	= None
2	= 500
3	= 330

T/C Length	
0	= None
A	= 8 in
B	= 12 in
E	= 18 in
F	= 24 in
G	= 30 in
H	= 36 in
J	= 40 in
K	= 4 ft
L	= 5 ft
M	= 6 ft
N	= 7 ft
P	= 8 ft
R	= 9 ft
S	= 10 ft
T	= 12 ft
U	= 15 ft
V	= 18 ft
W	= 20 ft
Y	= 22 ft
1	= 25 ft
2	= 30 ft

* For all thermostats, the heater must be two inches minimum width and five inches minimum length.

Lead Insulation	
0	= None
1	= 1180 Teflon [®]
2	= 1180 cJR [®]
3	= 3133 22 GA
4	= 3134 18 GA
6	= 1199 cJR [®]
7	= HPN
8	= 6 foot HPN Set
9	= Type E Teflon [®]
A	= 1180VDE*
B	= 1199VDE*

* 1180VDE denotes a cJR[®] heater plus a VDE stamp.

Lead Length	
A	= 8 in
B	= 12 in
E	= 18 in
F	= 24 in
G	= 30 in
H	= 36 in
J	= 40 in
K	= 4 ft
L	= 5 ft
M	= 6 ft
N	= 7 ft
P	= 8 ft
R	= 9 ft
S	= 10 ft
T	= 12 ft
U	= 15 ft
V	= 18 ft
W	= 20 ft
Y	= 22 ft
1	= 25 ft
2	= 30 ft

Availability:
Modified Stock: Shipment within 5 working days

Flexible Heaters

Silicone Rubber Etched Foil Element

Width in (mm)	Length in (mm)	Watts	W/in ² (W/cm ²)	Availability	120V~(ac) Code No.	120/240V~(ac) Code No.
1 (25)	5 (125)	25	5 (0.8)	Stock	F010050C3	
	5 (125)	50	10 (1.6)	Stock	F010050C7	
	5 (125)	12.5/50	2.5/10 (0.4/1.6)	Stock		F010050C8
	10 (255)	100	10 (1.6)	Stock	F010100C7	
	10 (255)	25/100	2.5/10 (0.4/1.6)	Stock		F010100C8
	15 (380)	150	10 (1.6)	Stock	F010150C7	
	15 (380)	37.5/150	2.5/10 (0.4/1.6)	Stock		F010150C8
	20 (510)	200	10 (1.6)	Stock	F010200C7	
2 (50)	20 (510)	50/200	2.5/10 (0.4/1.6)	Stock		F010200C8
	5 (125)	100	10 (1.6)	Stock	F020050C7	
	5 (125)	25/100	2.5 /10 (0.4/1.6)	Stock		F020050C8
	10 (255)	200	10 (1.6)	Stock	F020100C7	
	10 (255)	50/200	2.5 /10 (0.4/1.6)	Stock		F020100C8
	15 (380)	300	10 (1.6)	Stock	F020150C7	
	15 (380)	75/300	2.5/10 (0.4/1.6)	Stock		F020150C8
	20 (510)	400	10 (1.6)	Stock	F020200C7	
3 (75)	20 (510)	100/400	2.5/10 (0.4/1.6)	Stock		F020200C8
	5 (125)	75	5 (0.8)	Stock	F030050C3	
	5 (125)	150	10 (1.6)	Stock	F030050C7	
	5 (125)	37.5/150	2.5 /10 (0.4/1.6)	Stock		F030050C8
	10 (255)	300	10 (1.6)	Stock	F030100C7	
	10 (255)	75/300	2.5 /10 (0.4/1.6)	Stock		F030100C8
	15 (380)	450	10 (1.6)	Stock	F030150C7	
	15 (380)	112/450	2.5 /10 (0.4/1.6)	Stock		F030150C8
4 (100)	20 (510)	600	10 (1.6)	Stock	F030200C7	
	20 (510)	150/600	2.5 /10 (0.4/1.6)	Stock		F030200C8
	5 (125)	200	10 (1.6)	Stock	F040050C7	
	5 (125)	50/200	2.5 /10 (0.4/1.6)	Stock		F040050C8
	10 (255)	400	10 (1.6)	Stock	F040100C7	
	10 (255)	100/400	2.5 /10 (0.4/1.6)	Stock		F040100C8
	15 (380)	600	10 (1.6)	Stock	F040150C7	
	15 (380)	150/600	2.5/10 (0.4/1.6)	Stock		F040150C8
5 (125)	20 (510)	800	10 (1.6)	Stock	F040200C7	
	20 (510)	200/800	2.5/10 (0.4/1.6)	Stock		F040200C8
	5 (125)	125	5 (0.8)	Stock	F050050C3	
	5 (125)	250	10 (1.6)	Stock	F050050C7	
	5 (125)	62.5/250	2.5/10 (0.4/1.6)	Stock		F050050C8
	10 (255)	500	10 (1.6)	Stock	F050100C7	
	10 (255)	125/500	2.5/10 (0.4/1.6)	Stock		F050100C8
	15 (380)	750	10 (1.6)	Stock	F050150C7	
6 (150)	15 (380)	187/750	2.5/10 (0.4/1.6)	Stock		F050150C8
	20 (510)	1000	10 (1.6)	Stock	F050200C7	
	20 (510)	250/1000	2.5/10 (0.4/1.6)	Stock		F050200C8
	5 (125)	300	10 (1.6)	Stock	F060050C7	
	5 (125)	75/300	2.5/10 (0.4/1.6)	Stock		F060050C8
	10 (255)	600	10 (1.6)	Stock	F060100C7	
	10 (255)	150/600	2.5 /10 (0.4/1.6)	Stock		F060100C8
	15 (380)	900	10 (1.6)	Stock	F060150C7	
6 (150)	15 (380)	225/900	2.5/10 (0.4/1.6)	Stock		F060150C8
	20 (510)	1200	10 (1.6)	Stock	F060200C7	
	20 (510)	300/1200	2.5/10 (0.4/1.6)	Stock		F060200C8

