

Flexible Heaters

Flexible Heaters

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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 heat up and cool down rates, uniform heat distribution and high watt densities.

Features and Benefits

Flat geometry

- Permits holes, notches and unusual shapes

Option of two material types and two element styles

- Allows for wider flexibility

Lightweight construction and low thermal mass

- Permits use in applications that have limited space or weight requirements

Close heating elements (as close as 0.003 in. [0.08 mm])

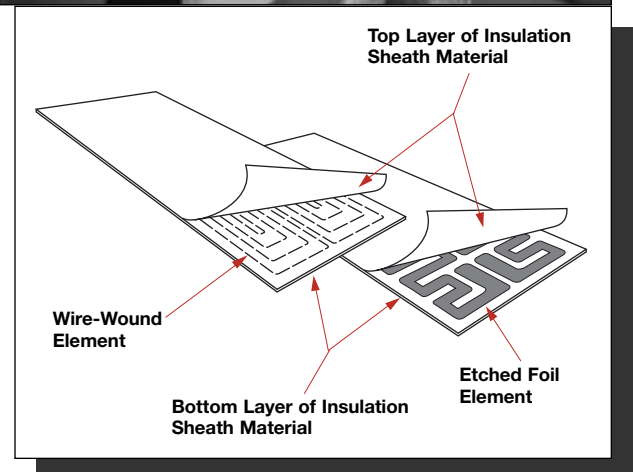
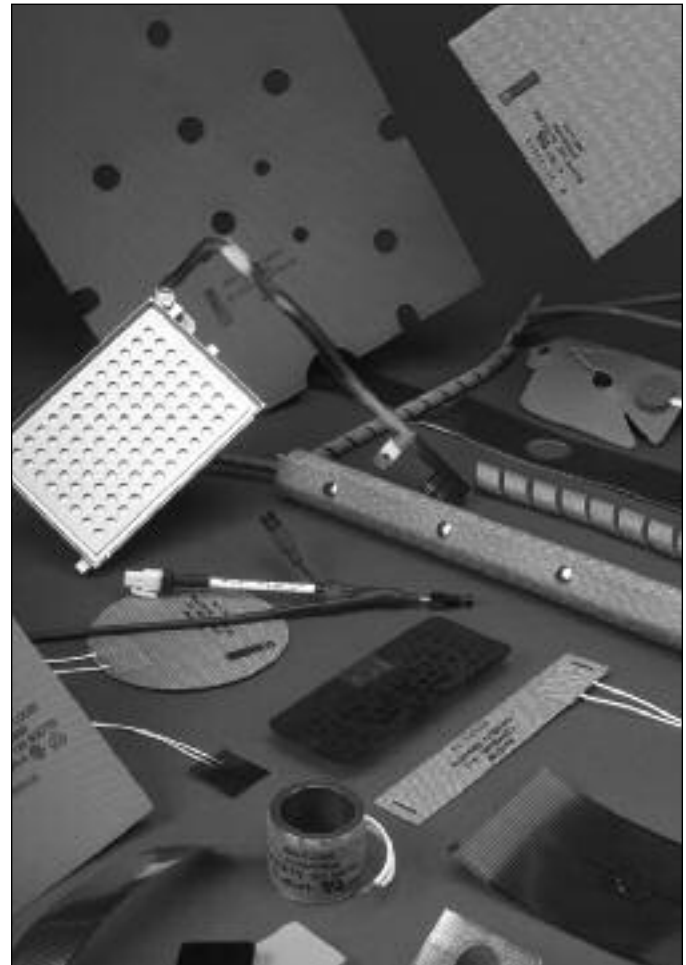
- Creates faster heat up and cool down time

Uniformly spaced element paths

- Distributes 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

Two Material Types

Silicone Rubber

This rugged, moisture- and chemical-resistant material is easily bonded or adhered 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®, VDE and CE recognition.

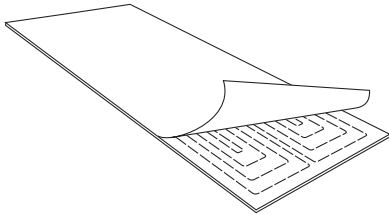
Polyimide

Polyimide is a thin, lightweight transparent material and is designed for 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.

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



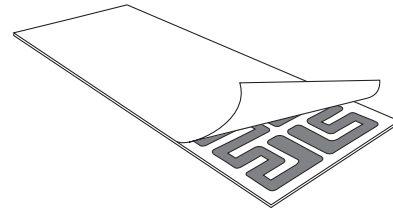
Available on silicone rubber heaters, this element style is created by spiraling fine resistance wires around a fiberglass cord. The element is then laid out in a pattern designed specifically for your application.

The benefits of wire-wound elements include:

- Excellent physical strength and flexibility; repeated flexing of the heater has no harmful effects on its performance
- 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 alloy resistance foil, is available in silicone rubber and polyimide 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
- Can provide complex heat distribution patterns

The etched foil element style is usually recommended for applications requiring high temperatures, watt densities, or multiple zoning.

Flexible Heaters

Silicone Rubber Heaters

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 is 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 in. (1.4 mm) thick with a wire-wound element; only 0.022 in. (0.56 mm) with an etched foil element
- UR®, cUR®, VDE and CE recognitions are available on many designs up to 428°F (220°C)

Features and Benefits

Designed in the exact shape and size needed

- Conforms to your equipment

More than 80 designs available immediately from stock

- Reduces downtime

Moisture and chemical-resistant silicone rubber material

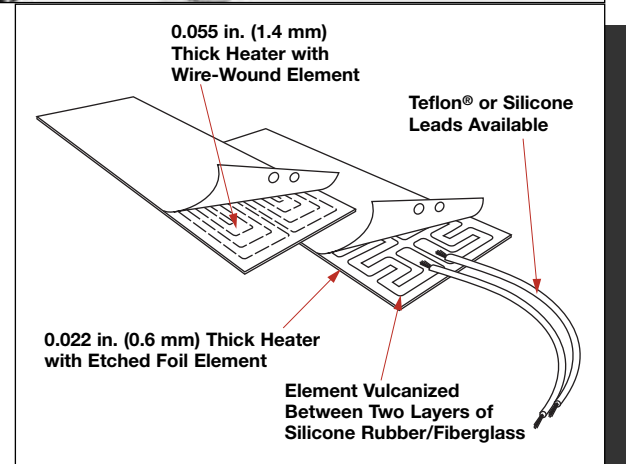
- Provides longer heater life

Vulcanizing adhesives or fasteners

- Easily bond heaters to your part

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
- Semiconductor processing equipment



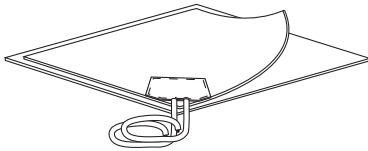
Flexible Heaters

Silicone Rubber 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.

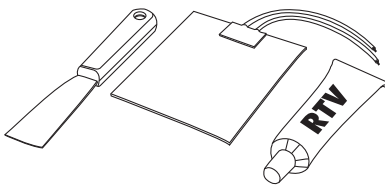
Pressure Sensitive Adhesive Surface (PSAS)



For speed, convenience and economy of installation, specify Pressure Sensitive Adhesive Surface (PSAS). Simply peel off the protective backing and roll the heater in place for an even bond to a clean, smooth surface. PSAS is not recommended for curved surfaces or for heaters rated above 10 W/in² (1.5 W/cm²). It should not be used for applications exceeding 400°F (205°C) on silicone rubber and 300°F (150°C) on polyimide.

Note: PSAS has a minimum six months storage life before heater installation when stored at or below 86°F (30°C)

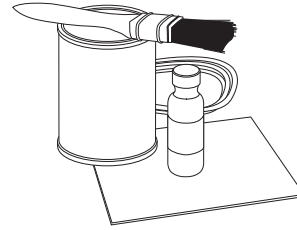
Field Applied Adhesive (RTV)



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.

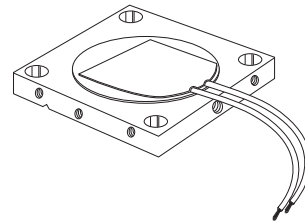
Note: Not recommended for polyimide heaters.

Silicone Contact Cement Kit



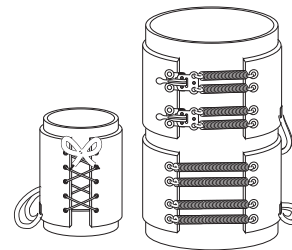
This two-part adhesive consists of a resin and catalyst that are easily mixed together and applied with a paintbrush. Recommended usage is for field cementing of silicone rubber heaters to customer parts. Available from stock, the cement kit will handle temperatures to 350°F (175°C). The resin is available 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 polyimide.

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

Silicone Rubber Heaters

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—Teflon® UL® 1180 CSA



Watlow's standard leads are 12 in. (305 mm) long, white, Teflon® insulated, flexible, plated copper UL® 1180 CSA wire. They are rated for 392°F (200°C)/300V. The lead connections on or at the heater are insulated with a cap of sheath material, vulcanized to the heater body.

HPN Cord and Plug Set



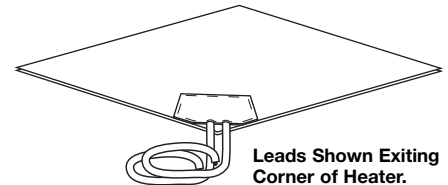
For removable heaters, a 6 ft (1.8 m) HPN cord and plug set provides convenience. It is rated for 194°F (90°C)/300V~(ac). HPN cord without a plug is also available in any length.

Special Teflon® Leads



Teflon® Type E (MIL-W-16878) and Teflon® UL® 1199 rated for 392°F (200°C)/600V are also available.

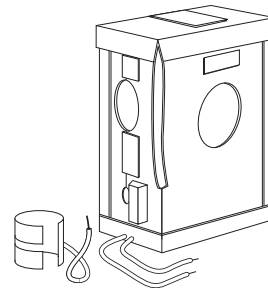
Silicone Insulated Leads



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.

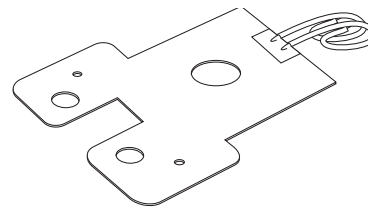
Construction

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 in. (3.2 mm) of all edges. Standard spacing is 1/4 in. (6 mm) from all edges.

Flexible Heaters

Silicone Rubber Heaters

Applications and Technical Data

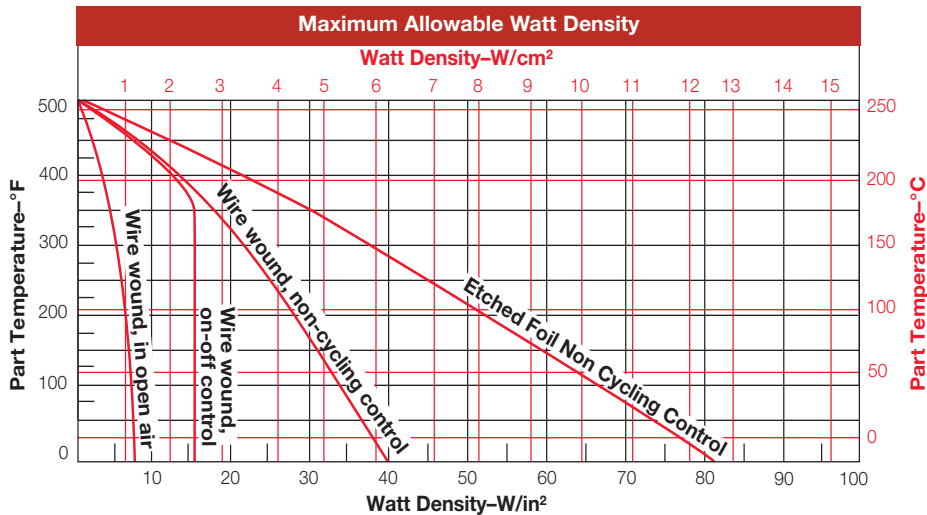
Determining Watt Density

The *Maximum Allowable Watt Density* graph illustrates the maximum recommended heater watt density at various metal parts 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 controllers are typically bimetal or capillary bulb.
- Non-cycling controllers are typically solid state, time-proportioning or SCR temperature controllers.

- Watt density values should be de-rated by one third if insulation is used.
- UL® recognition temperature limits are not detailed.
- Contact your Watlow representative 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

Max. width x max. length

- Wire-wound: 36 x 120 in. (914 mm x 3048 mm)
- Etched foil: 20 x 30 in. (508 mm x 762 mm)

Thickness (standard)

- Wire-wound: 0.055 in. (1.4 mm)
- Etched foil: 0.022 in. (0.6 mm)

Weight (standard)

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

Max. operating temperature: 500°F (260°C)

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

Min. ambient temperature: -80°F (-62°C)

Max. voltage: 600V~(ac)

Max. wattage: see watt density graph

Lead size: sized to load

Lead length: 12 +1½ -½ in. (305 mm +38 mm -13 mm)

Wattage tolerance

- Wire: ±5%
- Foil: +5% -10%

Dimensional tolerances

- 0 to 6 in. (0 to 152 mm): ±¼ in. (1.59 mm)
- 6 to 18 in. (152 to 457 mm): ±⅛ in. (3.18 mm)
- 18 to 36 in. (457 mm to 914 mm): ±⅜ in. (4.76 mm)
- Over 36 in. (914 mm): ±1%

Flexible Heaters

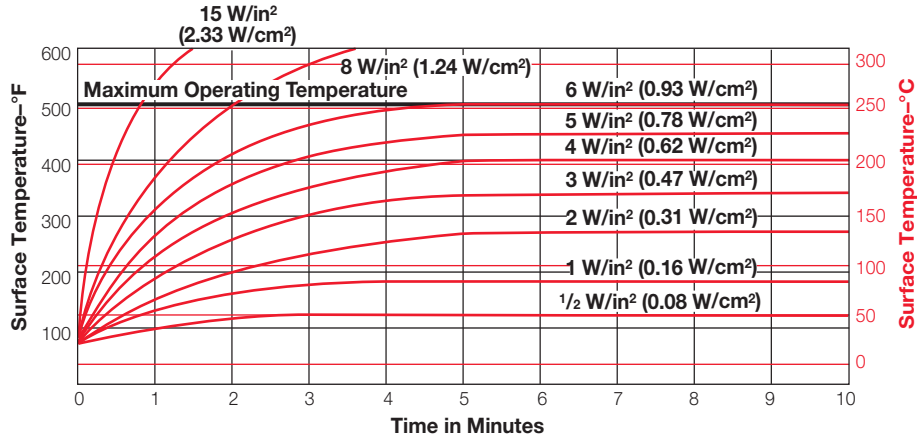
Silicone Rubber Heaters

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 in. (1.4 mm) thick standard construction and is offered as a reference tool.



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

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



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. Contact your Watlow representative for further information.

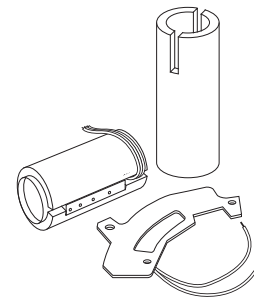
VDE Approval is available on several constructions of both wire-wound (File No. 62533) and etched foil (File No. 62535) silicone rubber heaters. The maximum ratings are 440V~(ac) and 428°F (220°C) surface temperature. Under VDE guidelines, minimum installed bend radius is 1/8 in. (3.2 mm) for etched foil and 1/4 in. (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 controller.

The **CE mark** is available on UR® and/or VDE recognized heaters.

Options

Watlow offers a variety of options such as attachment techniques, thermostats, special leads, holes and cutouts. 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 in. (1.6, 3.2, 6, 9.5 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.

Flexible Heaters

Silicone Rubber Heaters

Wire-Wound Elements

Width		Length		Watts	120V~(ac) Code Number	120/240V~(ac) Code Number
in.	(mm)	in.	(mm)			
1	(25)	2	(51)	10	010020C1*	
		3	(76)	15	010030C1*	
		4	(102)	20	010040C1*	
		5	(127)	25	010050C1*	
		5	(127)	6.25/25		010050C2*
		10	(254)	50	010100C1	
		10	(254)	12.5/50		010100C2*
		15	(381)	75	010150C1	
		15	(381)	18.75/75		010150C2
		20	(508)	100	010200C1	
		20	(508)	25/100		010200C2
		25	(635)	125	010250C1	
		30	(762)	150	010300C1	
		35	(889)	175	010350C1	
		40	(1016)	200	010400C1	
80	(2032)	400	010800C1			
120	(3048)	600	010F10C1			
2	(51)	2	(51)	20	020020C1*	
		5	(127)	50	020050C1	
		5	(127)	12.5/50		020050C2*
		10	(254)	100	020100C1	
		10	(254)	25/100		020100C2
		15	(381)	150	020150C1	
		15	(381)	37.5/150		020150C2
		20	(508)	200	020200C1	
		20	(508)	50/200		020200C2
		25	(635)	250	020250C1	
		30	(762)	300	020300C1	
		35	(889)	350	020350C1	
		40	(1016)	400	020400C1	
3	(76)	3	(76)	45	030030C1	
		5	(127)	75	030050C1	
		5	(127)	18.75/75		030050C2
		10	(254)	150	030100C1	
		10	(254)	37.5/150		030100C2
		15	(381)	225	030150C1	
		15	(381)	56.25/225		030150C2
		20	(508)	300	030200C1	
		20	(508)	75/300		030200C2
		25	(635)	375	030250C1	
		30	(762)	450	030300C1	
		35	(889)	525	030350C1	
		40	(1016)	600	030400C1	

CONTINUED

* These heaters are not recommended for curved or flexing applications - high resistance density.

Notes:

- Standard thickness 0.055 in. (1.4 mm)
- Stock heaters have standard lead length 12 in. (305 mm) UL® 1180 Teflon®
- UL® component recognition
- Silicone rubber wire-wound elements rated at 5 W/in²

Flexible Heaters

Silicone Rubber Heaters

Wire-Wound Elements (Continued)

Width		Length		Watts	120V~(ac) Code Number	120/240V~(ac) Code Number
in.	(mm)	in.	(mm)			
4	(102)	4	(102)	80	040040C1	
		5	(127)	100	040050C1	
		5	(127)	25/100		040050C2
		10	(254)	200	040100C1	
		10	(254)	50/200		040100C2
		15	(381)	300	040150C1	
		15	(381)	75/300		040150C2
		20	(508)	400	040200C1	
		20	(508)	100/400		040200C2
		25	(635)	500	040250C1	
		30	(762)	600	040300C1	
35	(889)	700	040350C1			
40	(1016)	800	040400C1			
5	(127)	5	(127)	125	050050C1	
		5	(127)	31.25/125		050050C2
		10	(254)	250	050100C1	
		10	(254)	62.5/250		050100C2
		15	(381)	375	050150C1	
		15	(381)	9.375/375		050150C2
		20	(508)	500	050200C1	
		20	(508)	125/500		050200C2
		25	(635)	625	050250C1	
		30	(762)	750	050300C1	
		35	(889)	875	050350C1	
40	(1016)	1000	050400C1			
6	(152)	5	(127)	150	060050C1	
		5	(127)	37.5/150		060050C2
		10	(254)	300	060100C1	
		10	(254)	75/300		060100C2
		15	(381)	450	060150C1	
		15	(381)	112.5/450		060150C2
		20	(508)	600	060200C1	
		20	(508)	150/600		060200C2
		25	(635)	750	060250C1	
		30	(762)	900	060300C1	
		35	(889)	1050	060350C1	
40	(1016)	1200	060400C1			

Notes:

- Standard thickness 0.055 in. (1.4 mm)
- Stock heaters have standard lead length 12 in. (305 mm) UL® 1180 Teflon®
- UL® component recognition
- Silicone rubber wire-wound elements rated at 5 W/in²

Flexible Heaters

Silicone Rubber Heaters

Wire-Wound Elements (Continued)

Stock Heater Coding Configured Options

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

Wire-Wound

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 in. sponge
- S = 1/8 in. sponge
- T = 1/4 in. sponge
- U = 3/8 in. sponge
- V = 1/2 in. sponge
- W = PSAS + 1/16 in. sponge
- Y = PSAS + 1/8 in. sponge
- 1 = PSAS + 1/4 in. sponge
- 2 = PSAS + 3/8 in. sponge
- 3 = PSAS + 1/2 in. sponge

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 in series with the heater; alternate location is rotated parallel with heater width; alternate wiring is separate leads for pilot control.

•For thermocouples, Type J standard is Teflon® insulation; Type J alternate is fiberglass insulation; Type K standard is fiberglass 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

B200 Set °F

- 0 = None
- 2 = 100-500
- 3 = 25-330

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

Lead Insulation

- 0 = None
- 1 = 1180 UL®R/C
- 2 = 1180 C-UL®R/C
- 3 = 3133 22 GA
- 6 = 1199 CSA
- 7 = HPN
- 8 = 6 ft HPN set
- 9 = Type E Teflon®
- A = 1180VDE*
- B = 1199VDE*
- C = Silicone leads w/waterproof cap
- E = SJO cord
- F = 6 ft SJO set

* 1180VDE denotes a C-UL® 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
- Y = 22 ft
- 1 = 25 ft
- 2 = 30 ft

* Customer specified length must be noted in inches when ordering.

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. Contact Watlow before combining options.

Made-to-Order: contact Watlow.

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 (with part number configuration -0001B) if received by 11:00 a.m. CST. All other modifications (other than -0001B) are modified stock and ship within five working days.

Flexible Heaters

Silicone Rubber Heaters

Etched Foil Elements

Width in. (mm)		Length in. (mm)		Watts	W/in ² (W/cm ²)	120V~(ac) Code Number	120/240V~(ac) Code Number
1	(25)	5	(127)	25	5 (0.8)	F010050C3	
		5	(127)	50	10 (1.6)	F010050C7	
	(254)	5	(127)	12.5/50	2.5/10 (0.4/1.6)		F010050C8
		10	(254)	100	10 (1.6)	F010100C7	F010100C8
		10	(254)	25/100	2.5/10 (0.4/1.6)		
		15	(381)	150	10 (1.6)	F010150C7	F010150C8
		15	(381)	37.5/150	2.5/10 (0.4/1.6)		
		20	(508)	200	10 (1.6)	F010200C7	F010200C8
20	(508)	50/200	2.5/10 (0.4/1.6)				
2	(51)	5	(127)	100	10 (1.6)	F020050C7	F020050C8
		5	(127)	25/100	2.5 /10 (0.4/1.6)		
	(254)	10	(254)	200	10 (1.6)	F020100C7	F020100C8
		10	(254)	50/200	2.5 /10 (0.4/1.6)		
		15	(381)	300	10 (1.6)	F020150C7	F020150C8
		15	(381)	75/300	2.5/10 (0.4/1.6)		
		20	(508)	400	10 (1.6)	F020200C7	F020200C8
		20	(508)	100/400	2.5/10 (0.4/1.6)		
3	(76)	5	(127)	75	5 (0.8)	F030050C3	F030050C8
		5	(127)	150	10 (1.6)	F030050C7	
		5	(127)	37.5/150	2.5 /10 (0.4/1.6)		
	(254)	10	(254)	300	10 (1.6)	F030100C7	F030100C8
		10	(254)	75/300	2.5 /10 (0.4/1.6)		
		15	(381)	450	10 (1.6)	F030150C7	F030150C8
		15	(381)	112/450	2.5 /10 (0.4/1.6)		
		20	(508)	600	10 (1.6)	F030200C7	F030200C8
20	(508)	150/600	2.5 /10 (0.4/1.6)				
4	(102)	5	(127)	200	10 (1.6)	F040050C7	F040050C8
		5	(127)	50/200	2.5 /10 (0.4/1.6)		
	(254)	10	(254)	400	10 (1.6)	F040100C7	F040100C8
		10	(254)	100/400	2.5 /10 (0.4/1.6)		
		15	(381)	600	10 (1.6)	F040150C7	F040150C8
		15	(381)	150/600	2.5/10 (0.4/1.6)		
		20	(508)	800	10 (1.6)	F040200C7	F040200C8
		20	(508)	200/800	2.5/10 (0.4/1.6)		
5	(127)	5	(127)	250	10 (1.6)	F050050C7	F050050C8
		5	(127)	62.5/250	2.5/10 (0.4/1.6)		
	(254)	10	(254)	500	10 (1.6)	F050100C7	F050100C8
		10	(254)	125/500	2.5/10 (0.4/1.6)		
		15	(381)	750	10 (1.6)	F050150C7	F050150C8
		15	(381)	187/750	2.5/10 (0.4/1.6)		
		20	(508)	1000	10 (1.6)	F050200C7	F050200C8
		20	(508)	250/1000	2.5/10 (0.4/1.6)		
6	(152)	5	(127)	300	10 (1.6)	F060050C7	F060050C8
		5	(127)	75/300	2.5/10 (0.4/1.6)		
	(254)	10	(254)	600	10 (1.6)	F060100C7	F060100C8
		10	(254)	150/600	2.5 /10 (0.4/1.6)		
		15	(381)	900	10 (1.6)	F060150C7	F060150C8
		15	(381)	225/900	2.5/10 (0.4/1.6)		
		20	(508)	1200	10 (1.6)	F060200C7	F060200C8
		20	(508)	300/1200	2.5/10 (0.4/1.6)		

Notes:

- Silicone rubber etched foil elements 0.022 in. (0.56 mm) thick
- Stock heaters have standard lead length 12 in. (305 mm) UL® 1180 Teflon®
- UL® Component Recognition

Flexible Heaters

Silicone Rubber Heaters

Etched Foil Elements

Stock Heater Coding Configured Options

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

Etched Foil
F0 - - - - -

Options
0 = None
A = PSAS bottom
B = PSAS top
K = PSAS and low loss
L = Low loss
R = 1/16 in. sponge
S = 1/8 in. sponge
T = 1/4 in. sponge
U = 3/8 in. sponge
V = 1/2 in. sponge
W = PSAS + 1/16 in. sponge
Y = PSAS + 1/8 in. sponge
1 = PSAS + 1/4 in. sponge
2 = PSAS + 3/8 in. sponge
3 = PSAS + 1/2 in. sponge

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
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 in series with the heater; alternate location is rotated parallel with heater width; alternate wiring is separate leads for pilot control.