Flexible Heaters

Approx. net weight: 3 ounces/ft² (0.09 g/cm²). Standard lead length: 12 inches UL 1180 Te on®.
Silicone rubber etched foil elements are 0.018 inch thick.
UL® Component Recognition (UR®).

Flexible Heaters

Silicone Rubber

Etched Foil Stock Heater Coding Configured Options

How to order

To order, complete the code number with the information below:

Etched Foil (p. 175)
F0 _____ -

Options
0 = None
A = PSAS Bottom
B = PSAS Top
K = PSAS and Low Loss
L = Low Loss
R = 1/16 inch Sponge
S = 1/8 inch Sponge
T = 1/4 inch Sponge
U = 3/8 inch Sponge
V = 1/2 inch Sponge
W = PSAS + 1/16 inch Sponge
Y = PSAS + 1/8 inch Sponge
1 = PSAS + 1/4 inch Sponge
2 = PSAS + 3/8 inch Sponge
3 = PSAS + 1/2 inch Sponge
4 = Tip Plugs
6 = Tip Plugs/PSAS

• Etched foil heaters not recommended for enclosure heaters.

Sensors	LOC	WIR
0 = None		
L = T10	STD	STD
M = T10	STD	ALT
N = T10	ALT	STD
P = T10	ALT	ALT
R = T207	STD	STD
S = T207	STD	ALT
T = T207	ALT	STD
U = T207	ALT	ALT
4 = JSTD	STD	STD
6 = JALT	STD	STD
7 = KSTD	STD	STD

• For thermostats, standard location is as shown in catalog; standard wiring is integral or series with the heater; alternate location is rotated parallel with heater width; alternate wiring is separate leads for pilot control.

• For thermocouples, J standard is Te on[®] insulation; J alternate is berglass insulation; K standard is berglass insulation.

T10 Set °F*
0 = None
A = 125
B = 150
E = 175
F = 200
G = 225
H = 250
J = 275
K = 300

T207 Set °F*
0 = None
1 = 40/55
2 = 60/75
3 = 95/110
4 = 145/160

T/C Length
0 = None
A = 8 in
B = 12 in
E = 18 in
F = 24 in
G = 30 in
H = 36 in
J = 40 in
K = 4 ft
L = 5 ft
M = 6 ft
N = 7 ft
P = 8 ft
R = 9 ft
S = 10 ft
T = 12 ft
U = 15 ft
V = 18 ft
W = 20 ft
Y = 22 ft
1 = 25 ft
2 = 30 ft

* For preset thermostats, the heater must be two inches minimum width and five inches minimum length.