•For thermocouples, Type J standard is Teflon® insulation; Type J alternate is fiberglass insulation; Type K standard is fiberglass insulation.

•Etched foil heaters not recommended for Enclosure heaters.

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

Lead Insulation
0 = None
1 = 1180 UL®R/C
2 = 1180 C-UL®R/C
3 = 3133 22 GA**
6 = 1199 CSA
7 = HPN
8 = 6 ft HPN set
9 = Type E Teflon®
A = 1180VDE*
B = 1199VDE*
C = Silicone leads w/waterproof cap
E = SJO cord
F = 6 ft SJO set

*1180VDE denotes a C-UL® heater plus a VDE stamp.

**Not available on composite heaters due to amperage.

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

*Customer specified length must be noted in inches when ordering

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. Contact Watlow before combining options.

Made-to-Order: contact Watlow.

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 (with part number configuration -0001B) if received by 11:00 a.m. CST. All other modifications (other than -0001B) are modified stock and ship within five working days.

Flexible Heaters

Silicone Rubber Heaters

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 utilizes 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 (0.8 W/cm²)

- Meets composite industry specifications

120V~(ac) standard / 240V~(ac) (option) single phase

- Matches standard composite industry equipment

Customized leads

- Allows up to 40 foot of lead length

Field service ease

- Makes on-site repairs possible

Equal length circuits - min. 2 x 2 in. (51 x 51 mm) tab with radius

- Creates temperature uniformity

Smooth contact surface

- Prevents composite surface imperfections

UL® recognized

- Available on many custom designs

Applications

- Aerospace industry
 - Repair
 - Fabrication
- Composite bonding processes



Flexible Heaters

Silicone Rubber Heaters

Wire-Wound Elements

Composite Heaters “L”

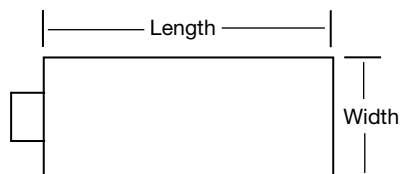
Width		Length		Watts	120V~(ac)	120/240V~(ac)
in.	(mm)	in.	(mm)		Code Number	Code Number
6	(152)	6	(152)	180	L060080C1	L060080C2
		6	(152)	180		
		10	(254)	300	L060120C1	L060120C2
		10	(254)	300		
8	(203)	8	(203)	320	L080100C1	L080100C2
		8	(203)	320		
		12	(305)	480	L080140C1	L080140C2
		12	(305)	480		
10	(254)	10	(254)	500	L100120C1	L100120C2
		10	(254)	500		
		12	(305)	600	L100140C1	L100140C2
		12	(305)	600		
		18	(457)	900	L100200C1**	L100200C2
		18	(457)	900		
12	(305)	12	(305)	720	L120140C1**	L120140C2
		12	(305)	720		
		18	(457)	1080	L120200C1**	L120200C2**
		18	(457)	1080		
		24	(610)	1440	L120260C1**	L120260C2**
		24	(610)	1440		
16	(406)	16	(406)	1280	L160180C1**	L160180C2**
		16	(406)	1280		
18	(457)	18	(457)	1620	L180200C1**	L180200C2**
		18	(457)	1620		
20	(508)	20	(508)	2000	L200220C1*	L200220C2**
		20	(508)	2000		

* Thermostat option is not available for this heater.

** Only T207 thermostat option is available.

Notes:

- Standard thickness 0.055 in. (1.4 mm)
- Standard lead length 12 in. (305 mm) UL® 1180 Teflon®
- UL® component recognition
- Silicone rubber wire-wound elements rated at 5 W/in²
- Length does not include 2 in. (51 mm) tab for leads
- Material A2



Flexible Heaters

Silicone Rubber Heaters

Wire-Wound Elements

Composite Heaters "L"

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

Composite Flexible Stock Heaters

L - - - - - - - - - -

Modification Options	Sensors	T10 Set °F*	Lead Insulation	Lead Length*																																																																																																																		
0 = None A = PSAS bottom B = PSAS top K = PSAS and low loss L = Low loss R = 1/16 in. sponge S = 1/8 in. sponge T = 1/4 in. sponge U = 3/8 in. sponge V = 1/2 in. sponge W = PSAS + 1/16 in. sponge Y = PSAS + 1/8 in. sponge 1 = PSAS + 1/4 in. sponge 2 = PSAS + 3/8 in. sponge 3 = PSAS + 1/2 in. sponge	<table border="1"> <thead> <tr> <th>Type</th> <th>LOC</th> <th>WIR</th> </tr> </thead> <tbody> <tr><td>0 = None</td><td></td><td></td></tr> <tr><td>L = T10</td><td>STD</td><td>STD</td></tr> <tr><td>M = T10</td><td>STD</td><td>ALT</td></tr> <tr><td>N = T10</td><td>ALT</td><td>STD</td></tr> <tr><td>P = T10</td><td>ALT</td><td>ALT</td></tr> <tr><td>R = T207</td><td>STD</td><td>STD</td></tr> <tr><td>S = T207</td><td>STD</td><td>ALT</td></tr> <tr><td>T = T207</td><td>ALT</td><td>STD</td></tr> <tr><td>U = T207</td><td>ALT</td><td>ALT</td></tr> <tr><td>4 = JSTD</td><td>STD</td><td>STD</td></tr> <tr><td>6 = JALT</td><td>STD</td><td>STD</td></tr> <tr><td>7 = KSTD</td><td>STD</td><td>STD</td></tr> </tbody> </table>	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	4 = JSTD	STD	STD	6 = JALT	STD	STD	7 = KSTD	STD	STD	<table border="1"> <thead> <tr> <th>T10 Set °F*</th> </tr> </thead> <tbody> <tr><td>0 = None</td></tr> <tr><td>A = 125</td></tr> <tr><td>B = 150</td></tr> <tr><td>E = 175</td></tr> <tr><td>F = 200</td></tr> <tr><td>G = 225</td></tr> <tr><td>H = 250</td></tr> <tr><td>J = 275</td></tr> <tr><td>K = 300</td></tr> </tbody> </table> <table border="1"> <thead> <tr> <th>T207 Set °F*</th> </tr> </thead> <tbody> <tr><td>0 = None</td></tr> <tr><td>1 = 40/55</td></tr> <tr><td>2 = 60/75</td></tr> <tr><td>3 = 95/110</td></tr> <tr><td>4 = 145/160</td></tr> </tbody> </table> <table border="1"> <thead> <tr> <th>T/C Length</th> </tr> </thead> <tbody> <tr><td>0 = None</td></tr> <tr><td>A = 8 in.</td></tr> <tr><td>B = 12 in.</td></tr> <tr><td>E = 18 in.</td></tr> <tr><td>F = 24 in.</td></tr> <tr><td>G = 30 in.</td></tr> <tr><td>H = 36 in.</td></tr> <tr><td>J = 40 in.</td></tr> <tr><td>K = 4 ft</td></tr> <tr><td>L = 5 ft</td></tr> <tr><td>M = 6 ft</td></tr> <tr><td>N = 7 ft</td></tr> <tr><td>P = 8 ft</td></tr> <tr><td>R = 9 ft</td></tr> <tr><td>S = 10 ft</td></tr> <tr><td>T = 12 ft</td></tr> <tr><td>U = 15 ft</td></tr> <tr><td>V = 18 ft</td></tr> <tr><td>W = 20 ft</td></tr> <tr><td>Y = 22 ft</td></tr> <tr><td>1 = 25 ft</td></tr> <tr><td>2 = 30 ft</td></tr> </tbody> </table>	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	<table border="1"> <thead> <tr> <th>Lead Insulation</th> </tr> </thead> <tbody> <tr><td>0 = None</td></tr> <tr><td>1 = 1180 UL® R/C</td></tr> <tr><td>2 = 1180 C-UL® R/C</td></tr> <tr><td>3 = 3133 22 GA**</td></tr> <tr><td>6 = 1199 CSA</td></tr> <tr><td>7 = HPN</td></tr> <tr><td>8 = 6 ft HPN set</td></tr> <tr><td>9 = Type E Teflon®</td></tr> <tr><td>A = 1180VDE*</td></tr> <tr><td>B = 1199VDE*</td></tr> <tr><td>C = Silicone leads w/waterproof cap</td></tr> <tr><td>E = SJO cord</td></tr> <tr><td>F = 6 ft SJO set</td></tr> </tbody> </table>	Lead Insulation	0 = None	1 = 1180 UL® R/C	2 = 1180 C-UL® R/C	3 = 3133 22 GA**	6 = 1199 CSA	7 = HPN	8 = 6 ft HPN set	9 = Type E Teflon®	A = 1180VDE*	B = 1199VDE*	C = Silicone leads w/waterproof cap	E = SJO cord	F = 6 ft SJO set	<table border="1"> <thead> <tr> <th>Lead Length*</th> </tr> </thead> <tbody> <tr><td>A = 8 in.</td></tr> <tr><td>B = 12 in.</td></tr> <tr><td>E = 18 in.</td></tr> <tr><td>F = 24 in.</td></tr> <tr><td>G = 30 in.</td></tr> <tr><td>H = 36 in.</td></tr> <tr><td>J = 40 in.</td></tr> <tr><td>K = 4 ft</td></tr> <tr><td>L = 5 ft</td></tr> <tr><td>M = 6 ft</td></tr> <tr><td>N = 7 ft</td></tr> <tr><td>P = 8 ft</td></tr> <tr><td>R = 9 ft</td></tr> <tr><td>S = 10 ft</td></tr> <tr><td>T = 12 ft</td></tr> <tr><td>U = 15 ft</td></tr> <tr><td>V = 18 ft</td></tr> <tr><td>W = 20 ft</td></tr> <tr><td>Y = 22 ft</td></tr> <tr><td>1 = 25 ft</td></tr> <tr><td>2 = 30 ft</td></tr> </tbody> </table>	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
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T = 12 ft																																																																																																																						
U = 15 ft																																																																																																																						
V = 18 ft																																																																																																																						
W = 20 ft																																																																																																																						
Y = 22 ft																																																																																																																						
1 = 25 ft																																																																																																																						
2 = 30 ft																																																																																																																						

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

•For thermocouples, Type J standard is Teflon® insulation; Type J alternate is fiberglass insulation; Type K standard is fiberglass insulation.

•Etched foil heaters not recommended for enclosure heaters.

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

**Not available on composite heaters due to amperage. * Customer specified length must be noted in inches when ordering.

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. Contact Watlow before combining options.

Made-to-Order: Contact Watlow.

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

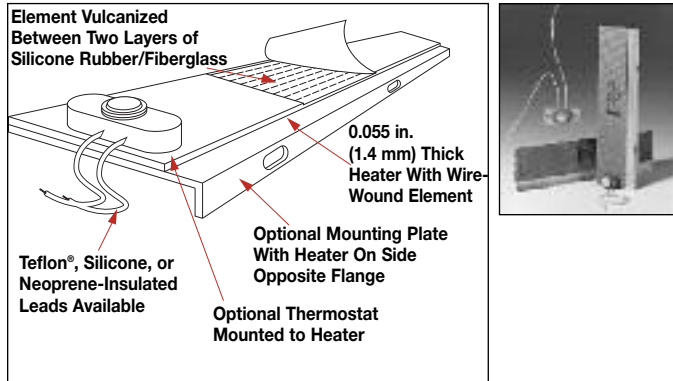
Stock: Same day shipment of orders (with part number configuration -0001B) if received by 11:00 a.m. CST. All other modifications (other than -0001B) are modified stock and ship within five working days.

Flexible Heaters

Silicone Rubber Heaters

Enclosure Heaters

Stock Product Offering – 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

Pressure sensitive adhesive, mounting to aluminum plate or customer cementing

- Reduces installation time
- Creates easy installation

Quick delivery on more than 72 variations

- Simplifies operation

No exposed electrical connections

- Creates a safe and reliable operation

Custom leads

- Available in any length

Horizontal and vertical mounting

- Simplifies operation

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	40	55	70	80	100	120	135	205	270	335	405	540	670
		10	10	15	20	20	25	30	35	50	65	80	100	130	160
	40 (22)	55	80	110	135	160	200	245	270	405	540	670	805	1075	1340
		15	20	30	35	40	50	60	65	100	130	160	195	260	320
	60 (33)	90	120	160	205	245	300	365	405	605	805	1005	1210	1610	2010
		20	30	55	50	60	75	90	100	145	195	240	290	385	480
	80 (44)	110	160	215	270	325	400	485	540	805	1075	1340	1610	2145	2680
		30	40	55	65	80	100	115	130	195	260	320	385	515	640
	100 (56)	135	200	270	335	405	500	605	670	1005	1340	1675	2010	2680	3350
		35	50	65	80	100	125	145	160	240	320	400	480	640	800
	120 (67)	165	240	320	405	485	600	725	805	1210	1610	2010	2415	3220	4020
		40	60	80	100	115	150	175	195	290	385	480	580	770	960
	140 (78)	190	280	375	470	565	700	845	940	1410	1880	2345	2815	3755	4690
		45	70	90	115	135	175	205	225	340	450	560	675	900	1120

*Note: Area = 2 X (L X W + L X H + W X H); Square feet = (square inch) divided by 144.

□ Uninsulated boxes

■ Insulated boxes

Flexible Heaters

Silicone Rubber Heaters

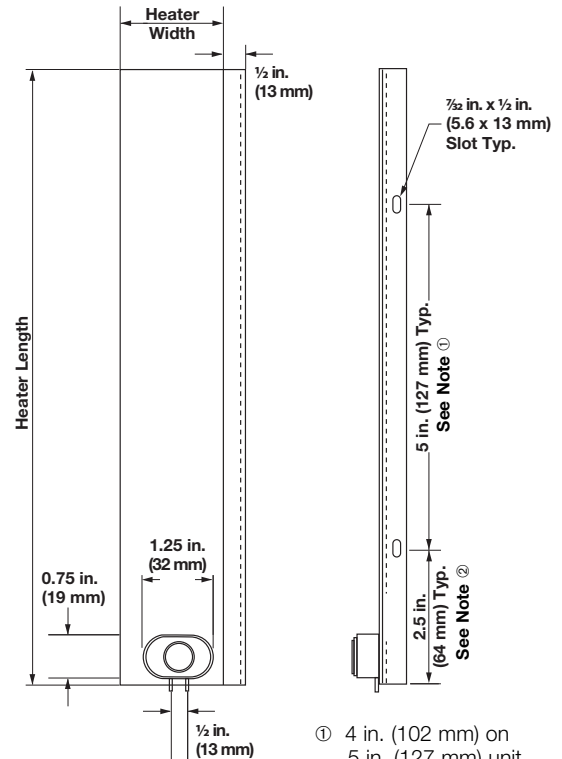
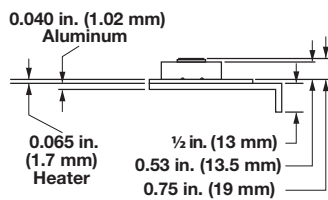
Enclosure Heaters

Stock Product Offering

Aluminum Mounting Plate

Both vertical and horizontal mounting can be accomplished with enclosure heaters. The mounting plates are 0.040 in. (1.02 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 in. (102 mm) on 5 in. (127 mm) unit.
- ② 0.5 in. (13 mm) on 5 in. (127 mm) 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 in. (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.

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 Heaters

Drum Heaters

Stock Product Offering

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

- Prevents fluids from freezing

Quick delivery on 28 styles from stock

- Simplifies operation

Includes six-foot cord and plug set

- Allows for application convenience

Custom heaters

- Available for non-standard sizes

Applications

- Freeze protection
- Viscosity control

Application Hints

- Allow a 3 in. (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 that is to be heated.
- When a single heater is used, place the heater at the bottom of the drum to minimize stratification.

Standard Features

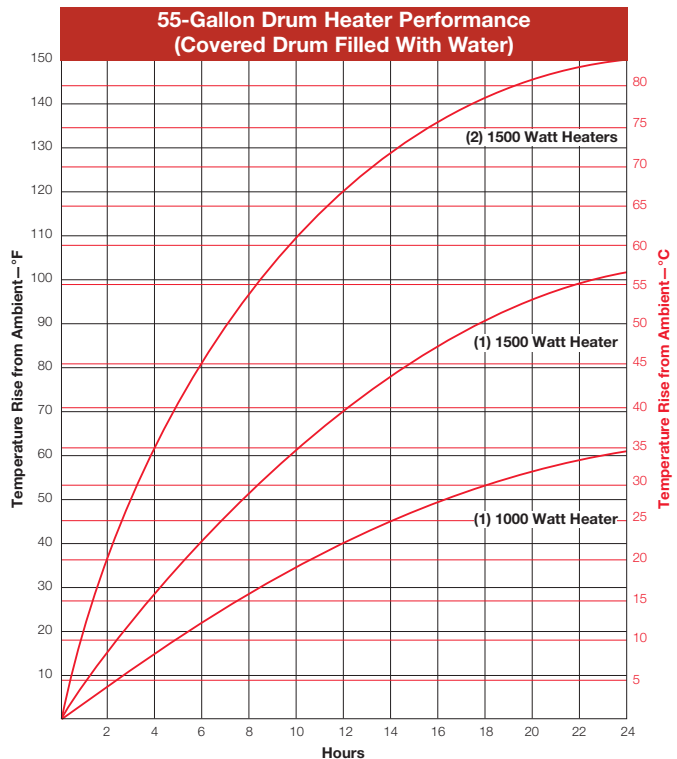
Watlow flexible drum heaters are designed for use on 5-, 30- and 55-gallon **metal** drums. They come with the following standard features:

- 6 ft (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 4 in. (102 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 below shows the temperature rise from ambient conditions, not drum content temperature.

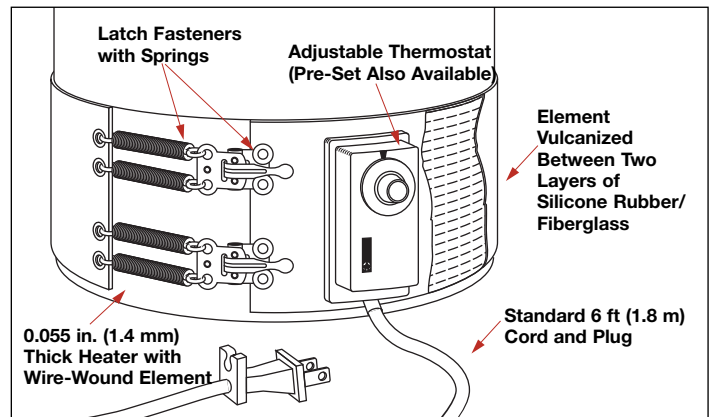


Flexible Heaters

Silicone Rubber Heaters

Drum Heaters

Stock Product Offering



Drum Size	Volts	Watts	Width in. (mm)	Thermostat	Availability	Code Number
5 gal. (20 L) 11½ in. (292 mm) nom. diameter	120	650	4 (102.0)	(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) 18½ in. (470 mm) nom. diameter	120	750	2¼ (68.3)	(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) 22½ in. (572 mm) nom. diameter	120	1000	2¼ (68.3)	(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) 22½ in. (572 mm) nom. diameter	120	1500	4 (102.0)	(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) 22½ in. (572 mm) nom. diameter	240 ^①	1500	4 (102.0)	(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

① Supplied with 6-ft (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: Contact your Watlow representative.

Flexible Heaters

Silicone Rubber Heaters

Conduit Heaters

Stock Product Offering PVC Wire-Wound 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 4 in. (102 mm) in diameter

Features and Benefits

Self-conforms to cylindrical shapes

- Fits snugly around the conduit

Portable design

- Makes it easy to use in the field

Included thermostat

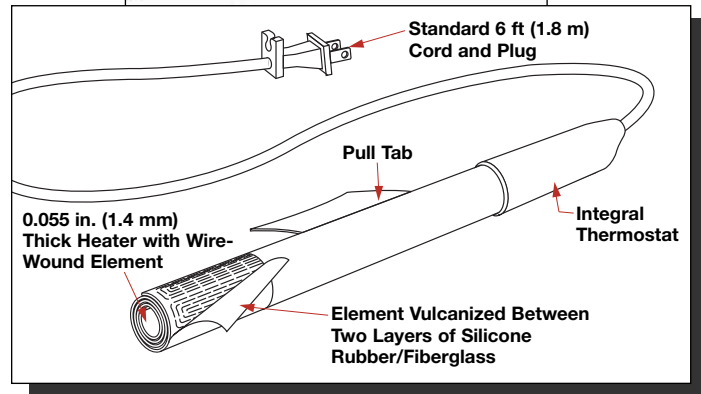
- Prevents overheating

Pull tab

- Allows for easy removal or positioning when heater is hot

Immediate delivery

- Simplifies operation



Conduit Diameter in. (mm)	Length in. (mm)	Watts	Volts	Temp. Limit °F (°C)	Warm-up Time	Code Number
½ to 1½ (13-38)	12 (305)	180	120	250 (121)	4-10 minutes	05712082
2 to 4 (51-102)	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: Contact your Watlow representative.

Flexible Heaters

Line Heating

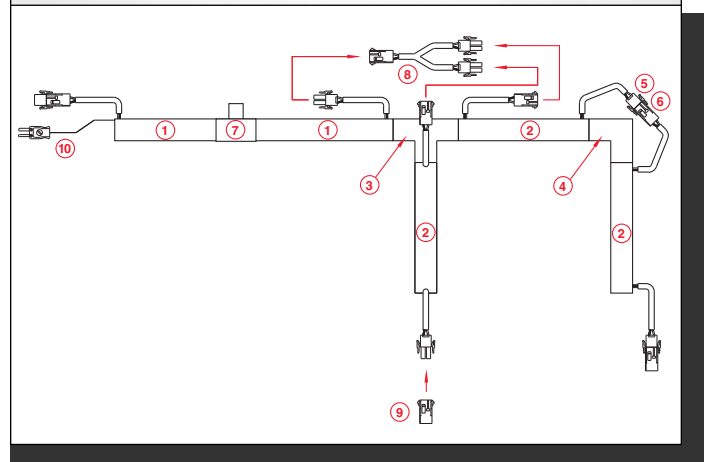
Modular Gas Line Heaters

Gas Delivery

Tetraethyl orthosilicate (TEOS), Boron trichloride (BCl_3), Aluminum Chloride (AlCl_3), Chlorine trifluoride (ClF_3) and Dichlorosilane (DCS) are gases that condense or liquefy due to a phase shift at low temperatures. The condensation occurs in the gas line and puddles in the shower head before being injected into the vacuum chamber. A substantial number of wafer defects will occur if liquefied gases are injected into the vacuum chamber. Uniform heating of the lines will prevent condensation. TEOS lines are typically heated above 194°F (90°C) and BCl_3 above 86°F (30°C), depending on pressure and flow rate. The optimum line temperature will vary depending on the process parameters.