Lead Insulation
0 = None
1 = 1180 Teflon [®]
2 = 1180 cUR [®]
3 = 3133 22 GA
4 = 3134 18 GA
6 = 1199 cUR [®]
7 = HPN
8 = 6 Foot HPN Set
9 = Type E Teflon [®]
A = 1180VDE*
B = 1199VDE*

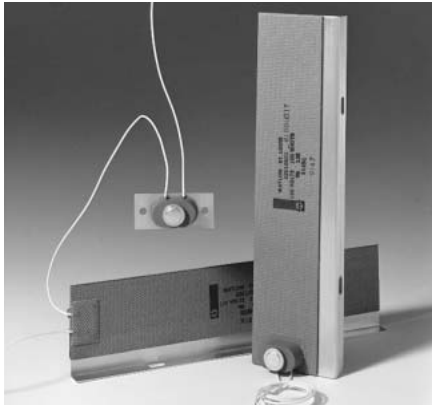
*1180VDE denotes a cUR[®] heater plus a VDE stamp.

Lead Length
A = 8 in
B = 12 in
E = 18 in
F = 24 in
G = 30 in
H = 36 in
J = 40 in
K = 4 ft
L = 5 ft
M = 6 ft
N = 7 ft
P = 8 ft
R = 9 ft
S = 10 ft
T = 12 ft
U = 15 ft
V = 18 ft
W = 20 ft
Y = 22 ft
1 = 25 ft
2 = 30 ft

Availability:
Modified Stock: Shipment within five working days

Flexible Heaters

Silicone Rubber Stock Product Offering Enclosure Heaters— Wire-Wound Only



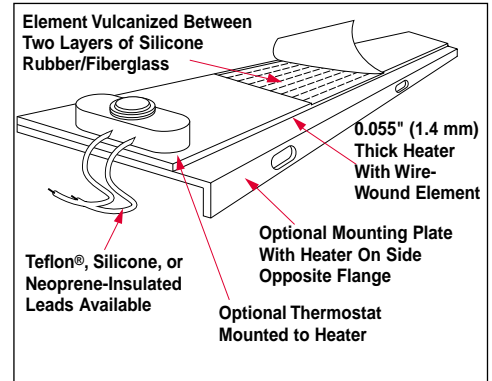
Designed for freeze and condensation protection, Watlow's enclosure heaters are rugged, reliable and safe to operate. These rectangular-shaped, wire-wound silicone rubber heaters can be ordered by themselves with adhesive or vulcanized to an aluminum mounting plate. A thermostat can be attached to the heater or mounted separately. Pictured are units with thermostat on heater in foreground and heater with remote thermostat in background.

Performance Capabilities

- Watt density rating of 5 W/in² (0.8 W/cm²)
- Temperatures to 150°F (66°C)

Features and Benefits

- **Easy to install** with options of pressure sensitive adhesive, mounting to aluminum plate, or customer cementing.
- **Quick delivery** on more than 72 variations.
- **Safe and reliable operation** due to no exposed electrical connections.
- **Custom leads** available in any length needed.
- **Horizontal and vertical mounting** options to meet your needs.



Applications

Freeze or condensation prevention in housings containing electronic equipment. Examples include:

- Traffic signal boxes
- Automatic teller machines
- Temperature control panels
- Gas or liquid control valve housings

Applications and Technical Data

Determining Minimum Wattage Requirements For Enclosures

This chart is an excellent guide for determining total wattage requirements for both insulated

and uninsulated enclosures, assuming the box is relatively airtight. For windy conditions, add an additional 50 percent to the wattage requirement listed.