Specifications

- Watt density: 2.5 W/in² (0.39 W/cm²) on gas line O.D.
- UL® recognized for U.S. and Canadian safety standards
- Heaters and insulators meet UL94-HB flammability requirements
- Insulated straight fillers for 100% line coverage-elbows and tees are trim-to-fit to proper length
- I.D. available: ¼, ⅜, ½, ¾ in. (6, 9.5, 13, 19 mm)
- 120V standard, other voltages available
- Small metal snaps
- ⅜ in. (9.5 mm) wall, silicone rubber, closed cell sponge



Upstream Gas Line Heater Assembly

- ① 9 in. (229 mm) heater with thermocouple. Heater leads have male plug on one end and a female cap on the other end. Heater materials UL® rated to 392°F (200°C)
- ② 6 in. (152 mm) heater. Heater leads, see 1
- ③ Union tee insulator
- ④ 90° union elbow insulator
- ⑤ Male plug, Amp p/n 1-480698-0 w/sockets ampere p/n 350689-1
- ⑥ Female cap, Amp p/n 1-480699-0 w/pins ampere p/n 350690-1
- ⑦ Valve or regulator
- ⑧ Y Connector: one female cap on one end; two male plugs on the other end
- ⑨ Dead plug (sealed)
- ⑩ Type J thermocouple w/ male mini-plug (optional)

Flexible Heaters

Line Heating

Modular Gas Line Heaters (Continued)

Standard Gas Line Diameter

¼ in. (6 mm) O.D. Tubing

¼ in. (6 mm) Heater I.D. x Length in. (mm)	Description	Volts	Watts	Amperes	Code Number		
					Without T/C Stock	With Type J T/C Stock	With Type K T/C Standard
6 (152)	Heated straight	120	12	0.10	008060C1	008060C1A	008060C1K
9 (229)	Heated straight	120	18	0.15	008090C1	008090C1A	008090C1K
12 (305)	Heated straight	120	24	0.20	008120C1	008120C1A	008120C1K
18 (457)	Heated straight	120	36	0.30	008180C1	008180C1A	008180C1K
24 (610)	Heated straight	120	48	0.40	008240C1	008240C1A	008240C1K
36 (914)	Heated straight	120	72	0.60	008360C1	008360C1A	008360C1K
18 (457) * Elbow * Tee	Straight insulator 90° Union Elbow insulator Union Tee insulator	N/A N/A N/A	Trim-to-fit Trim-to-fit Trim-to-fit	Insulator Insulator Insulator	008180C0 008020C0 008030C0		

⅜ in. (9.53 mm) O.D. Tubing

¼ in. (6 mm) Heater I.D. x Length in. (mm)	Description	Volts	Watts	Amperes	Code Number		
					Without T/C Stock	With Type J T/C Stock	With Type K T/C Standard
6 (152)	Heated straight	120	18	0.15	012060C1	012060C1A	012060C1K
9 (229)	Heated straight	120	27	0.23	012090C1	012090C1A	012090C1K
12 (305)	Heated straight	120	36	0.30	012120C1	012120C1A	012120C1K
18 (457)	Heated straight	120	54	0.45	012180C1	012180C1A	012180C1K
24 (610)	Heated straight	120	71	0.60	012240C1	012240C1A	012240C1K
36 (914)	Heated straight	120	107	0.90	012360C1	012360C1A	012360C1K
18 (457) * Elbow * Tee	Straight insulator 90° Union Elbow insulator Union Tee insulator	N/A N/A N/A	Trim-to-fit Trim-to-fit Trim-to-fit	Insulator Insulator Insulator	012180C0 012020C0 012030C0		

½ in. (13 mm) O.D. Tubing

¼ in. (6 mm) Heater I.D. x Length in. (mm)	Description	Volts	Watts	Amperes	Code Number		
					Without T/C Stock	With Type K T/C Stock	With Type K T/C Standard
6 (152)	Heated straight	120	24	0.20	016060C1	016060C1A	016060C1K
9 (229)	Heated straight	120	36	0.30	016090C1	016090C1A	016090C1K
12 (305)	Heated straight	120	48	0.40	016120C1	016120C1A	016120C1K
18 (457)	Heated straight	120	72	0.60	016180C1	016180C1A	016180C1K
24 (610)	Heated straight	120	96	0.80	016240C1	016240C1A	016240C1K
36 (914)	Heated straight	120	144	1.20	016360C1	016360C1A	016360C1K
18 (457) * Elbow * Tee	Straight insulator 90° Union Elbow insulator Union Tee insulator	N/A N/A N/A	Trim-to-fit Trim-to-fit Trim-to-fit	Insulator Insulator Insulator	016180C0 016020C0 016030C0		

* For use on Micro-Fit® weld fittings.

Notes: Stock items are ready for delivery in limited quantities.
Standard items are existing configurations and will be made to order.

Flexible Heaters

Line Heating

Modular Gas Line Heaters (Continued)

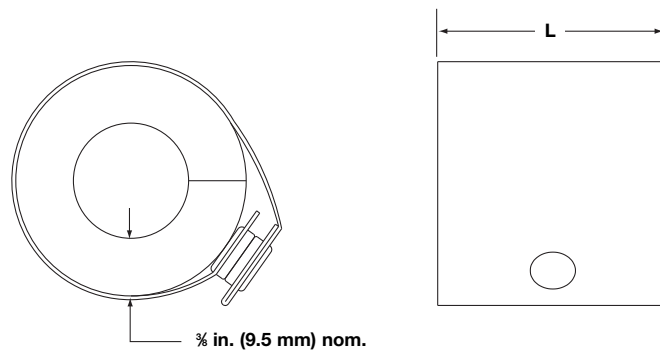
Standard Gas Line Diameter

3/4 in. (19.1 mm) O.D. Tubing

3/4 in. (6 mm) Heater I.D. x Length in. (mm)	Description	Volts	Watts	Amperes	Code Number		
					Without T/C Stock	With Type K T/C Stock	With Type K T/C Standard
6 (152)	Heated straight	120	36	0.30	024060C1	024060C1A	024060C1K
9 (229)	Heated straight	120	54	0.45	024090C1	024090C1A	024090C1K
12 (305)	Heated straight	120	71	0.60	024120C1	024120C1A	024120C1K
18 (457)	Heated straight	120	107	0.90	024180C1	024180C1A	024180C1K
24 (610)	Heated straight	120	142	1.19	024240C1	024240C1A	024240C1K
36 (914)	Heated straight	120	213	1.78	024360C1	024360C1A	024360C1K
18 (457)	Straight insulator	N/A	Trim-to-fit	Insulator	024180C0		
* Elbow	90° Union Elbow insulator	N/A	Trim-to-fit	Insulator	024020C0		
* T	Union Tee insulator	N/A	Trim-to-fit	Insulator	024030C0		

Standard Designs

VCR Union Heaters/Insulators



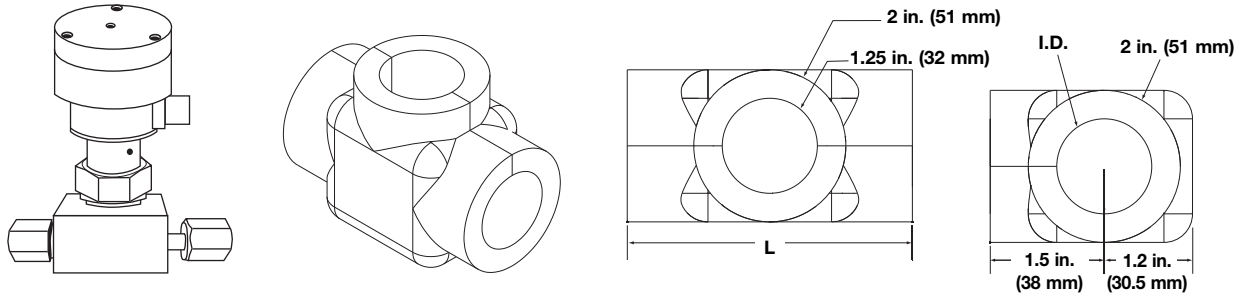
3/4 in. (6 mm) Heater I.D. x Length in. (mm)	Description	Volts	Watts	Amperes	Code Number		
					Without T/C Stock	With Type K T/C Stock	With Type K T/C Standard
3/4 x 1 1/4 (22.2 x 45)	3/4 in. (6 mm) VCR Union heater	120	10	0.09	01702783	01702783A	01702783K
3/4 x 1 1/2 (19.0 x 38)	3/4 in. (6 mm) VCR Union insulator	N/A	N/A	N/A	02401580	N/A	N/A
1 1/4 x 1 1/2 (32.0 x 38)	1/2 in. (13 mm) VCR Union heater	120	12	0.10	03901581	03901581A	03901581K
1 1/4 x 1 1/2 (32.0 x 38)	1/2 in. (13 mm) VCR Union insulator	N/A	N/A	N/A	03901580	N/A	N/A

Flexible Heaters

Line Heating

Modular Gas Line Heaters (Continued)

VCR Valve Heaters



Tube Diameter in. (mm)	I.D. in. (mm)	Fitting Type	Length in. (mm)	Watts	Amperes @ 120V	Code Number
¼ (6)	⅝ (22.2)	Male VCR valve heater	3.00 (76)	18	0.15	03104786
¼ (6)	⅝ (22.2)	Female VCR valve heater	4.75 (121)	28	0.24	04704893
½ (13)	1¼ (32.0)	Male VCR valve heater	3.75 (95)	27	0.23	03804782
½ (13)	1¼ (32.0)	Female VCR valve heater	6.51 (165)	47	0.39	04706690

Note: Heaters fit Nupro® BN and BK series valves.

Accessories

Part	Description	Code Number
Y connector*	Power splitter: 1 female, 2 male	Z5303-2
Y connector*	Power splitter: 2 female, 1 male	Z6333
Female dead plug*	Insulating plug for last connector in chain	Z5309-2
Male dead plug*	Insulating plug for last connector in chain	Z6332
Type J thermocouple	12 in. (305 mm) 24 ga Type J Teflon® w/mini plug	Z5786
Type J thermocouple extension	10 ft (3048 mm) Type K Teflon® thermocouple with mini plug and mini jack	Z6271
Type K thermocouple	12 in. (305 mm) 24 ga Type K Teflon® w/mini plug	Z5639
Adapter*	Female to male	Z6334
Adapter*	Male to female	Z6335
Power extension*	6 in. (152 mm)	Z6374
Power extension*	3 ft (914 mm)	A000136
Power extension*	6 ft (1829 mm)	A000137
Power extension*	10 ft (3048 mm)	A000138
Strap extension	1 in. (25 mm) long pump line strap extension	010010116
Strap extension	2 in. (51 mm) long pump line strap extension	010020113
Strap extension	3 in. (76 mm) long pump line strap extension	010030124

*All connectors use AMP Mate-N-Lok® connectors.

- Y-adapters and dead plugs
- Sensor pocket thermocouple: 12 in. (305 mm) long, Type J or K, Teflon® insulated, #24 AWG,
- Two-prong mini-plug connector
- Interconnects with Watlow temperature control consoles

Flexible Heaters

Line Heating

STRETCH-TO-LENGTH® Heaters

Condensation of many critical gases occurs due to a phase shift at low temperatures. Burning of the gases will occur if the delivery line is too hot. High or low temperature condition may result in undesirable particulates and cause costly device defects and tool maintenance.

The Watlow® STRETCH-TO-LENGTH® (S-T-L) gas line heater system was developed as an easy to assemble temperature solution with performance superior to heat tape. S-T-L's preformed construction gives engineers the ability to wrap around the delivery line with consistent heater/gas line contact for improved temperature uniformity. S-T-L's flexibility gives engineers the ability to compensate for the size of different components thus reducing the potential for hot and cold spots.

The S-T-L system includes a 2 W/in² S-T-L heater and silicone rubber foam insulation.

Watlow's control consoles with process and redundant high-limit protection are recommended for optimum system performance and to meet SEMI S2-93 guidelines.

Features and Benefits

Easy to install two part system

- Conveniently fits on most gas line configurations

Flexible heater design gives engineers the flexibility to easily customize the thermal profile for each gas line applications

- Standard designs and stocked product allow quick prototyping to determine energy distribution requirements for process improvements

Flexible standard system components

- Eliminate unnecessary lead times for custom designs

Applications

Gas deliver lines

- Boron trichloride, BCl₃
- Chlorine trifluoride, ClF₃
- Dichlorosilane, (DCS), SiH₂Cl₂
- Tetra ethyl orthosilicate, TEOS
- Tungsten hexafluoride, WF₃
- Process gas line qualification



Agency Certification, Recognition Compliance and Approvals

Contact factory for specific application and approvals

- Semi S2-93 compatible with a high-limit thermocouple and controller
- UL® recognized for U.S. safety standards

Specifications

- Heater and insulation jacket material reinforced silicone rubber fabric
 - Color:
 - Insulation and outer jacket – orange
 - Heater – orange
- Clean room strap fasteners
- Voltage: 120 and 240V~(ac)
- Max. operating temperature: 392°F (200°C)
- Heater watt density: 2 W/in² (0.31W/cm²) – Watlow recommends 80% line wrap for optimum performance
- Power lead wires: 12 in. (305 mm); #18 AWG UL® 1180 CSA, rated 10A, lead wire pair encapsulated in reinforced silicone rubber sleeving
- Heater interconnectable up to a 10A circuit
- Material rated UL® 94-HB
- Heater materials are UL® rated to 392°F (200°C)

Flexible Heaters

Line Heating

STRETCH-TO-LENGTH Heaters (Continued)

S-T-L heaters are specified by their straight length. In actual applications the engineer can wrap the heaters to achieve optimum temperature profile. Coverage lengths of approximately 60 and 80 percent on ¼ (6 mm) and ½ in. (13 mm) diameter tubes are provided as a guide in

selecting heater lengths for actual gas line dimensions. A gas line with 100 percent coverage would be approximately 2 W/in², 80 percent coverage 1.6 W/in² or 60 percent coverage 1.2 W/in².