		Total Enclosure Surface Area—Square Feet (Square Meters)													
		2 (0.2)	3 (0.3)	4 (0.4)	5 (0.5)	6 (0.6)	7.5 (0.7)	9 (0.8)	10 (0.9)	15 (1.4)	20 (1.9)	25 (2.3)	30 (2.8)	40 (3.7)	50 (4.7)
Temperature Rise from Ambient °F (°C)	20 (11)	30 10	40 10	55 15	70 20	80 20	100 25	120 30	135 35	205 50	270 65	335 80	405 100	540 130	670 160
	40 (22)	55 15	80 20	110 30	135 35	160 40	200 50	245 60	270 65	405 100	540 130	670 160	805 195	1075 260	1340 320
		90 20	120 30	160 55	205 50	245 60	300 75	365 90	405 100	605 145	805 195	1005 240	1210 290	1610 385	2010 480
	80 (44)	110 30	160 40	215 55	270 65	325 80	400 100	485 115	540 130	805 195	1075 260	1340 320	1610 385	2145 515	2680 640
		135 35	200 50	270 65	335 80	405 100	500 125	605 145	670 160	1005 240	1340 320	1675 400	2010 480	2680 640	3350 800
	120 (67)	165 40	240 60	320 80	405 100	485 115	600 150	725 175	805 195	1210 290	1610 385	2010 480	2415 580	3220 770	4020 960
		190 45	280 70	375 90	470 115	565 135	700 175	845 205	940 225	1410 340	1880 450	2345 560	2815 675	3755 900	4690 1120

□ Uninsulated boxes □ Insulated boxes

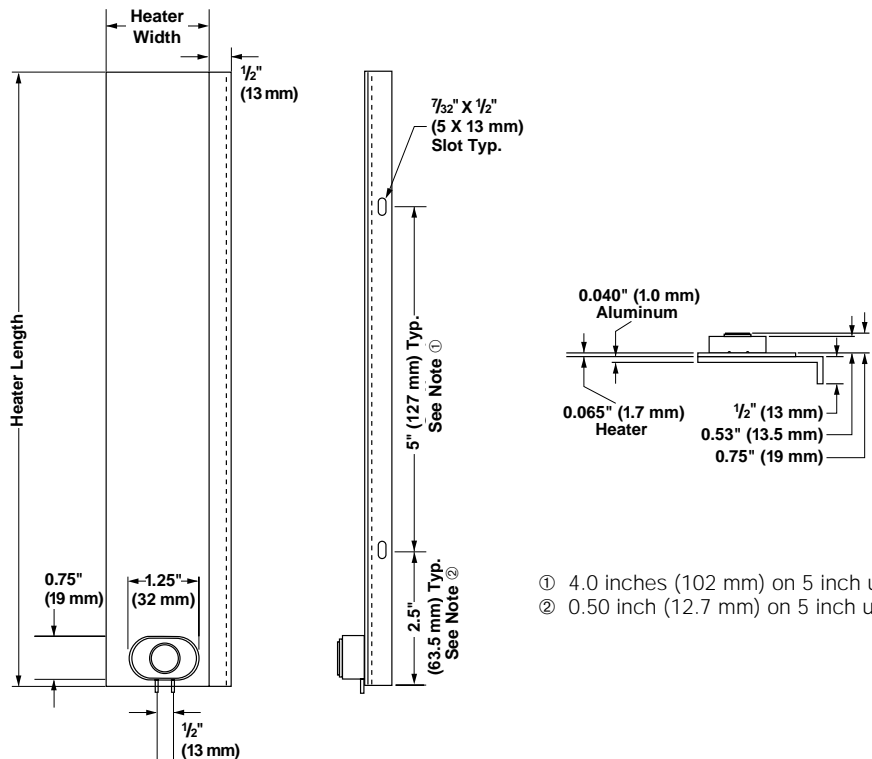
Flexible Heaters

Silicone Rubber Stock Product Offering Enclosure Heaters Options

Aluminum Mounting Plate

Both vertical and horizontal mounting can be accomplished with enclosure heaters. The mounting plates are 0.040 inch (1 mm) thick, specified as #3003 H14 aluminum. The preferred orientation is vertical, with a thermostat attached at the lower end (as shown in the drawing).

For horizontal mounting, a remote thermostat is recommended. An enclosure heater can be ordered by itself, with PSAS or vulcanized to an aluminum mounting plate. See *Thermostats* below for more information.