S-T-L Heater Ranges - ¼ in. (6 mm) O.D. Tubing

0.25 60% Coverage	0.25 80% Coverage	120V Version Code Number	Amperes	240V Version Code Number	Amps
10.20	8.04	005120500	0.10	N/A	N/A
14.45	11.39	005170500	0.14	N/A	N/A
18.70	14.74	005220500	0.18	005220501	0.09
23.80	18.76	005280500	0.23	005280501	0.12
30.60	24.12	005360500	0.30	005360501	0.15
39.95	31.49	005470500	0.39	005470501	0.20
51.00	40.20	005600502	0.50	005600503	0.25
63.75	50.25	005750500	0.63	005750501	0.31
76.50	60.30	005900500	0.75	005900501	0.38

S-T-L Heater Ranges - ½ in. (13 mm) O.D. Tubing

0.50 60% Coverage	0.50 80% Coverage	120V Version Code Number	Amperes	240V Version Code Number	Amps
10.20	6.63	005170501	0.14	N/A	N/A
15.00	9.75	005250501	0.21	N/A	N/A
21.00	13.65	005350502	0.29	005350503	0.15
29.40	19.11	005490502	0.41	005490503	0.20
38.40	24.96	005640502	0.53	005640503	0.27
47.40	30.81	005790502	0.66	005790503	0.33
59.40	38.61	005990502	0.82	005990503	0.41
73.80	49.97	005F103502	1.02	005F103503	0.51
92.40	60.06	005F128502	1.28	005F128503	0.64

¼ in. (6 mm) O.D. Tubing Insulators

¼ in. (6.4 mm) Heater I.D. x Length	Description	Code Number
18 in. (457 mm)	Straight insulator	012180500
36 in. (914 mm)	Straight insulator	012360500
Elbow	90° union elbow insulator	012020500
Tee	Union tee insulator	012030500
	VCR fitting	015030500

½ in. (13 mm) O.D. Tubing Insulators

½ in. (13 mm) Heater I.D. x Length	Description	Code Number
18 in. (457 mm)	Straight insulator	024180500
36 in. (914 mm)	Straight insulator	024360500
Elbow	90° union elbow insulator	020024500
Tee	Union tee insulator	024030500
	VCR fitting	015042500

Flexible Heaters

Line Heating

STRETCH-TO-LENGTH Heaters (Continued)

3/8 in. (9.5 mm) O.D. Tubing Insulators

3/8 in. (9.5 mm) Heater I.D. x Length	Description	Code Number
18 in. (457 mm)	Straight insulator	016180500
36 in. (914 mm)	Straight insulator	016360500
Elbow	90° union elbow insulator	016020500
Tee	Union tee insulator	016030501
	VCR fitting	015042500

Extensions

Description	Code Number
3 ft (914 mm)	A000136
6 ft (1829 mm)	A000137
10 ft (3048 mm)	A000138

Accessories

Description	Code Number
Power cord 6 ft 18-2 SJ	Z5302-2
Wiring Y connector – 1F-2M	Z5303-2
Wiring Y connector – 1M-2F	Z6333
Female termination plug	Z5309-2
Male termination plug	Z6332
12 in. 24 ga. Type J T/C w/mini plug	Z5786
12 in. 24 ga. Type K T/C w/mini plug	Z5639
Gender changer – M-F	Z6334
Gender changer – F-M	Z6335
6 in. power extension	Z6374
10 ft Type J T/C extension	Z6271

Note: All power connectors use AMP Mate-'n'-Lok®

Flexible Heaters

Line Heating

Modular Pump Line Heaters

The tight contact fit of Watlow's pump line heaters provide superior, uniform heating of transfer lines.

Agency Certification, Recognition Compliance, and Approvals

(Contact your Watlow representative for specific application and approvals)

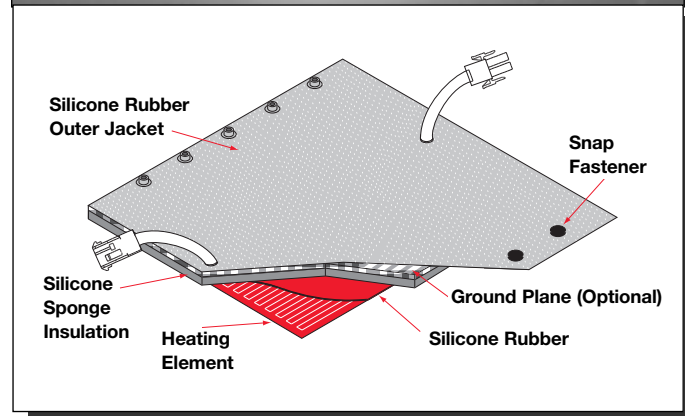
- Complies with SEMI S2-93 standards
- UL® recognized for U.S. and Canadian safety standards
- CE, VDE
- National Electrical Code (NEC), Article #427-23
- UL® Listed available

General Specifications

- Heater and jacket material: reinforced silicone rubber fabric
- Color: Insulation and outer jacket is gray, heater is red-orange



Sensor Pocket™ Built-in to all Straight Length Heaters 3 in. (76 mm) Long and Greater; One Per Heater.



- Snap type fasteners: ½ in. (13 mm) nominal diameter metal construction with nylon cover; max. operating temperature 392°F (200°C)
- Velcro® fasteners available
- 120 and 208V~(ac) standard. Contact your Watlow representative for other voltages.
- Power lead wires: 3 in. (76 mm) #18 AWG UL® 1180/CSA Teflon® insulated, rated 10A, lead wire pair encapsulated in reinforced silicone rubber sleeving
- Heaters interconnectable up to a 10A circuit
- **New low watt density:**
 - 1.5-2 in. (38-51 mm) diameter, 1.5 W/in² (0.23 W/cm²)
 - 3-4 in. (76-102 mm) diameter, 1.25 W/in² (0.19 W/cm²)

Flexible Heaters

Line Heating

Modular Pump Line Heaters (Continued)

Tube O.D. in. (mm)	Length "L" in. (mm)	Watts	Amperes @120V	Amperes @208V	Features	Base Code Number*
1.5 (38)	2 (51)	15	0.13	0.08	—	020050A
1.5 (38)	2T (51T)	8	0.07	NA	Trim-to-fit	020050T
1.5 (38)	3 (76)	22	0.19	0.11	Sensor Pocket	030050A
1.5 (38)	3T (76T)	15	0.13	0.08	Trim-to-fit	030050T
1.5 (38)	4 (102)	29	0.25	0.14	Sensor Pocket	040050A
1.5 (38)	4T (102T)	22	0.19	0.11	Trim-to-fit	040050T
1.5 (38)	5 (127)	36	0.30	0.18	Sensor Pocket	050050A
1.5 (38)	5T (127T)	29	0.25	0.14	Trim-to-fit	050050T
1.5 (38)	6 (152)	43	0.36	0.21	Sensor Pocket	050060A
1.5 (38)	6T (152T)	36	0.30	0.17	Trim-to-fit	050060T
1.5 (38)	7 (178)	50	0.42	0.24	Sensor Pocket	050070A
1.5 (38)	8 (203)	57	0.48	0.27	Sensor Pocket	050080A
1.5 (38)	9 (229)	64	0.53	0.31	Sensor Pocket	050090A
1.5 (38)	10 (254)	71	0.59	0.34	Sensor Pocket	050100A
1.5 (38)	12 (305)	85	0.71	0.41	Sensor Pocket	050120A
1.5 (38)	18 (457)	128	1.07	0.62	Sensor Pocket	050180A
1.5 (38)	24 (610)	170	1.42	0.82	Sensor Pocket	050240A
1.5 (38)	30 (762)	213	1.78	1.03	Sensor Pocket	050300A
1.5 (38)	36 (914)	255	2.13	1.23	Sensor Pocket	050360A
1.5 (38)	36 (914)	Insulator	NA	NA	—	050360B
2.0 (51)	2 (51)	19	0.16	0.10	—	020066A
2.0 (51)	2T (51T)	10	0.09	NA	Trim-to-fit	020066T
2.0 (51)	3 (76)	29	0.25	0.14	Sensor Pocket	030066A
2.0 (51)	3T (76T)	19	0.16	0.10	Trim-to-fit	030066T
2.0 (51)	4 (102)	38	0.32	0.19	Sensor Pocket	040066A
2.0 (51)	4T (102T)	29	0.25	0.14	Trim-to-fit	040066T
2.0 (51)	5 (127)	48	0.40	0.24	Sensor Pocket	050066A
2.0 (51)	5T (127T)	38	0.32	0.19	Trim-to-fit	050066T
2.0 (51)	6 (152)	57	0.48	0.28	Sensor Pocket	060066A
2.0 (51)	6T (152T)	47	0.39	0.23	Trim-to-fit	060066T
2.0 (51)	7 (178)	66	0.55	0.32	Sensor Pocket	066070A
2.0 (51)	8 (203)	76	0.63	0.37	Sensor Pocket	066080A
2.0 (51)	9 (229)	85	0.71	0.41	Sensor Pocket	066090A
2.0 (51)	10 (254)	95	0.79	0.46	Sensor Pocket	066100A
2.0 (51)	12 (305)	114	0.95	0.55	Sensor Pocket	066120A
2.0 (51)	18 (457)	170	1.42	0.82	Sensor Pocket	066180A
2.0 (51)	24 (610)	227	1.90	1.10	Sensor Pocket	066240A
2.0 (51)	30 (762)	283	2.36	1.37	Sensor Pocket	066300A
2.0 (51)	36 (914)	340	2.84	1.64	Sensor Pocket	066360A
2.0 (51)	36 (914)	Insulator	NA	NA	—	066360B

CONTINUED

*To complete the code number, please reference the *Build-a-Code* chart on page 454.

Flexible Heaters

Line Heating

Modular Pump Line Heaters (Continued)

Tube O.D. in.	(mm)	Length "L" in.	(mm)	Watts	Amperes @120V	Amperes @208V	Features	Base Code Number*
3	(76)	2	(51)	24	0.20	0.12	—	020096A
3	(76)	2T	(51T)	12	0.10	0.06	Trim-to-fit	020096T
3	(76)	3	(76)	36	0.30	0.18	Sensor Pocket	030096A
3	(76)	3T	(76T)	24	0.20	0.12	Trim-to-fit	030096T
3	(76)	4	(102)	48	0.40	0.24	Sensor Pocket	040096A
3	(76)	4T	(102T)	36	0.30	0.18	Trim-to-fit	040096T
3	(76)	5	(127)	59	0.50	0.29	Sensor Pocket	050096A
3	(76)	5T	(127T)	48	0.40	0.24	Trim-to-fit	050096T
3	(76)	6	(152)	71	0.60	0.35	Sensor Pocket	060096A
3	(76)	6T	(152T)	59	0.49	0.28	Trim-to-fit	060096T
3	(76)	7	(178)	83	0.69	0.4	Sensor Pocket	070096A
3	(76)	8	(203)	95	0.79	0.46	Sensor Pocket	080096A
3	(76)	9	(229)	106	0.88	0.51	Sensor Pocket	090096A
3	(76)	10	(254)	118	0.98	0.57	Sensor Pocket	096100A
3	(76)	12	(305)	142	1.19	0.69	Sensor Pocket	096120A
3	(76)	18	(457)	213	1.78	1.03	Sensor Pocket	096180A
3	(76)	24	(610)	283	2.36	1.37	Sensor Pocket	096240A
3	(76)	30	(762)	354	2.95	1.71	Sensor Pocket	096300A
3	(76)	36	(914)	425	3.55	2.05	Sensor Pocket	096360A
3	(76)	36	(914)	Insulator	NA	NA	—	096360B
4	(102)	2	(51)	32	0.27	0.16	—	020128A
4	(102)	2T	(51T)	16	0.14	0.08	Trim-to-fit	020128T
4	(102)	3	(76)	48	0.40	0.24	Sensor Pocket	030128A
4	(102)	3T	(76T)	32	0.27	0.16	Trim-to-fit	030128T
4	(102)	4	(102)	63	0.53	0.31	Sensor Pocket	040128A
4	(102)	4T	(102T)	48	0.40	0.24	Trim-to-fit	040128T
4	(102)	5	(127)	79	0.66	0.38	Sensor Pocket	050128A
4	(102)	5T	(127T)	63	0.53	0.31	Trim-to-fit	050128T
4	(102)	6	(152)	95	0.80	0.46	Sensor Pocket	060128A
4	(102)	6T	(152T)	79	0.66	0.38	Trim-to-fit	060128T
4	(102)	7	(178)	110	0.92	0.53	Sensor Pocket	070128A
4	(102)	8	(203)	126	1.05	0.61	Sensor Pocket	080128A
4	(102)	9	(229)	142	1.18	0.68	Sensor Pocket	090128A
4	(102)	10	(254)	157	1.31	0.75	Sensor Pocket	100128A
4	(102)	12	(305)	189	1.58	0.91	Sensor Pocket	120128A
4	(102)	18	(457)	283	2.36	1.37	Sensor Pocket	128180A
4	(102)	24	(610)	377	3.15	1.82	Sensor Pocket	128240A
4	(102)	30	(762)	472	3.94	2.27	Sensor Pocket	128300A
4	(102)	36	(914)	566	4.72	2.73	Sensor Pocket	128360A
4	(102)	36	(914)	Insulator	NA	NA	—	128360B

*To complete the code number, please reference the *Build-a-Code* chart on page 454.