- ① 4.0 inches (102 mm) on 5 inch unit.
- ② 0.50 inch (12.7 mm) on 5 inch unit.

Thermostats

Mounted on Heater

Built-in snap action thermostats from Watlow are designed to sense air temperature. See the ordering chart on the following page for available settings.

Remote From Heater

For an air sensing thermostat separate from the heater, the ST-207E is ideal. This is a modified ST-207 mounted on a 1/32 inch (0.8 mm) thick G-10 circuit board with the thermostat's metal cap exposed to sense air temperature. The thermostat is placed at the

midpoint of the lead length. The sensor can be preset at the temperatures listed for integral sensors. For more information, turn to **pages 167-168**.

Notes:

- On both integral and remote sensors, the thermostat's exposed metal cap is vulnerable to impact. This could defeat the thermostat's switching action and cause heater malfunction.
- T-10 thermostats are not recommended for enclosure heating applications.

Flexible Heaters

Silicone Rubber Stock Product Offering Drum Heaters

Performance Capabilities

- Available with fixed or adjustable thermostats for temperatures up to 330°F (165°C)
- Watt density of 6 W/in² (1 W/cm²)

Features and Benefits

- **Protects fluids** stored in drums from freezing temperatures.
- **Quick delivery** on 28 styles from stock.
- **Six-foot cord and plug set** included for convenient use.
- **Quick installation** with easy operating latch fasteners.
- **Custom heaters** available for non-standard sizes.

Applications

- Freeze protection
- Viscosity control

Application Hints

- Allow a three-inch (76 mm) gap between heater ends when clamped around a drum.
- Heaters with thermostat settings of 40°F and 60°F (4°C and 16°C) will have open circuit readings if room temperature exceeds the thermostat settings.
- Heaters cannot be bench tested since the thermostat is located over a no-heat section of the heater. Accurate testing of the heater requires it to be placed over the drum which is to be heated.
- When a single heater is used, place the heater at the bottom of the drum to minimize stratification.

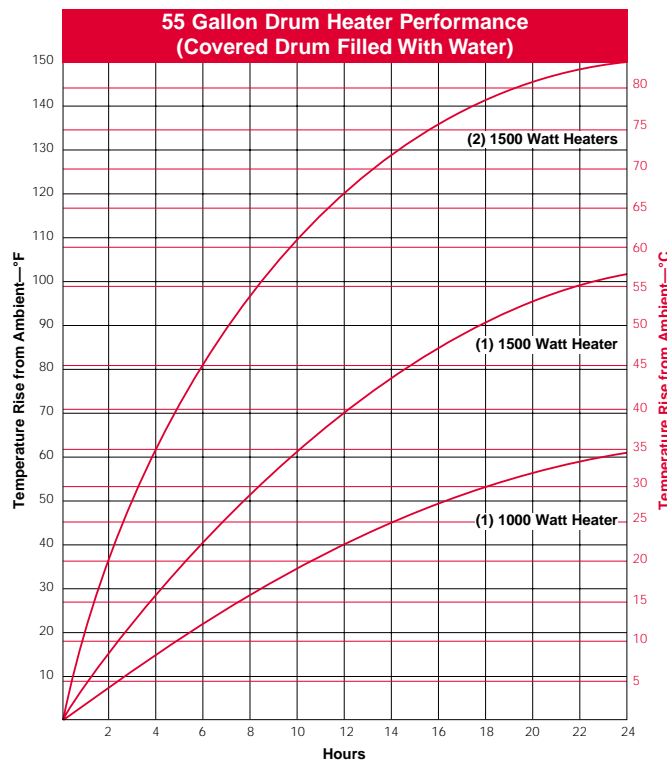


Standard Features

Watlow flexible drum heaters are designed for use on 5-, 30-, and 55-gallon metal drums. They come with the following standard features:

- Six-foot (1.8 m) cord and plug set
- Latch fasteners and springs

- Two styles of thermostats:
T-207 snap action, available on all sizes
B-200-3 adjustable, available only on four-inch (100 mm) wide units, and mounted in a silicone rubber boot to protect it from contamination



Determining Temperature Rise From Ambient

The total wattage (number of heaters and the material being heated) must be considered when estimating the

actual temperature the contents of the drum will reach. The graph above shows the temperature rise from ambient conditions, not drum content temperature.