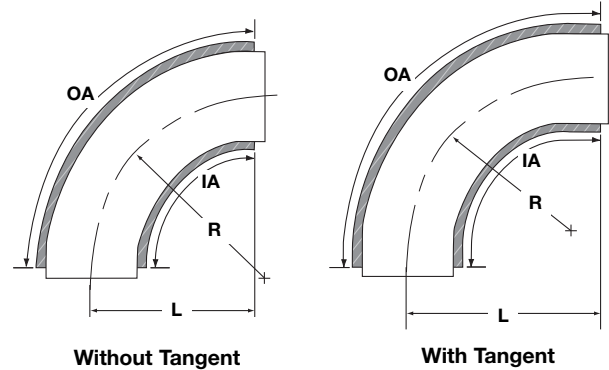
Flexible Heaters

Line Heating

Modular Pump Line Heaters (Continued)

90° Radius Elbow Heaters

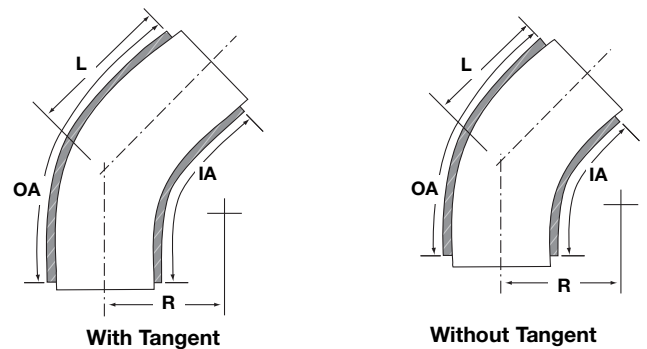
- 0.25 in. (6 mm) or 0.5 in. (13 mm) silicone rubber sponge insulation available
- With or without tangents
- Will fit both butt-weld and flanged style tubing elbows



Tube O.D. in. (mm)	Length "L" in. (mm)	Radius (R) in. (mm)	Watts	Outer Arc Length (OA)	Inside Arc Length (IA)	Amperes @120V	Amperes @208V	Base Code Number*
1.5 (38)	2.00 (51)	2.25 (57)	26	4.21	1.85	0.22	0.13	042050A
1.5 (38)	2.68 (68.1)	2.25 (57)	36	5.58	3.22	0.30	0.18	050055A
2.0 (51)	2.75 (70)	3.00 (76)	45	5.78	2.64	0.38	0.22	057066A
2.0 (51)	3.81 (96.8)	3.00 (76)	65	7.91	4.77	0.55	0.32	066079A
3.0 (76)	4.00 (102)	4.50 (114)	84	8.42	3.71	0.70	0.41	089097A
3.0 (76)	5.81 (147.6)	4.50 (114)	127	12.05	7.33	1.06	0.62	097125A
4.0 (102)	5.50 (140)	6.00 (152)	149	11.56	5.28	1.25	0.72	116128A
4.0 (102)	7.81 (198.4)	6.00 (152)	222	16.18	9.00	1.85	1.07	128166A

45° Radius Elbow Heaters

- 0.25 in. (6.4 mm) or 0.5 in. (13 mm) silicone rubber sponge insulation available
- With or without tangents
- Will fit both butt-weld and flanged style tubing elbows



Tube O.D. in. (mm)	Length "L" in. (mm)	Radius (R) in. (mm)	Watts	Outer Arc Length (OA)	Inside Arc Length (IA)	Amperes @120V	Amperes @208V	Base Code Number*
1.5 (38)	0.69 (17.5)	2.25 (57)	14	1.85	0.67	0.12	NA	018050A
1.5 (38)	1.38 (35.1)	2.25 (57)	23	3.23	2.04	0.20	0.12	032050A
2.0 (51)	1.00 (25)	3.00 (76)	23	2.64	1.07	0.20	0.12	026066A
2.0 (51)	2.06 (52.3)	3.00 (76)	44	4.77	3.20	0.37	0.22	047066A
3.0 (76)	1.37 (34.8)	4.50 (114)	43	3.71	1.35	0.36	0.21	042097A
3.0 (76)	3.18 (80.8)	4.50 (114)	85	7.33	4.97	0.71	0.41	078097A
4.0 (102)	2.00 (51)	6.00 (152)	75	5.28	2.14	0.63	0.37	057128A
4.0 (102)	4.31 (109.5)	6.00 (152)	148	9.90	6.76	1.24	0.72	104128A

*To complete the code number, please reference the *Build-a-Code* chart on page 454.

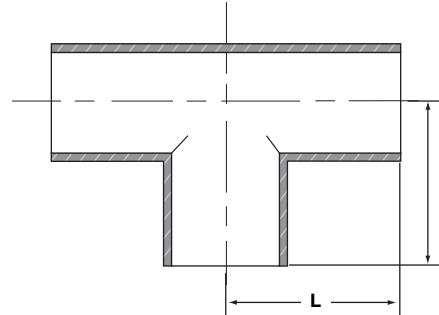
Flexible Heaters

Line Heating

Modular Pump Line Heaters (Continued)

Tee Section Heaters

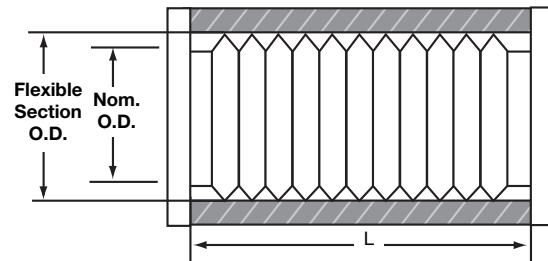
- 0.25 in. (6 mm) or 0.5 in. (13 mm) silicone rubber sponge insulation available
- Will fit both butt-weld and flanged style tee sections



Tube O.D. in. (mm)	Length "L" in. (mm)	Watts	Amperes @120V	Amperes @208V	Base Code Number*
1.5 (38)	2.00 (51)	38	0.32	0.19	047064A
2.0 (51)	2.75 (70)	69	0.58	0.34	062081A
3.0 (76)	3.00 (76)	89	0.75	0.43	095120A
4.0 (102)	3.63 (92)	140	1.17	0.69	125155A

Bellows Section Heaters

- 0.25 in. (6 mm) or 0.5 in. (13 mm) silicone rubber sponge insulation available
- Will fit both butt-weld and flanged style flexible sections



Tube O.D. in. (mm)	Bellows Section O.D. in. (mm)	Length "L" in. (mm)	Watts	Amperes @120V	Amperes @208V	Base Code Number*
1.5 (38)	1.92 (48.9)	3 (76)	26	0.22	0.13	030056A
1.5 (38)	1.92 (48.9)	3T (76T)	18	0.15	0.09	030056T
1.5 (38)	1.92 (48.9)	6 (152)	51	0.43	0.25	056060A
1.5 (38)	1.92 (48.9)	6T (152T)	44	0.37	0.21	056060T
2.0 (51)	2.47 (62.7)	3 (76)	34	0.29	0.17	030077A
2.0 (51)	2.47 (62.7)	3T (76T)	24	0.2	0.12	030077T
2.0 (51)	2.47 (62.7)	6 (152)	68	0.57	0.33	060077A
2.0 (51)	2.47 (62.7)	6T (152T)	59	0.49	0.28	060077T
3.0 (76)	3.77 (95.8)	3 (76)	44	0.37	0.22	030117A
3.0 (76)	3.77 (95.8)	3T (76T)	30	0.25	0.14	030117T
3.0 (76)	3.77 (95.8)	6 (152)	88	0.74	0.43	060117A
3.0 (76)	3.77 (95.8)	6T (152T)	74	0.62	0.36	060117T
3.0 (76)	3.77 (95.8)	12 (305)	175	1.46	0.85	117120A
4.0 (102)	4.75 (121)	3 (76)	56	0.47	0.27	030149A
4.0 (102)	4.75 (121)	3T (76T)	38	0.32	0.18	030149T
4.0 (102)	4.75 (121)	6 (152)	111	0.93	0.54	060149A
4.0 (102)	4.75 (121)	6T (152T)	94	0.78	0.45	060149T
4.0 (102)	4.75 (121)	12 (305)	222	1.85	1.07	120149A

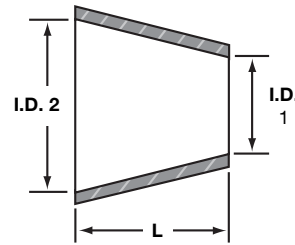
*To complete the code number, please reference the *Build-a-Code* chart on page 454.

Flexible Heaters

Line Heating

Modular Pump Line Heaters (Continued)

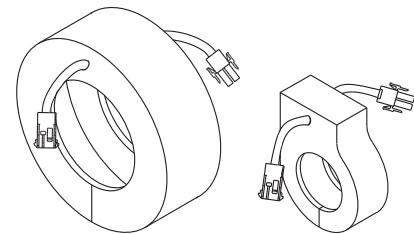
Reducers



Tube I.D. 2 to I.D. 1		Length "L"	Watts	Amperes @120V	Amperes @208V	Base Code Number*
in.	(mm)					
2 (51)	to 1.5 (38)	1.38 (35.1)	12	0.10	0.06	020062A
3 (76)	to 2.0 (51)	2.42 (61.5)	24	0.20	0.12	034090A
4 (102)	to 2.0 (51)	2.63 (66.8)	31	0.26	0.15	044103A
4 (102)	to 3.0 (76)	2.60 (66.0)	36	0.30	0.18	040121A

Flange Heaters

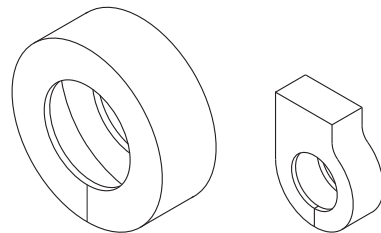
- 0.25 in. (6 mm) or 0.5 in. (13 mm) silicone rubber sponge insulation available
- For both KF screw flanges and ISO clamp flanges



Tube O.D. in.	Nominal Tube O.D. in. (mm)	Watts @120V	Amperes @120V	Amperes @ 208V	Base Code Number*
KF-40	1.5 (38)	10	0.09	NA	035040A
KF-50	2.0 (51)	15	0.13	0.07	045050A
ISO-80	3.0 (76)	70	0.59	0.34	020176A
ISO-100	4.0 (102)	82	0.69	0.40	020204A
CF 2¼ in.	1.5 (38)	21	0.18	0.10	016089A

Flange Insulators

- 0.25 in. (6 mm) or 0.5 in. (13 mm) silicone rubber sponge insulation available
- For both KF screw flanges and ISO clamp flanges



Tube O.D. in.	Nominal Tube O.D. in. (mm)	Base Code Number*
KF-40	1.50 (38)	035040B
KF-50	2.00 (51)	045050B
ISO-80	3.00 (76)	020176B
ISO-100	4.00 (102)	020204B
CF 1½ in.	0.75 (19)	010044B
CF 2¼ in.	1.50 (38)	016089B

*To complete the code number, please reference the *Build-a-Code* chart on page 454.