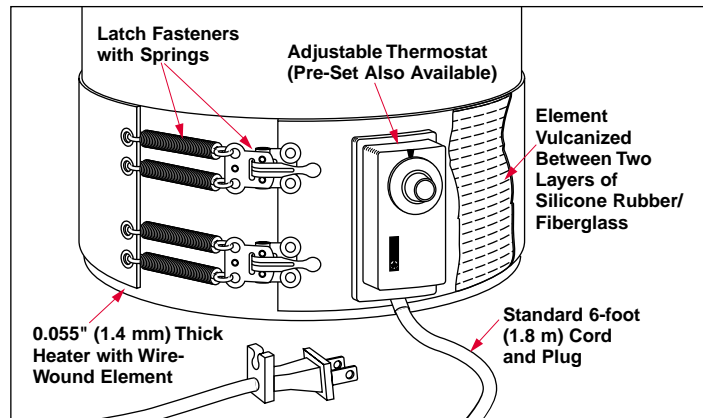


For more information on thermostats, turn to pages 167 to 168.

Flexible Heaters

F.O.B.: Columbia, Missouri

Silicone Rubber Stock Product Offering Drum Heaters



Drum Size	Volts	Watts	Width inches (mm)	Thermostat	Availability	Code No.
5 gal. (20 L) 11 1/2 in. (290 mm) nom. diameter	120	650	4 (100)	(no thermostat)	Stock	04031500A
				150°F (66°C)	Modified Stock	04031500BT
				100°F (38°C)	Modified Stock	04031500CT
				40°F (4°C)	Modified Stock	04031500DT
				60°F (16°C)	Modified Stock	04031500HT
				Adj. 25°-330°F (-5°-165°C)	Stock	04031510
30 gal. (115 L) 18 1/2 in. (470 mm) nom. diameter	120	750	2 1/8 (70)	(no thermostat)	Stock	02655080A
				150°F (66°C)	Modified Stock	02655080BT
				100°F (38°C)	Modified Stock	02655080CT
				40°F (4°C)	Modified Stock	02655080DT
				60°F (16°C)	Modified Stock	02655080ET
55 gal. (210 L) 22 1/2 in. (570 mm) nom. diameter	120	1000	2 1/8 (70)	(no thermostat)	Stock	02667700A
				150°F (66°C)	Modified Stock	02667700BT
				100°F (38°C)	Modified Stock	02667700CT
				40°F (4°C)	Modified Stock	02667700DT
				60°F (16°C)	Modified Stock	02667700ET
55 gal. (210 L) 22 1/2 in. (570 mm) nom. diameter	120	1500	4 (100)	(no thermostat)	Stock	04067700A
				150°F (66°C)	Modified Stock	04067700BT
				100°F (38°C)	Modified Stock	04067700CT
				40°F (4°C)	Modified Stock	04067700DT
				60°F (16°C)	Modified Stock	04067700GT
				Adj. 25°-330°F (-5°-165°C)	Stock	04067710
55 gal. (210 L) 22 1/2 in. (570 mm) nom. diameter	Ⓜ240	1500	4 (100)	(no thermostat)	Stock	04067701A
				150°F (66°C)	Modified Stock	04067701BT
				100°F (38°C)	Modified Stock	04067701CT
				40°F (4°C)	Modified Stock	04067701DT
				60°F (16°C)	Modified Stock	04067701ET
				Adj. 25°-330°F (-5°-165°C)	Stock	04067711

Ⓜ Supplied with 6-foot (1.8 m) cord—no plug.

How to Order

After determining the drum size, volts, watts and temperature sensing requirements, specify the corresponding Watlow code number and quantity desired.

Availability

Stock: Drum heaters without thermostats and those with adjustable thermostats are available for same day shipment if order is received by 11:00 a.m. CST.

Modified Stock: Drum heaters with pre-set thermostats require two to three days lead time before being shipped.