Flexible Heaters

Line Heating

Modular Pump Line Heaters (Continued)

Ordering Information

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

XXXXXXXX -

Base Code Number _____

Heater Voltage _____

CO = Insulator
 C1 = 120V
 C4 = 208V

Insulation _____

A = 0.25 in. (6 mm) insulation w/UL®94-HB jacket
 B = 0.5 in. (13 mm) insulation w/UL®94V-0 jacket
 C = 0.25 in. (6 mm) insulation w/UL®94-HB jacket and ground grid
 D = 0.5 in. (13 mm) insulation w/UL®94V-0 jacket and ground grid

Connectors _____

0 = None
 A = AMP Universal MATE-N-LOK® connector
 B = AMP CPC connector

Sensors _____

0 = None
 A = Thermal fuse 378°F (192°C)
 B = Type J thermocouple
 C = Type K thermocouple
 D = Thermal fuse + Type J thermocouple
 E = Thermal fuse + Type K thermocouple

Future Options _____

0 = None

Future Options _____

0 = None

Note: Not all options are available for every base code number.

Description	CE	SEMI S2-93	UL® Listing	NEC	VDE
0.25 in. (6 mm) insulation w/HOT marking	x	x	x		x
0.5 in. (13 mm) insulation	o	o	o		o
Ground grid	o	o	o	x	o
AMP MATE-N-LOK® connectors ①	x	x	x		x
AMP CPC connectors ②	o	o	o		o
Jacket w/UL®94V-0 rating	o	o	o		o
Jacket w/UL®94-HB rating	x	x	x		x
Thermal cut-off	o	x	x		o

x = Min. requirements
 o = Optional features

① Male plug: AMP p/n 1-480698-0, w/sockets AMP p/n 350689-1.
 Female cap: AMP p/n 1-480699-0, w/pins AMP p/n 350690-1.

② Plug: AMP p/n 206060-1, w/socket AMP p/n 66101-3.
 Receptacle: AMP p/n 206153-1, w/pin AMP p/n 66099-3, w/ground pin p/n 164164-2 if ground grid option is chosen.

Flexible Heaters

Polyimide Heaters

Polyimide is a thin, lightweight organic polymer film which provides excellent tensile strength, tear resistance and dimensional stability. This heater is ideal for applications requiring low outgassing in a vacuum, or resistance to radiation, fungus and chemicals. Polyimide is also solvent resistant.

Performance Capabilities

- For operating environments as low as -319°F (-195°C), heater temperature as high as 392°F (200°C)
- Watt densities to 50 W/in² (7.75 W/cm²)^①

Features and Benefits

Excellent physical and electrical properties

- Results in thermal stability over a wide temperature range

Transparent polyimide material

- Allows inspection of internal details

Resistance of radiation and fungus

- Allows it to be used in a wide range of applications

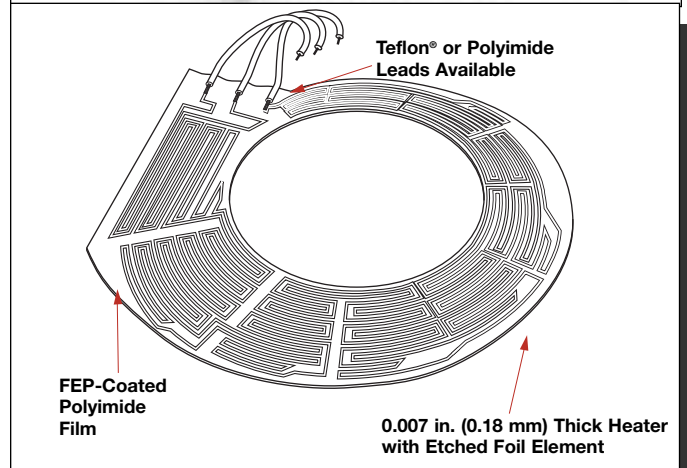
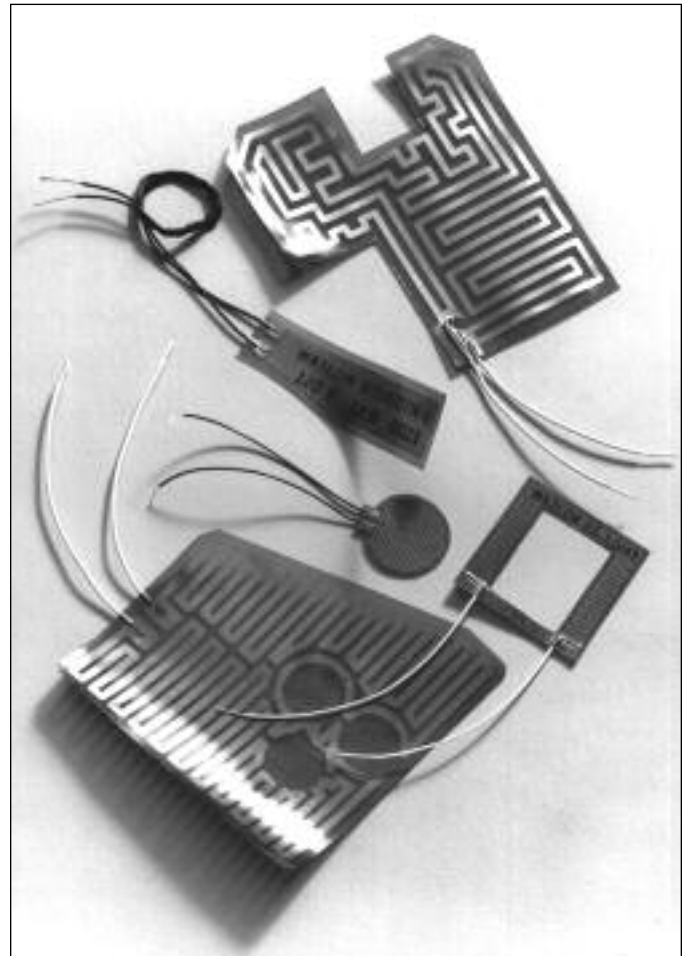
UR® and C-UR® recognitions

- Available on many custom designs

Applications

- Military/aerospace, where low outgassing properties are required
- Medical, where thorough cleaning or sterilization is needed
- Laboratory research
- Photographic equipment
- Optical equipment
- LCD displays
- Computer equipment

^① Watt density limits are application dependent (operating temperatures, bonding method and heat sink).



Quick Ship

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

Flexible Heaters

Polyimide Heaters

Technical Data

Standard Specifications

Thickness

- 0.007 in. (0.2 mm)

Flexibility (min. radius)

- 1/32 in. (0.8 mm)

Weight

- 1.5 oz./ft² (0.05 g/cm²)

Operating temperature: ^②

- Max.: 392°F (200°C)
- Min.: -319°F (-195°C)

Watt density rating on stock units

- 5 W/in² (0.8W/cm²)

Dielectric strength

- Min. V~(ac): 1000

Flammability rating

- Self-extinguishing

Heater size limitations

- 20 x 26 in. (508 mm x 660 mm)

Weight loss (outgassing):

- 0.51%

Standard lead length

- 12 in. (305 mm) Teflon[®] E

^② We recommend maximum **part** temperature at 300°F (150°C).

Options

Standard lead length, 12 in. (305 mm) “E” Teflon[®]

Width in. (mm)	Length in. (mm)	Watts	Avail.	28 Volt Code Number	120 Volt Code Number
0.5 (13)	2 (51)	5	Stock	K005020C5-0009B	
1 (25)	1 (25)	5	Stock	K010010C5-0009B	K010050C3-0009B K010150C3-0009B
	3 (76)	15	Stock	K010030C5-0009B	
	5 (127)	25	Stock		
	15 (381)	75	Stock		
2 (51)	10 (254)	100	Stock		K020100C3-0009B
3 (76)	5 (127)	75	Stock		K030050C3-0009B
4 (102)	4 (102)	80	Stock		K040040C3-0009B
5 (127)	5 (127)	125	Stock		K050050C3-0009B

Stock

- Pressure Sensitive Adhesive Surface (PSAS)

Made-to-Order

- PSAS
- Factory bonding
- Holes, cutouts, notches
- Special leads

How to Order

Determine width, length, volts and watts. Specify the code number and quantity if the heater is listed in the stock list above. To specify PSAS add **A** to code number. For **made-to-order** heaters, please provide the following:

- Quantity
- Size (dimensions)

- Voltage
- Wattage/watt density
- Operating temperature
- Options, such as holes, PSAS.
- Will heater be subject to flexing?

Availability

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

Made-to-Order: Contact your Watlow representative.

Flexible Heaters

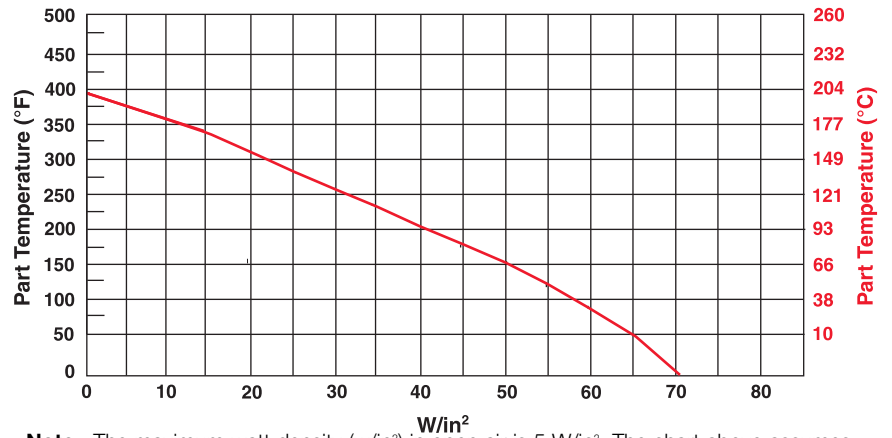
Polyimide Heaters

Options (Continued)

Maximum Allowable Watt Density Versus Temperature

To achieve the optimum performance with your Watlow polyimide sample heater, a proper watt density must be used on the surface of the heater.

This graph illustrates recommended watt densities for given operating temperatures with the process being controlled with a temperature controller. It does not indicate the watt density necessary to achieve a given part temperature.



Note: The maximum watt density (W/in^2) in open air is 5 W/in^2 . The chart above assumes bonding the polyimide heater to a part.

Flexible Heaters

Polyimide Heaters

Special Product Offering

Code Number	Size in. (mm)	Circuit	Resistance	Max. Voltage	Watts @ Max. Voltage
K05711980-A	½ x 2¼ (13 x 54)	A	40	12	4
K05711980-B	1 x 2¼ (25 x 54)	B	90	48	26
K05711980-C	1½ x 2¼ (38 x 54)	C	145	75	39
K05711980-D	2 x 2¼ (51 x 54)	D	205	105	54
K05711980-E	½ x 3¾ (13 x 34.9)	E	80	48	29
K05711980-F	1 x 3¾ (25 x 92.1)	F	165	90	49
K05711980-G	1½ x 3¾ (38 x 92.1)	G	275	120	52
K05711980-H	2 x 3¾ (51 x 92.1)	H	375	120	38
K05711980-I	½ x 5¾ (13 x 146)	I	130	60	28
K05711980-J	1 x 5¾ (25 x 146)	J	255	120	56
K05711980-K	1 x 1¼ (25 x 28.6)	K	28	12	5
K05711980-L	½ x 1¼ (13 x 28.6)	L	13	6	3
K05711980-M	1 in O.D. (25)	M	32	12	5
K05711980-N	2 in O.D. (51)	N	180	105	61
K05711980-O	4 in O.D. (102)	O	185	120	78
K05711980-P	1 x 1¼ (25 x 34.9)	P	45	24	13

Notes:

- To order individual heater circuits from the polyimide kit, see the matrix above.
- Leads shipped loose not soldered.

Example: To order the J heater circuit with PSAS use K05711980A-J.

To order the J heater circuit with PSAS and leads use K05711980AL-J.

Polyimide Handy Heater Kit—For Quick Heating Solutions

Watlow offers a convenient way to use polyimide heaters. The handy heater kit consists of 16 polyimide heaters — 13 rectangular and three circular—in different sizes and resistances. So when you need a small flexible heater in a hurry, you can pick the one that fits your application.

Other Features

- The heater sheet can be ordered with or without Pressure Sensitive Adhesive (PSAS), depending on your needs. To specify PSAS add **A** to code number.
- The kit comes with instructions for wiring, lead attachment and selection and installation. Pre-tinned solder pads are provided for easy lead connections.
- The instructions also show you how to dial in your desired wattage using a variable voltage transformer.
- The heaters can be wired individually, in series, or parallel for hundreds of variations to satisfy your special application.

Availability

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