Made-to-Order: Consult factory

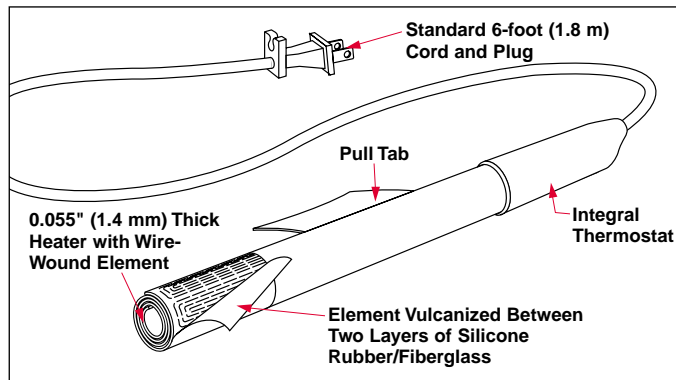
Flexible Heaters

Silicone Rubber

Stock Product Offering
PVC Wirewound
Conduit Heaters

Watlow's conduit heater simplifies bending PVC plastic conduit to the desired shape right on the job site. Just plug it in and within four to 18 minutes—depending upon heater size—the conduit is ready to be formed by hand into the shape or radius you need.

This lightweight silicone rubber heater is easily wrapped around the conduit because of its flexible, self-conforming construction.



Performance Capabilities

- Operating temperatures to 250°F (121°C)
- Handles plastic conduits as large as four inches (100 mm) in diameter

Features and Benefits

- **Self-conforming** to cylindrical shapes for a snug fit around the conduit.

- **Portable design** for easy use in the field.
- **Thermostat provided** to protect from overheating.
- **Pull tab** allows easy removal or positioning when the heater is hot.
- **Available for immediate delivery** from stock.

F.O.B.: Columbia, Missouri

Conduit Diameter in. (mm)	Length in. (mm)	Watts	Volts	Temp. Limit °F (°C)	Warm-up Time	Code No.
½ to 1 ½ (15-40)	12 (300)	180	120	250 (121)	4-10 minutes	05712082
2 to 4 (50-100)	25 (635)	950	120	250 (121)	7-18 minutes	14825081

How To Order

Choose between the two sizes available. Specify the Watlow code number and quantity desired.

Availability

Stock: Both sizes are available for immediate delivery from stock.

Made-to-Order: Consult factory

Flexible Heaters

F.O.B.: Anaheim, California

Silicone Rubber

Stock Product Offering

Composite Flexible Stock Heaters

The composite bonding industry is a large field that is expanding into a variety of areas. One of the primary fields that utilize flexible heaters for curing is the aerospace industry. Watlow offers a stock list of heaters commonly used for composite bonding and curing. The design includes equal length circuits and a no-heat tab for temperature uniformity. Also, the contact surface is made of a smooth silicone to prevent composite surface imperfections. The heaters are fiberglass reinforced to provide lasting field service durability and life.

Features and Benefits

- Standard 5 W/in²
- 120V~(ac) (standard)/ 240V~(ac) (option) single phase
- Customized leads
- Field service ease
- Equal length circuits— minimum 2 inch x 2 inch tab w/radius
- Smooth contact surface
- UL® recognized

Applications

- Aerospace industry
 - Repair
 - Fabrication
- Composite bonding processes

Heat Mapping Certification

Heat mapping certification is available on customer request at an additional charge.

- ±10°F conformity
- Serialized and records maintained five years minimum

Availability

- **Stock:** 24 hours
- **Heat mapping:** One week
- **Made-to-Order:** Two weeks — a net set-up charge will be applied

UL® is a registered trademark of Underwriter's Laboratories, Inc.



Size		Code Number
in.	(mm)	
6 x 6	(180)	L060080509S
6 x 10	(300)	L060120510S
8 x 8	(320)	L080100505S
8 x 12	(480)	L080140501S
10 x 10	(500)	L100120506S
10 x 12	(600)	L100140501S
10 x 18	(900)	L100200503S

Size		Code Number
in.	(mm)	
12 x 12	(700)	L120140510S
12 x 18	(1080)	L120200506S
12 x 24	(1440)	L120260504S
16 x 16	(1280)	L160180502S
18 x 18	(1620)	L180200502S
20 x 20	(2000)	L200220501S